Modernizing Safe Handling and Ready-to-Eat/Not-Ready-to-Eat Labeling Instructions: Behavior Change Study

Prepared for

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Executive Summary

The U.S. Department of Agriculture, Food Safety and Inspection Service (USDA, FSIS) conducted a study to inform decisions about modernizing the Safe Handling Instructions (SHI) label and to provide information on consumers’ use and understanding of labeling on ready-to-eat (RTE) and not-ready-to-eat (NRTE) meat and poultry products. FSIS contracted with RTI International and its subcontractor North Carolina State University (NCSU) to conduct the study.

- Phase I was a web-based experiment with a sample of U.S. consumers to select three variants of a revised SHI label (among 27 variants) that best attract participants’ attention.
- Phase II was a behavior change study using a randomized experimental design with participant meal preparation and eye tracking in four geographic locations to evaluate whether any of the three revised SHI labels result in greater adherence to recommended safe handling instructions and greater visual salience to the SHI label on product packaging compared with the current SHI label.
- Phase III was a cost-benefit analysis to compare the value of the benefits from predicted reductions in foodborne illness (estimated using a predictive modeling approach) with the costs to industry to voluntarily update their product packaging to incorporate the revised SHI label.

The approach and findings for Phase II, the behavior change study, are summarized below.

ES.1 Study Approach

Participants in the behavior change study (n = 483) took part in the following three activities:

- An observational meal preparation experiment using mobile eye tracking in a test kitchen to determine whether any of the three revised labels result in greater adherence to recommended safe handling instructions compared with the current SHI label. Participants prepared a meal of two types of pasta and meatballs: meatballs made from scratch using fresh ground beef and packaged, frozen NRTE meatballs.
- An eye-tracking study using mock food packages to obtain quantitative data that measure the visual salience of participants’ attention to three revised SHI labels compared with the current SHI label. We also assessed participants’ ability to correctly distinguish between RTE and NRTE products.
- Post-interviews to collect information on participants’ awareness and use of the current SHI label and other information.

Data collection took place in test kitchens located in four different locations (North Carolina, California, Texas, and Rhode Island).
ES.2 Findings and Conclusions

- The study findings suggest that the three revised SHI labels did not perform better than the current SHI label at encouraging participants’ overall adherence to the four safe handling instructions on the revised SHI labels (i.e., handwashing, cleaning and sanitizing, avoiding cross-contamination, and thermometer use). The label adherence scores were relatively low for the current SHI and the three revised SHI labels.

- Statistical analysis examining safe food handling behaviors individually indicate the experimental variant, Octagon-Long-Hybrid, was significantly better than the current SHI label at encouraging proper handwashing behavior, but did not influence other safe food handling behaviors.

- Based on statistical analysis of the eye-tracking data, there were no significant differences in visual salience (i.e., attention) between any of the three revised SHI labels tested and the current SHI label.

- According to the eye-tracking data, attention to the SHI label is generally low, ranging from 1% to 38% of participants having any fixation on the SHI label, depending on the product viewed. For many of the products in the study, the rate of any fixation was higher for the manufacturer's cooking instructions (MCI) relative to the SHI label. The higher rate of fixation may be due to the MCI's larger size on the package and use of more text.

- The study also examined the respective attention participants give to the SHI label and the MCI when asked how to safely prepare an NRTE product. The results indicated that for the two NRTE products examined, participants were significantly more likely to look at the MCI before the SHI label.

- Regarding participants’ ability to correctly distinguish between RTE products and NRTE products, the study found that participants are better at correctly identifying NRTE products than RTE products, that is, some participants incorrectly classified RTE products as NRTE products. From a food safety standpoint, participants handling and preparing RTE products as NRTE is not a concern.
1. Introduction

The U.S. Department of Agriculture, Food Safety and Inspection Service (USDA, FSIS) contracted with RTI International and its subcontractor North Carolina State University (NCSU) to conduct a study to inform decisions about modernizing the Safe Handling Instructions (SHI) label and to provide information on consumers’ use and understanding of labeling on ready-to-eat (RTE) and not-ready-to-eat (NRTE) meat and poultry products. In Phase I, we conducted a web-based experiment to select three variants of a revised SHI label (among 27 variants) that best attract participants’ attention (Blitstein et al., 2019). In Phase II, we conducted a meal preparation experiment with participants in test kitchens to evaluate the effectiveness of the three revised SHI labels compared with the current SHI label on adherence to recommended safe handling instructions and also examined participants’ visual response to labeling of mock meat and poultry products using eye tracking. In Phase III, we conducted predictive modeling and a cost-benefit analysis to examine the potential benefits and costs if industry voluntarily adopts a potential revised SHI label. This report presents the methods and results for Phase II, referred to as the behavior change study.

The remainder of this section provides information on the SHI label and discusses the need for this study, provides an overview of the three phases of the Modernizing Safe Handling and Ready-to-Eat/Not-Ready-to-Eat Labeling Instructions study, and presents the research questions for the behavior change study.

1.1 Background

Safe handling instructions are required if the meat or poultry component of a product is raw or partially cooked (i.e., not considered RTE) and if the product is destined for household consumers or institutional uses (9 CFR 317.2(l) [meat] and 9 CFR. 381.125(b) [poultry]). USDA, FSIS established the SHI label for raw and partially cooked meat and poultry products in 1994 (54 FR 14528). Consumer focus groups were conducted to inform the design of the SHI label (Teague & Anderson, 1995; Teague & Anderson, 1993). Since that time, the required design of the SHI label has not been changed, and little evaluation on efficacy has been performed.

In response to inquiries from consumer groups and other stakeholders for more information about potential changes to safe handling instructions requirements based on efficacy, FSIS gathered input from members of academia, industry, and consumer stakeholders in November 2013. FSIS
presented these suggestions to the National Advisory Committee on Meat and Poultry Inspection (NACMPI) in January 2014. When FSIS developed the SHI label in 1994, minimum internal temperature requirements for determining doneness varied by product. Given product and label size limitations and varying endpoint temperatures, FSIS concluded that “Cook Thoroughly” was the only simple, single statement appropriate to use for all products (54 FR 14538). FSIS now recommends four minimum internal temperatures: one for all poultry (165\(^\circ\)F), one for ground meat (160\(^\circ\)F), one for all whole-muscle meat (145\(^\circ\)F and rest for 3 minutes), and one for fish (145\(^\circ\)F). With only four temperature recommendations, the information could be more easily incorporated into the SHI label. Other possible changes to the SHI label include incorporating updated icons and providing a web link or phone number for more food safety information (NACMPI, 2014; Murphy-Jenkins, 2014).

The NACMPI Subcommittee on Food Handling Labels recommended that FSIS pursue changes in the existing SHI label and conduct consumer research to determine the effectiveness of any revisions to the SHI label (NACMPI, 2014). In November 2014, FSIS conducted a strategic planning session to elicit input from FSIS senior leadership on potential revisions to the SHI label, the impact any revisions may have on consumers and industry, and pitfalls to consider. The findings from this session underscored the need to conduct research on consumer response to the current SHI label (Cates, Kosa, & Muth, 2015).

In 2015, FSIS contracted with RTI to conduct six consumer focus groups to evaluate understanding of the current SHI label and responses to possible revisions. The focus groups revealed that consumers would find certain revisions to the SHI label useful. Participants suggested changes to improve comprehension and adherence to recommended safe handling practices (e.g., add recommendation to use a food thermometer and endpoint temperatures for different cuts of meat and poultry) (Cates, Kosa, & Muth, 2016). RTI also conducted a preliminary breakeven analysis to examine costs and benefits of potentially revising the SHI label (Muth, Capogrossi, Rains, & Cates, 2016).

Additionally, although FSIS has issued guidance to the industry on labeling uncooked boneless, breaded chicken products that may appear RTE because of their cooked appearance (USDA, FSIS, n.d.), there have been reports of illnesses associated with these products even when the labels follow the guidance. In May 2016, the National Chicken Council (NCC) submitted a petition requesting that FSIS establish regulations for the labeling and validated cooking instructions for NRTE stuffed chicken breast products. In their petition, the NCC also suggested that research be conducted to examine consumers’ handling of NRTE stuffed chicken breast products and their understanding of relevant labeling statements and validated cooking instructions. The American Frozen Food Institute, an industry trade association, and the Safe Food Coalition, a coalition of consumer advocacy organizations, submitted comments in support of the petition (NCC, 2016; American Frozen
Food Institute, 2016). Before this petition and comments, during the March 2016 NACMPI meeting, the committee reviewed and discussed whether FSIS should pursue proposing mandatory features on the label of processed NRTE products that may appear to be fully cooked (e.g., are breaded or have grill marks). The committee recommended that FSIS require statements such as “Raw,” “Uncooked,” or “Ready to Cook” on the labels of raw products that may appear RTE so it is clear that these products require cooking to a proper internal temperature before eating (USDA, FSIS, 2016). The committee also recommended that FSIS conduct consumer research to understand the optimal messaging and design of packaging to ensure consumers properly understand that NRTE products appearing to be fully cooked need to be cooked for lethality. The committee stated that such labeling may help consumers properly distinguish between NRTE products, which require a lethality step, and RTE products, which do not require a lethality step; therefore, the committee stated that this labeling may help consumers safely prepare NRTE products. Specifically, the committee suggested that FSIS conduct consumer research to evaluate the effectiveness of possible locations for point-of-purchase labeling information and various color options, fonts, and other display options.

1.2 Overview of the Study

Figure 1-1 provides an overview of the three phases of the study. In Phase I, we conducted a web-based experiment with a sample of U.S. consumers \( (n = 3,600) \) to select three variants of a revised SHI label (among 27 variants) that best attract participants’ attention. In Phase II, we conducted a behavior change study using a randomized experimental design in four geographic locations throughout the United States. The primary purpose of Phase II was to evaluate the effectiveness of three revised SHI labels (see Figure 1-2) compared with the current SHI label on adherence to recommended safe handling instructions. Participants in the behavior change study \( (n = 483) \) took part in the following three activities:

- An **observational meal preparation experiment** using mobile eye tracking in a test kitchen to determine whether any of the three revised SHI labels result in greater adherence to safe handling instructions compared with the current SHI label.

- An **eye-tracking study** using mock food packages to obtain quantitative data that measure the visual salience of or participants’ attention to the three revised SHI labels compared with the current SHI label. We also assessed participants’ ability to correctly distinguish between RTE and NRTE products.

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1 The petition and comments are available at https://www.fsis.usda.gov/wps/portal/fsis/topics/regulations/petitions.
2 Data collection for the study was approved by the Office of Management and Budget (OMB control number: 0583-0177, expiration date 4/30/2022) and NCSU’s Institutional Review Board for the protection of human subjects.
• **Post-interviews** to collect information on participants’ awareness and use of the current SHI label and their use of food thermometers in the meal preparation experiment compared with their use at home.

**Figure 1-1. Overview of the Three Phases of the Study**

**Phase I: Web-based Experiment for Label Redesign**
- Design 27 variants of revised SHI label
- Conduct web-based experiment to select the three SHI labels that best attract participants’ attention

**Phase II: Behavior Change Study**
- **Observational Meal Preparation Experiment**
  - Measure effectiveness of the three revised SHI labels compared with the current label on participants’ adherence to recommended safe handling instructions

**Eye Tracking**
- Collect quantitative data on participants’ attention to the three revised SHI labels compared with the current label and their ability to correctly distinguish between RTE and NRTE products

**Post-interviews**
- Collect information on awareness and use of current SHI label and thermometer use in meal preparation experiment vs. at home

Conduct analysis and recommend revised SHI label

**Phase III: Predictive Modeling and Cost-Benefit Analysis**
- Compare value of predicted reductions in foodborne illness with the cost to industry if industry voluntarily adopts a possible revised SHI label

RTI’s subcontractor, North Carolina State University, conducted the data collection for the behavior change study and coded the data from the meal preparation experiment, in addition to contributing to the study design, instrument development, data collection protocols, and analysis plan. We subcontracted with Tobii Technology (https://www.tobii.com/) to rent the eye-tracking devices and associated hardware and software, to code the eye-tracking data, and to derive the measures used in the analysis of the eye-tracking data.

In Phase III, we conducted a cost-benefit analysis to compare the value of the benefits from predicted reductions in foodborne illness (estimated using a predictive modeling approach).
with the costs to industry if industry voluntarily changes their product packaging to incorporate a possible revised SHI label.

**Figure 1-2. SHI Labels Tested in the Behavior Change Study**

<table>
<thead>
<tr>
<th>Current SHI Label</th>
<th>Octagon-Short-Abstract</th>
<th>Octagon-Medium-Hybrid</th>
<th>Octagon-Long-Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHI Label 1</td>
<td>SHI Label 2</td>
<td>SHI Label 3</td>
<td></td>
</tr>
</tbody>
</table>

**1.3 Research Questions for the Behavior Change Study**

The overall goal of the behavior change study was to compare three revised SHI labels to the current SHI label to determine whether enhancements and revisions to the label will lead to (1) greater awareness of the label or (2) greater adherence to the label’s recommendation for safe handling of raw meat and poultry products. To achieve this goal, the study addressed the following research questions:

1. Of the three revised SHI labels, do any of them lead participants to greater adherence to safe handling instructions compared with the current SHI label?

2. Of the three revised SHI labels, do any of them attract more visual attention when participants are asked to consider how to safely prepare the product compared with the current SHI label?

3. Do participants first look to the SHI label or the manufacturer’s cooking instructions (MCI) when asked to consider how to safely prepare the product?

4. What labeling elements do participants look at when they are asked to discriminate between RTE and NRTE meat and poultry products?

**1.4 Organization of the Report**

This report is organized as follows:

- Section 2 describes the research design, data collection procedures, and analysis approach for the behavior change study.
- Section 3 presents the results of the analysis.
- Section 4 concludes the report.
2. Methods

Participants in the behavior change study took part in the following three activities: (1) an observational meal preparation experiment, (2) an eye-tracking study using mock food packages, and (3) post-interviews. This section describes the setting; experimental design, sample size, and allocation; stimuli; instrument development and pilot testing; participant recruitment; the data collection procedures; training of data collectors and coders; the measures; and the analysis procedures.

