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3 **Do Consumers have an Appetite for Discolored Beef?**
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19 *Selected Paper prepared for presentation at the Southern Agricultural Economics Association*
20 *(SAEA) Annual Meeting, Birmingham, Alabama, February 2-5, 2019*
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Abstract

Consumers prefer beef to be bright, cherry-red in color. As beef becomes discolored consumers may perceive it unwholesome, reducing their willingness-to-pay (WTP). This study uses a choice experiment in an online survey to measure how discoloring affects consumer WTP for beef, using a cheap talk script combined with a trap question to mitigate hypothetical bias. Results indicate even slightly discolored beef may require at least a 50 percent discount before the average consumer will purchase it. However, if the quantity of discolored meat to be sold is low, retailers can sell discolored meat at lower discounts to less discriminating consumers.

Key Words: Attention bias; Beef color; Beef discoloration; Trap question; Willingness-to-pay

1. Introduction

Consumer purchasing decisions for beef are influenced by attributes of the meat itself. Among these attributes, the color can greatly influence consumer decisions. Quality inferences are based in part on the color of the meat. Research has shown the preferred color of beef to be bright, cherry-red (Carpenter, Cornforth, and Whittier, 2000; Killinger et al., 2004). Deviations from the preferred color create some level of unacceptability among consumers. As the surface of the meat becomes discolored, turning brownish-red to brown, consumers may perceive this as a condition of unwholesomeness (Faustman and Cassens 1989). This is expected to result in a decreased willingness-to-pay (WTP) for discolored beef (Grebitus, Jensen, & Roosen, 2013b) and, therefore, discolored beef cuts must be marked down in price, faced and repackaged, ground, cooked and sold as prepared foods, or discarded (Smith, Morgan and Tatum 1993). This creates waste and represents a significant cost to the beef industry (Smith, et al. 2000). Hermel (1993) and Williams, et al. (1992) both estimated that approximately \$1 billion is lost to the beef industry annually due to discoloration. To help mitigate this cost, research has focused on ways to prolong the bright cherry-red color through various packaging and display techniques (Greene, Hsin and Zipser 1971).

There is an abundance of consumer preference research in retail beef. Many attributes have been considered such as tenderness, taste, fat content, and region of production (Lusk *et al*, 2001; Feuz *et al*, 2004; Loureiro and Umberger, 2003). Studies measuring WTP that have focused on color, generally have considered only the color of non-discolored beef items (color vibrancy), finding that color does impact purchasing decisions, with bright, cherry-red beef being preferred (Carpenter, Cornforth, and Whittier, 2000; Killinger, *et al*, 2004). Grebitus, Jensen, & Roosen (2013a) evaluated consumer acceptance of modified atmosphere packaging (MAP) as

well as consumer WTP for color attributes. The color attributes they evaluated varied from bright cherry-red, light red, and brownish red. Similar to other past research, they found the preferred color to be bright, cherry-red and estimated the average WTP for cherry-red ground beef was \$2.00/lb. more than for brownish red ground beef. Within their choice experiment the brownish-red color attribute was constant and did not have varying levels. Additionally, these researchers did not provide any description of the level of discoloration beyond stating that the color was a consistent brownish-red. The extent to which consumers will purchase varying levels of discolored beef at discount prices has not been fully evaluated.

The objective of this study is to determine the WTP for varying levels of discoloration within both beef steak and ground beef relative to non-discolored beef. Using an internet survey, subjects are shown pictures of different beef items that are identical save for their level of discoloration. The pictures are embedded in a series of choice experiment choice sets, similar to those in Gracia and de-Magistris (2013) where each beef product is given a price and subjects are asked which item they would most likely purchase in a grocery store. By evaluating their choices under different price scenarios it is possible to identify the discount one would have to apply to a discolored beef item before the average consumer would purchase it instead of a similar non-discolored item.

This paper is organized as follows. The next section describes the beef items, participants, and survey instrument used to measure WTP for discolored beef. Also included in the second section is a discussion of the statistical model used and the survey techniques employed to correct for hypothetical bias and inattentiveness. The third section presents the results, and the fourth section provides a discussion of what the results imply about consumers'

true WTP for discolored beef and the discounts retailers would need to assign them for sale. The fifth section concludes.

2. Material and Methods:

2.1 Beef items used in the choice experiment

Two beef items, steak and ground beef, were evaluated. The items were purchased fresh and then intentionally discolored so that pictures could be taken of the same beef item at different levels of discoloration, allowing us to evaluate consumer preferences for beef holding all attributes constant except the level of discoloration and price.

The steak came from market-age cattle purchased from a local purveyor. The approximate postmortem age was 14 days. A 2.5-cm-thick steak was cut from the ribeye steak section using a meat slicer (Bizerba USA Inc, Piscataway, NJ) and placed onto foam trays with absorbent pads, over-wrapped with a PVC film (oxygen-permeable polyvinyl chloride fresh meat film; 15,500–16,275 cm³ O₂/m²/24 h at 23 °C, E-Z Wrap Crystal Clear Polyvinyl Chloride Wrapping Film, Koch Supplies, Kansas City, MO). After packaging, the steak was placed in a coffin-style open display case maintained at 2°C ± 1 under continuous lighting for eight days (1612 to 1800 lx, Philips Delux Warm White Fluorescent lamps; Andover, MA; color rendering index = 86; color temperature = 3000 K). During these eight days the steak became increasingly discolored, and was documented using a digital Cannon SLR camera. The 10 percent fat ground beef item was managed in an identical fashion except it required only five days of exposure. The discoloration gradually increased, as it naturally would in a retail environment. Photo editing software was then used to vary the intensity (level of darkness) of the discoloration.

2.2 Survey Design and Participants

The survey was created within the online survey creation platform, Qualtrics (Qualtrics 2017) and administered by Survey Sampling International (Survey Sampling International, LLC 2017). It was administered September 6, 2017 through October 3, 2017. In total 2,598 respondents completed the survey with the target sample set to be representative of the U.S. consumer population. Summary statistics for the demographics of the survey sample can be seen in table 1.

By comparing data from the United State Census Bureau (2018) it can be seen that overall the sample 'gender' and 'income' demographics are similar to the U.S. population. In 2017 the U.S. was estimated as 50.8 percent female with a median income of \$55,322. Age and education attainment in the sample may be slightly misrepresented. In 2017, 87 percent of the U.S. population (age $\geq$ 25) had an education level of high school graduate or higher while 30.3 percent had a Bachelor's degree or higher. This would indicate that our sample has a slightly higher average education level than the estimated U.S. population. The median age of the US population is 37.7 which is consistent with our sample. However, our sample appears to have a slightly greater percentage of those in the 18-25 age group as well as the 50-65 group.

