Effects of Information about Invasive Species on Risk Perception and Seafood Demand by Gender and Race[1]

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Abstract: In this paper we consider the effects of negative and positive risk information on perceived seafood risks and seafood consumption by gender and race. The data is from a Mid-Atlantic survey of coastal seafood consumers. We elicit risk perceptions in three risk scenarios with a dichotomous choice with a follow-up question format. We elicit continuous revealed and stated preference seafood consumption in nine risk and price scenarios. Analysis in four gender and race categories indicates that demographic groups respond to the positive and negative information in different ways. Communication of risk information as risk mitigation policy is a challenge.

Introduction

In 1992 researchers at North Carolina State University identified Pfiesteria Piscicida (Pfiesteria) as one possible cause of fish kills in eastern North Carolina's estuarine systems (Burkholder, Noga and Hobbs, 1992). Pfiesteria is a single-celled microorganism that lies dormant in the sediment of fresh and brackish water estuaries, but in combination with high nutrient concentrations potentially becomes a toxic predator of a number of local fish species. Pfiesteria has also been linked to fish kills in Virginia, Maryland and Delaware.

Public perception of Pfiesteria and other harmful algal blooms (e.g., red and brown tides) has the potential to impose significant economic losses on the mid-Atlantic region (Lipton 1998). Public concern over harmful algal blooms and, in particular, Pfiesteria can lead to a significant decrease in demand for seafood in affected areas, despite a lack of scientific evidence linking any illness from seafood consumption to Pfiesteria. Past research suggests that information about seafood safety may change behavior, consumers may self protect against seafood risk by reducing consumption, and self protection behavior may differ across different socioeconomic groups.

The general population tends to produce inaccurate estimates of risk (McIntosh and Acuff 1994, Johnson and Griffith 1996, Almas 1999). Most people receive information about environmental risks and food safety from the mass media and often ignore or disregard these warnings (Velicer and Knuth 1994). People may believe that a warning does not pertain to food in their area, or that they can limit the danger by various cooking methods. This is of particular concern for pregnant women and small children who are at higher risk for foodborne pathogens such as mercury in fish. When people receive information on food safety from individuals such as family and friends it is often incorrect (McIntosh and Acuff 1994), and these sources tend to convey the benefits of eating seafood rather than the risks (Burger 2005).

Past economic research finds that negative information about food safety tends to decrease consumption, while counter-information does not necessarily have the opposite effect (Smith, van Ravenswaay, and Thompson 1988, Brown and Schrader 1990, Lin and Milon 1993). On the other hand, Wessells, Kline, and Anderson (1996) and Parsons et al. (forthcoming) find that seafood consumption decreases with negative information about seafood safety and increases with some types of positive information.

Some of these results concerning the effect of information may be masked by socioeconomic factors. Social location and access to social resources strongly influence how people perceive, accept, and manage risk (Lupton, 1999; Slovic, 1999). For example, women, people of color, working classes, children, the less educated, and the elderly have all been argued to be "at risk" because of their limited abilities to communicate and control social situations, in part via reduced access to information (Luhmann, 1993). Women perceive higher food safety risks than men (Burger, Sanchez and Gochfeld, 1998) and are more concerned about the effects of food on health and the effect of the environment on food (Davidson and Freudenburg, 1996). Hersh (1996) determined that women and whites engage in safer behaviors than men and nonwhites including higher rates of non smoking, seat belt use, brushing and flossing teeth, exercise, and checking blood pressure. Similarly, Burger et al (1999) found whites, with much higher median incomes, have more accurate knowledge of seafood safety than blacks and hispanics.

In contrast, Burger, Sanchez and Gochfeld (1998) find no differences among men and women anglers in awareness of seafood safety information, perceptions of whether seafood was safe to eat, and seafood consumption. Jakus and Shaw (2003) find no gender or race effects in the decision of whether to keep fish caught from reservoirs with fish consumption advisories.