2.1 Setting

We conducted the data collection in test kitchens, each similar in design and layout, in four geographic locations across the country: (1) Wake County, NC; (2) El Paso County, TX; (3) Yolo County, CA; and (4) Bristol and Washington Counties in Rhode Island. We selected the four locations to provide geographic diversity with data collection in three of the four Census regions. Additionally, we selected areas in the South and West regions that have a relatively large percentage of Hispanic individuals so that the percentage of Hispanics in the study sample would approximate that of the U.S. population (16% of U.S. adults) (U.S. Census Bureau, n.d.). We selected Wake County, NC (South Atlantic Division, South region) because of the availability of three suitable test kitchens on NCSU’s campus. We selected the Texas (West South Central Division, South region) and California (West region) locations because of the availability of suitable test kitchens and to reach Hispanic individuals (82% Hispanic for El Paso County, TX, and 41.3% for Yolo County, CA). We selected Rhode Island (Northeast) because of the availability of a suitable test kitchen and to reach an urban population in the Northeast.3

2.2 Experimental Design, Sample Size, and Allocation

The study employed an experimental design in which participants were randomly assigned to one of four conditions (three revised SHI label groups and a control group with the current SHI label). The a priori power analysis (described in Appendix A) indicated a minimum sample size of 480 for the behavior change study, with 120 participants randomly assigned to each of the four study conditions.

Most of the data collection took place in North Carolina because of the greater availability of three test kitchens located in one facility, data collection staff availability in North Carolina, and budgetary constraints. Of the 480 participants, 360 participants were allocated to the North Carolina location, and 120 participants were equally allocated across the other three locations (40 per location; see Table 2-1).

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3 Percentage of population that is Hispanic available at http://www.city-data.com/.
### Table 2-1. Target Sample Allocation by Location and Condition

<table>
<thead>
<tr>
<th>Location</th>
<th>Control (Current SHI Label)</th>
<th>Octagon-Short-Abstract</th>
<th>Octagon-Medium-Hybrid</th>
<th>Octagon-Long-Hybrid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>360</td>
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<tr>
<td>Texas</td>
<td>10</td>
<td>10</td>
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<td>California</td>
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<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>480</td>
</tr>
</tbody>
</table>

#### 2.3 Stimuli

The stimuli for the study comprised the three revised SHI labels and the current SHI label and mock packages that displayed the labels. The three revised labels were selected among 27 variants using a web-based experimental approach. The four safe handling instructions included on the variants tested in the web-based experiment were based on an expert elicitation conducted with food safety experts from academia and cooperative extension. The design of the variants tested was based on a scan of existing literature for salience and incorporation of messages and approaches from the risk communication literature. The labels varied in terms of format/shape (octagon, rectangle, circle), message content/length (short, medium, long), and the format of the icons (pictorial, abstract, hybrid) (see Blitstein et al., 2019 for additional information).

We assessed label salience using a limited-time exposure approach with cued recall questions. Using this approach, participants were presented with 1 of the 27 SHI labels on a mock package and asked eight questions: four of the questions asked about phrases or images that were present on the package and four of the questions asked about phrases or images that were not on the package (i.e., false positives). Participants were also asked how confident they were in their responses for calculation of the salience measures. Using the responses to these questions, we estimated two measures of salience (referred to as $d'$ scores and receiver operating characteristic [ROC] curves) and location recall (participants identifying the location of food safety information [i.e., the SHI label] on the food package). Additionally, we conducted an analysis to identify the most preferred rationale statement (among five options) in terms of how clearly it communicates the dangers of foodborne illness using responses to a ranking question. The rationale statement is the text proceeding the messages and icons that explains the importance of safe food handling practices (Blitstein et al., 2019). Figure 1-2 shows the current SHI label and the three revised SHI labels that were selected based on the results of these analyses. The three revised labels
are octagon shaped (i.e., like a stop sign) and vary in icon style (abstract and hybrid) and message content/length (short, medium, long).

Working with a graphic designer, we developed eight mock meat and poultry products that resembled commercially available products and displayed all required labeling elements (e.g., Nutrition Facts panel and USDA seal of inspection): two for the meal preparation experiment and six for the eye-tracking study. For each product, we developed four versions, each version corresponding to the four SHI labels (control and three revised SHI labels). Appendix B shows the mock products and labeling (front, back, and side panels) used in the meal preparation experiment and eye-tracking study, including “close-ups” of the SHI and MCI.

For the meal preparation experiment, participants were asked to prepare two types of pasta and meatballs: (1) scratch-made meatballs using raw ground beef and other ingredients and (2) packaged, frozen meatballs labeled as NRTE.

- Raw ground beef: half a pound of ground beef packaged in a Styrofoam tray with clear plastic wrap with a sticker on the front describing the product and a sticker on the back with the SHI and MCI.

- Packaged, frozen NRTE meatballs: packaged in a box labeled on the front as “ready to cook.” The SHI label was on one side of the box and the MCI on the other side of the box.

For the eye-tracking study, participants took part in three distinct tasks that required them to interact with a total of six different products: Task A—distractor; Task B—measure visual salience; and Task C—measure ability to correctly distinguish between RTE and NRTE products.

- Packaged, frozen stuffed breaded RTE chicken breasts (broccoli and cheese) packaged in a box labeled as “fully cooked.” The manufacturer’s heating instructions were on the back of the box (no SHI because RTE).

- Packaged, frozen breaded RTE chicken tenders packaged in a box labeled as “fully cooked.” The manufacturer’s heating instructions were on the side of the box (no SHI because RTE).

- Packaged, frozen stuffed breaded NRTE chicken breasts (cordon bleu with ham and cheese) packaged in a box labeled as “raw.” The SHI and MCI were on the back of the box. The packages for the two types of frozen stuffed chicken breasts (RTE and NRTE) were designed so that they had the same manufacturer and similar packaging (e.g., same brand name, logo, and packaging features), same size package, and similar layout to commercially available products.

- Packaged, frozen breaded NRTE chicken tenders packaged in a box labeled as “uncooked.” The SHI was on the back of the box, and the MCI was on the side of the box. Unlike the two types of stuffed breaded chicken breasts, the RTE and NRTE chicken tenders did not have similar packaging.
• Packaged, frozen NRTE hamburger patties: packaged in a box labeled on the front as “ready to cook.” The SHI label was on the side of the box and the MCI was on the side of the box.

• Raw ground beef patties: four mock hamburger patties packaged in a Styrofoam tray with clear plastic wrap with a sticker on the front describing the product and a sticker on the back with the SHI and MCI.

2.4 Instrument Development and Pilot Testing

2.4.1 Instrument Development

We developed the following materials for the study: screening questionnaire (described in Section 2.5 on participant recruitment), a script for the meal preparation experiment, and a script for the eye-tracking study and post-interview. The materials were available in English and Spanish.

The script for the meal preparation experiment (see Appendix C) began by obtaining each participant’s informed consent to participate in the study, then walked through what participants could expect during the meal preparation experiment (research staff read the script from a tablet to ensure consistency in administration), provided instructions for preparing the meal, and concluded with fitting and calibrating the eye-tracking device. Additional information on the procedures for the meal preparation experiment is provided in Section 2.6.

The eye-tracking study included three tasks (Task A—distractor [one product], Task B—measure visual salience [three products], and Task C—measure ability to correctly distinguish between RTE and NRTE products [six products]), which are described in Section 2.6. The script (see Appendix D) provided instructions on each of the specific tasks and how participants should interact with the mock products. The post-interview followed the eye-tracking study and included questions on participants’ awareness and use of the current SHI label and their use of food thermometers in the meal preparation experiment compared with their usual use at home.

2.4.2 Pilot Tests

In September 2018, we conducted a pilot study to test the procedures and instruments for the behavior change study with two people in a test kitchen. Based on the pilot tests, we made several revisions to the procedures and instruments. For the meal preparation experiment, we originally considered having participants prepare a parsley garnish but decided to change this to a cherry tomato garnish to ensure participants used a knife to prepare an RTE food (to assess the potential for cross-contamination). Additionally, we simplified the instructions and tasks for the eye-tracking study, in particular to make the script more conversational. To decrease participant burden, we revised the post-interview script to remove some questions and focus on information specifically needed for the
analysis. Before data collection, we conducted additional pilots with four test subjects to assess and refine the training procedures for data collection staff and to practice using the eye tracking devices.

2.5 Participant Recruitment

We used convenience sampling with quotas (Table 2-2) to help ensure that study participants generally reflected the demographic characteristics of U.S. consumers.

Table 2-2. Target Sample Allocation by Demographic Characteristic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Recruitment Target (%)</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>68%</td>
<td>326</td>
</tr>
<tr>
<td>Non-White</td>
<td>32%</td>
<td>154</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>84%</td>
<td>403</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>16%</td>
<td>77</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>35%</td>
<td>168</td>
</tr>
<tr>
<td>35–54</td>
<td>39%</td>
<td>187</td>
</tr>
<tr>
<td>55+</td>
<td>26%</td>
<td>125</td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school, high school diploma/GED, or vocational school</td>
<td>26%</td>
<td>125</td>
</tr>
<tr>
<td>Some college (no degree) or associate's or 2-year degree</td>
<td>40%</td>
<td>192</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>19%</td>
<td>91</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>15%</td>
<td>72</td>
</tr>
<tr>
<td>Child 0–17 years in household</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>48%</td>
<td>230</td>
</tr>
<tr>
<td>No</td>
<td>52%</td>
<td>250</td>
</tr>
</tbody>
</table>

The study team 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. Participants who met the following inclusion criteria were eligible to participate in the study:
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- were 18 years of age or older and
- cook raw meat or poultry at home at least once per week.

The exclusion criteria were as follows:

- have cooked or worked professionally in a food preparation setting within the past 5 years;
- have taken any type of food safety training, such as ServSafe, in the past 5 years;
- have participated in a study about cooking within the past 2 years;
- have had a seizure or been diagnosed with epilepsy (it is recommended that such individuals not take part in eye-tracking studies);
- wear corrective lenses that may interfere with the calibration of the eye-tracking device (i.e., bifocals, trifocals, progressive lenses, hard or semi-hard contact lenses);
- have been diagnosed with any eye movement or alignment abnormalities, like lazy eye or nystagmus (may interfere with the calibration of the eye-tracking device); and
- have had any type of eye surgery like corneal, cataracts, or intraocular implants (may interfere with the calibration of the eye-tracking device).

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. After an appointment was scheduled, we sent one confirmation email and two texts leading up to the scheduled appointment.

A total of 483 people participated in the study. 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%. We recruited 63% of participants using Craigslist, 27% using social media (Facebook and Twitter), 3% using outbound recruiting conducted by a local market research company (California site only), and 7% using other recruiting efforts such as emails to individuals participating in the EFNEP. The expected show rate for the study was 80% based on our prior experience conducting observational studies; the actual show rate was 79%.
2.6 Data Collection Procedures

We conducted the study in North Carolina using three identical test kitchens (see Figure 2-1) and test kitchens with similar layouts in Texas (one kitchen), California (one kitchen), and Rhode Island (two kitchens). Each test kitchen had a sink, refrigerator, and stove/oven and was stocked with the same meal preparation equipment (e.g., dishes, knives, utensils, cutting boards, food thermometer) (see Appendix F). In each test kitchen, eight cameras recorded participants’ actions at various locations throughout the kitchen and recorded the meal preparation from beginning to end.

Participants received a $100 gift card and gift (food thermometer, mentioned after the completion of the research) for taking part in the 2-hour study. Participant recruitment began July 23, 2019. We conducted observations starting August 1, 2019, and ending February 14, 2020.

We randomly assigned participants to one of the three treatment groups or the control group when the appointment was scheduled with the goal of 120 participants in each group. The study team scheduled appointments at the test kitchen locations based on kitchen availability, with observations scheduled during the week, on weekends, and at different times of day (e.g., morning, afternoon, and evening).

2.6.1 Meal Preparation Experiment

Once participants arrived at the test kitchen, a data collector greeted them and instructed them to read and sign an informed consent form. Using a script (displayed on a tablet) to ensure consistency in delivery (see Appendix C for the script), the data collector described what participants could expect during the study. Initially, we told participants the purpose of the study was “to help us evaluate new product formulations and recipes, and that the recipes may be included in a publication on nutrition that extension agents will use in their community education programs.” Consistent with the approach used in other observation studies, we informed participants of the real purpose of the study following the post-interview and why it was important from a scientific perspective to inform them after the study was complete⁴ (Chapman, Eversley, Fillion, MacLaurin, & Powell, 2010; DeDonder et al., 2009).

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⁴ 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.
For the meal preparation experiment, the data collector instructed participants as follows:

"Today, you will be preparing pasta and meatballs in our test kitchen while wearing a mobile device that records what you see [hold up device].

You will be following two different recipes to prepare two dishes of pasta and meatballs. The pasta used for both meals is gluten-free. For one dish, you will make meatballs using raw ground beef with a few other ingredients, including gluten-free breadcrumbs, so someone who follows a gluten-free diet can eat them. For the other dish, you will use frozen, pre-packaged meatballs.

We will provide you with the recipes (recipe card provided in Appendix G) and the ingredients to prepare the gluten-free pasta with two types of meatballs. The pre-packaged meatballs are a new product, so please take a few minutes to become familiar with this product. A company plans to bring a new product to the marketplace and has asked us to test the look, feel, and preparation of the product before they produce and distribute it. Please pay close attention to the product packaging, including the back, front, and the sides of the package, as we are trying to help the company make decisions about what information to include on the package, how to label and present this information on the package, and whether the information provided on the package is clear.

After you are finished looking at the product packaging, please read the recipes and then prepare the dishes as you would at home; there is no right or wrong way. It should take you about an hour. Please prepare the frozen meatballs first and then the cooked meatballs; the oven is already preheated. Please do not eat any of the food, before or after you cook it.

After preparing the meal, please clean up the kitchen as you normally would at home; however, you do not need to put any dishes or utensils back. Also, if you normally use a dishwasher, feel free to load it, but please do not turn it on.

Please let us know when you are done preparing the meal and cleaning up by stepping out of the kitchen."

The data collector then showed participants the area where they would be cooking and pointed out available utensils and dishes in the drawers and cabinets and showed participants the location of cleaning supplies (under the sink). The participants were then instructed to put on the eye-tracking device, described as a “device that has cameras built in that allow us to see where you are looking as you prepare food.” The data collector

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5 The script informed participants the meal is for an individual who is on a gluten-free diet to avoid eliciting socially desirable behavior regarding food safety practices.