The survey consisted of five main sections, shown in figure 1. The first section confirmed that the respondents' computer monitor display (the survey was not allowed on smartphones or tablets) and the subjects' eyesight allowed them to distinguish between greater and lesser amounts of intensity (level of darkness) of discoloration. This was accomplished by presenting them with three steaks with different intensity levels and asking them to select the steak with the *darkest* discoloration, and then repeating the question for ground beef, only asking them to select the ground beef that has the *lightest* discoloration. In total 71.7 percent of respondents correctly

142 identified the steak with the darkest intensity of discoloration while only 50.8 percent correctly
143 identified the ground beef that had the lightest intensity. Overall, this demonstrates that
144 respondents were able to distinguish differences in the level of intensity of discoloration.

145 It was somewhat unexpected that a smaller percentage of respondents correctly answered
146 the question with regards to ground beef as compared to steak. The steak question was asked first
147 so while it is possible that it was more difficult for respondents to notice a difference in intensity
148 within ground beef, it could also be the case that some respondents didn't notice the change in
149 question format from 'darkest' to 'lightest' discoloration. It would then be plausible that some
150 level of inattentiveness could explain the lower percentage of respondents identifying the correct
151 ground beef. While we considered dropping respondents who failed to correctly identify the
152 darkest or lightest discolored beef item, we have chosen to retain them within the sample. Failing
153 to identify the difference in intensity once does not guarantee they could not have made the
154 correct selection in subsequent attempts. Additionally, as this survey was administered online
155 and viewed through individual participant computer monitor displays there is no way of knowing
156 whether the individuals answered incorrectly because of inattentiveness or poor eyesight, or if
157 their monitors failed to accurately portray the subtle differences in intensity of discoloration. As
158 some shoppers may have poor eyesight in the store as they might in the survey, to best represent
159 the population of beef consumers the individuals who did not distinguish between intensity
160 levels of discolored beef in the preliminary questions were retained in the sample. The decision
161 to retain these individuals was made before any statistical estimations were performed.

162 The second section of the survey contained the first set of choice experiment questions.
163 There was one set of questions for steaks and another section for ground beef. This section
164 randomly choose whether to display thirteen choice experiment questions for the steaks or the

ground beef. Each choice set question contained three beef products with varying discoloration, sold at prices which were (overall) orthogonal to the amount of discoloration. At each choice set question the subject was asked to indicate which of the three items they would mostly likely purchase in a store. This was a hypothetical choice, and studies have shown that in such cases subjects usually overestimate the actual amount they are willing to pay (Penn and Hu, 2018). Fortunately, there are tools available for reducing this hypothetical bias.

The third section then presented a version of cheap talk script popular among researchers for reducing hypothetical bias (Penn and Hu, 2018). Of course, a cheap talk script is only effective if the respondent reads it, and it is well known that respondents sometimes skim information or even answer questions without reading them well. Thus, a trap question was embedded within the cheap talk script to confirm whether the subject read the script. To test whether the cheap talk script/trap question has an effect it was only seen by half of the respondents.

The fourth section of the survey provided another thirteen choice set questions from the choice experiment using a different beef product than in the second section. For example, figure 1 shows a case where thirteen choice set questions for steaks were provided in the second section, in which case the fourth section contained an equal number of choice set questions for ground beef. The last section asked a number of questions about the subjects' beliefs about ground beef and steak and collected demographic data.

2.3 The Choice Experiment

The second and fourth section of the survey asked respondents to respond to a number of choice set questions in the choice experiment. The choice experiment method involves asking respondents to state their preferences over hypothetical alternative scenarios, goods or services.

Each alternative in the choice sets is then described by several attributes which can vary at multiple levels and the participants' responses are used to determine whether preferences are significantly influenced by the attributes. Each choice set in our survey required respondents to evaluate three beef products sold at different prices and indicate which one they would most likely purchase. Aside from price, the beef products varied by level of discoloration. Two types of discoloration were used: coverage (percent of surface area discolored) and intensity (the darkness of the discoloration). It is possible that one type of discoloration elicits a greater negative reaction, and that there are interaction effects between the two types. For this reason the beef products were allowed to differ in both their coverage and intensity of discoloration.

Figure 2 illustrates the twelve different levels of discoloration used in the choice experiment, using the steaks as an example (a similar figure could be made for ground beef). The coverage attribute could take the values: 25, 50, 75, or 100 percent. The intensity of the discoloration was either light, medium, or dark. Each beef product in a choice set could be thus described in terms of its coverage, intensity, and price. Twelve indicator variables were used to represent each possible combination of coverage and intensity of discoloration possible.

A price was also assigned to each beef product in a choice set. For steaks the price (per pound) could take one of the five values: \$5.25, \$7.25, \$8.25, \$9.25, or \$11.25. For ground beef the price (per pound) could take the values \$2.00, \$3.00, \$3.50, \$4.25, or \$6.25. An experimental design procedure was employed to construct choice sets such that the price assigned to each ground beef product was independent of its discoloration coverage or intensity, and to ensure efficient parameter estimates of the discoloration variables.

With both the steak and ground beef portions of the survey having one attribute varying at five levels (price), one attribute varying at four levels (discoloration coverage), and one

attribute varying at three levels (discoloration intensity) the total number of unique steak/ground beef descriptions was 60 ($5^1 \times 4^1 \times 3^1$). A full factorial design would have required a lengthy choice set and would not have been feasible for this survey. To shorten the choice set required and still ensure an efficient design, the choice sets in both the steak and ground beef portions of the survey were created using a fractional factorial design. This was accomplished through use of the proc optex procedure within SAS software. This procedure allows for much smaller choice sets to be used while still ensuring an efficient design is generated by maximizing the D-efficiency score. The resulting design required 13 questions for the steak and 13 questions for the ground beef portion of the survey. To help safeguard against the possibility of earlier questions affecting consumers' choices to later questions in a systematic way, the order of choice sets was randomized, as was the question order within choice sets.

2.4 Hypothetical Bias Correction

This choice experiment relied on stated preference methodology. Concerns are often raised with the use of stated preference methods to assess consumer WTP for nonmarket goods. Perhaps the largest concern comes from recognizing a lack of consistency that can exist between hypothetical behavior and behavior with real economic consequences (Penn and Hu 2018). There are several methods both *ex ante* and *ex post* for correcting for this potential hypothetical bias. Examples of *ex post* methods of hypothetical bias correction often include calibration techniques (Blackburn et al., 1994; Fox et al., 1998), as well as uncertainty coding (Champ et al., 1997).

One *ex ante* method known as 'cheap talk script' attempts to address hypothetical bias by directly informing respondents of the nature of the problem and urging them to actively consider the hypothetical nature of the questions and to respond with what they would choose in a real market situation characterized by actual payment of money. The cheap talk script method was

initially implemented by Cummings and Taylor (1999) and has become increasingly popular. Loomis (2014) provides a thorough summary of various *ex ante* and *ex post* methods of hypothetical bias correction. In reviewing eight studies that used cheap talk script Loomis (2014) finds three of the eight effectively eliminate the bias, three reduce the bias, one has no effect, and one study appears to over-correct for the hypothetical bias.

