Determinants of Subjective Food Safety Perceptions: A Case Study of Oysters in the Southeast

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Food safety is a concern for consumers, food processors, and food system regulators because of the multiple health risks from food contaminants. These health risks include long-term mortality risk due to carcinogens and both mortality and morbidity risks from bacterial/viral contaminants. Economists have documented many examples of the negative effects of short-term contamination scares on market demand for food (Brown; Brown and Folsom; Foster and Just; Johnson; Smith et al.; Swartz and Strand; van Ravenswaay and Hoehn), but we know relatively little about the factors that determine individual consumer's safety perceptions of specific foods.

There are many reasons why consumers may have different perceptions of a food's safety. Psychologists have shown that individuals use a variety of filters to interpret information about risks based on prior experiences, personal characteristics and cognitive skills. In some cases they may avoid any contact with a low risk activity but ignore information about potential high risks. We must understand the factors that influence these differences in consumers' subjective perceptions so that food processors and safety regulators can effectively respond to food safety concerns.

Here we investigate the determinants of consumers' safety perceptions of oysters in the southeastern U.S. Oysters are especially relevant because spokespersons for the seafood industry have cited health risks from shellfish as a serious impediment to growth in seafood consumption (Becker; Manges). The U.S. Food and Drug Administration (FDA) estimates that molluscan shellfish are 83 to 122 times more likely to cause illness than chicken on a pound for pound consumed basis. Illnesses attributed to shellfish contaminants range from minor stomach distress and diarrhea to severe intestinal disorders that can be fatal (Hackney and Dicharry). Currently, the government regulates shellfish safety under the voluntary National Shellfish Sanitation Program. However, shellfish are not subject to the same type of continuous, on-site inspection used for other flesh products such as beef and chicken. There is a proposal in Congress for legislation to overhaul and expand the shellfish inspection program. No action however has occurred as of this date because of differing opinions about the effects on consumer demand, administrative costs, and the appropriate regulatory agency. Shellfish are a significant part of the seafood harvesting and processing industries in South Carolina, Georgia, Florida, and Louisiana.

The Psychological Basis of Health Risk Perceptions

We can define risk in various ways. Knight defines risk as "measurable uncertainty," which arises from imperfect knowledge about the future. More often however, risk is associated with the negative dimension of uncertain events. Rowe related risk to "consequences that involve losses to the risk taker" (p. 23). From a consumer's point of view, risk is the product of an inability to anticipate "unpleasant" consequences with certainty (Bauer). Since this article involves events associated with consumption of a food which is potentially dangerous to human health, we shall use the term risk in the context as defined by Bauer.

Simon was the first to observe that human information processing abilities limit individuals' response to risks. He introduced the notion of "bounded rationality" that suggests cognitive limitations force people to construct simplified models of the world. One consequence of bounded rationality is that individuals may ignore uncertainty (Hogarth). Typically, people make risk judgments based on very general inferential rules known as heuristics to reduce difficult mental tasks to simpler ones.

One heuristic that has special relevance to risk perceptions is availability—people perceive an event as likely or frequent if instances of it are easy to imagine or recall (Tversky and Kahneman). This heuristic suggests that personal knowledge and experience are important determinants of perceived risk (Slovic et al. 1985). Other factors unrelated to frequency of occurrence affect availability. For example, a recent disaster or a vivid film could strongly influence risk perceptions (Slovic et al. 1982). New information about a risk also has systematic effects on individuals' perceptions of the risk (Smith and Johnson). Past studies of consumers' response to food contamination events have introduced availability of risk information by measuring the extent of newspaper coverage (Smith et al.; Swartz and Strand; van Ravenswaay and Hoehn). Since these studies were based on market data, they did not explore the effects of personal experience and individual traits in the formation of risk perceptions.