6 The script instructed participants to look at the product label to direct their attention to the product packaging without revealing the true purpose of the study, which was to examine response to the SHI.
checked the fit of the device and performed a calibration. Recording of the meal preparation then started on the eye-tracking device and the test kitchen cameras.

Before leaving the test kitchen, the data collector instructed participants:

"Here are the items you will be preparing today (physically pick up and hand the frozen meatball packaging to the participant). Please take a few minutes to become familiar with the packaging as this is the new product packaging I just described."

Recording on the test kitchen cameras ended after participants had finished cleaning the kitchen. The meal preparation experiment portion of the study took 50 to 80 minutes to complete. Following completion of the meal preparation, participants were asked if they needed a restroom break (if so, they removed the eye-tracking device and it was recalibrated after the break).

2.6.2 Eye-Tracking Study

Information on visual attention was captured using the Tobii Pro Glass 2 system (hereafter, the Tobii system), a wearable eye-tracking system designed specifically for mobile human behavior research. The Tobii system uses corneal reflection to track and correlate eye movements with information recorded in the wearer’s field of vision. The Tobii system uses four eye-tracking sensors with a sampling rate of 50 Hz and a field camera that provides a 90-degree field of vision with a video resolution of 1,920 x 1,080 at 25 frames per second. The Tobii system records gaze point data. Each gaze point consists of a spatial location (i.e., an x-y coordinate) and a time stamped 20-milliseconds (ms) interval. When the velocity or speed of eye movement is below 100 degrees per second, the gaze point is defined as a fixation, meaning that the eye is fixed on an image. This threshold is used specifically for wearable eye tracking because it takes into account more dramatic head movement. When eye movement exceeds this threshold, the gaze point is defined as a saccade.

The eye-tracking study included three tasks (Task A—distractor [one product]; Task B—measure visual salience [three products]; and Task C—assess ability to correctly distinguish between RTE and NRTE products [six products]). The script (see Appendix D) provided instructions on each of the specific tasks and how participants should interact with the mock products. The data collector read the script from a tablet to ensure consistency in delivery.

Participants completed three tasks using the mock products:

- **Task A—Distractor Task.** The purpose of the distractor task was to allow participants to acclimate to the eye-tracking component of the study and to help avoid disclosing the real purpose of the study. Participants were asked to look at the packaged, frozen stuffed RTE chicken breasts product and consider how healthy it is.

- **Task B—Attention to How to Prepare the Product Safely.** The purpose of this task was to collect eye-tracking data on participants’ attention to the SHI label and MCI on three different NRTE products (raw ground beef patties;
packaged, frozen NRTE hamburger patties; packaged, frozen stuffed breaded NRTE chicken breasts). The order of presentation of the products was balanced to control for order effects and the order of the products randomly assigned to the participant. Participants were instructed as follows:

"Now I am going to show you three different products. I will give you each product to look at one at a time and you can take as long as you need to look at it. Just let me know when you are finished.

As you look at each product, please consider how you would prepare the product safely if preparing it at home. I am going to ask you a few questions after you have looked at the three products."

**Tack C—Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE).** The purpose of this task was to assess whether participants could correctly distinguish between RTE and NRTE products and to collect eye-tracking data on participants’ attention to the SHI label (when applicable) and MCI for six different products (two RTE and four NRTE). Participants were instructed as follows:

"Now I want you to look at some products that are in the freezer. Put the products that have to be cooked to be safely eaten here and place the products that do NOT require cooking for safety here. Do you have any questions before you get started? (Lay out the two signs: Cooking for Safety Required vs. Not Required; if someone is not sure about a product they can place [it] to the side of the two signs; [i]f they ask questions or are confused, say, 'Please use your best judgment.'"

After completion of Task C, the data collector instructed the participants to remove the eye-tracking device.

### 2.6.3 Post-interview

The post-interview collected the following self-reported information on awareness and use of the SHI label and participants’ behaviors during the meal preparation experiment.

- If you were preparing this product [packaged, frozen breaded RTE chicken tenders] for the first time, what would you look for on the package to know how to prepare it safely?
- [Give participant handout with current SHI] Have you seen this label before today?
  - If the participant was aware, what is it, where have you seen it, and [if seen on food] what does it tell you about the food?
  - If the participant not aware, what do you think the label means?
- When you were cooking the meatballs from scratch, how did you tell when they were done?
  - If participant specifically mentions thermometer

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7 The questions were distractors and not used in the analysis.
• Was there something about the study today that prompted you to use a food thermometer; if yes, what?
• Do you have a food thermometer at home?
• If yes, would you usually use a food thermometer to cook meatballs from scratch at home?

The data collector read the questions from a tablet to ensure consistency in delivery. The post-interview was audio-recorded, transcribed, and coded for analysis. The eye-tracking study and post-interview took an average of 30 minutes to complete.

2.7 Training of Data Collectors and Coders

Before conducting an observation, data collectors were trained in all responsibilities including kitchen setup, participant check-in and consent, meal preparation and eye-tracking activities, Tobii eye-tracking operations, video backup, and eye-tracking file upload. Data collector training included the following:

• Shadowing an experienced data collector for a minimum of three observations.
• Attending a Tobii and eye-tracking training session. This session included an overview of the eye-tracking device and its role in the research project. This training also involved hands-on fitting, calibration, and cleaning of the device; connecting the eye-tracking device to its associated tablet; and file naming protocol. The data collector also had the opportunity to play the role of participant and wear the eye-tracking device while performing the eye-tracking tasks.
• Assisting the experienced data collector with all aspects of observation—from kitchen setup to video backup and eye-tracking upload for a minimum of two observations.
• Taking the lead on two observations under the supervision of an experienced data collector. A senior, full-time staff member also supervised the trainee during one of these observations to provide final evaluation and advice before clearing to lead an observation.

Project staff who coded observation videos attended training sessions on the following file management and coding schemes:

• Converting and exporting videos to an external drive.
• Splitting and merging videos.
• Coding rubric and decisions and data entry protocols for cleaning and sanitizing, cross-contamination, thermometer use, and handwashing.

After attending the above training sessions on video file management, each coder had the opportunity to practice converting, exporting, splitting, and merging videos under the supervision of an experienced coder until they demonstrated proficiency. The training sessions on coding schemes involved a discussion of the specific triggers (i.e., when handwashing or cleaning/sanitizing was required) under each coding scheme, demonstration
of how to code and enter data for an observation, and practice observations. All coders practiced on at least five observations and then reviewed their coding sheets with an experienced coder for accuracy. In the final step of the training, a pair of coders independently coded at least two observations for handwashing and cleaning and sanitizing and then compared and discussed any discrepancies with an experienced coder. At that point, a senior, full-time staff member reviewed the training and evaluation for each coder before allowing independent coding.

2.8 Measures

We developed the following measures for use in the analysis: adherence to safe food handling instructions (referred to as the label adherence score), visual attention measures, and additional covariates.

2.8.1 Adherence to Safe Food Handling Instructions (Label Adherence Score)

Participants’ adherence to safe food handling instructions (as displayed on the revised SHI labels) was determined using an observational scoring tool developed specifically for this study. Trained coders reviewed digitally recorded video of each participant during the meal preparation experiment and documented the extent to which the participant engaged in four safe food handling behaviors: handwashing, food thermometer use, avoidance of cross-contamination by keeping raw product separate from RTE foods, and cleaning and sanitizing of utensils and surfaces. An index (range 0–4) summarizing how well participants followed the safe food handling instructions was calculated by adding together the participant’s score for each of the four safe handling behaviors. Our analysis only considered adherence to safe handling instructions; we did not consider risk reduction from participants following some but not all of the instructions.

**Handwashing.** Proper handwashing consisted of four sub-behaviors\(^8\): (1) use water, (2) use soap, (3) rub hands for at least 20 seconds, and (4) dry hands on a single-use paper towel.\(^9\) For each handwashing event (i.e., instance that required handwashing), participants received one-quarter point for each sub-behavior. Handwashing events were required at the beginning of the observation (before handling food or dishes) and each time the participant touched raw meat (ground beef for the scratch-made meatballs or the NRTE frozen meatballs) or its packaging. Accordingly, the number of handwashing events varied by participant. The participant’s final handwashing score was calculated as the average across

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\(^8\) The sub-behaviors are based on the Centers for Disease Control and Prevention’s (CDC’s) handwashing guidelines: [https://www.cdc.gov/handwashing/when-how-handwashing.html](https://www.cdc.gov/handwashing/when-how-handwashing.html). Our analysis only considered adherence to CDC’s guidelines; we did not consider risk reduction from participants following some but not all of the required steps of a successful handwashing event.

\(^9\) Reusable kitchen towels were not available in the test kitchens.
all required handwashing events identified by the observer during the meal preparation period.

**Food Thermometer Use.** Proper use of a food thermometer consisted of inserting the thermometer into the food product and receiving a readout indicating that the food had reached a safe internal temperature of at least 160°F. Participants were scored on use of the food thermometer twice—once for each meat product (ground beef for the scratch-made meatballs and the NRTE frozen meatballs). Participants received one-quarter point for using the food thermometer (i.e., by placing the food thermometer into the food item) and one-quarter point if the last readout on the thermometer was at or above 160°F (the temperature readout was recorded through the eye-tracking device). Because of difficulties encountered when trying to capture the thermometer readout, participants received one-half point per product if the thermometer readout was indecipherable. This decision was based on the fact that among participants who used a thermometer and for whom the temperature readout was available, 91% of participants cooked the product to the proper temperature. Of the 173 instances of thermometer use, 92 (53%) could not be clearly read.

**Avoidance of Cross-Contamination.** Cross-contamination occurred when a raw meat product made direct contact with RTE foods that were part of the meal preparation task (cherry tomatoes, sauce, cooked pasta). Participants received one-half point for each meat product (ground beef for the scratch-made meatballs and the NRTE frozen meatballs) that did not make direct contact with RTE foods during the meal preparation.

**Clean and Sanitize.** Cleaning and sanitizing is a two-step, ordered process. Anytime raw meat (ground beef for the scratch-made meatballs or the NRTE frozen meatballs) or its packaging came into contact with a surface or utensil/cooking item, it needed to be cleaned and then sanitized before being used again. Cleaning occurred if the participant thoroughly washed the surface or utensil/cooking item with soap and water. Sanitizing occurred if the participant used one of the provided sanitizers (containing chlorine bleach, quaternary ammonia, or alcohol based) to spray the surface or utensil/cooking item and wiped it dry with a paper towel or if the utensil/cooking item was placed in the dishwasher.¹⁰ Similar to handwashing, the number of occurrences of cleaning and sanitizing varied by participant. For each required cleaning and sanitizing event, the participant received one-half point for properly executing each step. Participants could only receive one full point if they cleaned before sanitizing. The participant’s final cleaning and sanitizing score was calculated as the average across all required cleaning and sanitizing events identified by the observer during the meal preparation.

¹⁰ We assumed that dishwasher action, regardless of setting, results in a pathogen-free utensil.
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2.8.2 Visual Attention

For each of the eight mock food packages (two products for the meal preparation experiment and six products for the eye-tracking study), the research team designated areas of interest (AOIs) that contained information related to safe food handling (see Appendix B for location of AOIs on the mock packages). The AOIs for this study were the SHI label and MCI. For each AOI on each food package, Tobii recorded the following spatial-temporal variables:

**Number of Fixations.** This is a count variable that captured the number of gaze points (i.e., fixations) the participant had on the AOI.

**Total Fixation Time.** This is a continuous variable that captured total time in seconds that the participant was in fixation on the AOI.

**Any Fixation.** This is a dichotomous variable assigned “0″ if the participant did not fixate on the AOI and assigned a value of “1″ otherwise.

**Time to First Fixation.** This is a continuous variable that captured total time in seconds between the moment the participant was handed the food package and the moment their eyes fixated on the AOI.

2.8.3 Additional Covariates

Participants provided demographic and household information when completing the screening questionnaire that confirmed eligibility to participate in the study. These data were included as covariates in multiple regression, analysis of covariance (ANCOVA), and multivariate analysis of covariance (MANCOVA) models.

**Demographic Variables.** Demographic information consisted of the participant’s sex/gender (male, female, other, prefer not to answer); race/ethnicity (coded as non-Hispanic White, non-Hispanic Black, Hispanic, or multiracial/other\(^\text{11}\)); age (18–34 years, 35–54 years, 55–64 years, 65 years or older); and education (less than high school, high school graduate or GED, technical/vocational training, some college, or college graduate).

**Household Information.** Household information consisted of at-risk individual in the household, child in the household, and availability of a food thermometer. At-risk individual was a dichotomous indicator assigned the value of “1″ if someone in the participant’s household was at elevated risk for foodborne illness (i.e., 5 years of age or younger; 65 years of age or older; pregnant; or diagnosed with diabetes, kidney disease, or a condition that weakens the immune system) and “0″ otherwise. Child in the household was a dichotomous indicator assigned the value of “1″ if there was a child between the ages of

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\(^{11}\) The race/ethnicity category multiracial/other includes individuals who identified as American Indian or Native American, Asian, Native Hawaiian or Other Pacific Islander, and those who identified more than one racial category.
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birth and 17 in the household and “0” otherwise. Food thermometer was a dichotomous indicator assigned the value of “1” if there was a food thermometer available in the household and “0” otherwise.

**Risk Preference.** Personal comfort with risk taking was measured using the nine-item risk preferences subscale from Price and Ridgeway’s Use Innovativeness Scale (1983). The nine items present self-descriptive statements to the participant about rule-following behavior (e.g., “I always follow manufacturer’s warnings regarding how to use a product.” “When I try to do projects on my own, without exact directions, they usually work out really well.”) (Price & Ridgway, 1983). Participants responded using a Likert-type scale that ranged from 1 (not at all like me) to 7 (a lot like me). Item 3 (“When I try to do projects on my own, without exact directions, they usually work out really well.”) and Item 4 (“I find very little instruction is needed to use a product similar to one I’m already familiar with.”) were reverse scored, and the nine items were summed and averaged so that higher numbers indicate greater risk aversion.

