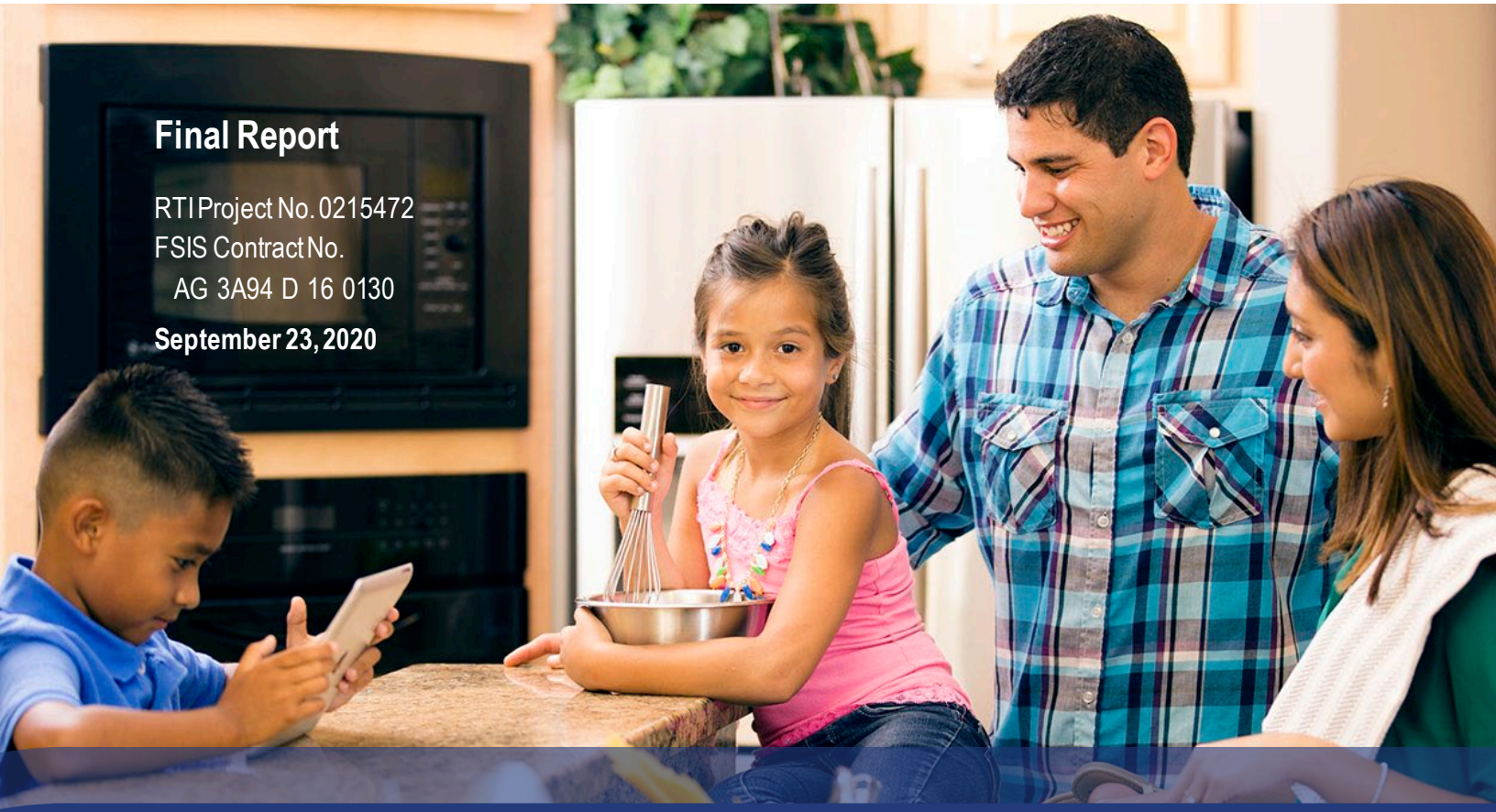

Final Report

RTI Project No. 0215472
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September 23, 2020

Food Safety Consumer Research Project: Meal Preparation Experiment on Raw Stuffed Chicken Breasts

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Executive Summary

The Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA) contracted with RTI International and its subcontractor North Carolina State University (NCSU) to conduct meal preparation studies to evaluate consumer food handling behaviors in a test kitchen. The research team is conducting five separate iterations of the meal preparation study. Each iteration addresses a specific consumer behavior and assesses the effectiveness of a related behavior change intervention. The meal preparation studies are part of a larger 5-year annual study that also includes focus groups (two iterations) and web surveys (two iterations). This report describes the results of the third iteration of the meal preparation study that examined participants' use of a food thermometer to check the doneness of raw stuffed chicken breasts prepared from frozen and also examined the effectiveness of a related educational intervention about the importance of using a food thermometer to check the doneness of not-ready-to-eat (NRTE) frozen foods. NRTE foods are foods that have not been fully cooked during processing and require cooking by the consumer for safety. These foods are required to have a label deeming them as not fully cooked and that cooking is required to ensure safety. However, these foods may appear to be fully cooked, causing some consumers not to cook before consuming and resulting in foodborne illness.

RTI and NCSU conducted the study in a test kitchen facility located in Raleigh, North Carolina (Wake County). Before preparing the meal, participants were told the study was behind schedule and were asked to wait in the waiting area for 10 minutes. During this time, a series of news stories was played on a continuous loop. For the treatment group, the loop included a 1:47-minute segment about safely preparing frozen NRTE foods. The food safety news segment communicated that although frozen NRTE foods may appear ready to eat, they are not fully cooked, and the endpoint temperature should be checked with a food thermometer to ensure safety. The series of news stories for the control group was similar, with the exception that instead of showing the food safety segment, one of the other segments was shown twice. Thus, the purpose of this experimental intervention was to evaluate the potential impact of proactive media placements USDA achieves throughout the year during seasonal outreach. These segments are usually presented to the public in the middle of newscasts and when people are preoccupied with other tasks.

In each of three identical test kitchens, eight cameras recorded participants preparing the meal from beginning to end. Participants were observed while cooking NRTE frozen, breaded stuffed chicken breasts and preparing a salad made from NRTE frozen corn, canned black beans, and fresh produce. The main outcome variables were (1) whether participants used a food thermometer to determine when the NRTE products were done and (2) whether participants adhered to other recommended food safety practices throughout the meal

preparation. Participants participated in a post-observation interview to collect information on their usual food preparation practices. A total of 403 people participated in the study (197 control, 206 treatment).

The key findings from the study are summarized below:

- The rate of thermometer use was high among both the control (77%) and treatment (88%) groups. Among participants using a thermometer, most checked the temperature of both chicken breasts.
  - Nearly all participants reported reading instructions on the package before preparing the product; the package displayed validated cooking instructions provided by the manufacturer that instructed consumers to use a thermometer to check for doneness.
  - About 70% of participants did not have experience preparing stuffed chicken breasts from frozen, which may have led some participants to read the manufacturer's cooking instructions.
  - In the post-observation interviews, among thermometer owners, nearly half of participants said they do not typically use a thermometer when cooking NRTE chicken products at home; thus, for some participants, their behavior in the test kitchen differed from their typical practices.
- The most common method to prepare the frozen NRTE corn for the corn and black bean salad was stovetop (58%), followed by microwave (38%). Three percent of participants did not cook the corn.
  - Participants reported relying on time (37%) and visual indicators such as steam (31%) to determine the doneness of the corn.
  - Few participants used a food thermometer to check the doneness of the corn (1% control, 3% treatment).
- Consistent with Years 1 and 2, handwashing compliance was low.
  - About 72% of participants attempted to wash their hands before beginning meal preparation. Among handwashing attempts, 5% of attempts contained all steps of correct handwashing and were considered successful according to the Centers for Disease Control and Prevention's criteria.
  - During meal preparation, handwashing was attempted 5% of the time that it was required (e.g., after touching the NRTE chicken product). There were no successful attempts.
  - The most common reason for unsuccessful handwashing attempts was not rubbing hands with soap for 20 seconds.

The results of this study suggest that the food safety segment on safe cooking of frozen NRTE products played as part of a series of news stories shown in the waiting room did not significantly affect thermometer use.

  - About 40% of the treatment group participants recalled the food safety news segment; thus, not all participants received exposure, which is not surprising given the more passive nature of the intervention.

- Among participants who recalled the food safety news segment, about half said it influenced their actions in the kitchen in that they used a thermometer to check the doneness of the NRTE chicken product, which may have served to reinforce what they read on the product packaging. Thus, exposure to the news segment may have led to the slightly higher rate of thermometer use among the treatment group compared with the control group, although the difference between the two groups was not statistically significant.

1. Introduction

This report describes the study methods and presents the results from a meal preparation study related to preparing not-ready-to-eat (NRTE) breaded chicken products from frozen that appear to be ready-to-eat (RTE), conducted as part of the Food Safety Consumer Research Project. The study, conducted in test kitchens, used an experimental design to measure consumers' adherence to the "cook" message by measuring the frequency with which consumers use a food thermometer to check the doneness of raw stuffed chicken breasts prepared from frozen between participants who received an educational intervention and those who did not. The NRTE study is the third of five iterations of a meal preparation experiment in which consumers are observed while preparing meat and poultry products regulated by the U.S. Department of Agriculture's (USDA's) Food Safety and Inspection Service (FSIS). This report details the study design, data collection procedures, and data analysis approach and presents the results of the study. Additionally, the report compares key behavioral outcomes for Years 1, 2, and 3 of the study.

1.1 Background and Project Overview

USDA FSIS' Office of Public Affairs and Consumer Education (OPACE) ensures that all segments of the farm-to-table chain receive valuable food safety information. The consumer education programs developed by OPACE's Food Safety Education Staff inform the public on how to safely handle, prepare, and store meat, poultry, and egg products to minimize the incidence of foodborne illness.

OPACE strives to continuously increase consumer awareness of recommended food safety practices with the intent to improve food handling behaviors at home. OPACE shares its messages through the *Food Safe Families* campaign, social media, the Meat and Poultry Hotline and Ask USDA (an online database of frequently asked food safety questions), the FSIS web site, FoodSafety.gov, publications, and events. These messages are focused on the four core food safety behaviors: clean, separate, cook, and chill. Additionally, OPACE's public education and outreach initiatives reach vulnerable and underserved populations.

By testing new consumer messaging and tailoring existing messaging, FSIS can help ensure that it is effectively communicating with the public and promoting behavior change with a goal of improving consumer food safety practices. FSIS contracted with RTI International to conduct consumer research over a 5-year period, fiscal year 2017 through fiscal year 2022. RTI is teaming with researchers at North Carolina State University (NCSU) to conduct the project. This behavioral research will include observation studies of food preparation in test kitchens using an experimental design (five iterations), focus group studies (two iterations), and web surveys (two iterations). Each iteration of each data collection activity will address different research questions and use a different sample of consumers. This research will provide insight into the effect FSIS consumer outreach campaigns have on consumers' food

safety behaviors. FSIS will use the results of this research to enhance messaging and accompanying materials to improve food safety behaviors of consumers.

1.2 Objectives of NRTE Meal Preparation Experiment

Previous research suggests that self-reported data collected through surveys on consumers' food safety practices may be unreliable because consumers tend to overreport their behavior (e.g., simply rinsing their hands instead of washing with soap and water for 20 seconds as recommended) (Redmond & Griffith, 2003). Because of this limitation, observation is often a preferred approach for collecting information on consumers' food safety practices.

Studies that have used direct observation of consumer food handling have reported that many consumers commit errors during preparation and self-report actions that are different from the ones they took (Anderson et al., 2004; DeDonder et al., 2009; Jay, Comar, & Govenlock, 1999; Kendall et al., 2004; Redmond, Griffith, Slader, & Humphrey, 2004). The results of the meal preparation experiments will help FSIS assess adherence to the four recommended food safety behaviors of clean, separate, cook, and chill; determine whether food safety messaging focused on those behaviors affects consumers' safe food handling behaviors; and determine whether consumers introduce cross-contamination during food preparation for certain raw meat and poultry products.

Each iteration of the meal preparation experiment addresses a specific consumer behavior. The third iteration examined preparation of NRTE poultry products that appear RTE, including thermometer use and handwashing practices. Additionally, to provide information to the Food and Drug Administration (FDA), participants prepared a corn and black bean salad to examine preparation of NRTE packaged frozen corn and washing of fresh produce (i.e., cucumbers). A microbiology testing strategy was not included as a component of Year 3 as it was in the previous 2 years because studies have reported no significant risk for cross-contamination posed by the handling of frozen products themselves given that no liquid matrix is associated with these foods (Schaffner & Schaffner, 2007). Additionally, using surrogates to inoculate breaded products poses challenges.

For this study, participants randomized to the control or treatment group (exposed to a news segment intervention on safely preparing frozen foods) were asked to prepare raw stuffed chicken breast cordon bleu from frozen and prepare a corn and black bean salad made with packaged frozen corn. We observed participants throughout the meal preparation to determine whether they used a food thermometer, adhered to recommended handwashing practices, and safely prepared the frozen corn and cucumber. Post-observation interviews collected information on participants' reasons for following or not following recommended food safety practices during the meal preparation and their response to the intervention (treatment group).

Table 1-1 lists the study's research questions, data sources, and the corresponding section of this report with the results of the analysis conducted to address each research question.

Table 1–1. Research Questions, Data Sources, and Location of Results in Report

Research Question	Data Source	Location in Report
Is the rate of thermometer use on the NRTE chicken product and corn higher for the treatment group compared with the control group?	Observations	Section 3.2, Tables 3-4, 3-6 Section 3.3, Table 3-7
What methods are used to determine doneness of the NRTE chicken product and corn in lieu of a food thermometer for the control and treatment groups?	Observations, post-observation interviews	Section 3.2, Table 3-4 Section 3.3, Table 3-8
What is the rate of successful handwashing attempts for the control and treatment groups? What are the reasons for unsuccessful handwashing attempts?	Observations	Section 3.4, Tables 3-9, 3-10, Figures 3-1, 3-2, 3-3
What is the rate of washing cucumbers?	Observations	Section 3.3, Table 3-7
Did participants recall the food safety news segment? If so, did participants report that the news segment influenced their actions? (treatment group only)	Post-observation interviews	Section 3.5, Table 3-11
Did the food safety news segment affect how consumers prepare NRTE foods?	Observations, post-observation interviews	Section 3.2, Table 3-4 Section 3.3, Table 3-7
What differences are there between key behavioral outcomes for Years 1, 2, and 3 of the study?	Observations	Section 3.6, Table 3-12

1.3 Organization of Report

This report is organized as follows:

- Section 2 describes the research design, data collection procedures, and analysis approach.
- Section 3 presents and discusses the results of the study for thermometer use, handwashing compliance, and other behaviors, as well as participants' responses to the intervention.
- Section 4 concludes the report by summarizing the key findings and discussing the implications of the study results for OPACE's consumer food safety education and outreach efforts.

The report includes the following appendixes:

- Appendix A: Transcript of Food Safety News Story Intervention
- Appendix B: List of Equipment Provided in Each Test Kitchen
- Appendix C: Observation Script and Recipe
- Appendix D: Post-observation Interview Guide
- Appendix E: Screening Questionnaire
- Appendix F: Observation Rubric for Coding Participant Actions in the Kitchen
- Appendix G: Pilot Exploration of Air Pockets

2. Study Methods

This section describes the methodology for the meal preparation experiment, the recruitment procedures, and the approach for coding and analyzing the observations and post-interview data. The Office of Management and Budget (OMB control number 0583-0169, expiration date 6/30/2020) and NCSU's Institutional Review Board (IRB) approved the study protocol and materials.