Crider et al. and Hogarth also suggest that unique personal characteristics may influence the interpretation of available safety information. What a person expects to see (or hear, touch, smell, or taste) can greatly affect perceptions. Motivations can cause one to perceive what one needs or wants. Also, sensory experiences during childhood can alter the way (s)he perceives risky events. Thus, it is likely that individuals will respond differently to publicized food contamination incidents depending on their expectations, motivations and experience with the food product.

In addition to the availability heuristic and personal interpretation, researchers have proposed other potential determinants of risk perceptions. Starr reviewed data on risk exposure and levels of participation in different activities and observed "...individuals appear willing to accept risks from voluntary activities roughly 1,000 times greater than they would tolerate from involuntary activities" (p. 1237). Later, Starr et al. speculated that this phenomenon was due to the perceived controllability of the risk. If people believe they can manage the risk situation, they may take the chance. If they do not consider the risk controllable, they become fearful and risk-averse, and will accept only a much smaller risk.

Another factor in the formation of risk perceptions cited by Starr was the probable severity of a negative outcome. For example, people perceive commercial air transportation to be more risky than auto travel because the results of an aviation accident are far more severe than the effects of an auto accident. This suggests that individuals may have different safety perceptions if they believe an activity could be fatal than if they expect only temporary disability.

An additional determinant of safety perceptions is individuals' propensity to rationalize their behavior. According to the theory of cognitive dissonance, a habitual behavior can lead individuals to adjust their beliefs to agree with the behavioral pattern (Akerlof and Dickens). For instance, a person who continues to work in a dangerous job believes the job is not dangerous.

The conceptual aspects of risk perceptions provide a framework to analyze food safety perceptions. However, to operationalize the analysis, we must measure perceived risk empirically. One approach is a unidimensional rating that puts the safety of a product on a single scale—from "very safe" to "very unsafe." Many have used this rating approach to elicit safety perceptions for a variety of hazards (Spence et al.; Viscusi and O'Connor; Desvousges et al.; Smith and Desvousges). It has the advantage of simplicity and the rating task is understandable by most individuals. However, there has been no work on specific food products. An alternative measure suggested by Dowling is to distinguish two characteristics of risk perceptions: the likelihood of an adverse outcome and the severity of the outcome. These components can be rated individually and then combined in an additive or multiplicative relationship (i.e. perceived risk = likelihood x severity of consequences). An additive relationship suggests that likelihood and severity are distinct factors in risk perceptions while a multiplicative relationship suggests interaction between the factors.

Model Specification

These conceptual and practical concerns led us to posit the relationship between an individual's safety perceptions of oysters, measured with a rating scale, and various factors as follows:

SAFETY RATING = f (AWARENESS, PRIOR ILLNESS, FREQUENCY OF USE, HEALTH STATUS, CONTROLLABILITY, SOURCE OF RISK, AGE, EDUCATION, LOCATION OF RESIDENCE, CHILDREN, RELIGION, LIKELIHOOD OF ILLNESS, SEVERITY OF ILLNESS).

Drawing on the availability heuristic, an individual's safety rating of a food is influenced by her awareness of illness problems due to the food. This awareness may come from media reports or from friends and family. Prior illness from eating a specific food should influence the safety rating since these consumers have direct experience with the health risk. Also, the frequency of eating a food can influence safety perceptions. Individuals who regularly consume a food and have had no adverse health effects may ignore information about product health risks. Authors frequently cite this type of "cognitive dissonance" in safety perception studies of smokers and workers in hazardous occupations.

If a consumer considers herself in good health, she may perceive a smaller risk. Similarly, if a person can control the risk she may simply discount the risk level. The degree of controllability may depend on the expected source of the health risk. If the health risk is due to improper food preparation in the home or restaurant, the risk is relatively more controllable by a consumer. However, if the health risk enters in harvesting and processing practices, the consumer may have little control. Also, past studies have found that young and middle age consumers are more aware of microbial contaminants in foods than older consumers. However, people's ability to control a risk may increase with age. Earlier studies also suggest consumers with more education are less likely to expect bacterial contamination in meat products purchased from stores (Penner et al.).