As Loomis (2014) notes, there is still no singular solution agreed upon to correct for hypothetical bias. What is agreed upon is that it can be significant and some attempt should be made to control for it. As cheap talk scripts help reduce hypothetical bias in most studies, and because they are easy to include in a survey, this study employed a cheap talk script. However, as shown in figure 1 it did so for only one-fourth of the steak and one-fourth of the ground beef choice set questions, allowing us to test whether it reduces WTP in the survey.

2.5 Attention Checks

As with nearly all studies involving survey methodologies, measurement error arising from the lack of respondent attentiveness is also a concern. Respondent attentiveness has long been a concern in survey research. Even 50 years ago Cannel and Kahn (1968) maintained that when the optimal length for a survey is surpassed respondents become less motivated to respond, put forth less cognitive effort, and may skip questions altogether, leading to a decrease in the quality of the data gathered. Krosnick (1991) describes the tendency for survey respondents to lose interest and become distracted or impatient as they progress through a survey, putting less and less effort into answering questions. Krosnick refers to this tendency as ‘satisficing’. Following Krosnick, many researchers began developing ways to recognize respondents who had potentially engaged in satisficing and, therefore, were inattentive in their responses.

In general, as respondents become less engaged, the tendency is to begin satisficing rather than attentively answering questions. This can result in more acquiescent responding, more frequent selection of non-substantive responses such as ‘don’t know’, non-differentiation in rating scales, choosing the first listed response (i.e. primacy), endorsing the status quo instead of endorsing social change, failing to differentiate among a set of diverse objects in ratings, and random responding. Such behaviors degrade the quality of data and diminish the ability of researchers to base strong conclusions on resulting studies. The online platform for survey administration is far from immune from these problems (Heerwegh and Loosveldt, 2008; Malhotra, 2008).

There are several methods utilized within the literature to try to identify inattentive respondents. Examples of such methods include trap questions, reverse worded questions, identifying respondents who give straight-lined responses to gridded matrix questions, excessive selection of “I don’t know,” nonsensical responses to open-ended questions, and short response times. This study focuses on the use of a trap question as a method of inattentive respondent control.

Oppenheimer, Meyvis, and Davidenko (2009) explore the use of a trap style question specifically known as an instructional manipulation check (IMC) as a way to identify inattentive respondents, remove the noise they cause in the data, and increase reliability of the dataset while simultaneously increasing the statistical power of results. A typical IMC consists of a question embedded within the survey that may appear to be similar to other questions in length and response format, however, unlike the other questions, the IMC asks participants to ignore the standard response format and instead provide a confirmation they have read the instruction. If respondents have carefully read the question and followed the instructions correctly then this

indicates they have been attentive in the survey process. In contrast, if respondents do not follow instructions correctly for the IMC this indicates they did not read the question carefully and provides an indirect measure of satisficing. Oppenheimer, Meyvis, and Davidenko (2009) are able to demonstrate through the use of an IMC that they successfully identify satisficing participants and by eliminating those respondents' responses from the dataset are able to increase the statistical power and reliability of a dataset.

Once inattentive respondents have been identified, often the common practice is to eliminate their responses from the sample. However, Berinsky, Margolis, and Sances (2014) caution against this practice. They assert if attentive and inattentive respondents are different types of people, removing all inattentive respondents may bias the sample. If attention on a survey is a function of the characteristics of respondents, then dropping respondents who fail the trap question can skew the demographics of the sample. Using OLS, Berinsky, Margolis, and Sances (2014) regress many characteristics of the respondents on the binary dependent variable of whether they passed the trap, and show those who pass do share common characteristics and are thus not randomly distributed throughout the survey sample demographics. They conclude their paper by offering three suggestions in the use of screener (trap) questions. First, the use of a single screener question is often insufficient. Passing the screener at one point in time does not imply passage at another point in time by the same respondent. Second, because screener passage is in part a function of measurable demographic characteristics, researchers should not simply discard respondents who fail screeners. Instead, results should be stratified by attention. Screeners have been shown to be successful in reducing noise in a sample. However, discarding all who fail can potential skew sample demographics. They recommend transparency when presenting results as a way to reconcile these two points. Third, researchers should analyze

predictors of screener passage in their sample. This allows for researchers to have a better understanding of the potential consequences to removing inattentive respondents from their sample.

For this study, to control for measurement error of inattentive respondents a trap question was added to our conventional cheap talk script. The cheap talk script/trap question seen by respondents is displayed in figure 3. Approximately half of the survey respondents were asked to answer the cheap talk script/trap question immediately after they finished the first portion of the choice experiment (either steak or ground beef questions). The other half of the respondents proceeded to the second portion of the choice experiment without being presented with the cheap talk script/trap question.

2.6 Statistical Model

Answers to the choice set questions can be modeled through Lancasterian consumer theory (Lancaster 1966) as well as random utility theory (McFadden 1973). Lancaster proposed consumers derive utility from individual product attributes and therefore, the total utility consumers derive from consumption of a product can be decomposed into separate utilities for their component characteristics. Random utility theory assumes consumers rationally choose the alternative from a given choice set that yields the highest level of utility. It follows from this theory that the probability of selecting a given alternative is higher if the utility provided by the alternative is the highest among the various other alternatives in the choice set. Given this theory, an individual i 's utility given the j^{th} alternative is selected can be defined as

$$(1) \quad U_{ij} = V_{ij} + \epsilon_{ij}$$

where U_{ij} is the utility obtained by individual i when selecting alternative j , V_{ij} is the systematic portion of the utility function and is determined by the attributes of the alternative j , and ϵ_{ij} is

the stochastic component of the utility function not determined by the attributes. This stochastic component implies the true utility can never be observed. However, assuming the consumer is a utility maximizer, given a choice set (C_i) we know the consumer selects the alternative type j , that yields the highest utility among the possible alternatives in the choice set. The probability that alternative j is chosen can then be defined as

$$(2) \quad Prob(j|C_i) = Prob(V_{ij} + \epsilon_{ij} \geq V_{ik} + \epsilon_{ik}; \text{ for all } k \in C_i).$$

As demonstrated by McFadden (1983), as long as the stochastic errors in equation (1) are independently and identically distributed across the j alternatives and N individuals with a type I extreme value distribution, the probability of individual i choosing alternative j is

$$(3) \quad prob(j) = \frac{e^{V_{ij}}}{\sum_{k \in C} e^{V_{ik}}}.$$

Assuming linearity in the parameters of V_{ij} allows the functional form of V_{ij} to be expressed as

$$(4) \quad V_{ij} = \mathbf{X}_{ij}'\boldsymbol{\beta}$$

where $\mathbf{X}_{ij}$ is a vector of attributes for alternative j and consumer i , and $\boldsymbol{\beta}$ is a vector of coefficients to be estimated. Equation (4) represents a standard conditional logit model.