2.1 Meal Preparation Experiment Methodology

2.1.1 Research Design

The third iteration of the meal preparation experiment focused on the food safety behavior of "cook," specifically whether participants used a food thermometer when preparing NRTE poultry products from frozen that appear to be RTE. We recruited adult individuals who self-reported preparing frozen breaded chicken products (such as chicken nuggets or stuffed chicken breasts) or who reported having children (0 to 18) who prepared these products during the past 6 months. We recruited these individuals to include people who may not consume the product themselves but may instruct children on preparing the product. Eligible participants were randomly assigned to a control group (no exposure) or a treatment (intervention) group.

Upon arrival for their scheduled appointment, recruited participants were told the study was about 10 minutes behind schedule and instructed to sit in a waiting room in which a series of news segments played on a looped video. The 8.5-minute loop comprised six separate news segments on topics such as vaping and emergency preparedness. The loop for the treatment group included a 1:47-minute news segment (shown as the fifth story) about safely preparing frozen NRTE foods. The video comprising news segments was developed by OPACE's subcontractor, Subject Matter. Other news segment topics were determined based on relevant current topics. The food safety news segment communicated

Screenshot of Intervention: News Segment on Safely Preparing NRTE Frozen Foods

Appendix A provides a transcript of the news segment.

that although frozen NRTE foods may appear RTE, they are not fully cooked, and the endpoint temperature should be checked with a food thermometer to ensure safety (see Appendix A for a transcript of the food safety news segment). The food safety news segment showed a variety of frozen NRTE foods, including stuffed chicken breasts and bagged frozen corn, as well as products that were not being prepared in the meal preparation study (e.g., frozen peas). The control group was exposed to a similar news segment loop, with the exception that instead of showing the food safety news segment the segment on adoption of older children was shown twice during the loop. The purpose of this experimental intervention was to evaluate the potential impact of proactive media placements USDA achieves throughout the year during seasonal outreach. These segments are usually presented to the public in the middle of newscasts and when people are preoccupied with other tasks.

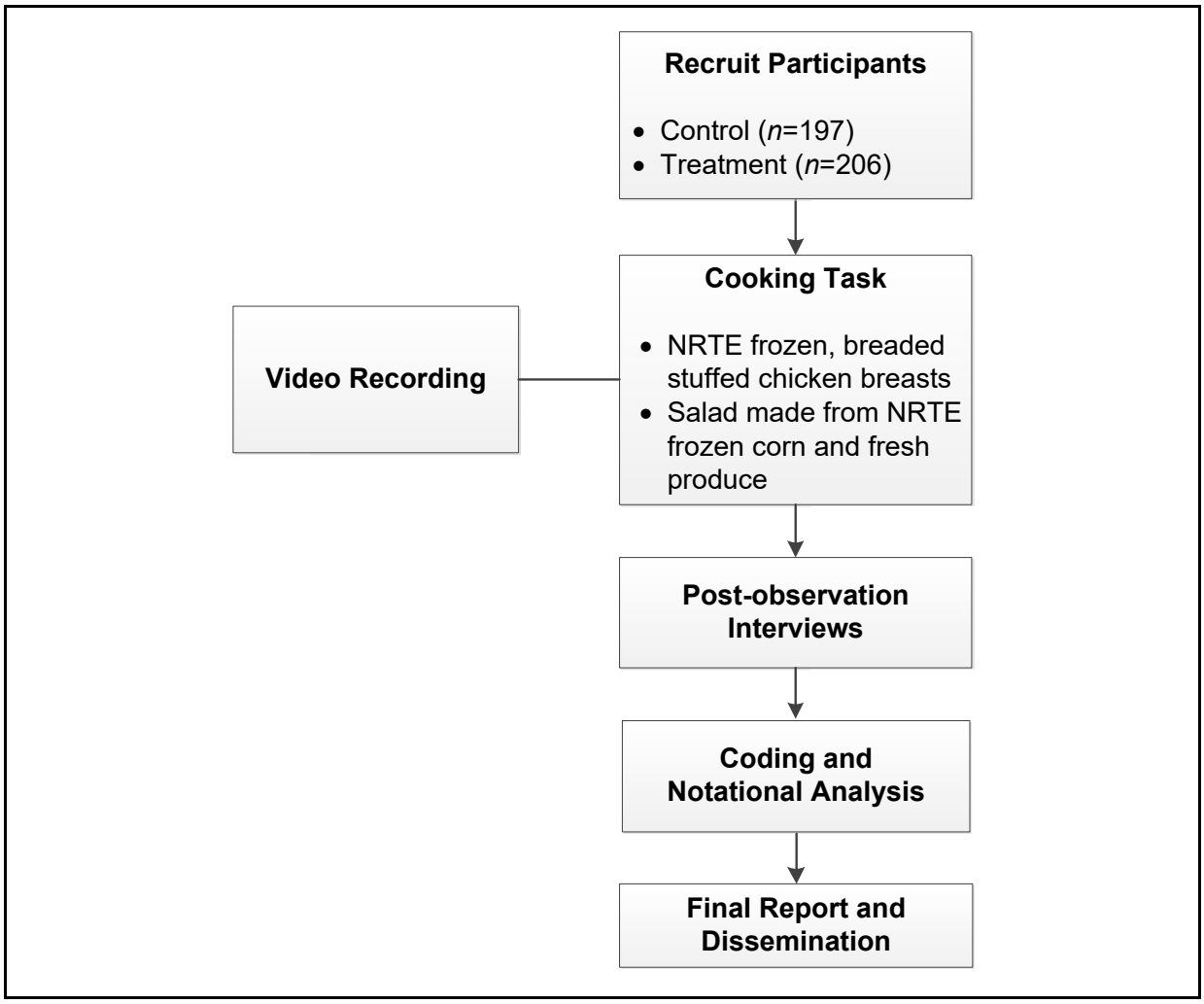
This study had the capacity to include up to 400 participants in each iteration of the meal preparation experiment. The baseline estimate of thermometer use was obtained from DeDonder et al.'s (2009) observational study of thermometer use among primary meal preparers cooking NRTE chicken, which stated that 19.5% of adults reported using thermometers to determine the internal temperature of raw, breaded chicken products. Based on this assumption, analysis of minimum detectable effects indicated that the intervention would need to be strong enough to encourage an additional 12.6% of the treatment group to use food thermometers ($h = 0.28$) to provide 80% statistical power and a 95% level of confidence. Because balanced designs are the most efficient in terms of statistical analysis, we randomly assigned half of the participants ($n = 200$) to the treatment group and the remaining 200 participants to the control group.

2.1.2 Study Procedures

Figure 2-1 summarizes the study procedures. We conducted the study in a test kitchen facility located in Raleigh, North Carolina (Wake County) with three identical test kitchens. Each test kitchen has a sink, refrigerator, and stove/oven and was stocked with the same meal preparation equipment (dishes, knives, utensils, cutting boards, thermometer). In each test kitchen, eight cameras recorded participants' actions at various locations throughout the kitchen and recorded the meal preparation from beginning to end.

We used convenience sampling to recruit participants using a variety of approaches. Section 2.2 describes the participant screening criteria and recruitment procedures. Participants received a $75 gift card and gift (food thermometer, mentioned after the completion of the research) for taking part in the 1.5-hour study. Participant recruitment began April 23, 2019. We conducted observations starting April 29, 2019, and ending September 5, 2019.

Figure 2-1. Study Procedures for Meal Preparation Experiment on NRTE Chicken Products



We randomly assigned participants to the treatment or control group when the appointment was scheduled with the goal of 200 participants in each group.

The study team scheduled appointments at the test kitchen location based on kitchen availability with observations scheduled during the week, on weekends, and at different times of day (e.g., morning, afternoon, and evening). Once participants arrived at the test kitchen, a study team member greeted them and instructed them to read and sign an informed consent form. As previously noted, participants were told the study was behind schedule and asked to wait in the waiting area for 10 minutes while the news loop was

playing. Using a script to ensure consistency in delivery (see Appendix C for the script), the study team member described what participants could expect during the study. Initially, we told participants the purpose of the study was testing a new product formulation for a frozen chicken entrée. Consistent with the approach used in other observation studies, we informed participants of the real purpose of the study following the post-observation interview and why it was important from a scientific perspective to inform them after the study was complete[1] (Chapman, Eversley, Fillion, MacLaurin, & Powell, 2010; DeDonder et al., 2009).

A study team member instructed participants as follows: "The chicken entrée is in the freezer. Please prepare it first, and as you would at home. For any instructions on how to prepare it, please see the package." (the oven was preheated). For the salad, participants were provided with a laminated recipe card with a corn and black bean salad recipe and told the location of the ingredients (see Appendix C for recipe). A study team member pointed out that cabinets contained utensils, dishes, pans, and cleaning supplies and were labeled accordingly (see Appendix B for a complete list of equipment provided in each test kitchen and a picture of one of the test kitchens). The chicken entrée

Figure 2-2. Packaging for NRTE Chicken Product Used in Meal Preparation Study

Front Panel

Back Panel

[1] After being informed of the study's purpose, participants could opt out of the study and have their data excluded from the analysis. No participants chose to opt out of the study.

was packaged to resemble a commercially available product including manufacturer cooking instructions and the Safe Handling Instructions (see Figure 2-2).

Supplementing the observations, we conducted semistructured post-observation interviews to provide insight into participants' views, opinions, and experiences during the meal preparation experiment. The interviews also collected information on potential behavioral antecedents such as concerns about food safety and previous experience with foodborne illness. Interviews lasted approximately 20 minutes (see Appendix D for the post-observation interview guide). The total time for the observation and interview was 80 to 90 minutes.

2.1.3 Pilot Testing

Before initiating the full-scale data collection, we conducted pilot studies to test the study materials, procedures, and the time allotted for data collection. We conducted the pilot with five subjects recruited through mutual acquaintances of NCSU staff working on the project. Based on the pilot observations, we made significant changes to the post-observation interview guide to remove questions that did not specifically address the study's research questions and to streamline and simplify the interview guide.[2] Additionally, we revised the script so that participants were instructed to prepare the chicken entrée first in order to minimize the length of each observation and participant burden.

2.2 Recruitment Procedures

The study team used convenience sampling with quotas to help ensure that study participants reflected the demographic characteristics of U.S. consumers who consume NRTE frozen breaded chicken products. We developed demographic quotas primarily based on data provided by the Centers for Disease Control and Prevention from the FoodNet Population Survey, 2006–2007, in which respondents were asked whether they consumed frozen chicken strips or nuggets or other chicken products in the past 7 days. We supplemented the FoodNet survey data with Census data to inform the quota for household status (i.e., presence of children in household, age category, and level of education) and also considered our recruitment experience for Years 1 and 2). Table 2-1 compares the recruitment targets with the FoodNet survey and Census data.

[2] Because the revisions to the interview guide were significant, it was necessary for NCSU to obtain IRB approval for the revised instrument. IRB approval took longer than anticipated; thus, we used the original interview guide for the first 206 observations and the revised interview guide for the remaining 197 observations.

Table 2-1. Comparison of the Recruitment Targets with Census Data (2016) and Consumption Data for Prepared, Frozen Chicken Products from FoodNet Population Survey (2006–2007)

Characteristic	Recruitment Target (%)	Census Data (%)	FoodNet Survey (%)
Race			
White	69%	73%	69%
Nonwhite[a]	31%	27%	31%
Ethnicity			
Not Hispanic or Latino	91%	83%	91%
Hispanic or Latino	9%	17%	9%
Age[b]			
<19	NA	NA	39%
18–34	37%	28%	21%
35–54	48%	36%	25%
55+	15%	36%	15%
Education[c]			
Less than high school, high school diploma/GED, or technical or vocational school	30%	40%	30%
Some college	34%	29%	70%
Bachelor's degree	22%	19%	NA
Graduate or professional degree	14%	12%	NA
Household status[d]			
Family household (children)	48%	66%	NA
Nonfamily household (no children)	52%	34%	NA

[a] Nonwhite includes Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, other races, or two or more races.

[b] For the Census data, the first age category was 20–34 years instead of 18–34 years. For the FoodNet data, the first category was less than 19 years (and the second category was 19–34). To develop the quotas for age, we allocated 15% to the "55+" category consistent with the FoodNet survey data, then split the remaining 85% by the same allocation for the remaining two age categories using the distribution from the Census data.

[c] For the FoodNet data, the 70% represents respondents with some college or better. To develop the quotas for education, we allocated the 70% using the distribution from the Census data for the three college categories.

[d] For the Census data, family household includes households with children 18 years or younger; married-couple families; male householder, no wife; and female householder, no husband. Nonfamily household includes people living alone and people 65 years or older. Because FoodNet survey data were not available, the quota considers the Census data and our actual recruiting experience for the Years 1 and 2 studies. For the current study, we classified a participant as a family household if the participant had a child less than 18 years of age living at home.

NA = not available

Sources: U.S. Census Bureau. (n.d.). 2012–2016 American Community Survey 5-year data profiles. Retrieved from https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2016/ FoodNet Population Survey data on consumption of frozen chicken strips or nuggets or any other frozen chicken product, 2006–2007, were taken from Centers for Disease Control and Prevention (2015, May 14). Foodborne Diseases Active Surveillance Network (FoodNet). Retrieved from https://www.cdc.gov/foodnet/surveys/population.html

We recruited participants using social media outlets (e.g., Facebook, Twitter) and online advertising platforms (e.g., Craigslist) and by sending emails to Expanded Food and Nutrition Education Program (EFNEP) participants (to reach low-income consumers).

Participants had to meet specific inclusion and exclusion criteria. The inclusion criteria were as follows:

- age 18 or older
- speak English[3]
- the participant or their child (18 years or younger) has prepared frozen breaded chicken nuggets or tenders or frozen stuffed chicken breasts in the past 6 months

The exclusion criteria were as follows:

- have cooked or worked professionally in a food preparation setting in the past 5 years
- have received any type of food safety training, such as ServSafe, in the past 5 years
- participated in a study about cooking within the past 2 years

Recruitment materials directed prospective participants to call or email the study team to be screened for eligibility or to a web link that hosted the screening questionnaire (see Appendix E). For participants screened by phone, we invited eligible participants to participate in the study and scheduled an appointment during the screening call. For participants who completed the web-based screener, we contacted eligible participants by phone, invited them to participate in the study, and scheduled an appointment. Appointments were scheduled during work hours, evenings, and weekends to allow for a broad participant pool. After an appointment was scheduled, we sent one confirmation email and two texts leading up to the scheduled appointment.

A total of 403 people participated in the study: 197 in the control group and 206 in the treatment group. Section 3 provides information on the demographic characteristics of participants. The overall eligibility rate (percentage of cases that completed the web-based or phone screening and met the eligibility criteria) was 63%. Among the 403 study participants, we recruited 71% using social media (Facebook and Twitter), 21% using Craigslist, and 8% using other recruiting efforts such as EFNEP email lists. Based on our experience with the Year 1 and Year 2 studies, the expected show rate was 80%; however, the actual show rate averaged 76%.

[3] The recruiting materials were available in Spanish to reach English-speaking Hispanics, but the study was only conducted in English.