2.9 Analysis

Statistical analyses addressed the study’s primary research questions as described below. Analytic procedures were based on inferential statistical procedures suitable for large samples and dependent variables that are independent and identically distributed (normal), unless otherwise noted. Preliminary analyses included descriptive statistics examining the demographic characteristics of the study participants, frequency distribution of categorical variables, and univariate examination of variables used in scales.

Data analysis procedures began with conducting quality checks for illogical or out-of-range values, examining the distribution of variables to confirm assumptions of normality and homogeneity of variances, validating categories on discrete variables, and examining value counts by variable to look for patterns of nonignorable missing data.

2.9.1 Descriptive Statistics

Descriptive statistics provide an understanding of the participants who completed the study (demographics), the distribution of scores for each safe food handling behavior (adherence to safe handling instructions during meal preparation), and the distribution of visual attention data in each study task. Heat maps generated using the eye-tracking data provide additional descriptive information as detailed below.

**Demographics.** Demographic information includes the participant’s gender, race and ethnicity, age (by category), highest level of formal education, and risk preference score. Additional information on the participant’s household included whether there is an at-risk person in the household, whether there is a child in the household, and availability of a food thermometer. We report demographic data at the study level (overall) and by study condition.
**Adherence to Safe Handling Instructions during Meal Preparation.** We summarized information from the meal preparation experiment for each behavior and sub-behavior overall and by study condition. Descriptive statistics include means and standard deviations for the four behavior scores and the composite label adherence score; we also present the proportion of participants who successfully completed each sub-behavior.

**Visual Attention Data.** We summarized visual attention data separately for the meal preparation experiment and the two eye-tracking study tasks (Task B—Attention to How to Prepare the Product Safely and Task C—Determination of Whether Cooking for Safety Is Required [NRTE] vs. Not Required [RTE]) for each product. Descriptive information includes the number of participants who fixated on each AOI (SHI and MCI), the mean number of fixation periods, and the mean total fixation time, reported at the study level (overall) and by study condition.

**Heat Maps.** Heat maps summarize visual attention by using variations in color to identify the amount of attention different areas in the visual plane received: warmer colors (i.e., reds) indicate more concentrations of visual attention than cooler colors (i.e., greens).

### 2.9.2 Methods to Address Research Questions

**Adherence to Safe Handling Behaviors (Research Question 1)**

Unadjusted and adjusted linear regression models assessed the null hypothesis that participants’ adherence to safe food handling instructions would not vary based on which of the SHI labels (control vs. one of three revised SHI labels) they saw during the meal preparation experiment. The dependent variable was the composite label adherence score, and the independent variable was a four-level categorical variable representing study conditions with the current SHI label (i.e., control condition) as the reference category. The adjusted model included demographic covariates (age, sex, race/ethnicity, education, presence of a child aged birth to 17 in the home, presence of an at-risk household member), a measure of risk preference, and two dichotomous variables indicating whether the participant had any recorded visual fixation on the SHI label or MCI. As a follow-up, we examined each of the safe food handling behaviors—handwashing, cleaning and sanitizing, thermometer use, and cross-contamination—separately using analysis of variance (ANOVA) models. We used two-tailed tests of statistical significance to reject the null hypotheses at \( p < .05 \) for all models.

**Visual Attention to SHI Labels (Research Question 2)**

We examined research question 2, "Of the three revised SHI labels, do any of them attract more visual attention when participants are asked to consider how to safely prepare the product compared with the current SHI label?" in two steps. First, unadjusted and adjusted logistic regression models assessed the null hypotheses that fixation (any vs. none) did not vary between the current SHI label and the revised SHI labels. The dependent variable was
a dichotomous indicator that categorized participants as having at least one fixation period within the SHI AOI (i.e., any) or having no fixation period within the SHI AOI (i.e., none). Fixation data were based on the first package the participant was handed during Task B. The four-level SHI condition variable (i.e., control and three experimental conditions) was the independent variable of interest. The adjusted model included demographic covariates (age, sex, race/ethnicity, education, presence of a child aged birth to 17 in the home, presence of an at-risk household member) and a measure of risk preference. We used two-tailed tests of statistical significance to reject the null hypotheses at \( p < .05 \).

Second, unadjusted and adjusted linear regression models assessed the null hypothesis that time to first fixation did not vary between the current SHI label and the revised SHI labels. These analyses were limited to participants with at least one fixation on the SHI AOI for the first package the participant was handed during Task B. The dependent variable was a continuous measure of the number of seconds between the point in time that the participant was handed the first food package and the time of their first fixation on the SHI AOI. The model infers that shorter time to first fixation is associated with SHIs with higher visual salience. The four-level SHI condition variable was the independent variable of interest. Because of the limited sample size, the adjusted model included only demographic covariates (sex, race/ethnicity, and presence of an at-risk household member). We used two-tailed tests of statistical significance to reject the null hypotheses at \( p < .05 \).

**Visual Prominence of the SHI Label Relative to the MCI (Research Question 3)**

We assessed the prominence of the SHI label relative to the MCI using visual attention data from Task B. For the packaged, frozen NRTE hamburger patties and the packaged, frozen NRTE stuffed chicken breasts, we created a dichotomous variable that indicated whether the participant fixated on the SHI first or on the MCI first. We used the chi-square goodness-of-fit test to compare the observed sample distribution with the expected sample distribution under the null hypothesis of no difference. For each product, we expected that the number of participants who looked at the SHI first would not differ significantly from the number of participants who looked at the MCI first.

Similar to commercially available products, the two products displayed the SHI in different locations: one package displayed the SHI on the side panel (hamburger patties) and the other package displayed the SHI on the back panel (stuffed chicken breasts). To rule out the possibility that the location of the SHI influenced the first look, we conducted a follow-up analysis using the McNemar test (Pett, 1977). This test also uses a chi-square test statistic to examine the null hypothesis that the location of the SHI does not influence attention.
Visual Discrimination: Determination of NRTE vs. RTE (Research Question 4)

Participants’ ability to differentiate NRTE and RTE meat and poultry products based on packaging is presented using descriptive statistics. For each of the six products (two RTE and four NRTE), we report in Section 3.4 the number and percentage of participants who correctly classified the product, incorrectly classified the product, and who reported they did not know. For each category of participants, we also provide descriptive eye-tracking data on the percentage of participants with any fixation and the mean and standard deviation for number of fixations and total fixation time on the MCI (for both RTE and NRTE) and the SHI (NRTE only).

Manipulation Checks

Order Effects. Order effects can occur in research studies when the sequence in which participants view stimuli contributes in some way to measured outcomes. Participants may, for example, spend less time looking at the SHI label on subsequent products after examining the SHI label on the first product they were given. Accordingly, we examined whether the order in which participants examined the three food packages in Task B of the eye-tracking study influenced average fixation time. We selected two products—packaged, frozen hamburger patties and packaged, frozen NRTE stuffed chicken breasts—and created an indicator variable for each that referenced whether the product was viewed first, second, or third. We regressed each indicator independently on average fixation time for its corresponding product to assess the null hypothesis that order does not influence average fixation time.

Assessing Reliability of Coding for Meal Preparation. We evaluated the reliability of the coding for the behavioral observation during meal preparation by having two coders independently code handwashing and cleaning and sanitizing behaviors for 20 participants. We determined interrater agreement for each of the scores using the kappa statistic (Kramer & Feinstein, 1981; Sim & Wright, 2005). Kappa results less than 0.40 are generally considered to reflect poor interrater values, values between 0.40 and 0.70 are fair to good, and values greater than 0.70 reflect excellent reliability (Landis & Koch, 1977).
3. Results

The overall goal of the Behavior Change Study was to compare three revised SHI labels with the current SHI label to determine whether enhancements and revisions to the label will lead to (1) greater awareness of the label or (2) greater adherence to the label’s recommendation for safe handling of raw meat and poultry products. To achieve this goal, the study addressed the following research questions:

1. Of the three revised SHI labels, do any of them lead participants to greater adherence to safe handling instructions compared with the current SHI label?

2. Of the three revised SHI labels, do any of them attract more visual attention when participants are asked to consider how to safely prepare the product compared with the current SHI label?

3. Do participants first look to the SHI label or the manufacturer’s cooking instructions (MCI) when asked to consider how to safely prepare the product?

4. What labeling elements do participants look at when they are asked to discriminate between RTE and NRTE meat and poultry products?

This section summarizes the study sample, provides the results of the manipulation checks described in Section 2, summarizes the descriptive eye-tracking data by study task, and presents and discusses the results of the analysis organized by the study’s four research questions.

3.1 Study Sample

Table 3-1 presents information on the study sample (n = 483) compared with the recruitment quotas. We exceeded the quota for non-Whites (47% obtained vs. 32% planned), thus failing to meet the quota for Whites (53% vs. 68%). We exceeded the quota for Hispanics (19% vs. 16%). Twenty-six participants (5%) were Spanish-speaking Hispanics and completed the study entirely in Spanish. We were unable to meet the quota for individuals aged 55 or older (12% vs. 26%) because the criteria used to screen out individuals who were not suitable for collecting data using eye tracking (e.g., wear bifocals for progressive lenses) made many individuals in this age group ineligible for study participation. We met the quotas for education level: 26% of our sample was high-school educated as targeted. We were close to meeting the quota for individuals having a child aged birth to 17 years living in the household (44% vs. 48%). Despite failing to meet some of the specific quotas, the final sample was diverse and generally mirrored the demographics of the U.S. population.

Regarding location, our target was 360 participants for North Carolina and 40 participants in each of the other locations. Because of last-minute kitchen unavailability in Rhode Island, we were only able to collect data from 28 participants in Rhode Island. To help compensate for this shortfall, we collected data from 45 participants in Texas (the last remote location in
which we collected data). Within each location, participants were about equally distributed across the four conditions (see Table 3-2).

### Table 3-1. Comparison of the Study Sample with Recruitment Quotas

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Study Sample N (%)</th>
<th>Recruitment Quota (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>255 (52.80)</td>
<td>68%</td>
</tr>
<tr>
<td>Non-White(^a)</td>
<td>228 (47.20)</td>
<td>32%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>389 (80.54)</td>
<td>84%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>94 (19.46)</td>
<td>16%</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>223 (46.17)</td>
<td>35%</td>
</tr>
<tr>
<td>35–54</td>
<td>204 (42.24)</td>
<td>39%</td>
</tr>
<tr>
<td>55+</td>
<td>56 (11.59)</td>
<td>26%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school, high school diploma/GED, or technical or vocational school</td>
<td>127 (26.29)</td>
<td>26%</td>
</tr>
<tr>
<td>Some college</td>
<td>180 (37.27)</td>
<td>40%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>106 (21.95)</td>
<td>19%</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>70 (14.49)</td>
<td>15%</td>
</tr>
<tr>
<td>Household status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family household (children)</td>
<td>213 (44.10%)</td>
<td>48%</td>
</tr>
<tr>
<td>Nonfamily household (no children)</td>
<td>270 (55.90%)</td>
<td>52%</td>
</tr>
</tbody>
</table>

\(^a\) 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.

Source: Screening questionnaire

### Table 3-2. Distribution of the Sample by Location and Condition

<table>
<thead>
<tr>
<th>Location</th>
<th>Revised SHI Labels</th>
<th>Control (Current SHI)</th>
<th>Octagon-Short-Abstract</th>
<th>Octagon-Medium-Hybrid</th>
<th>Octagon-Long-Hybrid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina</td>
<td></td>
<td>96</td>
<td>92</td>
<td>96</td>
<td>90</td>
<td>374</td>
</tr>
<tr>
<td>Texas</td>
<td></td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>California</td>
<td></td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Rhode Island</td>
<td></td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>121</td>
<td>120</td>
<td>121</td>
<td>121</td>
<td>483</td>
</tr>
</tbody>
</table>
Table 3-3 provides additional information on the study sample overall and by the four conditions. With the randomization, the demographics are reasonably balanced across conditions. Overall, 65% of participants identified as female, reflecting the fact that more females than males identified as cooking raw meat or poultry at home at least once a week. About 40% of participants identified as White, non-Hispanic; 31% as Black, non-Hispanic; and 19% as Hispanic. About 46% of participants were between the ages of 18 and 34, 42% were between the ages of 35 and 54, and 11% were 55 or older. About 26% of participants had not completed college or had technical or vocational training, 37% had some college, and 37% had a 4-year college degree or higher. About 28% of participants indicated that they or someone in their household is at risk of foodborne illness.

About 57% of participants reported having a food thermometer at home. The 2016 Food Safety Survey (Lando, Verrill, Liu, & Smith, 2016), a nationally representative telephone survey, found that 67% of consumers reported owning a food thermometer. Self-reported awareness of the current SHI label (as reported in the post-observation interview) was 74%. A survey conducted in 1995–1996, shortly after the SHI label was mandated by USDA, reported 51% awareness of the SHI label based on self-reported data (Yang, Angulo, & Altekruse, 2000).

### 3.2 Results of Manipulation Checks

The following results support the quality of the data used in the statistical models to address the research questions. Findings indicate that participants’ interaction with food packages was not affected by the order in which packages were presented (order effects) and that coding of participants’ safe food handling behavior was not influenced by coder bias.