Using the conditional logit model in equation 4 with price and the twelve discoloration indicator variables, the utility for steak and ground beef can be expressed as

$$(5) \quad V_{ij} = \beta_1 Price_{ij} + \alpha_1 light25_{ij} + \alpha_2 light50_{ij} + \alpha_3 light75_{ij} + \alpha_4 light100_{ij} + \alpha_5 medium25_{ij} + \alpha_6 medium50_{ij} + \alpha_7 medium75_{ij} + \alpha_8 medium100_{ij} + \alpha_9 dark25_{ij} + \alpha_{10} dark50_{ij} + \alpha_{11} dark75_{ij} + \alpha_{12} dark100_{ij} + \epsilon_{ij}$$

where V_{ij} is the utility of the i th individual having selected choice alternative j , $Price_{ij}$ is the price (\$/lb.) of the choice alternative j chosen by individual i , ε_{ij} is the random error term following a type I extreme value distribution, $light25_{ij}$ is a dummy variable equal to one if choice alternative j chosen by individual i had 25 percent coverage and light intensity of discoloration and equal to zero otherwise, and $light50_{ij}$ through $dark100_{ij}$ follow the same logic as the explanation for $light25_{ij}$.

Let (5) be written succinctly as

$$(6) \quad V_{ij} = \beta_1 Price_{ij} + \mathbf{X}_{ij}' \boldsymbol{\alpha} + \varepsilon_{ij}$$

where $\mathbf{X}_{ij}$ is a vector of indicator variables describing the product's coverage and intensity of discoloration and $\boldsymbol{\alpha}$ is a parameter vector.

As mentioned earlier this survey made use of cheap talk script combined with a trap question as a way to reduce hypothetical bias and measurement error resulting from inattentive respondents. Reductions in hypothetical bias can be modeled as an increase in the marginal utility of money, whereby a higher value means that each dollar received in income adds more to utility. As their marginal utility of money increases, people's willingness to pay for any attribute decreases as they value their money more and are less willing to trade money for goods. Previous literature suggests that those exposed to the cheap talk script exhibit a higher utility for money, and it seems reasonable to assume that the more attentive they are to the script, the greater the impact of that script on their utility of money. The negative of the coefficient for the price variable can be thought of as an individual's marginal utility for money. That is, for every dollar/lb. increase/decrease in the price of a steak or package of ground beef (taking away an individual's income) we estimate the respondent's utility will decrease/increase by the amount of this coefficient. Notice that, because there is no 'none' option in the choice sets we do not

estimate the overall value of a non-discolored steak but rather the discounts assigned to discolored steaks relative to a non-discolored steak. This has implications for how changes to the measured marginal utility of money are interpreted. Suppose the total willingness to pay for a whole non-discolored steak is WTP_{ND} , which can be decomposed into the utility of the steak (V_{ND}) divided by the marginal utility of money: $\left(WTP_{ND} = V_{ND} / -\beta_{price}\right)$. This study does not estimate V_{ND} but it does estimate β_{price} as well as the change in utility from that steak becoming discolored. Let $V_{25\%,Light}$ be the utility of a steak with 25 percent coverage and light intensity of discoloration. This study is able to estimate $\Delta V_{25\%,Light} = V_{ND} - V_{25\%,Light}$, which should be negative if consumers dislike discoloration. The WTP premium/discount consumers apply to the 25%-Light steak relative to the non-discolored steak is then $\left(\Delta V_{25\%,Light} / -\beta_{price}\right)$. This is a negative value expressed in dollars, making it a discount. The total value of the discolored steak is then

$$(7) \quad WTP_D = V_{ND} / -\beta_{price} + \Delta V_{25\%,Light} / -\beta_{price}.$$

There are two components to (7). One is the overall willingness to pay for non-discolored steaks, and the other is the discount assigned to the discolored steaks. When presented with a cheap talk script subjects presumably answer the questions more thoughtfully, attempting to give a more realistic depiction of their choices if, hypothetically, real money was used. It could be argued that consumers are more familiar with non-discolored beef than discolored beef. Some consumers may have never purchased discolored beef before, not even at a steep discount, largely because discolored steak is not displayed on store shelves as frequently as non-discolored steaks. Studies have shown hypothetical bias is larger for unfamiliar goods than it is for familiar goods (Schläpfer and Fischhoff 2012) which means that subjects may correct for hypothetical

bias differently for the non-discolored and the discolored steaks. For example, subjects may hypothetically say they would pay \$10 in total for a non-discolored steak and \$7 for a discolored steak. However, when asked to take their purchases seriously, and behave as if they are spending real money, they might

- reduce the total amount they are willing to pay for each steak by the same amount, maintaining the \$3 discount applied to the discolored steak,
- keep the total amount they are willing to pay for the non-discolored steak the same, as it is a familiar good, but reduce the amount they would pay for the discolored steak, thereby increasing the size of the discount applied to the discolored steak,
- reduce the total amount they are willing to pay for both steaks, but increase the size of the discount applied to the discolored steak, or
- reduce the total amount they are willing to pay for both steaks, but decrease the size of the discount applied to the discolored steak.

For example, being familiar with purchases of non-discolored steaks respondents may change their willingness to pay for those steaks only slightly, but when they take discolored steaks more seriously, being an unfamiliar item, they might make larger changes to the discounts assigned to those steaks.

Increasing the magnitude of β_{price} in (7), as would be expected when reducing hypothetical bias, would reduce the total WTP of both steaks, but it would also reduce the discount applied to the non-discolored steak, which may not be appropriate. In order to allow both the overall WTP of the steaks to fall and the discount applied to non-discolored steaks to be negative, zero, or positive, the term $\Delta V_{25\%,Light}$ must be allowed to change after the adjustment

for hypothetical bias, in addition to allowing β_{price} to change. This is achieved by expressing the utility function as

$$(8) \quad V_{ij} = \beta_1 Price_{ij} + \beta_2 No_CT_{ij} * Price_{ij} + \beta_3 TQF_{ij} * Price_{ij} + X_{ij}'\alpha + No_CT_{ij} * X_{ij}'\alpha + TQF_{ij} * X_{ij}'\alpha + \varepsilon_{ij}$$

where No_CT_{ij} is a dummy variable equal to one if individual i was not been presented with the cheap talk/trap question when selecting alternative j and equal to zero otherwise (individuals where $No_CT_{ij} = 1$ are referred to as ‘unexposed’ subjects), TQF_{ij} is a dummy variable equal to one if individual i was presented with, and failed, the cheap talk/trap question (individuals where $TQF_{ij} = 1$ are referred to as ‘exposed-inattentive’ subjects). Thus an individual was presented with the cheap talk/trap question and passed it if $No_CT_{ij} = TQF_{ij} = 0$; such individuals are referred to as ‘exposed-attentive’ subjects.