2.3 Coding of Observation Data and Analysis

We used notational analysis to assess recorded actions and their frequencies. Notational analysis is a generic tool used to collect observed events and place them in an ordered sequence (Hughes & Franks, 1997); it has been used to track food safety behaviors because it enables the recording of specific details about events in the order in which they occur by associating a time stamp with actions (Clayton & Griffith, 2004). Notational analysis has been used in both nonparticipant and participant consumer food safety behavior observation studies, as well as participant foodservice observation (Chapman et al., 2010; Clayton & Griffith, 2004; Green et al., 2006; Redmond et al., 2004).

We developed coding rubrics to characterize the following behaviors:

- thermometer usage and other methods to determine doneness of the NRTE chicken product
- method used to prepare the frozen corn
- method used to wash the cucumber
- handwashing compliance

A trained coder viewed each video and followed the rubric to indicate level of adherence to recommended behaviors while observing participants. Coders were trained by reviewing the coding rubric and using practice food safety handling scenarios to compare inter- and intracoding reliability. Incorrect and inconsistent coding situations were discussed with coders to ensure that proper and consistent training occurred. Appendix F provides the coding rubric for thermometer use and handwashing.

For each behavior of interest, we calculated proportions for the control and treatment groups and conducted statistical testing using a chi-squared test for the difference in proportions between the two groups. We used a p value of $\leq .05$ to indicate statistical significance.

2.4 Post-observation Interviews and Analysis

The post-observation interviews collected information on participants' behaviors while preparing the chicken and salad in the test kitchen and their usual behavior at home, behavioral antecedents, and other information. Additionally, participants in both groups were asked about their recall of the news loop playing in the waiting room and their recall of topics addressed in the news segment (unaided recall). For the treatment group, the interviewer probed for awareness of the story on safely preparing frozen foods, if it was not specifically mentioned (aided recall). If participants recalled the food safety news segment, they were asked if the information influenced their actions in the kitchen during the study and whether they believed the information would influence how they cook at home in the

future. Table 2-2 summarizes the information collected in the post-observation interviews (Appendix D provides the interview guide).

Table 2-2. Summary of Information Collected in the Post-observation Interviews

Participant Behavior in the Kitchen and at Home

- Experience with frozen products, including packaged frozen chicken products and vegetables
- Washing hands after handling the frozen NRTE chicken product during meal preparation
- Preparation of the NRTE chicken product and food thermometer use
- Preparation of the corn and black bean salad (including the method used to determine doneness of the frozen corn and vegetable washing)
- Concerns about cross-contamination when handling frozen NRTE chicken products

Behavioral Antecedents

- Concerns about food safety
- Perception of how common it is for people to get food poisoning because of the way food is prepared at home
- Confidence in ability to safely prepare food at home
- Participant and family experience with foodborne illness

Response to News Segment on Safely Preparing Frozen Foods

- Watched any of news segment
- Recalled food safety segment (unaided and aided recall)
- Previously aware of recommendation to use food thermometer to check doneness of NRTE frozen chicken products and NRTE frozen vegetables
- Whether food safety segment influenced actions during meal preparation (e.g., used thermometer, reinforced normal practices)
- Whether food safety segment will influence actions when cooking at home

We audio recorded the interviews and had typed transcripts prepared using the service TranscribeMe. We coded the transcripts using QSR International NVivo, Version 12 software. We assigned a unique case number to each participant to link the screener data and post-observation data. We output the coded data to Excel and tabulated the responses for the control and treatment groups.

3. Results

This section describes the characteristics of the study sample and presents the results of the meal preparation experiment for preparing the NRTE chicken product, including rate of thermometer use; preparing the corn and bean salad, including rate of thermometer use for the NRTE frozen corn and produce washing; and handwashing compliance.

3.1 Sample Characteristics

Of the 403 participants in the study sample, 80% were female, 62% were White, and 88% were non-Hispanic. Participants represented a variety of ages with 39% in the 18 to 34 years age category, 43% in the 35 to 54 years age category, and 18% in the 55 years or older age category. Participants also represented a variety of education levels; 26% of participants were in the lowest education level (high school or less/vocational school). More than half of participants (53%) had at least one child (≤17 years) living in the household. About 47% of participants had at least one individual in the household at risk for foodborne illness (i.e., adult aged 60 years or older; pregnant woman; child aged 5 years or younger; or individual diagnosed with diabetes, kidney disease, or another condition that weakens the immune system) (see Table 3-1). There were no statistically significant differences between the control and treatment groups for these demographic characteristics.

Table 3-2 compares the demographic characteristics of the study sample with the recruiting targets that were set for the study (as described in Section 2.2). Overall, the final study sample was similar to the targets reflecting the characteristics of people who prepare frozen breaded chicken products. The study exceeded the targets for non-White, Hispanic or Latino, and households with children. For age, the study slightly exceeded the targets for the 18 to 34 and 55 or older categories, with fewer than the target number of participants in the 35 to 54 age category. For education, the study did not meet the target for the lowest education level (high school or less/vocational school), 26% vs. the 30% target.

Table 3-1 also provides information on participants' experience with and perceptions regarding foodborne illness, as reported in the post-observation interviews. These factors may influence participants' food safety behaviors. We saw no significant differences between responses to these questions for the control and treatment group participants. Some participants in the study sample have had experience with foodborne illness; 47% reported they have personally had foodborne illness, and 47% reported a family member has had foodborne illness.[4] About 70% of participants had concerns about bacteria or

[4] Participants were asked the following questions: "Have you ever had food poisoning?" and "Has a family member ever had food poisoning?" Information was not collected on whether the person was diagnosed with food poisoning by a health care professional.

Table 3-1. Sample Characteristics

Characteristic	All Participants (*n* = 403)	Control (*n* = 197)	Treatment (*n* = 206)	*p* value[a]
Gender				.3224
Female	80% (320)	78% (153)	81% (167)	
Male	19% (78)	20% (40)	18% (38)	
Other/prefer not to answer	1% (5)	2% (4)	1% (1)	
Race				.2374
Caucasian or White	62% (250)	66% (130)	58% (120)	
Black or African American	33% (132)	30% (59)	35% (73)	
Other race[b]	5% (21)	4% (8)	6% (13)	
Ethnicity				.7495
Not Hispanic or Latino	88% (354)	87% (172)	88% (182)	
Hispanic or Latino	12% (49)	13% (25)	12% (24)	
Age				.2575
18–34	39% (159)	38% (75)	41% (84)	
35–54	43% (173)	41% (81)	45% (92)	
55 or older	18% (71)	21% (41)	15% (30)	
Education				.3375
Less than high school, high school diploma/GED, or technical or vocational school	26% (104)	22% (43)	30% (61)	
Some college	36% (146)	38% (74)	35% (72)	
Bachelor's degree	22% (88)	23% (45)	21% (43)	
Graduate or professional degree	16% (65)	18% (35)	15% (30)	
Have child 17 or younger living in household	53% (212)	50% (98)	55% (114)	.2609
Have at-risk individual living in household[c]	36% (144)	35% (69)	36% (75)	.7722
Participant has had foodborne illness (self-reported) (*n* = 401)	47% (191)	51% (100)	44% (91)	.6223
Participant's family member has had foodborne illness (self-reported) (*n* = 401)	47% (191)	42% (83)	52% (108)	.0962
Participant's level of concern about bacteria or viruses being on or inside food (*n* = 401)				.7535
Depends on the food	1% (6)	1% (2)	2% (4)	
1–3 (Not concerned)	10% (39)	12% (23)	8% (16)	
4 (Neutral)	18% (74)	19% (38)	18% (36)	
5–7 (Concerned)	70% (280)	67% (132)	72% (148)	
Answer unclear/unavailable[s]	<1% (2)	1% (1)	<1% (1)	

(continued)

Table 3-1. Sample Characteristics (continued)

Characteristic	All Participants (*n* =403)	Control (*n* =197)	Treatment (*n* =206)	*p* value[a]
Participant's confidence in ability to safely prepare food when cooking at home (*n* = 401)				.4638
1–3 (Not confident)	1% (2)	0% (0)	2% (2)	
4 (Neutral)	12% (25)	11% (11)	13% (14)	
5–7 (Confident)	83% (172)	85% (88)	81% (84)	
Answer unclear/unavailable[d]	4% (9)	5% (5)	4% (4)	
Participant's perception of how common it is for people to get food poisoning because of the way food is prepared at home (*n* = 401)				.5558
1–3 (Not common)	25% (101)	27% (53)	23% (48)	
4 (Neutral)	51% (206)	49% (97)	53% (109)	
5–7 (Common)	21% (85)	20% (40)	22% (45)	
Answer unclear/unavailable[d]	2% (9)	3% (6)	1% (3)	

[a] We calculated *p* value significance testing using a chi-squared test for the difference between the control and treatment groups for each characteristic. Differences are statistically significant if the *p* value is ≤.05.

[b] Other race includes American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and two or more races.

[c] At-risk populations are people who are 60 years of age or older, children 5 years of age or younger, pregnant women, people diagnosed with diabetes or kidney disease, and people diagnosed with a condition that weakens the immune system.

[d] Participant's response was not captured clearly in the transcript.

Sources: 2019 meal preparation experiment—data are from the screening questionnaire or post-observation interview. *N* = 403 participants coded for screening questionnaire and 401 interviews coded for post-observation interview.

Table 3-2. Comparison of the Study Sample with Recruiting Targets

Characteristic	Study Sample (*N* = 403)	Recruitment Target (%)
Race		
White	62% (250)	69%
Non-White[a]	38% (153)	31%
Ethnicity		
Not Hispanic or Latino	88% (354)	91%
Hispanic or Latino	12% (49)	9%
Age		
18–34	39% (159)	37%
35–54	43% (173)	48%
55+	18% (71)	15%
Education		
Less than high school, high school diploma/GED, or technical or vocational school	26% (104)	30%
Some college	36% (146)	34%
Bachelor's degree	22% (88)	22%
Graduate or professional degree	16% (65)	14%
Household status		
Family household (children)	53% (212)	48%
Nonfamily household (no children)	47% (191)	52%

[a] Non-White includes Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, other races, or two or more races.

Note: Responses may not sum to 100% because of rounding.

Source: 2019 meal preparation experiment—data are from the screening questionnaire.

viruses being on or inside the food they cook, and 83% expressed confidence in the ability to safely prepare food when cooking at home. About 21% perceived that it is common for people to get foodborne illness because of the way food is prepared at home. Comparing these results with those from the 2016 Food Safety Survey, 45% of respondents to the national survey believed that it is "very" or "somewhat" common, and 53% believed it is "not very common" (Lando et al., 2016);[5] thus, a smaller percentage of participants in the meal preparation experiment (21%) perceived food poisoning to be common.

[5] The 2016 Food and Drug Administration (FDA) Food Safety Survey was a national telephone survey of 4,169 adults (18 years or older).

As previously noted, the participant or their child (≤17 years) must have prepared either frozen breaded chicken nuggets/tenders or frozen stuffed chicken breasts in the past 6 months to be eligible to participate in the study. Table 3-3 summarizes participants' self-reported experience preparing these products, presented by whether the participant has children living in their household. We saw no significant differences between responses for the control and treatment group participants. For participants with children living in the household, 97% of all participants had prepared nuggets/tenders in the past 6 months, and 36% had children who had prepared nuggets/tenders in the past 6 months. About 43% of participants prepare nuggets/tenders once a week or more frequently, and 44% of participants' children prepare nuggets/tenders once a week or more frequently. In contrast, for participants without children, 92% had prepared nuggets/tenders in the past 6 months, and 22% prepare nuggets/tenders once a week or more frequently.

Table 3-3. Self-Reported Participant Experience with Frozen Breaded Chicken Products by Whether Children in Household

Characteristic	All Participants % (n)	Control % (n)	Treatment % (n)	*p* value[a]
Participants with children (0–17) in the household (*n* = 212)				
Frozen breaded chicken nuggets or tenders				
Participant purchased in past 6 months	98% (207)	98% (96)	97% (111)	.7775
Participant prepared in past 6 months	97% (205)	97% (95)	97% (110)	.8557
If participant prepared (*n* = 205), frequency of preparing				.1559
Less than once a month	4% (8)	2% (2)	6% (6)	
About once a month	16% (33)	11% (10)	21% (23)	
Two or three times a month	38% (77)	40% (38)	36% (39)	
About once a week	28% (57)	33% (31)	24% (26)	
More than once a week	15% (30)	15% (14)	15% (16)	

(continued)

Table 3-3. Self-Reported Participant Experience with Frozen Breaded Chicken Products by Whether Children in Household (continued)

Characteristic	All Participants % (n)	Control % (n)	Treatment % (n)	*p* value[a]
Child prepared in past 6 months	36% (144)	33% (65)	38% (79)	.2622
If child prepared (*n* = 144), frequency of preparing				.8786
Less than once a month	10% (15)	9% (6)	11% (9)	
About once a month	12% (17)	9% (6)	14% (11)	
Two or three times a month	33% (48)	34% (22)	33% (26)	
About once a week	25% (36)	28% (18)	23% (18)	
More than once a week	19% (28)	20% (13)	19% (15)	
Frozen stuffed chicken breasts				
Participant purchased in past 6 months	36% (76)	38% (37)	34% (39)	.5916
Participant prepared in past 6 months	34% (71)	35% (34)	33% (37)	.7307
If participant prepared (*n* = 71), frequency of preparing				.8741
Less than once a month	23% (16)	24% (8)	22% (8)	
About once a month	31% (22)	29% (10)	32% (12)	
Two or three times a month	34% (24)	32% (11)	35% (13)	
About once a week	11% (8)	12% (4)	11% (4)	
More than once a week	1% (1)	3% (1)	0% (0)	
Child prepared in past 6 months	4% (15)	3% (6)	4% (9)	.4830
If child prepared (*n* = 15), frequency of preparing				.1264
Less than once a month	7% (1)	17% (1)	0% (0)	
About once a month	47% (7)	33% (2)	56% (5)	
Two or three times a month	33% (5)	17% (1)	44% (4)	
About once a week	13% (2)	33% (2)	0% (0)	
More than once a week	0% (0)	0% (0)	0% (0)	

(continued)

Table 3-3. Self-Reported Participant Experience with Frozen Breaded Chicken Products by Whether Children in Household (continued)

Characteristic	All Participants % (n)	Control % (n)	Treatment % (n)	*p* value[a]
Participants without children in the household (*n* = 191)				
Frozen breaded chicken nuggets or tenders				
Purchased in past 6 months	93% (178)	92% (91)	95% (87)	.4681
Prepared in past 6 months	92% (175)	91% (90)	92% (85)	.7118
If prepared (*n* = 175), frequency of preparing				.9728
Less than once a month	18% (31)	19% (17)	17% (14)	
About once a month	24% (42)	24% (22)	24% (20)	
Two or three times a month	37% (65)	37% (33)	38% (32)	
About once a week	13% (22)	11% (10)	14% (12)	
More than once a week	9% (15)	9% (8)	8% (7)	
Frozen stuffed chicken breasts				
Purchased in past 6 months	40% (76)	37% (37)	42% (39)	.4790
Prepared in past 6 months	37% (71)	34% (34)	40% (37)	.4013
If prepared (*n* = 71), frequency of preparing				.4684
Less than once a month	24% (17)	24% (8)	24% (9)	
About once a month	40% (28)	35% (12)	43% (16)	
Two or three times a month	27% (19)	27% (9)	27% (10)	
About once a week	6% (4)	6% (2)	5% (2)	
More than once a week	4% (3)	9% (3)	0% (0)	

[a] We calculated *p* value significance testing using a chi-squared test for the difference between the control and treatment groups for each characteristic. Differences are statistically significant if the *p* value is ≤.05.