Many of the gender and race effects found, and not found, could be a result of the interaction between gender, race, and social class (Flynn, Slovic, and Mertz (1994)). White men perceived lower risks than others on nearly all hazards in Finucane et al.'s (2003) study, including hand guns, nuclear power, cigarette smoke, sexually transmitted diseases, drugs, blood transfusions, pesticides, lead poisoning, and food hazards. Nonwhite females tend to perceive the highest risk for most hazards. Other studies have found that white women eat less seafood than white men (Burger 2000). To examine these interactions, social researchers need to include interaction effects in their statistical models.

To our knowledge no study of food safety and consumption to date has considered the interaction of socioeconomic factors, particularly gender and race. We consider the effects of negative and positive risk information on perceived seafood risks from Pfiesteria Piscicida (hereafter, Pfiesteria) associated fish kills and seafood consumption by gender and race. The data is from a Mid-Atlantic survey of coastal seafood consumers (Whitehead et al. 2003). Previous research has examined the effects of information about Pfiesteria-related fish kills and seafood safety on seafood demand in a stated preference framework (Parsons et al. 2006). In this paper we examine the effect of Pfiesteria-related fish kills and health risk information on risk perception and seafood demand in a jointly estimating revealed and stated preference framework.

The Survey

To study the effects of health risk information on seafood risk perceptions and demand, we conducted a phone-mail-phone survey of mid-Atlantic residents. The sample frame included seafood eaters in Delaware, the eastern parts of Maryland (including the District of Columbia), North Carolina and Virginia. The sample frame was stratified with a 50/50 urban/rural split and a 50/50 North Carolina/rest of sample split.

The survey was conducted during fish kill season: June through November. The East Carolina University Survey Research Laboratory conducted the first telephone interviews from August to October. Almost nine thousand calls were made in an attempt to reach 2000 respondents. One thousand eight hundred and seven interviews were completed. Dividing the completed interviews by eligible contacts (i.e., refusals plus completed interviews) yields a response rate of 60.7%. This response rate varies significantly by state. The response rate in North Carolina was highest with 69% and 1085 completed interviews. The response rates in Delaware, District of Columbia, Maryland and Virginia were 52.9%, 46.2%, 48.7%, and 54.4%. The number of completed interviews was 237, 47, 216, and 222 respectively. These differences are probably attributable to the name recognition of East Carolina University in eastern North Carolina and the lack thereof for the rest of the sample.

An information brochure was mailed to respondents who agreed to participate in the second telephone survey. The information mail-out consists of four parts. The major part is the Pfiesteria brochure titled “What you should know about Pfiesteria” which was based on the brochure published by the U.S. Environmental Protection Agency’s Office of Water titled “What you should know about Pfiesteria Piscicida."[2] The brochure and the "counter information" insert followed the same format with the same headings and edited text. Each mail packet also included a combination of inserts we will refer to as: "fish kill information," "seafood inspection program," "hypothetical fish kill" and "counter information." The brochures were full color and included contact information for more information.

Each section of the Pfiesteria brochure includes one or two short paragraphs. Full color photographs accompany the text. The first page included three sections. The first section of the brochure began with a simple definition of Pfiesteria. The second section explains that Pfiesteria stuns with released toxins and that the toxins are believed to cause sores on fish. The third section states that toxic outbreaks of Pfiesteria are short but Pfiesteria-associated fish kills can last for days or weeks. The second page included three sections. The fourth section of the brochure describes other sources of fish kills and sores. The fifth section then describes more fully where Pfiesteria has and has not been found with an illustrative map. The sixth section emphasizes the scientific uncertainty about Pfiesteria by using qualifiers to describe each source of outbreaks including the presence of a large number of fish, pollutants and excess nutrients. The back page of the brochure contained three sections. The seventh section of the brochure discusses health effects and included the statement: "There is no evidence that Pfiesteria-associated illnesses are associated with eating finfish or shellfish." The eighth section stated that

[2]The fact sheet formerly resided at http://www.epa.gov/owow/estuaries/pfiesteria/fact.html. It has since been taken down from the EPA's website. The brochure and insert information was simplified by the authors and revised based on comments received from focus groups and from a review by an ecologist familiar with the Pfiesteria scientific literature. All survey materials are available upon request.

brown and red tides and Pfiesteria are types of harmful algal blooms. The ninth section provided state Pfiesteria hotline numbers.