Residents in coastal areas are likely to be more knowledgeable of oyster safety problems since local media coverage and product availability may be more influenced by marine pollution and contamination events. The availability heuristic suggests that these factors may increase the perceived risk. On the other hand, cognitive dissonance suggests the possibility that coastal residents discount the health risk of eating oysters, if they eat the food often. The presence of children in the household may also lead a consumer to be more adverse to illnesses from foods because parents or adults would not want the children exposed to unnecessary risks. A consumer's religious affiliation can also influence food safety perceptions. For example, orthodox Judaism prohibits shellfish consumption due to a fear of contamination. It would be expected that Jewish consumers would have lower safety ratings of shellfish products. Finally, we can use the two characteristics of food risks, likelihood and severity, to predict the safety rating since they represent individual components of the health risk. We can evaluate the risk to determine whether the two components have a distinct or interactive effect on safety perceptions.

Survey Design and Data Collection

We conducted a random digit telephone survey of adults (18 years or older) in the Mid-Atlantic and Southeastern states for this study. These states were Delaware, Maryland, Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. We selected the region because most oysters harvested in the Southeast are sold in these states. We administered the survey using a private market research firm in two waves: January 8-19, 1990 and April 10-June 27, 1990. The scope and framing of questions in the survey were based on focus group interviews with shellfish consumers and nonconsumers during the summer and fall of 1989 (Lin et al.). We stratified the phone survey sample to provide proportional representation for urban and rural consumers within each state in the region.

The interviews typically lasted about 10-15 minutes. Respondents reported their frequency of oyster consumption during the one-year period before the survey. They also registered their safety rating of oysters on a 1 (Not safe at all) to 7 (Perfectly safe) scale, knowledge of and experiences with unsafe oysters, and demographic profiles. We cited no specific contaminant as the cause of oyster safety problems so the ratings could reflect both morbidity and mortality risks. We further made no distinction between at-home or restaurant consumption of oysters because of the many non-food characteristics of restaurant meals that could influence perceptions. Also, we considered all oyster product forms (raw, canned and cooked) since contaminants could be present in each form.

We show the descriptions and sample statistics for the variables used in this analysis in Table 1. We deleted interviews that had missing values for any of the variables; 606 complete interviews were available for this analysis. Almost half of the respondents did not eat oysters during the recall period. The mean safety rating of oysters (3.90) in Table 1 was lower than the safety rating of other foods

Table 1.
Characteristics of the Oyster Safety Rating Sample

Variable	Mean	Std. Dev.
SAFETY RATING (1 = not safe at all, 7 = perfectly safe)	3.90	1.62
AWARENESS (1 = has read or heard about illnesses or diseases caused by unsafe oysters, 0 = otherwise)	0.87	—
PRIOR ILLNESS (1 = has got sick from eating bad or unsafe oysters, 0 = otherwise)	0.07	—
FREQUENCY OF USE (0 = nonuser in the past year, 1 = ate less than or equal to once per month, 2 = from 2 to 4 times per month, 3 = ate more than 4 times per month)	0.74	0.67
HEALTH STATUS (1 = self-rated health is excellent for the respondent's age, 4 = poor)	1.64	0.72
CONTROL (1 = shellfish safety problem is not perceived controllable by individuals, 4 = very controllable)	2.52	0.99
SOURCE OF RISK (1 = the respondent thought the primary source of food safety problem with oysters was in the water or during processing and transportation, 0 = otherwise)	0.88	—
AGE (1= 18-34, 2 = 35-64, 3 = over 65 years)	1.78	0.66
EDUCATION (1 = grade school, 6 = post-graduate)	3.93	1.20
LOCATION OF RESIDENCE (1 = the respondent's residence is more than 100 miles from the nearest coast, 0 = otherwise)	0.60	—
CHILD (1 = there are children under 12 years of age in the respondent's household, 0 = otherwise)	0.33	—
RELIGION (1 = Jewish, 0 = otherwise)	0.02	—
CHANCE OF ILLNESS* (1 = perceived chance of getting sick from oysters is very likely, 4 = not at all likely)	2.30	0.83
SEVERITY OF ILLNESS* (1 = perceived severity of such illness is very severe, 4 = not at all severe)	1.78	0.80
RISK OF ILLNESS INDEX (the product of CHANCE and SEVERITY)	4.27	2.86
20/20 (1 = saw the ABC *20/20* program on shellfish safety, 0 = otherwise)	0.15	—