Note: Participants who did not purchase the product were excluded from the calculations for prepare product and frequency of preparing the product.

Source: 2019 meal preparation experiment—data are from the screening questionnaire. Number of participants with children (0–17) in household = 212 (98 control and 114 treatment); number of participants with no children (0–17) in household = 191 (99 control and 92 treatment).

Participants had less experience with preparing stuffed chicken breasts. About 34% (with children) to 37% (without children) of all participants had prepared this product in the past 6 months. Participants do not frequently prepare stuffed chicken breasts; 23% reported preparing the product less than once a month, and 31% prepare the product about once a

month (for participants with children). Few participants reported that their children prepare this product for themselves (n = 15) (see Table 3-3).

3.2 Preparation and Thermometer Use for NRTE Chicken Products

Table 3-4 summarizes participants' observed behaviors for preparing the NRTE chicken products, and Table 3-5 summarizes participants' responses to the post-observation interviews regarding their experience in the test kitchen and their normal practices at home for preparing NRTE chicken products.

Table 3-4. Observed Preparation of NRTE Chicken Product

Behavior	Control (n = 196)	Treatment (n = 205)	p value[a]
Participant used thermometer to check doneness	77% (150)	88% (180)	.5538
Among participants who used thermometer (n = 330), number of chicken breasts checked	n = 150	n = 180	.5045
One	15% (23)	13% (23)	
Two	85% (127)	87% (157)	
Method used to determine doneness			.0213
Only used thermometer	76% (148)	85% (174)	
Only used visual cue (i.e., cut open to look inside)	4% (7)	<1% (1)	
Only used touch (e.g., firmness)	3% (6)	<1% (1)	
Only used time	16% (31)	10% (21)	
Observed using more than one method, including thermometer	1% (2)	3% (6)	
Observed using more than one method, not including thermometer	1% (2)	1% (2)	

[a] We calculated p value significance testing using a chi-squared test for the difference between the control and treatment groups for each behavior. Differences are statistically significant if the p value is ≤.05.

Source: 2019 meal preparation experiment—coding of food preparation. N = 401 observations coded.

Cooking Method. Participants received the following instructions for preparing the frozen breaded stuffed chicken breast product (referred to as the NRTE chicken product): "The chicken entrée is in the freezer. Please prepare it first, and as you would at home. For any instructions on how to prepare it, please see the package." In the post-observation interviews, nearly all participants (99%) reported reading the instructions on the package for information on how to prepare the product, and 84% believed the product was raw or partially cooked (see Table 3-5).

Table 3-5. Responses to Questions on Preparing NRTE Chicken Product Asked in the Post-observation Interviews

Question	Total % (*n*)	Control % (*n*)	Treatment % (*n*)
Participant reported reading instructions on frozen chicken packaging during meal preparation study (*n* = 401)			
Yes	99% (398)	99% (195)	99% (203)
Answer unclear/unavailable	1% (3)	1% (1)	1% (2)
Do you think the chicken product you prepared today was raw or fully cooked? (*n* = 401)			
Raw	69% (278)	73% (144)	65% (134)
Partially cooked	15% (61)	11% (22)	19% (39)
Fully cooked	11% (43)	10% (20)	11% (23)
Unsure	1% (4)	1% (2)	1% (2)
Answer unclear/unavailable	4% (15)	4% (8)	3% (7)
Does knowing if a frozen product is labeled as fully cooked or raw matter when making purchase decisions at grocery store? (*n* = 208)			
Yes	30% (62)	29% (30)	31% (32)
No	51% (106)	48% (50)	54% (56)
Depends on the food	16% (33)	18% (19)	13% (14)
Answer unclear/unavailable	3% (7)	5% (5)	2% (2)
If participant had children under 18, would you buy the frozen chicken product for them to prepare at home? (*n* = 401)			
Yes	72% (290)	76% (148)	69% (142)
No	20% (82)	17% (34)	23% (48)
Maybe	6% (23)	5% (10)	6% (13)
Answer unclear/unavailable	1% (6)	2% (4)	1% (2)
How do you know how to prepare frozen chicken products? (*n* = 208)			
Read label	88% (184)	85% (88)	92% (96)
Prior experience	6% (12)	9% (9)	3% (3)
Internet/cooking show	1% (3)	1% (1)	2% (2)
Ask someone	<1% (1)	0% (0)	1% (1)
Answer unclear/unavailable	4% (8)	6% (6)	2% (2)

(continued)

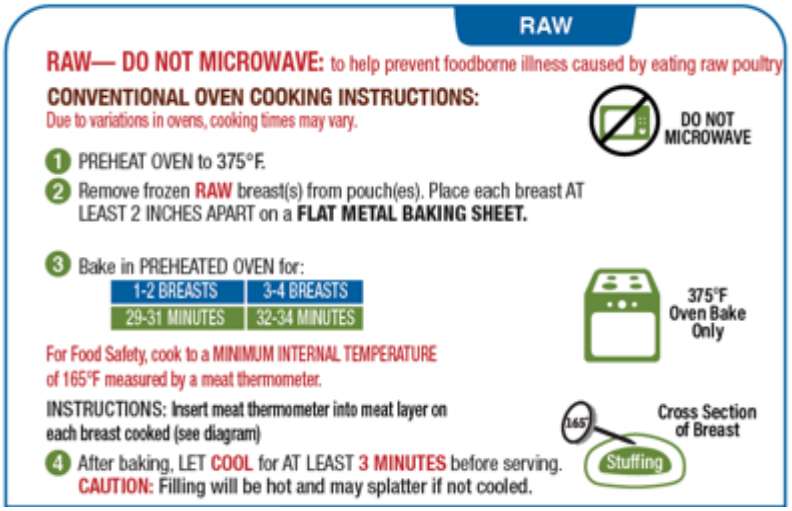
Table 3-5. Responses to Questions on Preparing NRTE Chicken Product Asked in the Post-observation Interviews (continued)

Question	Total % (*n*)	Control % (*n*)	Treatment % (*n*)
Method normally used to prepare frozen chicken products at home[a] (*n* = 401)			
Oven	94% (376)	94% (185)	93% (191)
Microwave	1% (5)	1% (2)	1% (3)
Depends on food	2% (8)	2% (4)	2% (4)
Answer unclear/unavailable	3% (12)	3% (5)	3% (7)
Self-reported food thermometer ownership (*n* = 401)	72% (288)	76% (149)	68% (139)
If own thermometer (*n* = 288), typically use it to check doneness of frozen chicken products			
Yes	38% (109)	37% (55)	39% (54)
No	52% (149)	53% (79)	50% (70)
Sometimes/depends	10% (30)	10% (15)	11% (15)
How important do you think it is to use a thermometer when cooking frozen chicken products? (*n* = 401)			
Very important	55% (222)	54% (106)	57% (116)
Somewhat important	32% (127)	30% (58)	34% (69)
Not important at all	6% (25)	8% (16)	4% (9)
Don't know	4% (16)	4% (8)	4% (8)
Answer unclear/unavailable	3% (11)	4% (8)	1% (3)
Are you concerned about frozen chicken products cross-contaminating other food or surfaces in kitchen when cooking? (*n* = 401)			
Yes	20% (80)	21% (41)	19% (39)
No	76% (306)	75% (147)	78% (159)
Answer unclear/unavailable	4% (15)	4% (8)	3% (7)

[a] More than one response may be selected, so total may sum to more than 100%.

Source: 2019 meal preparation experiment—post-observation interviews. *N* = 401 interviews coded for initial interview guide (196 control and 205 treatment) and 208 interviews coded for final interview guide (104 control and 104 treatment).

Manufacturer's Cooking Instructions for NRTE Chicken Product Prepared in the Experimental Study



The manufacturer's cooking instructions (see sidebar) instructed consumers to cook the breasts in the oven and to use a food thermometer to check for doneness, including a graphic image showing a food thermometer (with a temperature of 165°F) being inserted into a chicken breast. These instructions are similar to those provided on the packaging of comparable products available in the marketplace. All participants prepared the NRTE chicken product in the oven, as recommended by the manufacturer. In the post-observation interviews, 94% reported that they normally prepare similar products at home in the oven; thus, most participants followed their normal behavior in the test kitchen regarding preparation method.

Thermometer Use. Control group participants used a food thermometer to check the doneness of the NRTE chicken product 77% of the time, and treatment group participants used a thermometer 88% of the time. Although the rate of thermometer use was higher among the treatment group compared with the control group, the difference was not significantly different (see Table 3-4). As previously noted, nearly all participants (99%) reported reading the instructions on the packaging that provided specific instructions on using a food thermometer, which may have encouraged thermometer use.

Among participants who reported owning a food thermometer prior to the study (n = 288), 38% reported that they typically use one to check doneness of frozen chicken products when cooking at home, which is much lower than what was observed in the test kitchens, suggesting that some participants may not have exhibited their typical cooking practices in the test kitchen. The alteration of behavior by study participants because they are being observed is referred to as the Hawthorne effect (Roethlisberger & Dickson, 1966). Despite their reported normal practices regarding thermometer use, 87% of participants reported in the post-observation interviews that it was very or somewhat important to use a food thermometer to check the doneness of frozen chicken products (see Table 3-5).

Number of Chicken Breasts Checked for Doneness. Among all participants who used a food thermometer, 14% checked one of the two breasts and 86% checked both breasts,

which is the recommended practice. There were no significant differences between the control and treatment groups (see Table 3-4). The manufacturer's cooking instructions did not instruct consumers to check the temperature of each breast that was cooked.

Thermometer Use Among the Treatment Group. Among the 205 treatment group participants, 166 participants reported watching the news loop, and among these participants, 81 participants recalled seeing the food safety news segment (7% unaided and 42% aided recall). Among participants who recalled the food safety segment, 90% used a thermometer, and 76% checked both chicken breasts. Additional information on the treatment group's response to the intervention is presented in Section 3.5.

Endpoint Temperatures. When participants used a food thermometer to check doneness of the NRTE chicken product, observers obtained the final endpoint temperature when possible by viewing the thermometer reading on the video footage. Endpoint temperatures were available for 84 of the 330 participants who used a food thermometer to check the doneness of the first chicken breast and for 41 participants who used a food thermometer to check the doneness of the second chicken breast. In many cases, the temperature on the thermometer was not visible on the video footage, so we were unable to obtain temperature readings for most participants. Among all participants, 75% of the first chicken breast's temperature readings were 165°F or above (the recommended temperature), 8% read between 165°F and 160°F, and 17% read below 160°F. Eighty-five percent of the temperature readings of the second chicken breast read at 165°F or above, 8% read between 165°F and 160°F, and 7% read below 160°F. There was not a significant difference between the control and treatment groups for the temperatures recorded (see Table 3-6). The recorded temperatures were the final visible thermometer readings. In most cases, this was the final attempt, but in some instances, the participants used a food thermometer to check the temperature again, and the reading was not visible. Participants also could have continued cooking the product after this last recorded temperature reading, so we do not know if the chicken measuring below 160°F continued to cook. It is also important to note that some participants could have continued to cook the chicken and used a subjective measure (such as cutting the chicken breast open to check the color) to determine doneness.

Table 3-6. Visible Temperatures of Participants Who Used Thermometer to Check Doneness of NRTE Chicken Products

	Control % (n)	Treatment % (n)	*p* value
First Chicken Breast			.2230
165°F or higher	75% (30)	75% (33)	
164°F	8% (3)	0% (0)	
163°F	0% (0)	7% (3)	
162°F	0% (0)	0% (0)	
161°F	0% (0)	2% (1)	
160°F	0% (0)	0% (0)	
Less than 160°F	18% (7)	16% (7)	
Total available readings	40	44	
Second Chicken Breast			.5161
165°F or more	80% (16)	90% (19)	
164°F	0% (0)	0% (0)	
163°F	0% (0)	5% (1)	
162°F	0% (0)	0% (0)	
161°F	5% (1)	5% (1)	
160°F	0% (0)	0% (0)	
Less than 160°F	15% (3)	0% (0)	
Total available readings	20	21	

Source: 2019 meal preparation experiment—post-observation interviews.

Other Methods Used to Determine Doneness. Among participants who did not use a food thermometer, the most common method to determine doneness was time, which was determined when the participant referred to the timer without any other method to check doneness (13% among all participants). Few participants relied on sensory indicators such as cutting the breast open to look at the inside or touching it (see Table 3-4). There was a statistically significant difference between the control and treatment groups for method used to determine doneness; more participants in the control group relied on methods other than using a thermometer to determine doneness.

Concern for Cross-Contamination. We asked participants whether they were concerned about NRTE chicken products cross-contaminating other foods or surfaces in the kitchen during meal preparation. About 76% of participants were not concerned. As previously noted, there is no significant risk for cross-contamination posed by handling frozen products themselves because these foods have no liquid matrix associated with them (Schaffner & Schaffner, 2007).

3.3 Preparation of Corn and Black Bean Salad

Participants prepared a side salad made with frozen NRTE corn, fresh cucumber, and canned black beans. Participants received the following verbal instructions, "For the salad, the beans are here on the counter, the salsa and cucumber are in the refrigerator, and the corn is in the freezer. Here's the recipe for the salad (provide laminated sheet with recipe)." (see sidebar for recipe). The manufacturer's cooking directions on the corn included directions to prepare on the stovetop or the microwave and stated, "Not ready to eat. For food safety, cook to an internal temperature of 165°F." The manufacturer's cooking instructions did not indicate the need to use a food thermometer. Figure 3-1 shows a screenshot of the front and back panels of the corn package.

Corn and Black Bean Salad

Ingredients:

- 1 can black beans
- ½ cup salsa
- 1 cucumber
- 1 cup corn

Directions:

1. Drain and rinse the black beans.
2. Chop cucumber into bite-sized pieces.
3. Prepare 1 cup corn.
4. Combine cucumber in bowl with black beans, corn, and salsa and mix.

Figure 3-1. Packaging for NRTE Frozen Corn Used in Meal Preparation Study

Table 3-7 summarizes participants' observed behaviors for preparing the corn and black bean salad, and Table 3-8 summarizes participants' responses to the post-observation interviews regarding their experience in the test kitchen and their normal practices at home for preparing salads using frozen vegetables as an ingredient.

Cooking Method and Thermometer Use for Frozen NRTE Corn. Among all participants, the most common method to prepare the corn was boiling it in water on the stovetop (58%), followed by the microwave (38%). Three percent of participants did not cook the corn (i.e., took the frozen corn directly out of the freezer and mixed it into the salad), which is not recommended because the product is NRTE. Few participants (one in the control group and seven in the treatment group) used a thermometer to check the corn for

doneness as shown in the food safety news segment (this was demonstrated by inserting a thermometer into a bowl of cooked corn) and as recommended by the manufacturer's instruction to cook to an internal temperature of 165°F. Although the *p* value indicates statistical significance, caution should be exercised in drawing any conclusions because of the small number of participants using a thermometer. Among the seven participants in the treatment group using a thermometer, all reported awareness of the food safety news segment.