3. Results

3.1 Conditional Logit Estimation

For choice experiments to be reliably predictive, previous literature demonstrates the need for consumers to be knowledgeable about the product involved in the experiment (Beshears, et al. 2008). For this reason, those respondents who indicate they have never purchased beef steak or ground beef are excluded in the respective steak and ground beef models. These exclusions limit the total sample size for the steak model to 2,317 and for the ground beef model to 2,395.

Using equation (8) the results of the steak and ground beef models are summarized in table 2.

Consider the signs and significance of the discoloration variables (25%-Light to 100%-Dark). The case where all of these variables equal zero refers to a steak with no discoloration, so it is not surprising that all the coefficients are both negative and statistically significant ($p < 0.001$), indicating consumers dislike discoloration of any kind. For both beef types, an increase in the coverage of discoloration while holding the intensity of discoloration constant usually results in a smaller number (larger in absolute value), indicating a greater disutility due to coverage of discoloration. The same can be said for an increase in intensity while holding the coverage constant. This is expected. However, sometimes the coefficients are counter-intuitive. For example, in the steak case the coefficient for 25%-Medium is actually larger (less negative) than the coefficient for 25%-Light, whereas one would expect greater coverage of discoloration would result in greater disutility. However, the null hypothesis for the likelihood ratio test that these coefficients are equal has a p-value of 0.389 indicating they are not statistically different. The same can be said for the coefficients for 75%-Dark and 100%-Dark; their values appear counter-intuitive but in reality are not statistically different (p-value 0.722).

There are also cases where the relationship between coefficients is as expected but are not statistically different. For example, one would expect the coefficient for 100%-Medium to be smaller than the coefficient for 75%-Medium for steaks, but likelihood ratio tests confirm that the coefficients are not statistically different (p-value 0.525). When such likelihood-ratio tests are conducted for greater differences in discoloration (*e.g.*, 25%-Light and 100%-Dark) the null hypothesis that they are the same is usually rejected. This implies that overall discoloration does reduce the appeal of beef products, and the greater the discoloration, the greater the reduction,

but relatively small changes in coverage and intensity of discoloration sometimes are not detected.

Now consider how the cheap talk/trap questions influence response patterns across the three groups: (1) the unexposed (those who did not see the cheap talk script) (2) the exposed-attentive (those who saw it and passed the trap question) and (3) the exposed-inattentive (those who saw it and failed the trap question). Likelihood-ratio tests reject the null hypothesis that all of the coefficients for the interaction terms are zero, implying that the three groups demonstrate different response patterns. For both the steak and ground beef models the price coefficient is negative and significant at the one percent level. This indicates as the price of a beef item increases the utility from purchasing it decreases. To investigate the impact of the cheap talk/trap question, consider how the marginal utility of money (negative of the price coefficient) changes across the three groups. In the case of ground beef the marginal utility of money for the unexposed group is $0.2416 - 0.0272 = 0.2144$; for the exposed-attentive group, 0.2416; and for the exposed-inattentive, $0.2416 - 0.0358 = 0.2058$, which is a similar value to the unexposed group. The utility of money for the exposed-attentive group is about 15 percent larger than the other two groups, which would suggest they have a lower WTP for non-discolored steak. This is the expected result if the cheap talk script is effective. However, these three numbers are not statistically different, as indicated by the insignificant coefficients for $No_CT_{ij} * Price_{ij}$ and $TQF_{ij} * Price_{ij}$. For the steak case the exposed-attentive group has a lower utility of money than the unexposed group, contrary to theory yet occasionally documented in other studies (Morrison and Brown 2009), but again the differences are not statistically significant. Thus, overall, the cheap talk/trap question does not statistically alter the marginal utility of money for the participants.

However, as mentioned previously, this only implies that the value of the non-discolored steak is the same across the three groups. The discounts assigned to discolored steaks might vary between the groups though, and since the discounts are a function of multiple parameters, changes in discounts across the groups are studied in the context of willingness-to-pay (WTP).

3.2 Willingness to Pay (WTP)

In a conditional logit model, coefficients cannot be directly interpreted as the direct effects of the explanatory variables on the probability of choosing each alternative (steak or ground beef). Rather, they represent the direct effects associated with each of the explanatory variables on the utility function, which can be used to calculate the WTP for each of the attributes. Estimates of WTP are calculated using the ratio of the coefficient of the attribute of interest over the marginal utility of money (negative of the price coefficient) as in $\left(-\frac{\beta_{\text{attribute}}}{\beta_{\text{price}}}\right)$. For example, the ratio $\left(-\frac{\beta_{\text{Light100\%}}}{\beta_{\text{price}}}\right)$ is the discount assigned to steaks with 100 percent coverage with light intensity of discoloration relative to a non-discolored steak. This value should be negative because the coefficients $\beta_{\text{Light100\%}}$ and β_{price} are both negative (if consumers dislike coloration and dislike paying money). If, for example, its value is -\$2.00 it means that the maximum price consumers will pay for the 100%-Light discolored steak is \$2.00/lb. less than the maximum price they will pay for the non-discolored steak.

Note that the probability of a person choosing a non-discolored steak over a discolored steak (for exposed-attentive consumers) is calculated as $\exp\{\beta_1 \text{Price}_{ij} + \mathbf{X}_{ij}'\boldsymbol{\alpha}\} / [\exp\{0\} + \exp\{\beta_1 \text{Price}_{ij} + \mathbf{X}_{ij}'\boldsymbol{\alpha}\}]$ (see equation 3), and WTP is the value that sets this probability to 0.5. While WTP is often referred to as consumers' WTP, as if all consumers had homogenous preferences, in reality it measures the WTP for the average consumer. For example,

if a discount of \$2.00/lb. for a discolored steak is calculated, it implies that at a \$2.00/lb. discount, if consumers are presented with one non-discolored and one discolored steak, half of consumers would purchase the discolored steak and half would purchase the non-discolored steak, making the ‘average’ consumer indifferent between the two and giving them a 50 percent chance of purchasing the discolored or non-discolored steak.

As mentioned previously, allowing the cheap talk/trap question to influence WTP only through a larger utility of money would guarantee that the discounts associated with discolored steaks would fall, while it seems plausible that consumers could actually increase the discounts. Thus, we allow both the numerator and the denominator to vary between the three groups. For example, while the discount for the exposed-attentive group for Light-100% discoloration is calculated as $\left(-\frac{\beta_{Light100\%}}{\beta_{price}}\right)$, for the unexposed group this numerator is adjusted by adding the coefficient for $No_CT_{ij} * light100_{ij}$, and the denominator is adjusted by adding the term - $No_CT_{ij} * Price_{ij}$.

The WTP discounts for each form of discoloration for steak and ground beef are reported in table 3 and table 4.