In the hypothetical fish kill insert, respondents in North Carolina were asked to consider a hypothetical press release about fish kill in the Neuse River near New Bern, NC. The wording for the hypothetical press release followed closely the wording of actual government press releases describing fish kill events. Respondents in Delaware, Maryland, and Virginia were asked to consider a hypothetical fish kill in the Pokomoke River on the eastern shore of Maryland. There were major and minor versions for the hypothetical fish kills. The major fish kill is described to affect approximately 300,000 Menhaden, 10,000 Croaker and 5,000 Flounder. The minor fish kill is described to affect approximately 10,000 Menhaden.

Another insert provided further information about fish kills and a proposed mandatory seafood inspection program. The fish kill information included a bar chart defining major and minor fish kills. The other side of the insert proposed a mandatory inspection program by the U.S. Department of Commerce (USDC) instead of the voluntary inspection services of seafood producers and processors (under the authority of the Agricultural Marketing Act of 1946).

The final insert, "counter information" is intended to enforce the notion of the safety of seafood. The information states "YES. In general it IS safe to eat seafood". It further reports that there has never been a case of illness from eating finfish and shellfish exposed to Pfiesteria and that swimming and boating and other recreational activities in costal waters are generally safe. Finally, it has information on what is being done about Pfiesteria by the collaboration of state, federal, and local government and academic institutions. The expectation is that respondents who received this counter information are less likely to worry about seafood safety. Eighty percent of the sample were to receive the Pfiesteria brochure and 40 percent of these were to receive the counter information. Twenty-percent were to receive neither source of information. All respondents receive either the major or minor fish kill insert.

About three weeks after the information was mailed, interviewers attempted to contact the respondents. The second telephone interviews were conducted from October through November. One thousand four hundred and three respondents agreed to participate in the second survey. This represents 77 percent of respondents to the first survey and 46.9 percent of those contacted for the first survey. Of these, 1149 were contacted with 846 completing the interview. After deleting coding errors between the first and second survey, 835 completed interviews remain. The response rate to the second survey is 72.7 percent of those who were contacted for the second survey and 27.9 percent of those contacted for the first survey. The response rate of those who agreed to participate and were contacted for the second survey is 70.1 percent for Delaware, 43.5 percent for Washington D.C., 81.7 percent for Maryland, 73.5 percent for North Carolina and 76.9 percent for Virginia. Deletion of ineligible respondents and those who did not answer all of the risk perception and demand questions leaves a sample of 646.

The Questionnaires

The first telephone interview collected information on seafood consumption patterns and costs, revealed and stated seafood demand under a variety of pricing scenarios, seafood health risk, attitudes and perceptions about seafood and Pfiesteria, and socioeconomic information. A series of questions were asked to gather qualitative and quantitative perceived risk information. The qualitative risk question is: “To get a better idea of how safe you think you are from eating seafood, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are very likely, somewhat likely, somewhat not likely, or not likely at all?"

A quantitative risk question was asked immediately after the qualitative question and presents a dichotomous choice with a follow-up: "Do you think your chances are greater or less than 1 percent?" The interviewers accepted the potential answer categories "more," "less," or "about 1 percent." Respondents who perceive that the chance of getting sick is less than one percent were asked a follow-up question with a lower risk amount: "This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in D?" The denominator D took on one of four possible values: 1000, 10,000, 100,000, or 1,000,000.