Table 3-7. Observed Preparation of Corn and Black Bean Salad

Behavior	Control (*n* = 196)	Treatment (*n* = 205)	*p* value[a]
Method used to prepare frozen corn			.5501
Stovetop	55% (108)	61% (126)	
Microwave	41% (80)	36% (74)	
Did not cook	4% (8)	2% (5)	
Thermometer used to check doneness of corn	1% (1)	3% (7)	.0090
Method used to wash cucumber			.9182
Rinsed without rubbing or scrubbing	27% (52)	28% (58)	
Rinsed and rubbed surface using hands	48% (95)	47% (96)	
Scrubbed surface using vegetable brush	0% (0)	0% (0)	
Did not rinse or wash	25% (49)	25% (51)	
Cucumber peeling (*n* = 148)	*n* = 84	*n* = 64	.4509
Rinsed and peeled	45% (38)	53% (34)	
Scrubbed and peeled	31% (26)	22% (14)	
Did not wash but peeled	24% (20)	25% (16)	

[a] We calculated *p* value significance testing using a chi-squared test for the difference between the control and treatment groups for each behavior. Differences are statistically significant if the *p* value is ≤.05.

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401 observations coded.

In the post-observation interviews, participants said they know how to prepare frozen vegetables by reading the label (66%) and from their prior experience (26%). Most participants (88%) reported reading the instructions on the corn package during the meal preparation study. About 17% of participants (*n* = 35) reported that they normally use a different method to prepare frozen corn at home than done during the meal preparation experiment. Among these participants, 43% reported that they normally would prepare frozen corn in the microwave, and 17% said they would thaw the corn before putting it in a salad or put the corn in the salad without thawing, which are unsafe practices for an NRTE product (see Table 3-8).

Participants said when preparing the corn in the test kitchen, they relied on time (37%) and visual indicators (e.g., steam) (31%) to know when the corn was done. As previously noted,

few participants used a food thermometer to check the doneness of the corn during the meal preparation study (1% control, 3% treatment). Among the participants using a food thermometer during the meal preparation study, only one person said this is something they usually do when cooking at home.

Table 3-8. Self-Reported Practices for Preparing Corn and Black Bean Salad

Question	Total % (*n*)	Control % (*n*)	Treatment % (*n*)
How do you know how to prepare frozen vegetables?[a] (*n* = 208)			
Read label	66% (138)	70% (73)	63% (65)
Prior experience	26% (55)	24% (25)	29% (30)
"Wing it"	2% (5)	2% (2)	3% (3)
Depends on vegetable	3% (6)	2% (2)	4% (4)
Answer unclear/unavailable	2% (4)	2% (2)	2% (2)
Participant reported reading instructions on corn package during meal preparation study (*n* = 208)			
Yes	88% (182)	83% (86)	92% (96)
No	10% (21)	13% (13)	8% (8)
Answer unclear/unavailable	2% (5)	5% (5)	0% (0)
Participant normally uses different method to prepare frozen corn than method used during meal preparation study (*n* = 208)	17% (35)	16% (17)	17% (18)
If participant reported different method for preparing frozen corn at home, method normally used (*n* = 35)			
Prepare on stovetop	20% (7)	24% (4)	17% (3)
Prepare in microwave	43% (15)	47% (8)	39% (7)
Thaw corn before putting in salad	14% (5)	12% (2)	17% (3)
Put corn into salad without thawing	3% (1)	6% (1)	0% (0)
Other	20% (7)	12% (2)	28% (5)
How did you know the corn prepared during the meal preparation experiment was done?[a] (*n* = 208)			
Time	37% (77)	40% (42)	34% (35)
Used thermometer	2% (5)	0% (0)	5% (5)
Visual indicators (e.g., steam)	31% (64)	33% (34)	29% (30)
Feel ("texture")	19% (40)	17% (18)	21% (22)
"Popping" noise made when food is cooked in microwave	3% (7)	4% (4)	3% (3)

(continued)

Table 3-8. Self-Reported Practices for Preparing Corn and Black Bean Salad (continued)

Question	Total % (*n*)	Control % (*n*)	Treatment % (*n*)
Taste	4% (9)	6% (6)	3% (3)
Smell	6% (12)	6% (6)	6% (6)
Other response	2% (4)	3% (3)	1% (1)
Answer unclear/unavailable	7% (15)	7% (7)	8% (8)
Did not cook/no need to cook	3% (7)	4% (4)	3% (3)

[a] More than one response may be selected, so total may sum to more than 100%.

Source: 2019 meal preparation experiment—post-observation interviews. *N* = 208 interviews coded for final interview guide (104 control and 104 treatment).

Washing Method for Cucumber. The most common method used to wash the cucumber was to rinse and scrub the surface using hands (48% of participants), followed by rinsing without rubbing or scrubbing (27%). Twenty-five percent of participants did not rinse or wash the cucumber. FDA recommends scrubbing the surface of firm produce, such as melons and cucumbers, using a vegetable brush (FDA, 2018) (see Table 3-7). Among participants who peeled the cucumber (*n* = 148), 24% did not wash the cucumber before peeling it.

3.4 Handwashing Compliance

Inadequate handwashing has been identified as a contributing factor to foodborne illness, especially when preparing raw meat and poultry. Hands can become vectors that move pathogens around sites for foodborne pathogens found in raw meat and poultry and that contribute to home-acquired foodborne illnesses. Frequency and level of contamination of hands have not been well studied. The food safety news segment did not provide information on proper handwashing.

The total handwashing events required per observation were determined during the coding for each observation. A handwashing event was required for each of the following instances:

- before onset of food preparation
- anytime between touching the packaging for the NRTE chicken product and then touching a different item
- after touching another person or self
- after touching cell phone
- after multitasking (chores)
- after touching contaminated (post-meal) trash or trash can

The total number of attempts per observation was the number of times a participant washed their hands. Each handwashing event was coded as successful or unsuccessful based on CDC's criteria: wet hands with water; rub hands with soap for at least 20 seconds; rinse hands with water; and dry hands using a clean, one-use towel. For example, participant 001T was required to wash her hands nine times but attempted only two times. Of these two times, neither was coded as successful because she did not rub her hands with soap for a total of 20 seconds. Our analysis only considered compliance with CDC's handwashing criteria; we did not consider risk reduction from participants following some but not all required steps of a successful handwashing event.

It is estimated that proper handwashing results in approximately 1 log reduction (Montville, Chen, & Schaffner, 2002). Among all participants, 72% attempted to wash hands before beginning meal preparation (see Table 3-9). Among handwashing attempts, 5% of attempts contained all steps of a correct handwashing event according to CDC's criteria and were considered successful attempts. The most common reason for unsuccessful handwashing was not rubbing hands with soap for at least 20 seconds (93% in the control group and 89% in the treatment group), followed by not wetting hands with water (69% in the control group and 62% in the treatment group). Eight percent of attempts did not include proper drying with a one-use towel. Both dish/hand towels and paper towels were provided. Drying hands using a clean, one-use towel is an important step in handwashing because it can physically remove microbes and contaminants from hands, resulting in up to 1 additional log reduction (Huang, Ma, & Stack, 2012). There were no statistically significant differences between the two groups.

Table 3-9. Handwashing Compliance before Onset of Meal Preparation

	Control (*n* = 196)	Treatment (*n* = 205)	*p* value[a]
Did not attempt	29% (56)	27% (56)	.7192
Attempts[b]	71% (140)	73% (149)	
Successful attempts[c]	4% (6)	5% (8)	.5700
Unsuccessful attempts	96% (134)	95% (141)	
Reasons for unsuccessful attempt[d]			
Did not wet hands with water	69% (93)	62% (87)	.8988
Did not use soap	1% (2)	1% (1)	.5918
Did not rub hands with soap for at least 20 seconds	93% (125)	89% (125)	.7059
Did not rinse hands with water	3% (4)	1% (2)	.4483
Did not dry hands	4% (5)	1% (2)	.2841

(continued)

Table 3-9. Handwashing Compliance before Onset of Meal Preparation (continued)

	Control (*n* = 196)	Treatment (*n* = 205)	*p* value[a]
Dried hands with surface other than clean, one-use towel (e.g., wiped hands on clothing or used previously used towel)	5% (7)	6% (8)	.7528

[a] We calculated *p* value significance testing using a chi-squared test for the difference between the control and treatment groups for handwashing compliance. Differences are statistically significant if the *p* value is ≤.05.

[b] "Attempt" was defined as any time that a participant appeared to wash their hands; the attempt could be successful or unsuccessful.

[c] A successful attempt was defined as a participant meeting all of the CDC criteria for handwashing: wet hands with water; rub hands with soap for at least 20 seconds; rinse hands with water; and dry hands using a clean, one-use towel.

[d] There may be multiple reasons for unsuccessful attempts, so the total may sum to more than 100%.

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401 observations coded.

We observed 1,003 cases in which a handwashing event was required to prevent cross-contamination during meal preparation. Required handwashing events varied by person based on each participant's handling behaviors; as a result, some participants had a greater number of required handwashing events than others (e.g., touched the packaging of the NRTE chicken product more often). Of these 1,003 cases, handwashing was not attempted most of the time (95%). Among the 47 handwashing events attempted, only one event resulted in correct handwashing according to CDC's criteria (see Table 3-10). None of the unsuccessful attempts included rubbing hands with soap for at least 20 seconds.

Table 3-10. Handwashing Compliance during Meal Preparation

	Control (*n* = 196)	Treatment (*n* = 205)	*p* value[a]
Handwashing event required (*n* = 1,003)	499	504	
Did not attempt	97% (482)	94% (474)	.6797
Attempts[b]	3% (17)	6% (30)	
Successful attempts[c]	0% (0)	3% (1)	.4285
Unsuccessful attempts	100% (17)	97% (29)	
Reasons for unsuccessful attempt[d]			
Did not wet hands with water	47% (8)	48% (14)	.5672
Did not use soap	6% (1)	7% (2)	.5683
Did not rub hands with soap for at least 20 seconds	100% (17)	100% (29)	.4519
Did not rinse hands with water	35% (6)	7% (2)	.0620

(continued)

Table 3-10. Handwashing Compliance during Meal Preparation (continued)

	Control (*n* = 196)	Treatment (*n* = 205)	*p* value[a]
Did not dry hands	12% (2)	3% (1)	.3949
Dried hands with surface other than clean, one-use towel (e.g., wiped hands on clothing or used previously used towel)	18% (3)	17% (5)	.7795

[a] We calculated *p* value significance testing using a chi-squared test for the difference between the control and treatment groups for handwashing compliance. Differences are statistically significant if the *p* value is ≤.05.

[b] "Attempt" was defined as any time that a participant appeared to wash their hands; the attempt could be successful or unsuccessful.

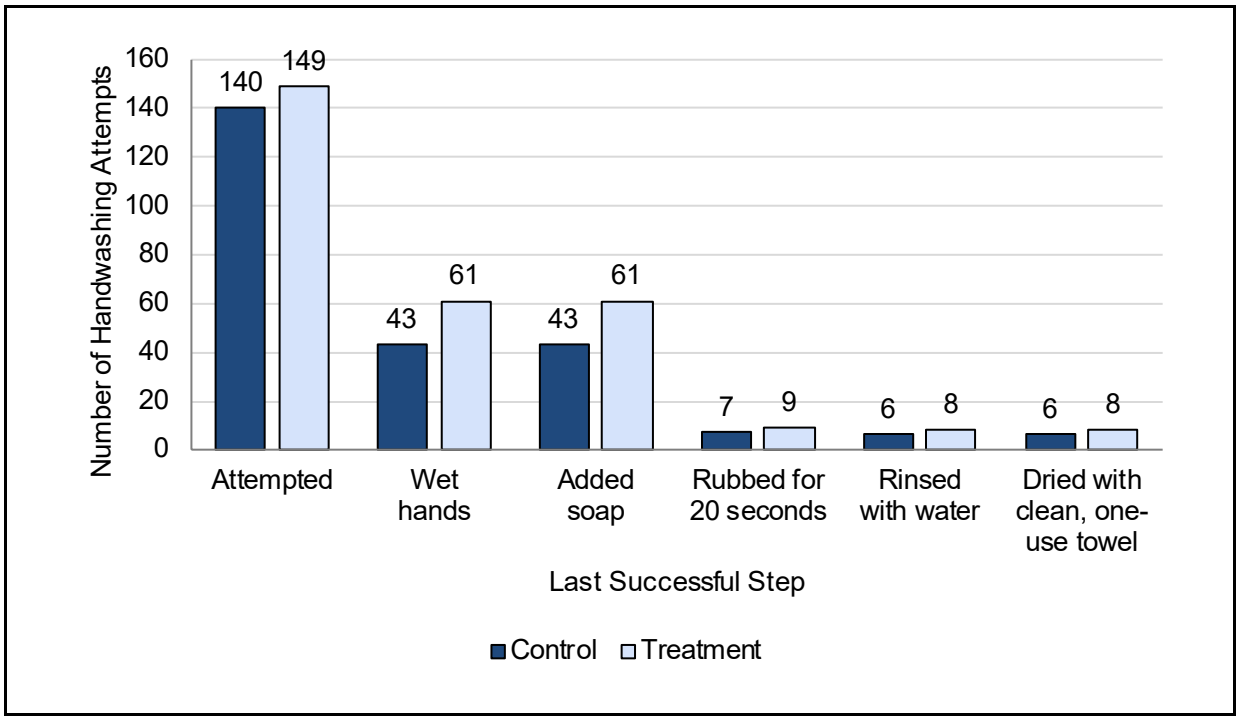
[c] A successful attempt was defined as a participant meeting all CDC criteria for handwashing: wet hands with water; rub hands with soap for at least 20 seconds; rinse hands with water; and dry hands using a clean, one-use towel.

[d] There may be multiple reasons for unsuccessful attempts, so the total may sum to more than 100%.

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401 observations coded.

Figure 3-2 shows the point at which participants fell out of compliance with the CDC definition of a successful handwashing attempt before the onset of meal preparation by giving counts associated with the last successful step of handwashing performed (the steps are mutually exclusive). Participants wet hands in 43 of the events for the control group and in 61 of the events for the treatment group, and they used soap in 43 of the events for the control group and 61 of the events for the treatment group. Most of the remaining events failed at the step of rubbing hands for 20 seconds (seven successful completions of that step in the control group and nine successful completions in the treatment group). Overall, there was a total of six successful attempts for the control group and eight successful attempts for the treatment group for completing all steps required for handwashing successfully before starting meal preparation.

Figure 3-2. Handwashing Compliance before Onset of Meal Preparation



Notes: Illustrates point at which participants fell out of compliance with the CDC definition of a successful handwash when washing their hands before meal preparation by giving counts associated with the last successful step of handwashing performed (the steps are mutually exclusive).