*The introduction of these questions was "sometimes foods are not safe because of bacterial contamination." Hence, the safety issue referred to illnesses or diseases caused by bacterial associated problems but not problems caused by other contaminants.

(chicken and shrimp) that we asked respondents to rate in the survey (a comparative analysis of the other food safety ratings is provided in Lin). The mean value of the severity of illness variable (1.78) at the bottom of the table shows that, on average, the respondents expected a relatively severe illness if they ate bacterially contaminated oysters. More than two-thirds of the respondents expected a somewhat severe or very severe illness. Since 87 percent of the sample had heard or read about illnesses caused by unsafe oysters, the survey shows that a large majority were aware of health risks from oysters.

We also included a dummy variable for a respondent's viewing the American Broadcasting Company's report on shellfish safety during their *20/20* television news show on February 9, 1990. This report focused on the FDA risk estimates, problems in the current shellfish inspection program, and examples of the health problems caused by contaminated shellfish. Since this report occurred after the first wave of telephone interviews, it provided a unique opportunity to identify the effect of national media attention on individual consumer's food safety perceptions.

Empirical Results

We used respondent's ratings of oyster safety in an ordered probit statistical model to identify the effects of each variable on safety perceptions. The ordered probit model (McKelvey and Zavoina) provides statistical estimates of the relationship between a set of independent variables and an ordinal ranking of individual preferences. The model assumes the observed categorical dependent variable (the ordinal ranking) is an inadequate measure of an underlying variable (the preferences) which is continuous. The correspondence between the observed and underlying variables is established by a set of unobserved thresholds, along a real number line, that partitions the continuous underlying variable into various portions. Statistically, we estimated the probability that the observed ranking falls in a particular category with consideration of both the unobserved thresholds and regression coefficients. Thus, an ordered probit coefficient measures the direction and magnitude of change in the underlying dependent variable (the preferences) due to an independent variable. For interpretation purposes, a coefficient qualitatively shows the change in probability of a higher ranking attributable to an independent variable. We can interpret the test statistics for individual coefficients and the model in the same way as results from multiple regression analysis.

We present the maximum likelihood estimates for the ordered probit model of oyster safety ratings in Table 2. We report estimates for an additive model in which the perceived chance and severity of illness enter as independent variables. We also report on a multiplicative model in which these variables interact. Statistical results for the two models are very similar so the discussion will include both models.

Several of the variables related to the availability heuristic had the expected sign and were statistically significant. Individuals who said they had heard or

Table 2.
Maximum Likelihood Estimates from Ordered Probit Model of Oyster Safety Rating

Variable	Coefficient Additive Model[a]	Multiplicative Model[b]
Intercept	0.75(0.32)[c]	1.32(0.30)
Awareness	–0.70(0.15)**	–0.72(0.15)**
Prior illness	–0.22(0.18)	–0.26(0.17)
Frequency of use	0.36(0.07)**	0.37(0.07)**
Health status	0.08(0.06)	0.06(0.06)
Control	0.11(0.04)**	0.11(0.04)**
Source of risk	–0.16(0.13)	–0.15(0.13)
Age	0.20(0.07)**	0.23(0.07)**
Education	–0.11(0.04)**	–0.09(0.04)**
Location of residence	–0.16(0.09)*	–0.18(0.09)*
Child	0.01(0.10)	0.01(0.10)
Religion	–0.46(0.34)	–0.40(0.34)
Chance of illness	0.36(0.05)**	–
Severity of illness	0.15(0.06)**	–
Risk of illness index	–	0.10(0.01)**
20/20	–0.36(0.07)**	–0.38(0.12)**
N	606	606
–Log L	1032.50	1042.70
–Log L (Slopes = 0)	1119.10	1119.10
McFadden's R^2	0.08	0.07