Respondents answered a set of four questions about the number of seafood meals they consumed each month. They were first asked how many seafood meals they ate the previous month (revealed behavior) and how many they would eat the next month (stated behavior). They were asked how many seafood meals they would eat next month if seafood meal prices went up by one of four different prices ($1, $3, $5, $7) while all other food prices remain the same. Also they were asked how many seafood meals they would eat next month if price went down by one of four different prices ($1, $2, $3, $4) while all other food prices remain the same. Price changes were randomly assigned to respondents.

The second (follow-up) interview was designed to collect information on seafood demand, seafood health risk, and attitudes about seafood and Pfiesteria. Most of the questions were identical or similar to questions asked in the first survey. The main purpose of these questions is to determine if seafood demand, perceived health risk and attitudes about Pfiesteria change after receiving the informational inserts.

Respondents were asked to assess their perceived risk of eating seafood under two different scenarios. First, they were asked for their qualitative and quantitative risk assessment after the hypothetical fish kill. Then they were asked for their qualitative and quantitative risk perceptions after the mandatory seafood inspection program is implemented. The qualitative and quantitative risk questions are the same as those in the first interview.

Respondents were asked five additional seafood consumption questions: how much seafood they ate during the past month (revealed preference), how much they would eat next month, how much they would eat next month after the fish kill, how much they would eat next month after the fish kill and with the seafood inspection program and, finally, how much they would eat next month after the fish kill, with the seafood inspection program and a higher price for seafood meals ($1, $3, $5, or $7).

Data Summary

The data summary for four groups of respondents is presented in Table 1. Thirty-one percent of the sample is white male, 7 percent is nonwhite male, 45 percent is white female and 17 percent is nonwhite female. A key difference across group is in income with white male respondents reporting substantially greater household income. Nonwhite males and females are more likely to live in an urban county.

The quantitative risk perception data is summarized in Table 2. The variable SICK is equal to one if respondents thought there chances of getting sick are greater than the suggested probability. In the baseline scenario, 37 percent of respondents thought that their chance of getting sick from eating seafood meals during a month was greater than 1 percent. After a fish kill, 57 percent of respondents thought their chances of getting sick were greater than 1 percent. After a fish kill but with a seafood inspection program, 31 percent of respondents thought their chances of getting sick were greater than 1 percent. For those respondents who thought their chances of getting sick were less than 1 percent, the percentage that thinks their chances of getting sick are greater than the randomly assigned probability rises as the probability falls. In the baseline sample the probability rises from 34 percent to 59 percent as the probability falls from p = .001 to p = .000001. In the fish kill scenario the probability rises from 30 percent to 42 percent. In the fish kill with the seafood inspection scenario, the probability rises from 21 percent to 39 percent.

Seafood consumption choices and seafood prices are presented in Table 3. Scenarios 1-4 were elicited in the first telephone survey. The seafood meal price is defined as the product of the average price of seafood meal at a restaurant and the quantity of seafood meals at a restaurant plus the product of the average price of seafood meals cooked at home and the quantity of seafood meals at home. This is then divided by the sum of quantity of seafood meals at a restaurant and quantity of seafood meals at home to give the average price of a seafood meal for each respondent. The average, or typical, prices of seafood at restaurants and at home were obtained during the survey. The average price of all meals is about $10. The randomly assigned price changes are added to this price where appropriate.

The first question elicited seafood consumption for the past month (revealed behavior). The second question elicited stated preference seafood consumption for the next month. The third question elicited stated preference seafood consumption for the next month with a price increase. The fourth question elicited stated preference seafood consumption for the next month with a price decrease. As expected, seafood consumption decreases with the price increase and decreases with the price increase. There are no significant differences between the baseline revealed and stated preference data. Scenarios 5- 9 were elicited in the second telephone survey. Comparing across surveys, seafood consumption is higher in the baseline revealed and stated preference scenarios. This suggests that information, specifically participation in a seafood safety survey, negatively influenced seafood consumption. As expected, seafood consumption decreases with the fish kill, increases with the seafood inspection program (with the fish kill) and decreases with the price increase (with the fish kill and seafood inspection program).