Total control handwashing attempts = 140

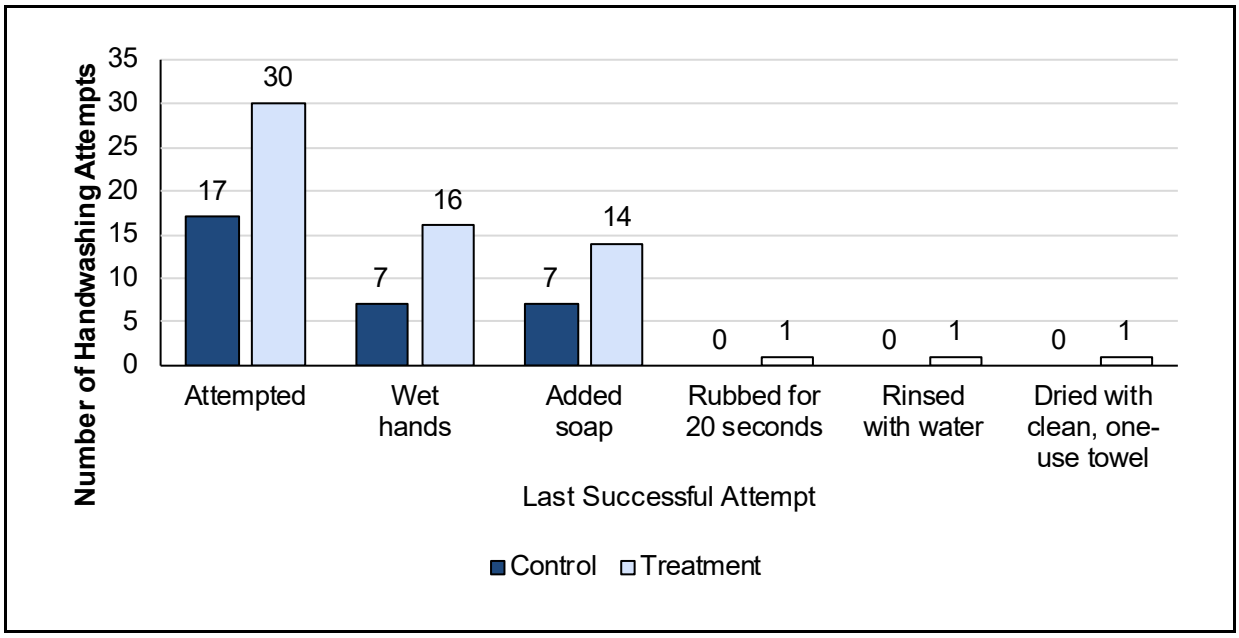
Total treatment handwashing attempts = 149

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401.

Handwashing during meal preparation shows similar results (Figure 3-3). The largest deviation from compliance occurred for participants rubbing hands for 20 seconds (none from the control group and only one from the treatment group were successful).

Figure 3-4 illustrates the number of handwashing attempts per participant observation, which includes both before and during meal preparation. The largest number of observations (289) involved participants who had one handwashing attempt (generally before the start of meal preparation), followed by 19 observations who had two attempts, and 17 observations who had three attempts. No observations had more than five handwashing attempts. The small number of handwashing attempts is likely attributable to participants preparing a raw frozen breaded chicken product rather than fresh raw poultry.

Figure 3-3. Handwashing Compliance during Meal Preparation



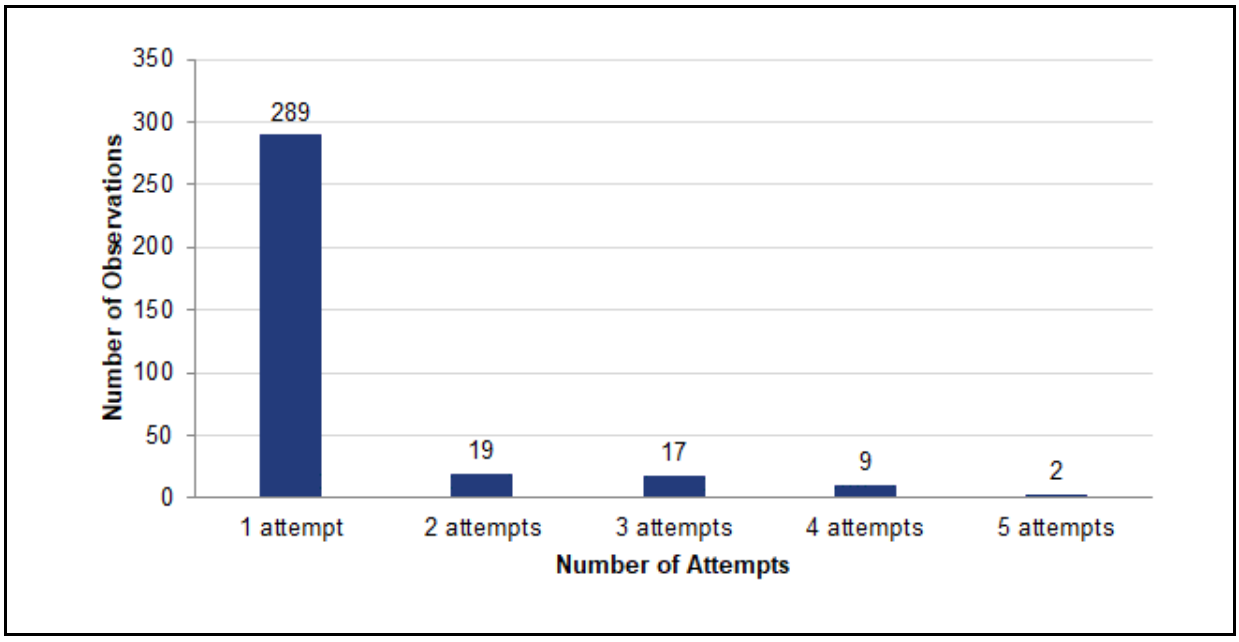
Notes: Illustrates point at which participants fell out of compliance with the CDC definition of a successful handwash when washing their hands during meal preparation by giving counts associated with the last successful step of handwashing performed (the steps are mutually exclusive).

Total control handwashing attempts = 17

Total treatment handwashing attempts = 30

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401.

Figure 3-4. Number of Handwashing Attempts per Participant Observation Before and During Meal Preparation (All Participants)



Notes: Illustrates number of handwashing attempts per participant observation.

Source: 2019 meal preparation experiment—coding of food preparation. *N* = 401.

3.5 Participants' Responses to Intervention (Treatment Group Only)

During the post-observation interviews, we collected information about the treatment participants' responses to the food safety segment shown as part of the news loop that was playing in the waiting room while waiting for the study to start (see Table 3-11). About 81% of participants in the treatment group reported watching any of the news stories. Among these participants, 7% reported seeing information on food safety when asked what they recalled watching (unaided recall). If food safety was not mentioned, then the participant was prompted ("Do you remember seeing the segment about food safety?"); 42% recalled the food safety segment (aided recall), thus increasing total aided recall to 49% (40% among all treatment group participants).

Table 3-11. Treatment Participants' Responses to Food Safety News Segment Intervention

Question	Response % (*n*)
Watched any of news loop playing in the waiting room	81% (166)
If watched any of news loop (*n* = 166), recalled segment on food safety	
Unaided recall	7% (12)
Aided recall (with prompting)	42% (69)
If recalled segment on food safety (*n* = 81), was previously aware that some frozen products are not fully cooked and thus need to use food thermometer to determine doneness	37% (30)
If recalled food safety segment, did the information influence participants' actions in the kitchen today? (*n* = 81)	
Yes, influenced actions	53% (43)
Used thermometer on chicken	79% (34)
Used thermometer on corn	2% (1)
Reinforced normal practices	16% (7)
Other reason: time, "awareness," thermometer use	2% (1)
No, did not influence actions	43% (35)
Already use thermometer on chicken	11% (4)
Followed directions on product packaging	14% (5)
Reinforced normal practices	23% (8)
Other[a]	20% (7)
Reason not provided	31% (11)
Not answered/answer not clear/answer not relevant	4% (3)

(continued)

Table 3-11. Treatment Participants' Responses to Food Safety News Segment Intervention (continued)

Question	Response % (*n*)
If recalled food safety segment, will the information influence how participant cooks at home in the future? (*n* = 81)	
Yes, will influence	56% (45)
New information about cooking practices	91% (41)
Reinforced normal food preparation practices	9% (4)
No, will not influence	33% (27)
Reinforced normal food preparation practices	81% (22)
Other	19% (5)
Not answered/answer not clear/answer not relevant	11% (9)

[a] "Other" refers to other reasons that do not fit into one of the previous categories, such as "considering risk and possibility" or that they prepared the food as they would at home.

Source: 2019 meal preparation experiment—post-observation interviews. *N* = 205 observations coded.

Among participants who recalled the food safety segment (aided or unaided recall), 37% were previously aware of the recommendation to use a food thermometer to determine doneness of frozen foods that are not fully cooked.

Approximately 56% of participants who recalled the food safety segment reported that the information contained in the food safety segment will likely influence future cooking behaviors, and 91% of these participants mentioned learning new information about preparing frozen foods as the primary reason for behavior change.

> *"I will start cooking my frozen vegetables if I can figure out what temperature they're supposed to be at. I'll have to do a little research."*

> *"I definitely think I want to get a food thermometer just to make sure you're not just guessing if it's done."*

> *"Like I said, I'll take more precautions to check the temperature of things that I wouldn't necessarily think need to be checked."*

3.6 Comparison by Study Year for Control Group Participants

Table 3-12 compares the results for Years 1, 2, and 3 for handwashing and thermometer use. In Year 1, participants prepared turkey burgers with a garnish and a chef salad. The primary focus was to examine thermometer use when cooking turkey patties, but data were also collected on handwashing behaviors and potential cross-contamination of kitchen surfaces and the lettuce (Cates et al., 2018). In Year 2, participants that self-identified as poultry washers prepared chicken thighs and a mixed green salad. The primary focus was to

determine whether participants washed poultry, as well as their handwashing behaviors and potential cross-contamination of kitchen surfaces and the salad lettuce (Cates et al., 2019).

Table 3-12. Comparison of Handwashing Compliance and Thermometer Use for Annual Meal Preparation Experiments (Control Group Participants)

	Year 1 (*n* = 185)	Year 2 (*n* = 154)	Year 3 (*n* = 196)
Handwashing			
Handwashing event required before the start of or during meal preparation [a]	1,195	—	—
% did not attempt	69%	—	—
% attempt	31%	—	—
% successful attempt (out of all attempts)	3%	—	—
Handwashing event required before the start of meal preparation	—	154	196
% did not attempt	—	26%	29%
% attempt	—	74%	71%
% successful attempt (out of all attempts)	—	1%	4%
Handwashing event required during meal preparation	—	1,145	499
% did not attempt	—	74%	97%
% attempt	—	26%	3%
% successful attempt (out of all attempts)[a]	—	1%	0%
Thermometer Use			
% used thermometer on at least one item	34%	44%	77%
% checked temperature of multiple items (among thermometer users)	79%	76%	85%

[a] For year 1, data are not available by when handwashing took place (i.e., before the start of or during meal preparation), so the combined data are presented.

[b] Successful attempt represents successful handwashing attempts out of all attempts.

Sources: 2017, 2018, and 2019 meal preparation experiment—coding of food preparations.

The number of handwashing events required was much lower in Year 3 relative to Years 1 and 2 likely because this year's study involved preparing a raw frozen breaded chicken product rather than fresh raw poultry. Consistent with the results for Years 1 and 2, the most common reason for unsuccessful handwashing attempts was not rubbing hands with soap for 20 seconds.

Regarding thermometer use, in Year 1, 34% of participants in the control group used a thermometer on at least one turkey patty, and in Year 2, 44% of the control group used a thermometer on at least one chicken thigh. In Year 3, the rate of thermometer use was much higher at 77%. The higher rate of thermometer use may be attributed to the large percentage of participants who reported reading the manufacturer's cooking instructions when preparing the stuffed chicken breasts, with many of these participants not having

prior experience preparing the product. Additionally, for some participants, their self-reported practices for preparing similar products at home differed from their observed practices in the test kitchen, suggesting the test kitchen environment may have altered their behavior. For all 3 years, among thermometer users, most participants checked the temperature of both items, which is the recommended practice.

4. Conclusion

This section concludes the report by summarizing the key findings from the meal preparation experiment and discussing implications for message development that FSIS OPACE may want to consider.

4.1 Thermometer Use for NRTE Chicken

The rate of thermometer use to check the doneness of NRTE chicken products was high among both the control (77%) and treatment (88%) groups. Among participants using a thermometer, most checked the temperature of both chicken breasts. Three factors may have contributed to the high rate of thermometer use. First, nearly all participants reported reading instructions on the package before preparing the product. The package used in the experiment displayed validated manufacturer cooking instructions from a commercially available product that instructed consumers to use a thermometer to check for doneness. Second, participants' limited experience with this type of product—34% reported prior experience preparing stuffed chicken breasts from frozen—may have led many participants to read and follow the manufacturer's cooking instructions. Third, the test kitchen environment may have led some participants to use a thermometer even though this is not their normal practice when cooking at home. Among participants who reported owning a food thermometer before participating in the study, only 38% said that they typically use one to check doneness of NRTE chicken products when cooking at home.

Limited research has been conducted on preparing NRTE chicken products. An observational study with 21 adult meal preparers found that 19% used a food thermometer to check the doneness of NRTE frozen chicken products (chicken strips and chicken Kiev) (DeDonder et al., 2009); thus, thermometer use was much higher for the current study compared with this study. The DeDonder et al. study was conducted in 2007, only 1 year after validated cooking instructions were required in 2006.[6] The higher rate of thermometer use observed in the current study may be attributed to the detailed cooking instructions provided by the manufacturer, including a visual of a thermometer being inserted into a chicken breast. It is possible that the manufacturer's instructions provided in the current study were clearer and easier for participants to understand that thermometer use is recommended compared with the instructions provided on the packaging for the product used in the DeDonder et al. study.[7]

[6] https://www.aamp.com/news/documents/Notice75-06.pdf

[7] Instructions on breaded chicken product used in the DeDonder et al. study: "Cooking instructions (This raw product must be thoroughly cooked). "This is a raw product that must be fully cooked." "We recommend: Always cook to at least 165F. Always use a food thermometer, checking all final portion's temperatures in several places."

4.2 Thermometer Use for Frozen NRTE Corn

The majority of participants cooked the frozen corn either on the stovetop or in the microwave (only three individuals did not cook it); however, few participants used a thermometer to check for doneness. Of the treatment group participants who used a thermometer, all stated that they had seen the food safety news segment (the segment included instructions on using a food thermometer and included a visual of thermometer use for frozen corn). Most participants reported reading the instructions on the corn packaging. The package displayed the following statement, "Not ready to eat. For food safety, cook to an internal temperature of 165°F." The statement was located at the bottom of the package and not located as a part of the cooking instructions as it was for the NRTE chicken product. The corn packaging did not include instructions on using a thermometer. The lower rate of thermometer use may be because consumers are more familiar with frozen corn than with the frozen chicken product, and participants were not aware of the recommendation to use a thermometer to check for doneness of NRTE frozen corn.

4.3 Impact of the Food Safety News Segment on Participants' Behavior

The results of this study suggest that the food safety segment on safe cooking of frozen products played as part of a news segment shown in the waiting room did not affect thermometer use. Forty percent of the treatment group participants recalled the food safety news segment; thus, not all participants received exposure, which is not surprising given the more passive nature of the intervention. For example, participants were frequently observed using their phones while waiting for the study to start instead of watching the news loop. Among those who recalled the food safety segment, about half said it influenced their actions in the kitchen in that they used a thermometer to check the doneness of the NRTE chicken product, which may have served to reinforce what they read on the product packaging which included instructions for thermometer use. Thus, exposure to the food safety segment may have led to the slightly higher rate of thermometer use among the treatment group compared with the control group, although the difference between the two groups was not statistically significant.

Other studies with similar passive interventions (news or video segments in a waiting room) related to a health behavior have reported similar findings and suggest evidence that these messages may increase knowledge and intention to change behaviors, but more research is needed (Chan et al., 2008; Jawad et al., 2017; Matthews et al., 1999; Wheeler et al., 2001).