#### 3.2.1 Order Effects

We examined average fixation on the SHI label based on the order that the three food packages were presented to the participant. A significant difference in average fixation time suggests that the order of presentation influenced how the participant interacted with the food package. We regressed the three-level indicator variables indicating order of presentation on average fixation time and found that order had no effect on how long participants fixated on the SHI.
### Table 3-3. Demographic and Other Information on Study Sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 483)</th>
<th>Current SHI (N = 121)</th>
<th>Octagon-Short-Hybrid (N = 120)</th>
<th>Octagon-Med-Hybrid (N = 121)</th>
<th>Octagon-Long-Hybrid (N = 121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>162 (33.54%)</td>
<td>40 (33.06%)</td>
<td>41 (34.17%)</td>
<td>37 (30.58%)</td>
<td>44 (36.36%)</td>
</tr>
<tr>
<td>Female</td>
<td>315 (65.22%)</td>
<td>79 (65.29%)</td>
<td>76 (63.33%)</td>
<td>83 (68.6%)</td>
<td>77 (63.64%)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (0.41%)</td>
<td>1 (0.83%)</td>
<td>1 (0.83%)</td>
<td>0 (0.00%)</td>
<td>0 (0.00%)</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>4 (0.83%)</td>
<td>1 (0.83%)</td>
<td>2 (1.67%)</td>
<td>1 (0.83%)</td>
<td>0 (0.00%)</td>
</tr>
<tr>
<td>Race/ethnicity—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>192 (39.75%)</td>
<td>52 (42.98%)</td>
<td>52 (43.33%)</td>
<td>45 (37.19%)</td>
<td>43 (35.54%)</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>148 (30.64%)</td>
<td>43 (35.54%)</td>
<td>30 (25%)</td>
<td>35 (28.93%)</td>
<td>40 (33.06%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>94 (19.46%)</td>
<td>20 (16.53%)</td>
<td>24 (20%)</td>
<td>26 (21.49%)</td>
<td>24 (19.83%)</td>
</tr>
<tr>
<td>Other¹</td>
<td>49 (10.14%)</td>
<td>6 (4.96%)</td>
<td>14 (11.67%)</td>
<td>15 (12.4%)</td>
<td>14 (11.57%)</td>
</tr>
<tr>
<td>Age category—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>224 (46.38%)</td>
<td>54 (44.63%)</td>
<td>57 (47.5%)</td>
<td>57 (47.11%)</td>
<td>56 (46.28%)</td>
</tr>
<tr>
<td>35–54</td>
<td>203 (42.03%)</td>
<td>52 (42.98%)</td>
<td>44 (36.67%)</td>
<td>54 (44.63%)</td>
<td>53 (43.8%)</td>
</tr>
<tr>
<td>55–64</td>
<td>46 (9.52%)</td>
<td>14 (11.57%)</td>
<td>15 (12.5%)</td>
<td>7 (5.79%)</td>
<td>10 (8.26%)</td>
</tr>
<tr>
<td>65 and older</td>
<td>10 (2.07%)</td>
<td>1 (0.83%)</td>
<td>4 (3.33%)</td>
<td>3 (2.48%)</td>
<td>2 (1.65%)</td>
</tr>
<tr>
<td>Education—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>5 (1.04%)</td>
<td>3 (2.48%)</td>
<td>0 (0.00%)</td>
<td>1 (0.83%)</td>
<td>1 (0.83%)</td>
</tr>
<tr>
<td>High school graduate/GED</td>
<td>97 (20.08%)</td>
<td>23 (19.01%)</td>
<td>28 (23.33%)</td>
<td>21 (17.36%)</td>
<td>25 (20.66%)</td>
</tr>
<tr>
<td>Technical/vocational training</td>
<td>24 (4.97%)</td>
<td>5 (4.13%)</td>
<td>6 (5.00%)</td>
<td>5 (4.13%)</td>
<td>8 (6.61%)</td>
</tr>
<tr>
<td>Some college (includes 2-yr degree)</td>
<td>180 (37.27%)</td>
<td>42 (34.71%)</td>
<td>46 (38.33%)</td>
<td>44 (36.36%)</td>
<td>48 (39.67%)</td>
</tr>
<tr>
<td>College graduate</td>
<td>107 (22.15%)</td>
<td>30 (24.79%)</td>
<td>24 (20%)</td>
<td>35 (28.93%)</td>
<td>18 (14.88%)</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>70 (14.49%)</td>
<td>18 (14.88%)</td>
<td>16 (13.33%)</td>
<td>15 (12.4%)</td>
<td>21 (17.36%)</td>
</tr>
</tbody>
</table>

(continued)
Table 3-3.  Demographic and Other Information on Study Sample (continued)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 483)</th>
<th>Current SHI (N = 121)</th>
<th>Octagon-Short-Abstract (N = 120)</th>
<th>Octagon-Med-Hybrid (N = 121)</th>
<th>Octagon-Long-Hybrid (N = 121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0–17) living in household—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>213 (44.1%)</td>
<td>51 (42.15%)</td>
<td>47 (39.17%)</td>
<td>63 (52.07%)</td>
<td>52 (42.98%)</td>
</tr>
<tr>
<td>No</td>
<td>270 (55.9%)</td>
<td>70 (57.85%)</td>
<td>73 (60.83%)</td>
<td>58 (47.93%)</td>
<td>69 (57.02%)</td>
</tr>
<tr>
<td>Individual in household at risk of foodborne illness—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>137 (28.36%)</td>
<td>33 (27.27%)</td>
<td>36 (30%)</td>
<td>31 (25.62%)</td>
<td>37 (30.58%)</td>
</tr>
<tr>
<td>No</td>
<td>346 (71.64%)</td>
<td>88 (72.73%)</td>
<td>84 (70%)</td>
<td>90 (74.38%)</td>
<td>84 (69.42%)</td>
</tr>
<tr>
<td>Have food thermometer at home—N (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>274 (56.61%)</td>
<td>78 (64.46%)</td>
<td>58 (48.33%)</td>
<td>68 (56.2%)</td>
<td>69 (57.02%)</td>
</tr>
<tr>
<td>No</td>
<td>210 (43.39%)</td>
<td>43 (35.54%)</td>
<td>62 (51.67%)</td>
<td>53 (43.8%)</td>
<td>52 (42.98%)</td>
</tr>
<tr>
<td>Reported prior awareness of current SHI label—N (%)</td>
<td>329 (74.1%)</td>
<td>79 (76.7%)</td>
<td>80 (71.43%)</td>
<td>78 (67.83%)</td>
<td>92 (80.7%)</td>
</tr>
<tr>
<td>Risk preference score—Mean (SD)</td>
<td>30.48 (6.83)</td>
<td>29.74 (5.97)</td>
<td>30.78 (6.62)</td>
<td>29.98 (7.15)</td>
<td>31.41 (7.44)</td>
</tr>
</tbody>
</table>

Notes: GED = General Equivalency Degree. SD = standard deviation

a Other includes individuals who identified their race as American Indian/Native American, Asian, or Native Hawaiian/Pacific Islander and includes multiracial.

b Participant indicated at least one household member was (1) 65 years of age or older, (2) 5 years of age or younger, (3) pregnant, (4) diagnosed with diabetes or kidney disease, or (4) diagnosed with a condition that weakens the immune system (e.g., cancer, HIV, or AIDS).

c Based on a 9-item scale that measured general orientation toward risk taking (Price & Ridgway, 1983).

Source: Except as noted, all items from screening questionnaire. Prior awareness of current SHI label collected during post-interview.
3.2.2 Assessing Reliability of Coding for Meal Preparation

Two trained coders watched the videos and coded handwashing behavior and clean/sanitize behaviors for 20 participants. For the test coding for handwashing, the number of instances of handwashing varied based on the participants’ action in the kitchen, ranging from 5 to 9. Simple (2x2) and weighted (Nx2) Kappa statistics ranged from .89 to 1.00, indicating excellent agreement among coders. For the test coding of cleaning and sanitizing, the number of instances of cleaning/sanitizing varied based on the participants’ action in the kitchen, ranging from 2 to 5. Simple (2x2) Kappa statistics ranged from .68 to 1.00, indicating substantial to excellent agreement among raters.

3.3 Descriptive Information for Participant Eye-Tracking Data by Study Task

Tables 3-4, 3-5, and 3-6 provide descriptive information on the eye-tracking measures (any fixation, number of fixations, and total time of fixation) for each product overall and by condition for the meal preparation experiment, Task B of the eye-tracking study, and Task C of the eye-tracking study. See Appendix B for the labeling of the mock packages used in the study. For each mock package, Appendix B identifies the AOIs for the SHI label and the MCI.

Heat maps for each task (Appendices H, I, and J) provide additional descriptive information on visual attention. Heat maps summarize visual attention by using variations in color: warmer colors (i.e., reds) indicate more concentrations of visual attention than cooler colors (i.e., greens). For each task, one set of heat maps, including the front of the package and side/back panels that contain the MCI and SHI, is presented for each product viewed in the task. Figure 3-1 shows heat maps for the MCI, the current SHI label, and the Octagon-Medium-Hybrid experimental SHI label, for the packaged, frozen meatball product that participants prepared during the meal preparation experiment.

12 Usable data were unavailable for 62 participants because the data were incorrectly backed up, the files were corrupt, or a working eye-tracking device was not available at the time of the participant’s scheduled appointment.
Figure 3-1. Heat Maps for the Packaged, Frozen Meatball Product Prepared during the Meal Preparation Experiment

- **Manufacturer's Cooking Instructions (MCI):**
  - **COOKING INSTRUCTIONS:**
    - For food safety and quality, follow these cooking instructions.
    - Meatballs should be cooked thoroughly to an internal temperature of 160°F. Heating time and temperature may require adjustment due to variation in appliance thermostats.
  - **PREPARE FROM FROZEN STATE**
    1. Preheat oven to 425°F
    2. Place the meatballs in a single layer on aluminum-lined baking sheet and place in pre-heated oven.
    3. Bake meatballs 15 minutes, then turn meatballs over and bake for an additional 10-15 minutes.

- **Current SHI Label**

- **Octagon-Medium-Hybrid Revised SHI**

**Wake Farms**

**KEEP FROZEN READY TO COOK**

**CONNECT WITH US**

**IMPORTANT! Food Safety Instructions**

Food safety and quality are essential. This product is a meat product and may contain pathogenic bacteria. Proper cooking is necessary to ensure food safety. It is recommended to follow these food safety instructions for all preparations:

- **Wash Hands:**
  - Wash hands with soap and warm water for at least 20 seconds.
- **Cover Utensils and Equipment:**
  - Use clean utensils and equipment with each use.

**Marinade Internal Temperature:**

- **145°F**

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### Table 3-4. Eye-Tracking Outcomes for Each Product by SHI Label Condition: Meal Preparation Experiment

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overall  ((N = 421))</th>
<th>Current SHI Label  ((N = 100))</th>
<th>Octagon-Short-Abstract  ((N = 106))</th>
<th>Octagon-Medium-Hybrid  ((N = 105))</th>
<th>Octagon-Long-Hybrid  ((N = 110))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation  (N (%))</td>
<td>Mean  (SD)</td>
<td>Any Fixation  (N (%))</td>
<td>Mean  (SD)</td>
<td>Any Fixation  (N (%))</td>
</tr>
<tr>
<td>Raw Ground Beef—NRTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>26  ((6.18))</td>
<td>4.65  (5.41)</td>
<td>4  ((4.00))</td>
<td>2.25  (1.89)</td>
<td>7  ((6.60))</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>3.16  ((5.45))</td>
<td>1.03  (1.22)</td>
<td>2.21  (2.39)</td>
<td>4.03  (7.46)</td>
<td>4.47  (6.35)</td>
</tr>
<tr>
<td>MCI</td>
<td>12  ((2.85))</td>
<td>4.08  (5.33)</td>
<td>3  ((3.00))</td>
<td>1.00  (0.00)</td>
<td>3  ((2.83))</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>4.89  ((5.78))</td>
<td>3.41  (5.53)</td>
<td>5.22  (5.55)</td>
<td>5.29  (7.67)</td>
<td>6.34  ((0.00))</td>
</tr>
<tr>
<td>Packaged, Frozen Meatballs—NRTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>130  ((30.88))</td>
<td>9.76  (12.07)</td>
<td>23  ((23.00))</td>
<td>6.78  (6.5)</td>
<td>34  ((32.08))</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>6.48  ((8.61))</td>
<td>5.44  (8.7)</td>
<td>7.30  (6.74)</td>
<td>7.14  (11.24)</td>
<td>5.75  ((7.38))</td>
</tr>
<tr>
<td>MCI</td>
<td>152  ((36.10))</td>
<td>22.56  ((19.68))</td>
<td>29  ((29.00))</td>
<td>18.48  ((12.49))</td>
<td>39  ((36.79))</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>12.76  ((10.88))</td>
<td>11.60  ((9.09))</td>
<td>13.68  ((10.71))</td>
<td>13.49  ((11.79))</td>
<td>11.89  ((11.42))</td>
</tr>
</tbody>
</table>

Notes: MCI = manufacturer’s cooking instructions; RTE = ready to eat; NRTE = not ready to eat; SD = standard deviation.
Any fixation indicates the number and percentage of participants who had at least one recorded fixation on the area of interest.
Number of fixations indicates the number of instances that participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.
Total time of fixation is the number of milliseconds participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.
Source: Meal Preparation Experiment
Table 3-5.  Eye-Tracking Outcomes for Each Product by SHI Label Condition: Attention to How to Prepare the Product Safely (Task B)

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Current SHI Label</th>
<th>Octagon-Short-Abstract</th>
<th>Octagon-Medium-Hybrid</th>
<th>Octagon-Long-Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any Fixation $N$ (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation $N$ (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation $N$ (%)</td>
</tr>
<tr>
<td><strong>Raw Ground Beef Patties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>120 (28.50)</td>
<td>7.22 (6.31)</td>
<td>23 (23.00)</td>
<td>6.13 (4.31)</td>
<td>36 (33.96)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>3.50 (4.05)</td>
<td>2.94 (1.92)</td>
<td>3.16 (2.71)</td>
<td>2.03 (1.77)</td>
<td>1.92 (1.43)</td>
</tr>
<tr>
<td>MCI</td>
<td>90 (21.38)</td>
<td>3.41 (2.78)</td>
<td>19 (19.00)</td>
<td>3.63 (2.93)</td>
<td>28 (26.42)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>2.64 (2.43)</td>
<td>2.65 (1.74)</td>
<td>2.65 (1.74)</td>
<td>2.36 (1.64)</td>
<td>2.53 (2.35)</td>
</tr>
<tr>
<td><strong>Packaged, Frozen Hamburger Patties—NRTE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>94 (22.33)</td>
<td>5.89 (6.58)</td>
<td>15 (15.00)</td>
<td>5.07 (4.82)</td>
<td>23 (21.70)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>2.90 (3.46)</td>
<td>2.19 (2.59)</td>
<td>2.19 (2.59)</td>
<td>2.36 (3.39)</td>
<td>3.97 (3.21)</td>
</tr>
<tr>
<td>MCI</td>
<td>192 (45.61)</td>
<td>15.18 (15.27)</td>
<td>34 (34.00)</td>
<td>12.53 (12.46)</td>
<td>54 (50.94)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>7.34 (7.26)</td>
<td>5.76 (5.34)</td>
<td>5.76 (5.34)</td>
<td>8.03 (7.29)</td>
<td>8.12 (8.9)</td>
</tr>
<tr>
<td><strong>Packaged, Frozen Stuffed Chicken Breasts—NRTE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>113 (26.84)</td>
<td>3.42 (3.24)</td>
<td>23 (23.00)</td>
<td>2.70 (2.03)</td>
<td>34 (32.08)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>1.50 (2.11)</td>
<td>1.56 (2.22)</td>
<td>1.56 (2.22)</td>
<td>1.71 (2.65)</td>
<td>1.71 (2.65)</td>
</tr>
</tbody>
</table>

(continued)
### Table 3-5. Eye-Tracking Outcomes for Each Product by SHI Label Condition: Attention to How to Prepare the Product Safely (Task B) (continued)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overall (N = 421)</th>
<th>Current SHI Label (N = 100)</th>
<th>Octagon-Short-Abstract (N = 106)</th>
<th>Octagon-Medium-Hybrid (N = 105)</th>
<th>Octagon-Long-Hybrid (N = 110)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation N (%)</td>
</tr>
<tr>
<td>Number of fixations</td>
<td>185 (43.94)</td>
<td>13.97 (11.84)</td>
<td>34 (13.23)</td>
<td>52 (49.06)</td>
<td>47 (12.23)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>7.99 (7.69)</td>
<td>7.02 (7.01)</td>
<td>7.02 (49.36)</td>
<td>9.34 (8.74)</td>
<td>6.15 (5.67)</td>
</tr>
</tbody>
</table>

Notes: MCI = manufacturer’s cooking instructions; RTE = ready to eat; NRTE = not ready to eat; SD = standard deviation.