The WTP numbers are all negative because they refer not to the value of a steak but incremental amounts of discoloration. That is, they measure consumers’ willingness to pay for greater discoloration, and since consumers do not want discoloration, the WTPs are negative. For the steak model a value of -\$5.66 for the 25%-Light attribute in the exposed-attentive group can be interpreted to mean: for a steak that has 25 percent coverage and light discoloration intensity we would expect the average consumer to be willing to pay \$5.66/lb. less than they would for the perfect (no discoloration) steak. Similarly, a value of -\$4.49 for the 25%-Light attribute in the ground beef model can be interpreted to mean that for ground beef that has 25 percent coverage

and light discoloration intensity we would expect the average consumer to be willing to pay \$4.49/lb. less than they would for the perfect ground beef

To compare the WTP values across the three groups, we follow the Krinsky Robb method (parametric bootstrap). Within tables 3 and 4, WTP values across the three groups are compared for each discoloration attribute. Those values within a row that are statistically different from one another differ in superscript letters. This allows us to quickly evaluate the effect of the cheap talk script as well as the trap question. One general trend is that when holding coverage constant at 25 percent the exposed-attentive and exposed-inattentive WTP values differ significantly ($p < .05$) for all levels of intensity within the steak model and for all but light intensity within the ground beef model. At higher levels of coverage this does not appear to be true. A plausible explanation for this would be that at higher levels of discoloration coverage, no matter the attention level, even at a steep discount respondents are unwilling to purchase the discolored products. However, at low levels of discoloration coverage the attentive respondents respond carefully (while considering hypothetical bias) and take time to consider their true preferences while the inattentive may demonstrate a greater propensity to simply reject discoloration in favor of the ‘perfect’ product no matter the price. This result supports the use of the cheap talk script and trap question within the survey and demonstrates the divergence in results when the attention level of respondents is considered.

4. Discussion

4.1 Failing the Trap Model

As discussed previously, Berinsky, Margolis, and Sances (2014) recommend analyzing the predictors of trap question passage/failure. By following this recommendation researchers

learn what the demographic predictors of trap passage are for the specific sample, which allows researchers to have a better understanding of how removal of inattentive respondents from the sample may induce bias.

Demographic information is collected through the survey including, gender, income, age, and education level. To test if these variables are proportionally different between those respondents who pass as compared to those who fail the trap question a Chi-squared test is conducted for each. Consider the test for gender, where “Female” is a dummy variable equal to one if the respondent is female and zero if male. The Chi-square test is used to determine if the proportion of females among the exposed-inattentive differs from the exposed-attentive group, and as Table 5 shows, this proportion is not significantly different at the 0.05 level. We thus conclude that in terms of gender, using the WTP for the exposed-attentive group only does not bias the results. Similar tests are conducted for “Education”, “Age”, and “Income”, which are all categorical variables. As with gender there are no income or education differences between the exposed-attentive and the exposed-inattentive subjects. However, there are statistically significant differences in the ages of the two groups, and a correlation analysis reveals that older subjects are less likely to fail the trap test. These results are summarized in table 5.

These results help us get a better picture of what type of demographics are contributing to trap failure. Because the chi-squared test for ‘age’ indicates significant differences, it is evident those respondents who fail the trap test are not distributed randomly throughout the entire sample. Looking at the distribution of respondent ages within the group who passed the trap question reveals that while this subset of the sample still contains a diverse distribution of ages, the median age increases as compared to the entire sample (which fit the U.S. population reasonably well) to approximately 50 years old. If the responses of the exposed-inattentive

group are simply discarded, as is often the common practice, then the survey sample data may be misrepresentative of the desired population (U.S. consumers). For this reason, we follow the recommendation of Berinsky, Margolis, and Sances (2014) and don't discard all who fail the trap but rather display the results stratified by level of attention; exposed-attentive, exposed-inattentive, and unexposed. This allows readers to easily see how the results change with attention level and promotes transparency in the presentation of results.

4.2 Strategic discounts for quick sale of discolored beef

Overall these discounts are large, especially relative to the listed prices of the beef products. The price of an average steak in 2017 was around \$7.93/lb., while the price of ground beef was \$3.71/lb. Let us assume the average prices of \$7.93/lb. and \$3.71/lb. for the steak and ground beef respectively represent the price of non-discolored ribeye steak and ground beef, respectively. To calculate the market price for a discolored steak for an average consumer to be indifferent when comparing the discolored steak to a non-discolored steak we can add the average WTP discounts estimated for specific discoloration attributes to the prices of the 'perfect' steaks or ground beef packages. For example, adding the average WTP estimate of -\$5.66/lb. for a steak that has 25 percent coverage and classified as having a light intensity of discoloration to the perfect steak price of \$7.93/lb. results in an estimated market price of \$2.27/lb. for a steak with those discoloration attributes.

Scanning over the WTP estimates calculated for steak displays estimates ranging in value from -\$5.66/lb. (25%-Light) to -\$20.14/lb. (75%-Dark). It is evident any steak that has at least 50 percent of its surface area discolored and classified as either light, medium, or dark intensity of discoloration would be expected to be unmarketable to the average consumer (when compared to the average 2017 price) as the negative WTP estimate for these discoloration attributes would

exceed the market price of the perfect steak. The resulting estimated market prices for steaks with these discoloration attributes would be negative. This would essentially indicate the average consumer would have to be compensated by this value before purchasing a steak with these discoloration attributes. In ground beef the smallest WTP discount estimated is -\$4.13/lb. (25%-Medium) and the price of the perfect ground beef is only \$3.71/lb. (2017 average price per lb. in the U.S.). This would indicate any ground beef that has 25 percent coverage and classified as having either light, medium, or dark intensity of discoloration would be expected to be unmarketable to the average consumer as the negative WTP estimate for these discoloration attributes would exceed the market price of the perfect ground beef.

This demonstrates that the average consumer displays a considerable aversion to discoloration. However, this does not indicate that we should expect retailers to begin paying consumers to ‘purchase’ discolored beef products or even offer them at steep discounts (e.g. >50 percent). Three reasons motivate this claim. First, many consumers may have preferences that differ considerably from the average consumer. Second, stores may have only a few discolored items to sell relative to non-discolored beef items. Third, many stores have other options available to them other than simply discarding unsold raw beef.

Consider a store that has a number of steaks on display for sale, and all are basically identical except for one, and it differs only due to 25%-Light discoloration. With many identical non-discolored steaks and one discolored but otherwise identical steak the consumer problem reduces to a choice between a non-discolored and a discolored steak. This discolored steak requires a \$5.66/lb. discount before the average (attentive) consumer will be indifferent between it and a non-discolored steak, as $\exp\{-0.9732 + (-0.172)(-\$5.66)\} / [\exp\{1\} + \exp\{-0.9732 + (-0.172)(-\$5.66)\}] = 0.5$. However, suppose the discount offered is only \$1.00/lb., making the

probability of a consumer purchasing the discolored steak about 30 percent. Assume also that customers arrive at meat display at the rate of one every five minutes and each customer purchases one steak. The probability the store will sell the discolored steak (assuming there is always at least one non-discolored steak) in less than $n \times 5$ minutes can be calculated as $\sum_{i=1}^n (0.3)(0.7)^{i-1}$. The probability they will sell the discolored steak within thirty-five minutes is then greater than 90 percent. Thus, while the average consumer discounts discolored meats heavily, with enough shoppers the store can expect to sell a discolored steak within a reasonable amount of time at a much smaller discount.