a. Estimated underlying thresholds (for the variate) and their standard errors are: μ_1 = 0.57(0.07), μ_2 = 1.24(0.08), μ_3 = 1.92(0.09), μ_4 = 2.67(0.10), and μ_5 = 3.29(0.13).
b. Estimated underlying thresholds (for the variate) and their standard errors are: μ_1 = 0.56(0.07), μ_2 = 1.21(0.08), μ_3 = 1.88(0.09), μ_4 = 2.62(0.10), and μ_5 = 3.24(0.12).
c. Number in parentheses are asymptotic standard errors.
** and * denote significance at the 0.05 and 0.10 levels, respectively.

read about illnesses caused by contaminated oysters gave a lower safety rating of oysters than individuals who had not. Respondents who attributed a prior illness to unsafe oysters also gave a lower safety rating but the coefficient was not statistically significant. A possible explanation for this result may be that only seven percent of respondents had ever been ill from oysters. Seventy-seven percent of these individuals reported that the illness lasted only a day or two; and, the majority did not consult a doctor about their illness, but seven percent did require hospitalization (Lin). The relative mildness of these actual illnesses is quite different from the average respondent's expected severity of illness (see Table 1 and earlier discussion).

Individuals who consumed oysters more frequently gave oysters a higher safety rating. It may suggest that these individuals had decided that the health risks from oysters were acceptable or believed they could control the risks through food preparation practices. Cooking can reduce the likelihood of illness but it does not guarantee complete elimination of pathogens (Barnett). The finding also suggests a form of cognitive dissonance since safety perceptions may have been formed to reinforce current consumption habits. Thus, frequent consumers held relatively more positive beliefs about oyster safety than others because their behavior pattern could be rationalized with positive beliefs.

However, the average individual, whether an oyster consumer or not, gave a significantly lower safety rating if they had seen the ABC *20/20* program on shellfish safety. This program, which presented many facts that probably were not known by the public, seemed to have influenced the information available to these viewers and had a negative impact on oyster safety perceptions. Since the program did not focus on a specific contamination event, these results suggest that individuals reevaluate their perceptions of food safety based on factual information about the product.

The perceived controllability of the health risk was also important. Individuals who agreed with the statement, "... there isn't much the average person can do to avoid safety problems from shellfish products," were less likely to believe they could control the health risks from oysters. Therefore, they were less likely to give a higher safety rating to oysters. Individuals who disagreed with the statement were more likely to give a higher rating. Also, individuals who felt that the source of health risks was improper harvesting and processing practices rather than improper food preparation were more likely to give a lower safety rating to oysters. Although this coefficient is statistically insignificant, the finding is consistent with the relationship between perceived controllability and perceived risk mentioned above.

The age and education of the respondent also had an impact on the safety rating. Consistent with the results in Penner et al., older respondents were more likely to give a higher safety rating than younger respondents. We can not determine from the data whether we can attribute the difference in perceptions to better understanding or more concern about food contaminants by younger people, or the perceived controllability of the risk increases with age. Respondents who had more education were more likely to give oysters a lower safety rating. This suggests that more educated consumers may be more knowledgeable of the health risks of oysters.