Any fixation indicates the number and percentage of participants who had at least one recorded fixation on the area of interest.

Number of fixations indicates the number of instances that participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.

Total time of fixation time is the number of milliseconds participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.
### Table 3-6. Eye-Tracking Outcomes for Each Product by Safe Handling Instructions (SHI) Label Condition: Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overall ((N = 421))</th>
<th>Current SHI Label ((N = 100))</th>
<th>Octagon-Short-Abstract ((N = 106))</th>
<th>Octagon-Medium-Hybrid ((N = 105))</th>
<th>Octagon-Long-Hybrid ((N = 110))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation (N(%)) Mean (SD)</td>
<td>Any Fixation (N(%)) Mean (SD)</td>
<td>Any Fixation (N(%)) Mean (SD)</td>
<td>Any Fixation (N(%)) Mean (SD)</td>
<td>Any Fixation (N(%)) Mean (SD)</td>
</tr>
<tr>
<td><strong>Ready-to-Eat (RTE) Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, Frozen Stuffed Chicken Breasts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCI Number of fixations</td>
<td>83 (19.72)</td>
<td>21 (21.00)</td>
<td>19 (17.92)</td>
<td>24 (22.86)</td>
<td>19 (17.27)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>2.60 (2.62)</td>
<td>2.79 (2.7)</td>
<td>2.58 (2.62)</td>
<td>2.08 (2.46)</td>
<td>3.06 (2.81)</td>
</tr>
<tr>
<td>Packaged, Frozen Chicken Tenders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCI Number of fixations</td>
<td>83 (19.72)</td>
<td>19 (19.00)</td>
<td>18 (16.98)</td>
<td>20 (19.05)</td>
<td>26 (23.64)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>3.24 (3.22)</td>
<td>4.20 (3.91)</td>
<td>2.54 (2.77)</td>
<td>3.35 (3.46)</td>
<td>2.94 (2.73)</td>
</tr>
<tr>
<td><strong>Not-Ready-to-Eat (NRTE) Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, Frozen Stuffed Chicken Breasts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI Number of fixations</td>
<td>16 (3.80)</td>
<td>5 (5.00)</td>
<td>2 (1.89)</td>
<td>4 (3.81)</td>
<td>5 (4.55)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>0.76 (0.94)</td>
<td>0.58 (0.52)</td>
<td>0.41 (0.35)</td>
<td>0.77 (1.29)</td>
<td>1.08 (1.25)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overall (N = 421)</th>
<th>Current SHI Label (N = 100)</th>
<th>Octagon-Short-Abstract (N = 106)</th>
<th>Octagon-Medium-Hybrid (N = 105)</th>
<th>Octagon-Long-Hybrid (N = 110)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation N (%)</td>
</tr>
<tr>
<td>MCI</td>
<td>40 (9.5)</td>
<td>3.65 (3.44)</td>
<td>9 (9.00)</td>
<td>2.33 (1.66)</td>
<td>10 (9.43)</td>
</tr>
<tr>
<td></td>
<td>1.58 (1.87)</td>
<td>0.84 (0.79)</td>
<td>0.95 (0.89)</td>
<td>4.77 (4.82)</td>
<td>2.24 (2.01)</td>
</tr>
<tr>
<td>Packaged, Frozen Chicken Tenders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>59 (14.01)</td>
<td>3.8 (3.36)</td>
<td>10 (10.00)</td>
<td>4.7 (5.23)</td>
<td>18 (16.98)</td>
</tr>
<tr>
<td></td>
<td>1.95 (2.28)</td>
<td>2.28 (2.48)</td>
<td>1.32 (1.8)</td>
<td>1.25 (1.8)</td>
<td>2.98 (3.91)</td>
</tr>
<tr>
<td>MCI</td>
<td>64 (15.2)</td>
<td>4.31 (4.63)</td>
<td>12 (12.00)</td>
<td>4.08 (3.2)</td>
<td>21 (19.81)</td>
</tr>
<tr>
<td></td>
<td>2.51 (4.10)</td>
<td>1.66 (1.48)</td>
<td>2.98 (3.91)</td>
<td>5.24 (5.88)</td>
<td>3.81 (6.96)</td>
</tr>
<tr>
<td>Packaged, Frozen Hamburger Patties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>28 (6.65)</td>
<td>2.04 (1.45)</td>
<td>4 (4.00)</td>
<td>1.25 (0.50)</td>
<td>9 (8.49)</td>
</tr>
<tr>
<td></td>
<td>0.77 (0.85)</td>
<td>0.60 (0.33)</td>
<td>0.49 (0.36)</td>
<td>1.67 (1.32)</td>
<td>5 (4.76)</td>
</tr>
<tr>
<td>(continued)</td>
<td>(continued)</td>
<td>(continued)</td>
<td>(continued)</td>
<td>(continued)</td>
<td>(continued)</td>
</tr>
</tbody>
</table>

(continued)
Table 3-6.  Eye-Tracking Outcomes for Each Product by Safe Handling Instructions (SHI) Label Condition: Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C) (continued)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overall ((N = 421))</th>
<th>Current SHI Label ((N = 100))</th>
<th>Octagon-Short-Abstract ((N = 106))</th>
<th>Octagon-Medium-Hybrid ((N = 105))</th>
<th>Octagon-Long-Hybrid ((N = 110))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation (N) (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation (N) (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation (N) (%)</td>
</tr>
<tr>
<td>MCI</td>
<td>Number of fixations</td>
<td>80 (19.00)</td>
<td>20 (20.00)</td>
<td>18 (16.98)</td>
<td>24 (22.86)</td>
</tr>
<tr>
<td></td>
<td>Total time of Fixation</td>
<td>2.76 (3.14)</td>
<td>2.68 (2.68)</td>
<td>1.80 (1.9)</td>
<td>3.65 (4.43)</td>
</tr>
<tr>
<td>SHI Raw Ground Beef Patties</td>
<td>Number of fixations</td>
<td>8 (1.90)</td>
<td>3 (3.00)</td>
<td>3 (2.83)</td>
<td>6 (7.81)</td>
</tr>
<tr>
<td></td>
<td>Total time of fixation</td>
<td>1.65 (1.85)</td>
<td>2.37 (2.74)</td>
<td>1.58 (1.65)</td>
<td>0.56 (0.00)</td>
</tr>
<tr>
<td>MCI Raw Ground Beef Patties</td>
<td>Number of fixations</td>
<td>5 (1.19)</td>
<td>3 (3.00)</td>
<td>1 (0.94)</td>
<td>3 (0.00)</td>
</tr>
<tr>
<td></td>
<td>Total time of fixation</td>
<td>0.84 (0.9)</td>
<td>0.69 (0.72)</td>
<td>2.08 (0.00)</td>
<td>0.08 (0.00)</td>
</tr>
</tbody>
</table>

Notes: MCI = manufacturer’s cooking instructions; RTE = ready to eat; NRTE = not ready to eat; SD = standard deviation.

Any fixation indicates the number and percentage of participants who had at least one recorded fixation on the area of interest.

Number of fixations indicates the number of instances that participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.

Total time of fixation is the number of milliseconds participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.

Source: Eye-tracking Study
3.3.1 Meal Preparation Experiment

For the meal preparation experiment (Table 3-4), the SHI label and MCI were on the back panel for the fresh raw ground beef package and on separate side panels for the packaged frozen meatballs. Overall, 6% of participants had any fixation on the SHI for the raw ground beef, and 31% of participants had any fixation on the SHI for the packaged frozen meatballs. The average number of fixations was 5 for raw ground beef and 10 for packaged frozen meatballs, and the total time of fixation ranged from 3.2 to 6.5 ms. The higher rate of fixation for the packaged frozen meatballs may be attributed to participants’ lack of familiarity with the product. Because of the small number of participants by condition, conclusions cannot be drawn about differences by SHI condition.

For the MCI, 3% of participants had any fixation on the MCI for the raw ground beef package, and 36% of participants had any fixation on the MCI for the packaged frozen meatballs. The average number of fixations was 4 for raw ground beef and 23 for packaged frozen meatballs, and the total time of fixation ranged from 4.9 to 12.8 ms. The rates of any fixation on the SHI were higher for the three revised SHI labels relative to the current label, although we did not test to see if these differences were statistically significant.

Examining the heat maps for the meal preparation experiment (Appendix H), we see that participants had more visual attention on the fronts of the packages than on the backs/sides of the packages for both the raw ground beef package and the packaged frozen meatballs.

3.3.2 Eye-Tracking Task B

Eye-tracking Task B examined participants’ attention to how to prepare the product safely for fresh raw ground beef patties, packaged frozen hamburger patties, and packaged frozen stuffed chicken breasts (see Table 3-5). The MCI and SHI were on the back panel for the raw ground beef patties. For the frozen hamburger patties, the MCI was on the back panel and the SHI was on the side panel. For the stuffed chicken breasts, the SHI and MCI were on the back panel. For the two packaged frozen products (beef patties and stuffed chicken breasts), the rate of any fixation was higher for the MCI (44% to 46%) relative to the SHI (22% to 27%). The number of fixations on the SHI ranged from 3 to 7 depending on the product, and the total time of fixation ranged from 1.5 to 3.5 ms, depending on the product.

For the two packaged frozen products, the rates of any fixation on the SHI were higher for the three revised SHI labels relative to the current label, although we did not test to see if these differences were statistically significant. Likewise, the rates of any fixation on the MCI were higher for participants in the three revised SHI conditions, relative to the control group (current SHI label), although the MCI remained the same across conditions.
3.3.3 Eye-Tracking Task C

Eye-tracking Task C examined participants’ ability to correctly distinguish between RTE (two products) and NRTE (four products) meat and poultry products. Section 3.8 provides information on the rate that participants successfully classified products. Table 3-6 provides an understanding of where participants looked on the product to make this determination. Overall, looking across the four NRTE products, we see that participants with any fixation on the SHI ranged from 2% for the fresh raw ground beef patties to 14% for the packaged frozen chicken tenders. Participants with any fixation on the MCI was 20% for the two RTE products and ranged from 1% for the fresh raw ground beef patties to 15% for the packaged frozen chicken tenders.

3.4 Participants’ Safe Food Handling Behaviors during the Meal Preparation Experiment

As shown in Table 3-7, the label adherence score was 1.78 for the current SHI label and ranged from 1.81 to 1.86 for the three revised labels (possible score of 0.0 to 4.0); thus, the scores were relatively low for the current SHI label and the revised experimental labels. The behavior that contributed the most to the adherence score was avoiding cross-contamination. Across all SHI conditions, cross-contamination based on visual observation (i.e., preventing raw ground beef and frozen NRTE meatballs from coming into contact with RTE product) was a rare event, and most participants received full credit (1.0 points) for this behavior. In contrast, thermometer use and handwashing were the behaviors that contributed the least to the adherence score (0.18 points and 0.21 points, respectively), indicating that these behaviors were not carried out consistently by participants. The label adherence score is used in the analysis to answer research question 1.

Table 3-8 provides information on participants’ success within each of the behaviors that constitute the label adherence score. This information was not used to answer a research question but is provided as additional descriptive information on participants’ safe handling behaviors during the meal preparation experiment. The “number of required events” column provides the number of instances across all participants that a safe food handling behavior should have occurred based on the set of triggers used by the coders (see table footnotes for triggers). For handwashing and cleaning and sanitizing, there were multiple potential events per participant, and the number of events varied from participant to participant based on their behavior in the kitchen. For thermometer use and cross-contamination, each participant was scored by the coder twice, once for each meat product (ground beef and packaged frozen meatballs). The remaining columns indicate the proportion of successful completion of each sub-behavior overall and by label condition.
### Table 3-7. Participants’ Safe Food Handling Behaviors During Meal Preparation Experiment: SHI Label Adherence Scores

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite label adherence score$^a$</td>
<td>1.82 (0.50)</td>
<td>1.78 (0.49)</td>
<td>1.81 (0.48)</td>
<td>1.84 (0.54)</td>
<td>1.86 (0.51)</td>
</tr>
<tr>
<td>Handwashing score$^b$</td>
<td>0.21 (0.14)</td>
<td>0.19 (0.16)</td>
<td>0.20 (0.15)</td>
<td>0.20 (0.12)</td>
<td>0.24 (0.15)</td>
</tr>
<tr>
<td>Clean and sanitize score$^c$</td>
<td>0.44 (0.24)</td>
<td>0.43 (0.23)</td>
<td>0.45 (0.24)</td>
<td>0.42 (0.24)</td>
<td>0.45 (0.25)</td>
</tr>
<tr>
<td>Thermometer use score$^d$</td>
<td>0.18 (0.36)</td>
<td>0.16 (0.33)</td>
<td>0.17 (0.34)</td>
<td>0.22 (0.40)</td>
<td>0.17 (0.35)</td>
</tr>
<tr>
<td>Avoidance of cross-contamination score$^e$</td>
<td>0.999 (0.02)</td>
<td>1.00 (0.00)</td>
<td>0.996 (0.05)</td>
<td>1.00 (0.00)</td>
<td>1.00 (0.00)</td>
</tr>
</tbody>
</table>

Notes: SD = standard deviation.