Discolored beef products are sold in low quantities compared to non-discolored beef products. Thus, it is natural to assume that a retailer attempting to maximize profits will not price discolored beef using the average WTP discount but rather a smaller discount, targeting the less discriminating consumer instead of the average consumer.

Additionally, many stores may have a section where they offer cooked foods, and it is likely they may use discolored beef that has not sold as an input into these cooked foods, such as making meatloaf from discolored ground beef. For this reason the store may only be willing to sell the discolored beef at only a small discount, as the opportunity cost of selling it as a cooked food item is high.

These results illustrate that even at low levels of discoloration the average consumer has little appetite (WTP) for discolored beef. This would indicate that not only is there a need for, but that retailers should be interested in, technology advancement that would prolong the shelf life of the vibrancy of the bright, cherry-red color of fresh beef. Much research is being done in this field. Suman et al. 2014 provides a thorough overview of the current literature on strategies to improve beef color and stability of color. Their work highlights numerous noteworthy efforts

within the meat industry using both pre-harvest (i.e. diet, animal management) and post-harvest (i.e. packaging, aging, antioxidants) intervention strategies to improve color stability in beef. They note that much of the current research suggests that the effects of several of these strategies are specific to type of animal, feeding regimen, packaging system, and muscle source. Their concluding recommendation is that “meat scientists should explore novel ways to manipulate these factors using a biosystems approach to achieve improved beef color stability, satisfy consumer perception, and increase market profitability” (Suman, et al. 2014, pp 490). Our results for this study only highlight the continued need for further research and advancement in this area.

4.3 Limitations

Though this study makes a concerted attempt to control for hypothetical bias it is important to note that without the use of revealed preference methodologies hypothetical bias is always a concern. Our results indicate a strong aversion to even relatively low levels of discoloration in beef. Within this hypothetical survey respondents entire responsibility is to focus on the choice experiment questions and make selections based off of the varying attributes of the meat products. This could result in participants focusing on the negative aspects of the discoloration attributes more than might otherwise mimic reality compared to the focus of shoppers in a retail environment. Shoppers typically go to a grocery store with the purpose of buying multiple products and are constrained by time. It is therefore possible that while in our study we find a strong aversion to discoloration, this same level of aversion may not be found if we could evaluate consumers actual purchase decisions. Given their limited time, the level of attention that consumers actually place on the color of the beef they purchase could result in different revealed preferences than those stated in our hypothetical survey.

As WTP estimates for varying levels of discoloration have yet to be studied, this research looks at discoloration attributes over the entire continuum of possibilities (0-100 percent coverage; light, medium, and dark intensity of discoloration) to begin to get an overall understanding of consumer preferences and WTP for discoloration attributes in beef. As the results indicate average consumers would require steep WTP discounts for discolored beef with even 25 percent of its surface area discolored, further research is needed to understand the WTP for discoloration within the range of 0-25 percent discoloration coverage. Additionally, this research selected steaks and ground beef as the beef products to focus on. As research continues in this area, additional beef cuts should be used to better understand how consumer preferences for discoloration change within higher and lower quality beef cuts. Demartini et al. (2018) demonstrated that by grouping respondents together in clusters based on their attitudes and then adding this information to the model through additional interaction terms, niche market preferences may be better identified. As discolored beef is unfamiliar to many consumers, it is reasonable to expect consumer attitudes towards beef discoloration to vary considerably. Future research in this area may benefit through additional analysis including clustering of consumers by attitudes.

Conclusion

Research has shown consumers prefer beef to be bright, cherry-red in color. Deviations from this color are perceived by consumers as a possible indication of unwholesomeness. Often meat begins to lose its bright, cherry-red color long before it begins to spoil, resulting in meat that is either marked down in price to entice a quick sale, ground for other products, or in some cases discarded completely. This leads to waste and loss of revenue within the beef market.

688 While consumers' avoidance of discolored meat is well-known there is little information
689 regarding the extent to which discoloration reduces its value. This study demonstrates that even
690 at low levels of discoloration the value of a beef item can fall as much as 50 percent.

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Table 1. Summary Statistics of Survey Respondents

Description	Category	Percentage
Gender	Female	51.98%
	Male	48.02%
Age	18 to 25 years old	17.72%
	26 to 34 years old	15.41%
	35 to 49 years old [†]	23.72%
	50 to 65 years old	25.95%
	more than 65 years old	17.21%
Education	less than high school	1.25%
	high school/GED	18.31%
	some college	24.19%
	2-year college degree [†]	11.25%
	4-year college degree	29.95%
	graduate degree	15.05%
Income	less than \$30,000	26.93%
	\$30,000 to \$59,000 [†]	27.75%
	\$60,000 to \$89,999	19.33%
	\$90,000 to \$119,999	11.84%
	\$120,000 to \$149,999	7.53%
	\$150,000 or more	6.62%
Shopper	Is the primary shopper in the household	88.51%
	Is not the primary shopper in the household	11.49%
Frequency of steak purchase	never	9.17%
	less than once a month	22.74%
	about once a month	23.48%
	about once every two weeks	22.89%
	about once a week	16.35%
	more than once a week	5.37%
Frequency of ground beef purchase	never	6.12%
	less than once a month	14.11%
	about once a month	20.85%
	about once every two weeks	27.52%
	about once a week	24.54%
	more than once a week	6.86%

Note: [†] Indicates median category.