OPACE faces many challenges when developing food safety communications given the need to compete with mobile devices and other media sources for consumers' attention. The results from this study highlight that fact, given that many participants exposed to the food safety news segment intervention did not recall it. There are also limitations in how much

control OPACE has over the news segment when working with journalists; news segments must be short and concise. The use of an informational news segment as an intervention in these types of food preparation settings warrants further study.

We suggest that OPACE consider the development of a style guide for journalists to use in their communication with the public about food safety. This style guide could be used as a reference point for media organizations when developing news segments discussing food safety risk factors and include examples on how to handle food safely.

4.4 Handwashing

Similar to what was observed in Years 1 and 2, handwashing compliance is low, with most participants failing to properly wash their hands according to CDC's guidelines. Consistent with the results for Years 1 and 2, the most common reason for unsuccessful handwashing attempts was not rubbing hands with soap for 20 seconds. Consumers continue to need guidance on when and how to properly wash their hands.

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Appendix A:
Transcript of Food Safety News Segment Intervention

VIDEO	AUDIO
B-roll: Footage of freezer showing different frozen products like pizza, chicken nuggets, and frozen veggies. Someone putting frozen stuffed chicken breasts on a pan ready to be put into the oven and frozen corn being cooked in the microwave.	Foodborne illness—what most of us know as "food poisoning"—kills 3-thousand people every year. But it is preventable with just a few easy tips. First, whether your food is fresh or frozen, use a food thermometer to make sure your food is cooked to the proper internal temperature. And sometimes, food that looks or seems like it's cooked is actually still raw and needs to be cooked further for safety.
Tanya Brown (FSIS)	It's extremely important that every kitchen have a food thermometer because it's the only way to determine if food is cooked to the correct internal temperature and is safe to eat. You can't look at your vegetables, your frozen vegetables, or your meat and determine by color if it's safe to eat. You must use the food thermometer. So for poultry, as well as your frozen vegetables, you want to cook it to 165 degrees Fahrenheit. For whole cuts of meat like pork or roast, you want to cook it to 145 degrees Fahrenheit. And also for your ground meat, any type of ground meat, you want to cook it to 160 degrees Fahrenheit.
B-roll: Video of someone looking at cooking instructions on the back of a package	If you're not quite sure how to deal with the cooking, read the instructions on the back of the package.
Tanya Brown (FSIS)	Once you understand what temperature your meat and your frozen vegetables should be cooked to, you want to also know the proper way to use the food thermometer to get the correct reading. So for whole pieces of meat such as a roast or pork, you want to stick the probe into the thickest part of the meat. For thinner pieces of meat, such as a hamburger or fish, you want to stick it on the side and as far into the center as you possibly can. And for ground meats and frozen vegetables, you want to stick it into the center of each serving.
B-roll: Shots from past b-roll to cover the 4 steps: clean, separate, cook, and chill, plus final plate.	And no matter what you're doing in the kitchen, keep these four tips in mind: clean, separate, cook, and chill. You can find more food safety tips at foodsafety.gov. Or, if you'd like to talk to somebody—give the USDA a ring. Their number: 1-888-m-p-hot-line.

Appendix B:
List of Equipment Provided in Each Test Kitchen

The picture below shows one of the test kitchens used for the meal preparation experiment. The equipment provided in each test kitchen is listed below.

Kitchenware

Skillet

- Medium-sized skillet (9–12 inch)

Frying pans (store frying pans in the cabinets)

- Small (8 inch) nonstick
- Medium or large (10–12 inch)

Saucepans

- Small (2–3 quarts)
- Medium or large (4–5 quarts)

Knives

- Chef's knife
- Paring knife/fruit knife

Baking dishes

- 9 x 13 baking dish (rectangular)
- Smaller square, rectangular, or oval baking dish

Utensils

- Wooden or plastic stirring spoons (1–2)
- Heat-resistant plastic or silicone spatula
- Slotted spoon
- Ladle
- Flat spatula
- Cooking tongs
- Digital tip-sensitive instant read thermometer
- Dry measuring cups
- Liquid measuring cup (1 cup)
- Measuring spoons
- Can opener
- Liquid measuring cup (2 cup)
- Whisk
- Rolling pin
- Peeler
- Zester/grater
- Large cutting boards
- Splatter guard
- Serving bowl
- Serving utensils (serving fork, spoon, and tongs)
- Salt and pepper shaker (must be glass)
- Garlic and onion powder
- Utensil holder

Other essential tools

- Small, medium, and large mixing bowls
- Colander
- Salad spinner

Silverware/dinnerware

- Set of spoons, knives, and forks
- Dinner plates
- Salad plates
- Bowls

Cleaning/dishwashing supplies

- Kitchen towels
- Dish cloths
- Hand soap
- Dish drain board/dish rack
- Paper towels
- Sponge
- Sponge caddy
- Paper towel holder
- Apron
- Oven mitts
- Pot holders
- Dishwashing detergent

Cleaning items for under sink

- Windex
- Clorox bleach
- 409 cleaner
- Lysol spray

Leftover kit supplies

- Ziploc bags (gallon and quart sizes)
- Plastic wrap
- Plastic containers with lids

Note: Containers must be sanitized between observation events. Ziploc bags and plastic wrap must be taken out of retail packaging and placed in kitchen drawers.

Housekeeping items

- First-aid kit
- Toolbox

Food

Recipe card

- Single-sided, laminated card

Ingredients

- Frozen chicken entrée
- Black beans
- Frozen corn
- Salsa
- Cucumber

Appendix C:
Observation Script and Recipe

Check-in Script

Welcome! My name is _____ and I'll be walking you through what you'll be doing as part of our study today.

Today you will be preparing a chicken entrée from frozen and a black bean salad and we will interview you after you finish cooking. The cooking and interview will last no longer than an hour and a half.

Have a seat in the waiting room. We are a little behind schedule, someone will be with you in about 10 minutes.

Pre-cooking Script

Before we start, I need you to read and sign the consent form.

Please let me know if you have any questions or concerns. You will receive a copy of the form to take home.

After Consent Form Is Signed

Today you will be preparing a chicken entrée from frozen, helping us test a new product formulation, and a black bean salad.

Please do not eat the chicken or salad or take any of the food home with you. We will interview you after you are finished cooking. The cooking and interview will last no longer than an hour and a half.

This is the area where you will be cooking. All the available utensils and dishes are in these drawers/cabinets. [Note: open a few cabinet and drawers and be sure to open the drawer with the thermometer].

The chicken entrée is in the freezer. Please prepare it first, and as you would at home. For any instructions on how to prepare it, please see the package. For the salad, the beans are here on the counter, the salsa and cucumber are in the refrigerator, and the corn is in the freezer. Here's the recipe for the salad (provide laminated sheet with recipe). Please plate the food once you have finished cooking. After you are done, please clean up as you would at home. You can load the dishwasher, but please do not turn it on.

Feel free to use whatever you need. Please make yourself at home, you are welcome to use your phone to listen to music, or whatever you usually do when cooking at home. If the temperature of the kitchen is not okay, let me know and I can adjust it.

Restrooms are located _____, and in case of an emergency, the exits are _____. The fire extinguisher is located _____ and the first aid kit is located _____.

Before you begin, do you have any questions?

If you have any questions or concerns while you're cooking, I will be in the _____ room.

[After food preparation]

Now that you have finished the cooking portion of the study, we are ready to begin the interview. It should take about 15 minutes to complete. Do you need a break before we begin that portion?

Chicken Entree

We did not provide a recipe for the chicken entrée; participants are told to prepare the chicken as they would at home, and for further instructions to consult the package.

Black Bean Salad

[Note: The recipe was printed on a laminated card.]

Ingredients:

- 1 can black beans
- ½ cup salsa
- 1 cucumber
- 1 cup corn

Directions:

1. Drain and rinse the black beans.
2. Chop cucumber into bite-sized pieces.
3. Prepare 1 cup corn.
4. Combine cucumber in bowl with black beans, corn, and salsa and mix.

Appendix D:
Post-observation Interview Guide

OMB Control Number: 0583-0169
Expiration date: 6/30/2020

Introduction Script

Thank you so much for your time today and allowing us to record your actions while you prepared a meal just like you would in your home. If it is okay with you, I'm going to ask you a few follow-up questions that will focus on some of the activities you participated in while in the model kitchen.

Is it okay with you if I record your answers? The recording is confidential and will only be used to accurately capture our conversation (allowed recording y/n).

If it is okay with you, I'd like to begin this interview, which will take about 15 minutes. If **no**: Terminate interview.

If **yes**: Proceed.

1.1 Experience with Frozen Products

What types of frozen products do you prepare at home? Can you provide a few examples? Probe if necessary: meat, poultry, vegetables.

Some frozen products are labeled as fully cooked and some are labeled as uncooked or raw. For the frozen products that you prepare at home, what type were they?

How do you know that?

Does knowing if a frozen product is labeled as fully cooked or raw matter to you when you are deciding what to buy when you're shopping in the grocery store?

How do you figure out how to prepare these frozen products?

Is this the same or different for frozen chicken products?

How do you figure out how to prepare frozen vegetables?

1.2 Washing Hands after Handling Frozen Chicken Product

Did you **wash your hands after handling the frozen chicken product**?

Can you tell me why you did that?

Is that something you typically do when cooking at home? Why?

When handling this type of product, do you handle it the same way you handle raw chicken? Why or why not?

1.3 Cooking Process for Chicken/Food Thermometer

Did you read the instructions on the frozen chicken packaging?

If yes: What did it say?

Do you think the chicken product you cooked today was raw or fully cooked? Why do you say that?

I saw that you prepared the chicken product in the (INSERT: microwave, oven, stovetop, etc.)? Why did you choose to prepare it this way?

How would you normally prepare it at home? Why?

If you had children younger than 18, would you buy the chicken product you cooked today for them to prepare at home or not?

If yes: What cooking tips would you share?

If no: Why not?

Do you have a food thermometer at home?

If yes: do you typically use a food thermometer when cooking frozen chicken products like the one you prepared today? Why or why not?

If yes: With what type of products do you normally use a food thermometer? Why?

If yes: With what type of products do you <u>not</u> use a food thermometer? Why?

Did you **use a food thermometer** to check the doneness of the chicken product?

If yes: What information were you looking for?

If no: Why not?

How important do you think it is to use a food thermometer when cooking frozen chicken products like the one you prepared today? Would you say …

- Very important
- Somewhat important
- Not important at all

[Don't know]

1.4 Preparing Corn and Black Bean Salad

How did you prepare the corn?

Is this how you would normally do it at home?

Did you read the preparation instructions on the frozen corn?

If yes: What specific information were you looking for?

How did you know the corn was done?

Is this the same or different for other frozen vegetables?

If said used food thermometer to determine doneness: Why did you do this?

Is this something you would normally do at home?

How did you wash the cucumber?

Is this how you would normally do it at home?

Do you wash different kinds of produce differently at home? Please give some examples.

1.5 Cleaning Kitchen Items

Are you concerned about this type of frozen chicken product **cross-contaminating** other food or surfaces in your kitchen? Why or why not?

If necessary: By cross-contamination I mean spreading germs from the breaded chicken to another surface.

1.6 Thawing

Imagine you have raw chicken in the freezer, and you plan to cook it for dinner later in the week. How would you **thaw it**?

Probe: Do you thaw it the day you're cooking it or a couple days before?

Probe: What method of thawing do you use: in the microwave, in the refrigerator, in water in the sink, or on the countertop?

If in microwave: do you cook it immediately or wait awhile before cooking it? How long do you wait?

If in refrigerator: where do you place the frozen chicken? On the top, bottom, or middle shelf?

What, if anything, do you place it on? When do you cook it?

If water in sink: Do you use hot or cold water? Running or standing water?

Do you change the water at some point?

If on counter or another surface in kitchen: About how long do you typically leave it out?

Let's say you thawed the chicken for dinner tonight, but something came up and you were not able to cook it. How many days would you leave it in the refrigerator before cooking it or throwing it away?

1.7 Antecedent Questions

1. How concerned are you about bacteria or viruses being on or inside the food you cook? On a scale of 1-7, with 1 being not at all concerned, 4 being neutral, and 7 being very concerned, how concerned are you?

   Why do you say that?

2. How common do you think it is for people in the United States to get food poisoning because of the way they prepare food in their home? On a scale of 1-7, with 1 being not at all common, 4 being neutral, and 7 being very common, how common do you think it is?

   Why do you say that?

3. How confident are you in your ability to safely prepare food when cooking at home? On a scale of 1-7, with 1 being not at all confident, 4 being neutral, and 7 being very confident. how confident are you?

   Why do you say that?

   When thinking about the food you prepare and cook at home, what steps do you take to make sure the food you cook is safe?

4. Have you ever had food poisoning? Y/N

   If yes: Can you tell me about your experience? What were the symptoms?

   What food do you think made you sick?

   Do you think you got sick from food cooked at home, or food prepared away from home?

5. Has a family member ever had food poisoning? Y/N

1.8 Question about Video

1. After you arrived for the study and were waiting in the waiting room, a news program was playing. Did you watch any of the news program? Y/N

    a. If yes:

        - What was your impression of the news program?
        - What do you recall watching?
        - What information was new to you?
        - If did not mention food safety story: Do you remember seeing the story about food safety? If yes, tell me what you remember about it.
        - If mentioned food safety story: before today, had you heard that these types of frozen products may not be fully cooked so that doneness needs to be checked with a thermometer to ensure it is cooked to a safe internal temperature?
            - If had heard before: Where did you hear this information?
            - If had heard before: Do you have children that prepare these products at home? If yes, do you plan to share this information with your children or not?
        - Tell me what else you remember about the news story.

    b. If no:

        - Why didn't you watch the news story? **[Go to Conclusion]**

[If respondent does not remember seeing any of the news story, Go to Conclusion.]

2. Did the information in the news story influence your actions in the kitchen today or not?

    a. If yes: In what way?

3. Do you think the information in the news story will influence how you cook at home in the future or not? Why?

4. If mentioned food safety story: Do you have any questions about the news story on food safety?

5. Is there additional information that you would like to see in the food safety story to help you safely prepare such products for your family?

1.9 Conclusion

We mentioned in our recruiting materials that we were interested in testing a new breaded chicken product prepared from frozen. However, the specific focus of our study is on food safety and how to prevent food poisoning. While you were in the waiting room, you watched a produced news video that discussed a wide variety of topics and may have included a segment on safely preparing frozen foods. This video was part of the study. We purposely did not tell you exactly what our specific research objectives were in advance in order to capture your behaviors in a natural way. You can request to be removed from the study at any time, and if you decide to exit the study at this point, we will destroy the recordings of your actions, and you will not be included in the data set.

We want to confirm with you now that you understand the focus of our study and that you wish to remain as a participant.

If **no**: Thank you so much for your time we will remove your data from our dataset and destroy any records.

If **yes**: Thank you for your consent.

Thank you again for your time and for your participation in our study today. Are there any questions that you have for me?

Please see the greeter on your way out to receive the $75 gift card and gift.

Appendix E:
Screening Questionnaire

Screen 1[1]

Thank you for your interest in our research study, which is funded by the U.S. Department of Agriculture and conducted by researchers from North Carolina State University and RTI International.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0583-0169 and the expiration date is 6/20/2020. The time required to complete this information collection is estimated to average 8 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Screen 2

If you are eligible for the study, you will be asked to prepare a meal using pre-packaged frozen foods while being videotaped and participate in an interview. The study will last up to 90 minutes, and you will receive a $75 gift card and a small gift for taking part in the study.