$^a$ Composite label adherence score is the sum of the four safe food handling behaviors (possible score of 0.0 to 4.0).

$^b$ Handwashing is the sum of the four component behaviors: used water, used soap, rubbed hands for at least 20 seconds, and dried hands with single-use paper towel (possible range = 0.0 to 1.0). Participants received .25 points for each component behavior during each required handwashing event. The reported score is the average across all required handwashing events.

$^c$ Participants received .5 point for cleaning (only), sanitizing (only), or sanitizing before cleaning. Participants received 1 point for cleaning before sanitizing (possible range = 0.0 to 1.0). The reported score is the average across all required clean and sanitize events.

$^d$ For each product ($N = 2$), participants received .25 point for using a food thermometer and an additional .25 point if the product was cooked to an internal temperature of 160°F or greater (possible range = 0.0 to 1.0). Because of difficulties encountered when trying to capture the thermometer readout, participants received .5 point per product if the thermometer readout was unreadable.

$^e$ For each product ($N = 2$), participants received .5 points for avoiding cross-contamination (i.e., preventing raw ground beef and frozen NRTE meatballs from coming into contact with RTE product) (possible range = 0.0 to 1.0).

Source: Meal preparation experiment
Table 3-8. Participants’ Safe Food Handling Behaviors During Meal Preparation Experiment: % Success for Behavior Subcomponents Overall and by Label Condition

<table>
<thead>
<tr>
<th>Safe Food Handling Behavior</th>
<th>No. of Required Events</th>
<th>Overall ( (N = 473) )</th>
<th>Current SHI Label ( (N = 117) )</th>
<th>Octagon-Short-Abstract ( (N = 118) )</th>
<th>Octagon-Medium-Hybrid ( (N = 121) )</th>
<th>Octagon-Long-Hybrid ( (N = 117) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handwashing(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used water</td>
<td>3,264</td>
<td>30.25</td>
<td>27.61</td>
<td>29.46</td>
<td>29.50</td>
<td>34.47</td>
</tr>
<tr>
<td>Used soap</td>
<td>3,264</td>
<td>25.54</td>
<td>22.65</td>
<td>24.62</td>
<td>25.35</td>
<td>29.56</td>
</tr>
<tr>
<td>Rubbed hands for at least 20 seconds</td>
<td>6.38</td>
<td>6.28</td>
<td>5.44</td>
<td>6.89</td>
<td>6.89</td>
<td>6.89</td>
</tr>
<tr>
<td>Dried hands with single-use paper towel</td>
<td>21.27</td>
<td>20.53</td>
<td>19.88</td>
<td>19.72</td>
<td>25.04</td>
<td></td>
</tr>
<tr>
<td>Clean and sanitize(^b)</td>
<td>1,821</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaned (with soap and water)</td>
<td></td>
<td>59.89</td>
<td>58.03</td>
<td>59.76</td>
<td>59.92</td>
<td>61.86</td>
</tr>
<tr>
<td>Sanitized (with sanitizer)</td>
<td></td>
<td>29.25</td>
<td>32.77</td>
<td>32.40</td>
<td>23.66</td>
<td>28.33</td>
</tr>
<tr>
<td>Cleaned before sanitizing</td>
<td></td>
<td>25.87</td>
<td>23.81</td>
<td>30.08</td>
<td>21.74</td>
<td>27.98</td>
</tr>
<tr>
<td>Thermometer use(^c)</td>
<td>946</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used thermometer</td>
<td></td>
<td>36.36</td>
<td>31.62</td>
<td>34.75</td>
<td>44.63</td>
<td>34.19</td>
</tr>
<tr>
<td>Cooked to correct temperature</td>
<td></td>
<td>34.88</td>
<td>30.77</td>
<td>32.20</td>
<td>42.15</td>
<td>34.19</td>
</tr>
</tbody>
</table>

(continued)
Table 3-8. Participants’ Safe Food Handling Behaviors During Meal Preparation Experiment: % Success for Behavior Subcomponents Overall and by Label Condition (continued)

<table>
<thead>
<tr>
<th>Safe Food Handling Behavior</th>
<th>Overall ((N = 473))</th>
<th>Current SHI Label ((N = 117))</th>
<th>Octagon-Short-Abstract ((N = 118))</th>
<th>Octagon-Medium-Hybrid ((N = 121))</th>
<th>Octagon-Long-Hybrid ((N = 117))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Required Events</td>
<td>Success (%)</td>
<td>Success (%)</td>
<td>Success (%)</td>
<td>Success (%)</td>
</tr>
<tr>
<td>Avoidance of cross-contamination(^a)</td>
<td>946</td>
<td>99.89</td>
<td>100.00</td>
<td>99.89</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes: Success is the percentage of events in which the behavior was correctly carried out across all events.

\(^a\) Handwashing events were required at the beginning of the observation (before handling food or dishes) and each time the participant touched raw meat (ground beef for the scratch-made meatballs or the NRTE frozen meatballs) or its packaging.

\(^b\) Cleaning and sanitizing is a two-step, ordered process. Cleaning and sanitize events were required any time raw meat (ground beef for the scratch-made meatballs or the NRTE frozen meatballs) or its packaging came into contact with a surface or utensil/cooking item and used again.

\(^c\) For thermometer use, two events occurred per participant, one for ground beef and one for NRTE frozen meatballs. If the thermometer readout was unreadable, events were considered successful for “cook to correct temperature” if the participant used a thermometer and attempted to check the temperature.

\(^d\) For avoidance of cross-contamination, two events occurred per participant, one for ground beef and one for NRTE frozen meatballs.

Source: Meal preparation experiment
Section 3 — Results

Across all participants, there were about 3,300 required handwashing events. For 30% of events, water was used, suggesting that for about 70% of events handwashing did not occur. Similar to the findings from the Year 1, Year 2, and Year 3 observation studies for the FSIS Food Safety Consumer Research Project, adherence to the recommendation to rub hands for at least 20 seconds was low (6% of all required events).

Across all participants, there were about 1,800 required cleaning and sanitizing events. Across all participants, for nearly 60% of these events, participants cleaned with soap and water, for 29% of events participants sanitized using a sanitizer, and for 26% of events participants cleaned before sanitizing, as recommended.

The rate of thermometer use was 36% across all participants and 34% for using a thermometer and cooking to 160°F. As previously noted when discussing the label adherence score, cross-contamination based on visual observation for keeping raw product separate from ready-to-eat product was rare; the success rate for not cross-contaminating was 99.89% (cross-contamination occurred for only one event).

3.5 Adherence to Safe Handling Instructions (RQ1)

Table 3-9 presents the results of the unadjusted linear regression with the dependent variable as the label adherence score. The intercept value in the coefficient column indicates the mean for the reference condition (current SHI) and the condition specific values in the coefficient column indicate the difference between the reference condition and the indicated SHI label condition. The mean for the Octagon-Short-Abstract SHI label is 1.81 (1.78 + 0.03) and the mean for the Octagon-Long-Hybrid SHI label is 1.86 (1.78 + 0.08). Table 3-9 also shows the probability value associated with the t test for statistical significance. Probability values greater than 0.05 indicate differences that are not statistically significant. None of the revised SHI label formats led to greater adherence to safe food handling behavior based on the label adherence score. The adjusted linear regression results in slightly larger differences among SHI label conditions, but differences between conditions remain not statistically significant (see Appendix K, Table K-1).

Post-hoc examination of the four behaviors that constitute the label adherence score are presented in Table 3-10. We ran a set of unadjusted linear regression models with the total score for each safe food handling behavior as the dependent variable and the four-level SHI condition variables as the independent variable. Handwashing scores varied significantly across conditions. Participants exposed to the SHI label “Octagon-Long-Hybrid” exhibited significantly more proper handwashing than participants exposed to the Current SHI Label or the “Octagon-Short-Abstract” Label. There were no significant differences across SHI conditions for cleaning and sanitizing or thermometer use. There was insufficient variation to examine avoidance of cross-contamination.
Table 3-9. Unadjusted Linear Regression Model for Adherence to Instructions on SHI Label (RQ1)

| Variable                  | Coefficient | Standard Error | t value | Pr > |t| |
|---------------------------|-------------|----------------|---------|------|---|
| Intercept                 | 1.78        | 0.05           | 38.05   | <0.0001 |
| SHI Label Condition       |             |                |         |      |   |
| Octagon-Short-Abstract    | 0.03        | 0.07           | 0.47    | 0.64 |
| Octagon-Medium-Hybrid     | 0.06        | 0.07           | 0.89    | 0.38 |
| Octagon-Long-Hybrid       | 0.08        | 0.07           | 1.22    | 0.22 |
| Current SHI               | 0.00        | .              | .       | .    |

Notes: 473 of 483 (97.93%) participants included in unadjusted analysis.

The composite label adherence score (dependent variable) is the sum of the four safe food handling behaviors (possible score of 0.0 to 4.0)

Source: The label adherence score (dependent variable) was derived from data on observed behaviors collected during the meal preparation experiment.

Table 3-10. Participants’ Safe Food Handling Behaviors During Meal Preparation Experiment: SHI Label Adherence Scores for Each Behavior

<table>
<thead>
<tr>
<th>Safe Food Handling Behavior</th>
<th>Mean (Standard Error)</th>
<th></th>
<th>Octagon-Short-Abstract (N = 118)2</th>
<th>Octagon-Medium-Hybrid (N = 122)</th>
<th>Octagon-Long-Hybrid (N = 118)1,2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handwashing scorea</td>
<td>0.193 (0.013)</td>
<td>0.198 (0.019)</td>
<td>0.204 (0.019)</td>
<td>0.239 (0.019)</td>
<td></td>
</tr>
<tr>
<td>Clean and sanitize scoreb</td>
<td>0.430 (0.022)</td>
<td>0.448 (0.031)</td>
<td>0.416 (0.031)</td>
<td>0.448 (0.031)</td>
<td></td>
</tr>
<tr>
<td>Thermometer use scorec</td>
<td>0.156 (0.033)</td>
<td>0.167 (0.046)</td>
<td>0.217 (0.047)</td>
<td>0.171 (0.047)</td>
<td></td>
</tr>
<tr>
<td>Avoidance of cross-contamination scored</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Unadjusted means based on ANOVA model. Pairs of superscripted numbers indicate means that are significantly different at p < .05. For example, the superscript 1 indicates that the means for the current SHI label and Octagon-Long-Hybrid label are significantly different.

a Handwashing is the sum of the four component behaviors: used water, used soap, rubbed hands for at least 20 seconds, and dried hands with a single-use paper towel (possible range = 0.0 to 1.0). Participants received .25 points for each component behavior during each required handwashing event. The reported score is the average across all required handwashing events.

b Participants received .5 point for cleaning (only), sanitizing (only), or sanitizing before cleaning. Participants received 1 point for cleaning before sanitizing (possible range = 0.0 to 1.0). The reported score is the average across all required clean and sanitize events.

c For each product (N = 2), participants received .25 point for using a food thermometer and an additional .25 point if the product was cooked to an internal temperature of 160°F or greater (possible range 0.0 to 1.0). Because of difficulties encountered when trying to capture the thermometer readout, participants received .5 point per product if the thermometer readout was unreadable.

d Insufficient variation to assess mean differences across conditions.

Source: Meal preparation experiment
3.6 Visual Attention When Asked to Consider How to Safely Prepare the Product (RQ2)

Table 3-11 presents coefficients, standard errors, odds ratios, and statistical probability values from the unadjusted logistic regression model examining any fixation (vs. no fixation) on the SHI. The odds ratios indicate the likelihood of any fixation on an experimental SHI label compared with the reference (i.e., current SHI label). When the 95% confidence intervals include 1.00, they indicate that the odds ratio is not significantly different from chance. Odds ratios ranged from 1.31 (Octagon-Medium-Hybrid) to 1.55 (Octagon-Long-Hybrid). Based on these results, participants were not more likely to fixate on any of the revised SHI labels than on the current SHI label. The addition of covariates to the model did not change these findings (see Appendix K, Table K-2).

Table 3-11. Unadjusted Logistic Regression Model Assessing the Likelihood of Any Fixation on the SHI Label (RQ2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>Odds Ratio</th>
<th>95% CI for Odds Ratio</th>
<th>t value</th>
<th>Pr &gt;</th>
<th>t</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI Label Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagon-Short-Abstract</td>
<td>0.41</td>
<td>0.32</td>
<td>1.51</td>
<td>(0.81–2.81)</td>
<td>1.92</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagon-Medium-Hybrid</td>
<td>0.27</td>
<td>0.32</td>
<td>1.31</td>
<td>(0.70–2.47)</td>
<td>0.71</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagon-Long-Hybrid</td>
<td>0.44</td>
<td>0.31</td>
<td>1.55</td>
<td>(0.84–2.81)</td>
<td>1.68</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current SHI (reference)</td>
<td>0.00</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 430 of 483 (89.03%) participants included in the analysis because of missing data for the dependent or independent variables. Statistical significance at p < .05. CI = confidence interval.

Any fixation (dependent variable) indicates at least one instance when participants looked at the SHI label with a gaze velocity below 100 degrees/second.

Odds ratios indicate the likelihood of participants in one study condition fixating on the SHI label compared with participants in the reference condition (in this case, the current SHI label).

Source: Any fixation (dependent variable) based on the first package handed to the participant in Task B of the eye-tracking study.

Next, as shown in Table 3-12, we examined whether time to first fixation varied by SHI label among participants with at least one fixation period (N = 115). Average time to first fixation for the current SHI label was 52.1 ms and did not vary significantly for any of the revised SHI label formats. The addition of covariates to the model did not change these findings (see Appendix K, Table K-3).
Table 3-12. Unadjusted Linear Regression Model Assessing Time to First Fixation on the SHI Label (RQ2)

| Variable                      | Coefficient | Std. Error | t value | Pr > |t| |
|-------------------------------|-------------|------------|---------|-------|---|
| Intercept                     | 52.1        | 8.91       | 5.85    | <0.0001 | |
| SHI Label Condition           |             |            |         |       |   |
| Octagon-Short-Abstract         | −10.96      | 11.76      | −0.93   | 0.35  | |
| Octagon-Medium-Hybrid         | −11.93      | 12.03      | −0.99   | 0.32  | |
| Octagon-Long-Hybrid           | −3.18       | 11.61      | −0.27   | 0.78  | |
| Current SHI (reference)       | 0.00        | .          | .       | .     | . |

Notes: 115 of 483 (23.8%) participants included in the analysis (only those participants with any fixation on the SHI label). Statistical significance at \( p < .05 \).