Empirical Models

To analyze the dichotomous responses to the quantitative risk question we first briefly describe the empirical modeling strategy. Let *r* be the risk of getting sick from eating seafood in a typical month. In general:

(1) $$r = r(s, \varepsilon)$$

where *s* is a vector of socio-demographic, attitudinal and information variables, and ε is an unobservable error term assumed to be mean zero. The function $r(s, \varepsilon)$ is bound between zero and 1.

If the probability of getting sick per seafood meal, π, is independent of all other seafood meals eaten then the probability of getting sick in a given month is the binomial probability:

(2) $$r = \pi^{x}(1-\pi)^{T-x}$$

where $\pi = g(s)$ is the per seafood meal probability of illness and T is the total number of meals eaten per month. Because unobservable effects (e.g., poor food handling practices at home or in frequented stores, or restaurants) might introduce interdependence between the probabilities of illness from one meal to the next, we will rely on the more general formulation of the monthly probability of illness. In general, the monthly probability of illness is at the very least unobservable to the researcher, and in many cases uncertain to the respondent.

The quantitative risk question asks respondents a series of dichotomous risk response questions of the stylized form: Do you think your chances of getting sick (in a typical month) are greater or less than *z* percent? Suppose**:**

$$(3) \qquad r(s,\varepsilon) = \frac{1}{1+e^{s\beta+\varepsilon}}$$

where *s* is a vector of individual specific covariates that may include socio-demographic variables, attitudinal and perception of illness and safety variables, and information treatments. The probability that $r \geq z$ is then:

$$(4) \qquad \begin{aligned} P(r \geq z) &= P\left(\frac{1}{1+e^{s\beta+\varepsilon}} \geq z\right) \\ &= P\left(\varepsilon \leq \ln\left(\frac{1}{z}-1\right) - s\beta\right) \end{aligned}$$

If we assume that $\varepsilon \sim N(0,\sigma^2)$ then

$$P(r \geq z) = P\left(\frac{\varepsilon}{\sigma} \leq \frac{\ln\left(\frac{1}{z}-1\right)}{\sigma} - s\frac{\beta}{\sigma}\right) \tag{5}$$
$$= \Phi\left(\frac{\ln\left(\frac{1}{z}-1\right)}{\sigma} - s\frac{\beta}{\sigma}\right)$$

This should be recognized as the standard probit probability from a dichotomous choice survey. The risk perception function can be estimated as a probit model with covariate vector $s^* = \left(\ln\left(\frac{1}{z}-1\right), s\right)$ and estimated parameter vector $\beta^* = \left\{\frac{1}{\sigma}, -\frac{\beta}{\sigma}\right\}$.

The quantitative choice question was asked of respondents three different times. The first survey elicits the baseline quantitative risk assessment. If the respondent states that perceived risk is greater than .01 (the amount offered to all respondents), then the quantitative risk assessment was ended. If the respondent perceived risk to be less than 1 percent then they were randomly assigned a follow-up from one of four amounts (z = .001, .0001, .00001 or .000001). The same procedure was followed twice on the follow-up survey: once after the hypothetical fish kill, but before they were told the seafood inspection program (SIP) would be implemented, and once after the seafood inspection was implemented.