Table 2. Steak and Ground Beef Model Results

Variable	Steak			Ground Beef		
	Parameter		Standard Error	Parameter		Standard Error
Price	-0.1720	***	0.020	-0.2416	***	0.029
No Cheap Talk x Price	-0.0230		0.022	0.0272		0.031
Trap Question Failed x Price	0.0208		0.024	0.0358		0.032
25%-Light	-0.9732	***	0.084	-1.0858	***	0.085
50%-Light	-1.9401	***	0.087	-2.2545	***	0.097
75%-Light	-3.2192	***	0.158	-2.5794	***	0.121
100%-Light	-3.2217	***	0.173	-3.9502	***	0.234
25%-Medium	-1.1536	***	0.081	-0.9975	***	0.080
50%-Medium	-1.6576	***	0.092	-1.7279	***	0.091
75%-Medium	-3.0370	***	0.150	-3.0205	***	0.154
100%-Medium	-3.1679	***	0.153	-4.0345	***	0.238
25%-Dark	-1.0768	***	0.087	-1.0370	***	0.085
50%-Dark	-3.2054	***	0.164	-3.0364	***	0.157
75%-Dark	-3.4649	***	0.176	-3.7176	***	0.203
100%-Dark	-3.2285	***	0.156	-3.6246	***	0.180
25%-Light x Trap Fail	-0.1920	*	0.100	-0.0211		0.098
50%-Light x Trap Fail	-0.0871		0.104	0.0518		0.115
75%-Light x Trap Fail	0.2835		0.179	0.2366	*	0.135
100%-Light x Trap Fail	0.3157	*	0.189	0.6249	***	0.241
25%-Medium x Trap Fail	-0.1700	*	0.096	-0.0623		0.092
50%-Medium x Trap Fail	-0.0751		0.108	-0.0305		0.106
75%-Medium x Trap Fail	0.2482		0.162	0.2987	*	0.172
100%-Medium x Trap Fail	0.5600	***	0.156	0.5646	**	0.267
25%-Dark x Trap Fail	-0.1530		0.103	-0.0759		0.099
50%-Dark x Trap Fail	0.3592	**	0.166	0.2739		0.170
75%-Dark x Trap Fail	0.5026	***	0.173	0.4339	**	0.212
100%-Dark x Trap Fail	0.3292	*	0.168	0.5347	***	0.192
25%-Light x No Cheap Talk	-0.0381		0.090	0.0110		0.090
50%-Light x No Cheap Talk	-0.0476		0.094	-0.2559	**	0.104
75%-Light x No Cheap Talk	-0.1208		0.169	-0.0424		0.129
100%-Light x No Cheap Talk	-0.0623		0.183	-0.0625		0.244
25%-Medium x No Cheap Talk	0.0283		0.087	-0.0334		0.085
50%-Medium x No Cheap Talk	-0.0336		0.099	-0.0637		0.097
75%-Medium x No Cheap Talk	0.1367		0.158	-0.1493		0.164
100%-Medium x No Cheap Talk	0.1119		0.159	-0.5085	**	0.258
25%-Dark x No Cheap Talk	-0.0504		0.093	-0.1122		0.091
50%-Dark x No Cheap Talk	0.2803	*	0.170	-0.0073		0.166
75%-Dark x No Cheap Talk	0.3303	*	0.182	0.0233		0.212
100%-Dark x No Cheap Talk	0.1261		0.164	-0.0577		0.190

***, **, * Statistically significant at the 0.01, 0.05, and 0.1 level

Number of observations: Steak= 30,121; Ground Beef= 31,135

Log Likelihood: Steak= -20,677; Ground Beef = -19,415

Table 3. Willingness-to-Pay Estimates for Discoloration Attributes in Steak

Attribute	Exposed Attentive	Exposed Inattentive	Non-Exposed
25%-Light	-\$5.66 ^a	-\$7.71 ^b	-\$5.19 ^a
50%-Light	-\$11.28 ^{ab}	-\$13.41 ^b	-\$10.19 ^a
75%-Light	-\$18.72 ^a	-\$19.42 ^a	-\$17.13 ^a
100%-Light	-\$18.73 ^a	-\$19.22 ^a	-\$16.84 ^a
25%-Medium	-\$6.71 ^a	-\$8.75 ^b	-\$5.77 ^a
50%-Medium	-\$9.64 ^{ab}	-\$11.46 ^b	-\$8.67 ^a
75%-Medium	-\$17.66 ^a	-\$18.44 ^a	-\$14.87 ^a
100%-Medium	-\$18.42 ^a	-\$17.25 ^a	-\$15.67 ^a
25%-Dark	-\$6.26 ^a	-\$8.13 ^b	-\$5.78 ^a
50%-Dark	-\$18.64 ^a	-\$18.82 ^{ab}	-\$15.00 ^b
75%-Dark	-\$20.14 ^a	-\$19.59 ^{ab}	-\$16.07 ^b
100%-Dark	-\$18.77 ^a	-\$19.18 ^a	-\$15.91 ^a

Note: WTP estimates within a row followed by different letters differ significantly ($p < 0.05$).

Table 4. Willingness-to-Pay Estimates for Discoloration Attributes in Ground Beef

Attribute	Exposed Attentive	Exposed Inattentive	Non-Exposed
25%-Light	-\$4.49 ^a	-\$5.38 ^a	-\$5.01 ^a
50%-Light	-\$9.33 ^a	-\$10.70 ^{ab}	-\$11.71 ^b
75%-Light	-\$10.68 ^a	-\$11.38 ^a	-\$12.23 ^a
100%-Light	-\$16.35 ^a	-\$16.16 ^a	-\$18.72 ^a
25%-Medium	-\$4.13 ^a	-\$5.15 ^b	-\$4.81 ^{ab}
50%-Medium	-\$7.15 ^a	-\$8.54 ^a	-\$8.36 ^a
75%-Medium	-\$12.50 ^a	-\$13.23 ^a	-\$14.78 ^a
100%-Medium	-\$16.70 ^a	-\$16.86 ^{ab}	-\$21.19 ^b
25%-Dark	-\$4.29 ^a	-\$5.41 ^b	-\$5.36 ^b
50%-Dark	-\$12.57 ^a	-\$13.42 ^a	-\$14.20 ^a
75%-Dark	-\$15.39 ^a	-\$15.96 ^a	-\$17.23 ^a
100%-Dark	-\$15.00 ^a	-\$15.01 ^a	-\$17.17 ^a

Note: WTP estimates within a row followed by different letters differ significantly ($p < 0.05$).

Table 5. Comparing Demographics of Respondents Who Passed vs. Failed the Trap

Variable	Chi-Square Test Statistic	P-value	Interpretation
Income	8.4182	0.1346	Not significant
Age	51.0798	<0.001	Older respondents are less likely to fail the trap
Education	10.7533	0.0565	Not significant
Female	0.1662	0.6835	Not significant

832 **Figures**

850 **Figure 1. Overview of Survey**

Figure 2. Twelve levels of discoloration used in the choice experiment

The experience from previous similar surveys is that people often state a higher willingness to pay than what one is actually willing to pay for the good. For instance, a recent study asked people whether they would purchase a new food product similar to the beef products you are evaluating. This purchase was hypothetical (as it is for you) in that no one actually had to pay money when they indicated a willingness to purchase. In the study, 80% of people said they would buy the new product, but when a grocery store actually stocked the product, only 43% of people actually bought the new product when they had to pay for it. This difference (43% vs. 80%) is what we refer to as hypothetical bias. Accordingly, it is important that you make each of your upcoming selections like you would if you were actually facing these exact choices in a store, i.e., noting that buying a product means that you would have less money available for other purchases. Of course, providing this information only matters if survey respondents read it. To demonstrate that you have read this information, please select the option that says it was left blank intentionally, instead of the option ‘I have read the above information’.

☐ Yes, I have read the above information

☐ This option intentionally left blank

859

860 **Figure 3.** Cheap Talk Script/Trap Question