To determine whether you are eligible, you will need to answer a few questions. These questions will take less than 10 minutes to complete. Your participation in this study is completely voluntary. All of your answers and your contact information will be kept private. Please click the ">>" arrows below if you would like to continue.

Question Screens

1. Have you received any type of food safety training, such as ServSafe, in the past 5 years?
   ☐ Yes →***Ineligible. Terminate.***
   ☐ No
2. Have you cooked or worked professionally in a food preparation setting in the past 5 years?
   ☐ Yes →***Ineligible. Terminate.***
   ☐ No
3. Have you participated in any research studies about cooking in the past 2 years?
   ☐ Yes →***Ineligible. Terminate.***
   ☐ No
4. Do you have any children living in your household who are less than 18 years of age?
   ☐ Yes
   ☐ No
5. Which of the following have you purchased in the past 6 months for your family to eat at home? *(Select all that apply.)*
   ☐ Frozen pizza

[1] A telephone version of the screening questionnaire was available for people who contacted NCSU by phone to participate in the study.

- ☐ Frozen waffles
- ☐ Frozen breaded chicken nuggets or tenders
- ☐ Frozen stuffed chicken, such as chicken Cordon bleu or chicken Kiev
- ☐ Frozen pre-formed hamburger patties
- ☐ Frozen vegetables
- ☐ Frozen fruit

6. Which of the following have you prepared at home in the past 6 months? *(Select all that apply.)*
   - ☐ Frozen pizza
   - ☐ Frozen waffles
   - ☐ Frozen breaded chicken nuggets or tenders
   - ☐ Frozen stuffed chicken breasts, such as chicken Cordon bleu or chicken Kiev
   - ☐ Frozen pre-formed hamburger patties
   - ☐ Frozen vegetables
   - ☐ Frozen fruit

7. [IF Q4 = YES] Which of the following have your children, 18 years or younger, prepared at home in the past 6 months? *(Select all that apply.)*
   - ☐ Frozen pizza
   - ☐ Frozen waffles
   - ☐ Frozen breaded chicken nuggets or tenders
   - ☐ Frozen stuffed chicken breasts, such as chicken Cordon bleu or chicken Kiev
   - ☐ Frozen pre-formed hamburger patties
   - ☐ Frozen vegetables
   - ☐ Frozen fruit

   NOTE: Continue if Q6 = frozen breaded chicken nuggets/tenders or frozen stuffed chicken breasts OR Q7 = frozen breaded chicken nuggets/tenders or frozen stuffed chicken breasts (i.e., respondent or their child prepares these products).

8. How often do you prepare frozen breaded chicken nuggets or tenders for your family to eat at home?
   - ☐ Less than once a month
   - ☐ About once a month
   - ☐ Two or three times a month
   - ☐ About once a week
   - ☐ More than once a week

9. How often do you prepare frozen stuffed chicken breasts for your family to eat at home?
   - ☐ Less than once a month
   - ☐ About once a month
   - ☐ Two or three times a month
   - ☐ About once a week
   - ☐ More than once a week

10. [IF Q4 = Yes] How often do your children, 18 years or younger, prepare frozen breaded chicken nuggets or tenders to eat at home?
    - ☐ Less than once a month
    - ☐ About once a month
    - ☐ Two or three times a month
    - ☐ About once a week
    - ☐ More than once a week

11. [IF Q4 = Yes] How often do your children, 18 years or younger, prepare frozen stuffed chicken breasts to eat at home?
    - ☐ Less than once a month
    - ☐ About once a month
    - ☐ Two or three times a month
    - ☐ About once a week
    - ☐ More than once a week

12. When cooking a food product at home for the first time, how often do you read the cooking instructions on the package before you start cooking?
    - ☐ Always
    - ☐ Most of the time
    - ☐ Sometimes
    - ☐ Hardly ever
    - ☐ Never

13. Which of the following items do you have in your kitchen? *(Select all that apply.)*
    - ☐ Chef's knife
    - ☐ Garlic press
    - ☐ Citrus zester
    - ☐ Food thermometer
    - ☐ Manual can opener
    - ☐ Vegetable peeler
    - ☐ Cheese grater
    - ☐ Wine opener
    - ☐ None of the above

14. Do you identify as …?
    - ☐ Female
    - ☐ Male
    - ☐ Other
    - ☐ Prefer not to answer

15. Are you…?
    - ☐ Hispanic or Latino
    - ☐ Not Hispanic or Latino

16. What is your race? Please select one or more.
    - ☐ American Indian or Alaska Native
    - ☐ Asian
    - ☐ Black or African American
    - ☐ Native Hawaiian or Other Pacific Islander
    - ☐ White

17. What is the highest level of education that you have completed?
    - ☐ Less than high school
    - ☐ High school graduate or GED
    - ☐ Technical or vocational school
    - ☐ Some college, but did not get a degree
    - ☐ 2-year associates degree
    - ☐ 4-year college degree
    - ☐ Post-graduate degree

18. Are you or any members of your household …? *(Select all that apply.)*
    - ☐ 60 years of age or older
    - ☐ 5 years of age or younger
    - ☐ Pregnant
    - ☐ Breastfeeding
    - ☐ Diagnosed with an allergy to any food or food ingredient
    - ☐ Diagnosed with diabetes or kidney disease
    - ☐ Diagnosed with a condition that weakens the immune system, such as cancer, HIV, or AIDS; a recipient of a transplant; or receiving treatments, such as chemotherapy, radiation, or special drugs or medications to treat these conditions
    - ☐ None of the above

19. Where did you hear about this study?
    - ☐ Facebook
    - ☐ Twitter
    - ☐ Craigslist
    - ☐ Email from a North Carolina extension program
    - ☐ Sign

    Specify location: _____
    - ☐ Other

    Specify location: _____
    - ☐ Don't know

20. Great! You qualify for the study. Would you like to participate in the Convenience Food Study?
    - ☐ Yes
    - ☐ No → ***Terminate.***

Contact Screen 1

Great! Please enter your name and telephone number so that a study team member can call you and schedule an appointment for the Convenience Food Study at a day and time that works best for you. The study will last up to 90 minutes, and you will receive a $75 gift card and a small gift for taking part in the study.

[ENTER NAME]

[ENTER TELEPHONE NUMBER]

Contact Screen 2

Please enter your email address so we can send you a confirmation email with directions. [ENTER EMAIL ADDRESS; REQUIRE DOUBLE ENTRY FOR VERIFICATION].

☐ No Email

[If no email] Please enter your mailing address. [STREET ADDRESS, CITY, NC, ZIP]

Thank you for your time. A study team member will call you in 1 or 2 days to schedule an appointment with you.

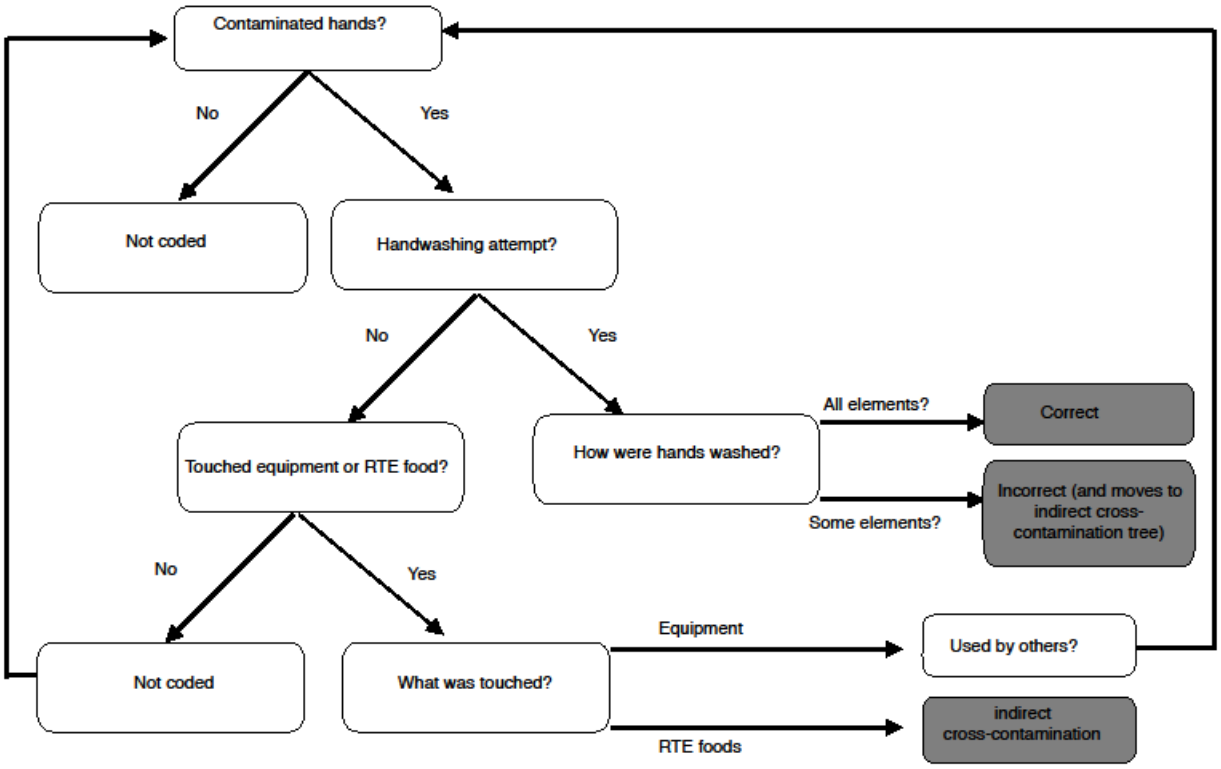
If you have any questions about the study or scheduling, you may contact Lisa Shelley at 919-659-8254. If you have concerns about your rights as a research participant, contact North Carolina State University's Office of Research Protection at 919-515-8754 or via email at irb-director@ncsu.edu.

Ineligible/Terminate Screen

Thank you for your time. Unfortunately, you are not eligible to take part in our study. Have a great day.

Appendix F:
Observation Rubric for Coding Participant Actions in the Kitchen

Handwashing Rubric



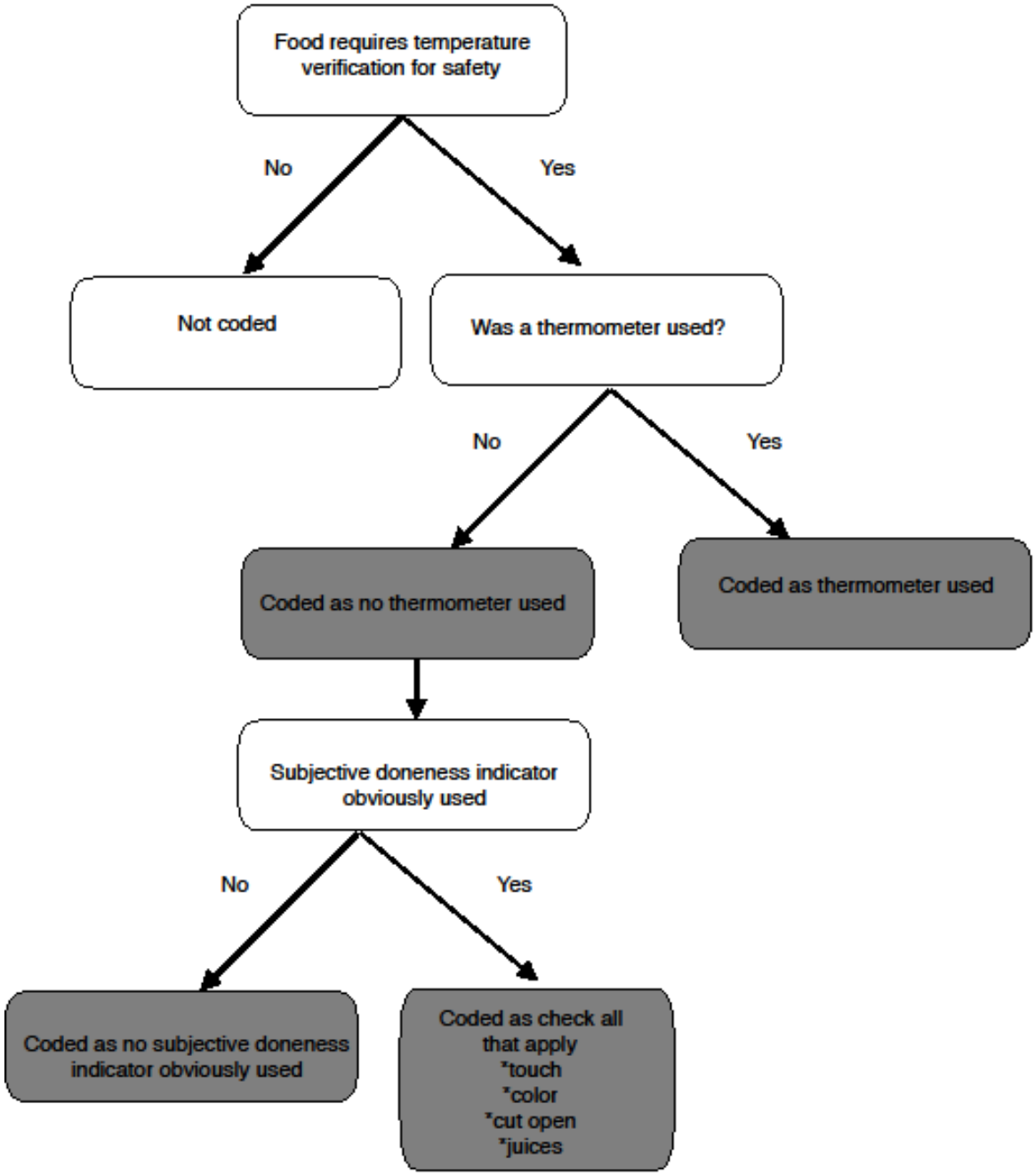
Notes and Definitions: Contaminated hands: Hands that have come into contact with potentially contaminated material (raw food, contaminated equipment, touching of face or other parts of body or clothing) and that have not been washed according to CDC's recommended guidelines for proper handwashing.

Elements of handwashing:

- Wet your hands with clean, running water (warm or cold), turn off the tap, and apply soap.
- Lather your hands by rubbing them together with the soap. Be sure to lather the backs of your hands, between your fingers, and under your nails.
- Scrub your hands for at least 20 seconds.
- Rinse your hands well under clean, running water.
- Dry your hands using a clean (one use/paper) towel or air dry them. https://www.cdc.gov/handwashing/when-how-handwashing.html

For a successful handwashing attempt, all elements should occur in the sequence listed above.

Thermometer Rubric



Appendix G:
Pilot Exploration of Air Pockets

The air pocket temperature within the stuffed chicken breasts was determined for a subset of 50 observations. Immediately following the completion of the participant interview (10 to 12 minutes in length), the observer took four temperature readings: two with the thermometer probe inserted into the meat portion of the stuffed chicken breast and two with the thermometer probe inserted into the center of the breast. The two thermometers at each probe location were averaged. Placement of the thermometer probe in the air pocket was not visually confirmed; however, the correct placement of the probe in the air pocket was determined by the free movement of the probe in comparison with the placement of the probe in the meat.

Temperature of Air Pockets for NRTE Chicken Product

N	Minimum Temperature	Maximum Temperature	Mean Temperature
50	100°F	167°F	125.7°F