Other demographic variables also influenced the safety rating. Consumers who lived less than 100 miles from the nearest coast gave higher safety ratings than inland residents (the distance of 100 miles was chosen out of convenience). This may be because there are more specialty seafood stores in coastal areas, and consumers may feel that these stores are discriminating in the selection of suppliers and in product handling (Lin et al.). However, this result is probably not a result of cognitive dissonance because the survey does not indicate coastal respondents ate oysters more often than others. A Chi-square test between "location of residence" and "frequency of use" indicates negligible association between the two variables. The other demographic variables, presence of a young child in the respondent's household and the respondent's religious affiliation, did not have a significant effect on the safety rating.

Finally, the additive and multiplicative models both suggest that the characteristics of the risk were important. In the additive model, individuals who felt that an illness from eating oysters was not very likely gave higher safety ratings than those who believed an illness was likely. In addition, individuals who did not expect a severe illness even if an illness from oysters did occur gave a higher safety rating than those who expected a severe illness. Both of these variables were highly significant but the chance of illness variable had a larger effect on the safety rating than the severity variable. This suggests that consumers may be more concerned about the likelihood of getting sick from the food than the severity of the illness they would experience. Thus, if a shellfish inspection program could control for different types of contaminants, these results suggest that reducing the incidence of illness from oysters may be more important than controlling specific contaminants that have severe health effects.

The results from the multiplicative model show that the risk index is also a valid indicator of individuals' safety perceptions. Higher values of the index reflect lower likelihood or severity of illness or both, and we associated these higher values with higher safety ratings. However, the statistical results do not suggest that one model is more appropriate than another. Both models account for the characteristics of the health risk in a different way and support the hypothesis that these components of a risk are important determinants of oyster safety perceptions.

Implications for Shellfish Inspection Programs

The survey results show concern by many individuals about the safety of oysters. The results also highlight a belief that the primary source of the safety problems was in the water or during processing and transportation of oysters. However, the statistical analysis did not show that the safety problems are with harvesting and processing alone. Therefore, respondents may perceive a safety problem associated with the product itself rather than any specific sources of the health hazard. If this is correct, then a more comprehensive shellfish inspection program focused on harvesters and processors may do little to improve the safety perceptions of oysters. Where the results show that the feeling of control over health risks improved respondents' safety perceptions of oysters, changes in the inspection program should be one element of a broader program. This program would also improve consumers' ability to control the health risks from oysters.

One part of such a program would be an education campaign by the seafood industry or government (or both) to improve consumers' knowledge of oyster product choice, handling and preparation. For example, the program could provide consumers with information on times of the year when potential oyster safety problems are most likely to occur. The use of a uniform product safety seal is another method that can help establish positive images of the product. This education campaign could also include information about the susceptibility of individuals with certain health problems to illnesses from shellfish. While this type of effort may have some short-term negative impacts on product demand because consumers will become more aware of the safety problems, the long-term effects may be better product image and improved safety perceptions. Part of this improved awareness could be an understanding that shellfish related illnesses are not likely to be severe. This type of consumer education program would also make it clear that consumers can take an active role in assuring the safety of the food they eat.

Finally, the importance of the components of the health risk from oysters suggests that targeting an inspection and consumer education program on specific aspects of the risk may be helpful. For example, an inspection program that lessened the likelihood of frequent, relatively minor illnesses may have more impact on safety perceptions than a program that reduced rare and severe illnesses alone. Opportunities to begin such a program will depend on improvements in on-site microbial detection methods and ethical judgments about the types of risk that are acceptable to society. Nonetheless, our research shows that market surveys can identify important determinants of consumer food safety perceptions. We can use this information to clarify consumers' safety concerns and to enhance the discussion of industry and government alternatives to address these food safety concerns.

Finally the results from our survey of consumers in the southeastern U.S. confirm that many of the determinants that influence individual's perceptions of risks in everyday activities also influence their perceptions of food product safety. Awareness of the risk as well as media coverage on the risk influence these subjective perceptions. It is clear however that individuals interpret the risk information in different ways and adjust their perceptions of product safety in light of their personal characteristics.

Notes

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