Time to first fixation (dependent variable) indicates the number of seconds between the point at which participants were handed the product and the point at which they looked at the SHI label with a gaze velocity below 100 degrees/second for the first time.

Source: Time to first fixation (dependent variable) was based on the first package handed to the participant in Task B of the eye-tracking study.

3.7 First Look (SHI Label vs. MCI) When Asked to Consider How to Safely Prepare the Product (RQ3)

We tested the null hypothesis that participants asked to consider how to prepare a food safely would be equally likely to look first at the SHI label or at the MCI (i.e., no preference) for two food packages included in Task B of the eye-tracking study: packaged frozen hamburger patties and packaged frozen stuffed chicken breasts (Table 3-13). We selected these packages because the SHI is located in different locations for the two products (side panel for hamburger patties and back panel for stuffed chicken breasts). For the packaged frozen hamburger patties, 194 participants out of 421 (46%) recorded a fixation on either the MCI or the SHI, with 142 fixating on the MCI first and 52 fixating on the SHI first. This difference is statistically significant \( \chi^2(1, N = 194) = 41.75, p < 0.001 \). For the packaged frozen stuffed chicken breasts, 190 participants out of 421 (45%) recorded a fixation on either the MCI or the SHI, with 165 fixating on the MCI first and 25 fixating on the SHI first. This difference is statistically significant \( \chi^2(1, N = 190) = 103.58, p < 0.001 \). Accordingly, the null hypothesis is rejected in favor of the alternative hypothesis that participants are not equally likely to first look at either the SHI or MCI; they were, in fact, more likely to look at the MCI first for both products.
Table 3-13. Visual Search Priority When Prompted to Consider Safe Food Preparation: Do Participants Look at the SHI Label or the MCI First? (RQ3)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Percentage</th>
<th>Chi-square</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Packaged, Frozen Hamburger Patties—NRTE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI label (Side)</td>
<td>52</td>
<td>26.80%</td>
<td>41.75</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>MCI (Back)</td>
<td>142</td>
<td>73.20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaged, Frozen Stuffed Chicken Breasts—NRTE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI label (Back)</td>
<td>25</td>
<td>13.16%</td>
<td>103.58</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>MCI (Back)</td>
<td>165</td>
<td>86.84%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Eye-tracking data are available for 421 participants. This analysis only included participants with recorded fixation on the MCI or the SHI. MCI = manufacturer’s cooking instructions; NRTE = not ready to eat.

Chi-square goodness of fit test: results at $p < .05$ indicate that the number of participants who fixated on a given area of interest is greater than would be expected by chance.

Source: Task B of Eye-Tracking Study

Next, we tested the null hypotheses that the location of the SHI did not influence whether participants looked first at the MCI or the SHI (Table 3-14). For the two food packages used to address this research question, the SHI is located on the side panel for the packaged frozen hamburger patties and on the back panel for the packaged frozen stuffed chicken breasts. For both packages, the MCI is on the back panel. The results of McNemar’s test indicate that among participants who first looked at the SHI on one package and first looked at the MCI on the other package (i.e., this test ignores participants who looked at the same AOI first on both packages), participants were more likely to look at the SHI first when it was located on the side panel (23%) than when it was located on the back panel (9%), and this difference is statistically significant ($\chi^2(1, N = 185) = 12.36, p < .001$).
Table 3-14. Visual Search Priority When Prompted to Consider Safe Food Preparation: Does Location of the SHI (Side Panel vs. Back Panel) Influence Visual Search Priority? (RQ3)

<table>
<thead>
<tr>
<th>Packaged, Frozen Stuffed Chicken Breasts—NRTE (SHI on back of package)</th>
<th>MCI N (%)</th>
<th>SHI N (%)</th>
<th>Chi-square</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaged, Frozen Hamburger Patties—NRTE (SHI on side of package)</td>
<td>MCI N (%)</td>
<td>118 (63.78%)</td>
<td>16 (8.65%)</td>
<td>12.36</td>
</tr>
<tr>
<td></td>
<td>SHI N (%)</td>
<td>43 (23.24%)</td>
<td>8 (4.32%)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Eye-tracking data are available for 421 participants. This analysis only included participants with recorded fixation on the MCI or the SHI. MCI = manufacturer’s cooking instructions; NRTE = not ready to eat.

McNemar’s Test: results at $p < .05$ indicate that the location of the SHI (back panel vs. side panel) influenced first fixation among participants who first looked at the SHI on one package and first looked at the MCI on the other package (i.e., this test ignores participants who looked at the same AOI first on both packages).

Source: Task B of Eye-Tracking Study

3.8 Discrimination between RTE and NRTE Meat and Poultry Products (RQ4)

Eye-tracking Task C examined participants’ ability to correctly distinguish between RTE (two products) and NRTE (four products) meat and poultry products. Table 3-15 provides the percentage of participants who correctly classified each product, the percentage who did not correctly classify each product, and the percentage who did not know. The results suggest that participants are better at correctly identifying NRTE products compared with RTE products. Correct classification for NRTE products ranged from 88 to 99%, while correct classification for RTE products ranged from 70 to 71%. Few participants provided a response of “don’t know.”

Table 3-15. Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C): Participants’ Responses (RQ4)

<table>
<thead>
<tr>
<th>Product</th>
<th>Classified Correctly</th>
<th>Classified Incorrectly</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>RTE Products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, frozen stuffed chicken breasts</td>
<td>284</td>
<td>71.18%</td>
<td>114</td>
</tr>
<tr>
<td>Packaged, frozen chicken tenders</td>
<td>278</td>
<td>69.85%</td>
<td>115</td>
</tr>
</tbody>
</table>

(continued)
Table 3-15. Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C): Participants’ Responses (RQ4) (continued)

<table>
<thead>
<tr>
<th>Product</th>
<th>Classified Correctly</th>
<th>Classified Incorrectly</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>NRTE Products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, frozen stuffed chicken breasts</td>
<td>375</td>
<td>93.98%</td>
<td>23</td>
</tr>
<tr>
<td>Packaged, frozen chicken tenders</td>
<td>350</td>
<td>87.72%</td>
<td>48</td>
</tr>
<tr>
<td>Packaged, frozen hamburger patties</td>
<td>362</td>
<td>90.95%</td>
<td>34</td>
</tr>
<tr>
<td>Raw ground beef patties</td>
<td>394</td>
<td>98.75%</td>
<td>5</td>
</tr>
</tbody>
</table>

Notes: Number of participants included in analysis (N = 399, one participant did not provide responses for two of the six products). RTE = ready to eat; NRTE = not ready to eat

Source: Task C of the Eye-Tracking Study

Table 3-16 provides information on eye-tracking outcomes by whether participants did or did not correctly classify the product. For the two RTE products, the percentage of participants with any fixation was similar among participants who classified the product correctly compared with those who did not (did not test for statistical significance). The heat maps in Appendix J provide additional descriptive information on where participants looked on the product to determine whether the product was RTE or NRTE.
Table 3-16. Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C): Eye-Tracking Outcomes by Whether Participants Classified Product Correctly (RQ4)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Classified Correctly</th>
<th></th>
<th></th>
<th>Classified Incorrectly</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td>Any Fixation N (%)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RTE Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaged, Frozen Stuffed Chicken Breasts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCI</td>
<td>284</td>
<td>59 (20.77)</td>
<td>6.44 (5.59)</td>
<td>114</td>
<td>21 (18.42)</td>
<td>4.86 (3.73)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>2.90 (2.85)</td>
<td></td>
<td>1.90 (1.85)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaged, Frozen Chicken Tenders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCI</td>
<td>278</td>
<td>56 (20.14)</td>
<td>8.20 (8.7)</td>
<td>115</td>
<td>23 (20.00)</td>
<td>8.91 (7.25)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>3.09 (3.03)</td>
<td></td>
<td>3.66 (3.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NRTE Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaged, Frozen Stuffed Chicken Breasts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td>375</td>
<td>15 (4.00)</td>
<td>2.20 (1.9)</td>
<td>1</td>
<td>1.00 (0.00)</td>
<td></td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>0.80 (0.96)</td>
<td></td>
<td>0.12 (0.00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCI</td>
<td>37</td>
<td>37 (9.87)</td>
<td>3.57 (3.40)</td>
<td>3</td>
<td>4.67 (4.62)</td>
<td></td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>1.59 (1.91)</td>
<td></td>
<td>1.41 (1.63)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued)
### Table 3-16. Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C): Eye-Tracking Outcomes by Whether Participants Classified Product Correctly (RQ4) (continued)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Classified Correctly</th>
<th></th>
<th>Classified Incorrectly</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>N</strong></td>
<td><strong>Any Fixation</strong></td>
<td><strong>Mean (SD)</strong></td>
<td><strong>N</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>N (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, Frozen Chicken Tenders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>350</td>
<td>51</td>
<td>(14.57)</td>
<td>3.76</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td></td>
<td>2.05</td>
<td>(2.33)</td>
<td></td>
</tr>
<tr>
<td>MCI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>58</td>
<td>4.40</td>
<td>(4.79)</td>
<td>48</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>2.58</td>
<td>(4.24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaged, Frozen Hamburger Patties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>362</td>
<td>27</td>
<td>(7.46)</td>
<td>2.07</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>362</td>
<td>0.78</td>
<td>(0.86)</td>
<td>34</td>
</tr>
<tr>
<td>MCI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>67</td>
<td>5.66</td>
<td>(5.20)</td>
<td>34</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>67</td>
<td>2.93</td>
<td>(3.33)</td>
<td>34</td>
</tr>
</tbody>
</table>

(continued)
### Table 3-16. Determination of Whether Cooking for Safety Is Required (NRTE) vs. Not Required (RTE) (Task C): Eye-Tracking Outcomes by Whether Participants Classified Product Correctly (RQ4) (continued)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Classified Correctly</th>
<th>Classified Incorrectly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Fixation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>Raw Ground Beef Patties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>7</td>
<td>3.57 (5.09)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>394</td>
<td>1.10 (1.09)</td>
</tr>
<tr>
<td></td>
<td>(1.78)</td>
<td>(20.00)</td>
</tr>
<tr>
<td>MCI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fixations</td>
<td>4</td>
<td>1.50 (1.00)</td>
</tr>
<tr>
<td>Total time of fixation</td>
<td>394</td>
<td>0.68 (0.94)</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(20.00)</td>
</tr>
</tbody>
</table>

Notes: Number of participants included in analysis ($N = 399$); one participant did not provide responses for two of the six products. Because of the small number of participants (1 to 5 depending on the product), results are not shown for participants who responded “don’t know.” MCI = manufacturer’s cooking instructions; RTE = ready to eat; NRTE = not ready to eat; SD = standard deviation.

Number of fixations indicates the number of instances that participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.

Total time of fixation is the number of milliseconds participants looked at the area of interest (SHI or MCI) with a gaze velocity below 100 degrees/second.

Source: Task C of Eye-Tracking Study
4. Conclusion

This study examined the potential of three revised SHI labels to influence consumer safe food handling behavior compared with the current SHI label during meal preparation in an experimental kitchen setting. The study employed a label adherence score that included handwashing, cleaning and sanitizing, thermometer use, and avoidance of cross-contamination. The label adherence scores were relatively low for the current SHI label and the three revised SHI labels because of inadequate proper handwashing, cleaning and sanitizing, and thermometer use.

Findings indicate that participants exposed to the three revised SHI labels did not have significantly higher label adherence scores compared with participants exposed to the current SHI label. Follow-up analysis examining safe food handling behaviors individually indicate the experimental variant Octagon-Long-Hybrid was better than the current SHI label at encouraging proper handwashing behavior. Accordingly, this variant offers some, albeit limited, promise at improving safe food handling practices.

The study also examined whether one of the three revised SHI labels was more visually salient than the current SHI label. We addressed visual salience by having participants wear a mobile eye-tracking device that collected information on their fixation on designated areas of the food package such as the SHI label or the MCI during the meal preparation experiment and by interacting with mock meat and poultry products outside the meal preparation setting. Our findings indicated no significant differences in visual salience between any of the revised SHI labels compared with the current label. According to the eye-tracking data, attention to the SHI label was generally low, ranging from 1% to 38% of participants having any fixation on the label, depending on the product viewed. For many of the products in the study, the rate of any fixation was higher for the MCI relative to the SHI label, possibly because of the MCI’s larger size on the package and use of more text.

Additionally, we examined the respective attention participants gave to the SHI label and the MCI. For these analyses, we collapsed across SHI label conditions and used time to first fixation to determine whether participants looked at the SHI label before the MCI or vice versa when asked how to prepare the product safely. The first model indicated that participants were significantly more likely to look at the MCI before the SHI label; this finding was true for both NRTE packages we examined. Next, we considered whether the location of the SHI label influenced whether participants looked at the SHI first or the MCI first. The findings indicated that among participants who varied their initial look from
product to product (i.e., looked at the SHI first on one product and MCI first on the other product), significantly more looked at the SHI label first when it was on the side panel of the product. This may have to do with the process of rotation. In other words, turning the box from front to back led participants to examine the side panel as they turned the box over. Alternatively, it may be that when the SHI and the MCI are on the back panel, participants’ eyes are drawn to the MCI. This may be because the MCI has more text and participants are seeking information, or because the MCI occupies more of the package area and participants’ gaze is more likely to land in this area.

Finally, we examined participants’ ability to correctly distinguish between RTE products and NRTE products. Several of the NRTE products examined appeared to be fully cooked (e.g., the picture of the chicken nuggets showed a breaded, cooked product). The results suggest that participants are better at correctly identifying NRTE products compared with RTE products; that is, some participants incorrectly classified RTE products as NRTE products. From a food safety standpoint, participants handling and preparing RTE products as NRTE is not a concern.
References


Modernizing Safe Handling and Ready-to-Eat/Not-Ready-to-Eat Labeling Instructions: Behavior Change Study