To assess the individual responses to the various information treatments the three versions of the quantitative risk perception questions are combined into a single random effects probit panel model.

$$Y_{it} = \phi' X + \varepsilon_{it} \tag{6}$$

where Y_{it} = 1 if household i, $i = 1, \ldots, n$, chooses "greater than" and 0 if "less than" or "about z percent" in time $t = 1, \ldots, 6$, ϕ is a vector of parameters, and X is a vector of independent variables. Each respondent has between three and six responses to the risk perception questions yielding unbalanced panels. A respondent that responded that perceived risk is greater than 1 percent for all three questions would have only three cases. A respondent that answered that the risk is less than or equal to 1 percent for all three questions will have 6 cases (3 first responses and 3 follow-ups). It is assumed that each individual has an error term that carries across all six potential responses, and a random effect that is specific to each of the six responses. This random effect is assumed to be distributed the same across all responses.

Seafood consumption is measured as meals per month and each respondent gave up to nine quantities under different scenarios. We employ a random effects Poisson model. Assume that the number of seafood meals eaten by the individual i in the scenario t, is drawn from a Poisson distribution with mean μ_{it}.

$$(7) \qquad \Pi(x_{it}) = \frac{e^{-\mu_{it}} \mu_{it}^{x_{1it}}}{x_{it}!}$$

where x_{it} = 0, 1, 2,... seafood meals. The logarithm of the mean seafood consumption μ_{it} is assumed to be a function of a vector of variables X including price, income, information treatments, and individual characteristics. In addition, to allow for variation across observations that cannot be explained by the regressors, we assume that μ_{it} also depends on a random variable (u_{it}).

$$(8) \qquad \ln \mu_{it} = \beta' X_{it} + u_{it}$$

If $\exp(u_{it})$ follows a gamma distribution with equal (and constant) scale and shape parameters (θ, θ), then the unconditional number of meals x_{it} follows a negative binomial distribution. If $exp(u_{it})$ is assumed to follow a gamma distribution with parameters varying across groups (θ_i, θ_i), and $\theta_i/(1+\theta_i)$ follows a beta distribution with parameters (a, b), then the random group effects are "layered onto the negative binomial model" (Greene 2003). It also indicates the possible correlation in responses to different scenarios for the same individual.

Empirical Results

The risk perception models are presented in Table 4. We present five models. The first is the pooled model with gender (MALE) and race (WHITE) dummy variables to determine if the magnitude of risk perception differs by demographic group. The next four models are the sub-groups: white-male, nonwhite-male, white-female and nonwhite-female. In each model sample weights based on county population are used to correct for the oversampling of North Carolina and rural areas. The coefficient vector in each of the five models is statistically significant. The random effect parameter, ρ, measures the degree of correlation between the first and second responses. Its significance indicates positive but non-unitary correlation between the initial risk offering and the follow-up.

In our model individuals report whether or not they think their chances of getting sick from a seafood meal are above or below some suggested risk level (.01 through .000001). Their response to this query is our dependent variable – above is coded as 1 and below is coded as 0. As expected, as the amount of risk suggested increases, the probability of reporting above or higher falls. As shown in Table 4 the result (coefficient on PROB) is large, negative, and significant suggesting that individuals had a reasonable understanding of risk in our study. If we think of an individual's perceived risk as being higher when he or she reports above and lower when he or she reports below, we have the following findings. Risk perceptions increase with the major fish kill and if the respondent received the Pfiesteria brochure. The seafood inspection program scenario leads to reduced risk perceptions. Risk perceptions decrease with children, income and tenure in the state of residence. Risk perceptions increase with education and household size. The magnitude of risk perceptions do not differ by gender or race. This pooled model obscures differential results that arise when the four subgroups are estimated separately. A likelihood ratio test indicates that the coefficients of vectors in the subgroup models are statistically different than in the pooled model ($\chi^2 = 124.94$ [df=15]).[3]

The results for the subgroups are somewhat surprising. The only group to consider the probability of getting sick in their responses is the white males. Each of the other groups has statistically insignificant coefficients on the probability variable. The fish kill scenarios had no effect on the nonwhite males and white females. The major fish kill led to increased risk perceptions for white males and nonwhite females. The Pfiesteria brochure had the unintended effect of increasing the risk perception of nonwhite males but had no effect on the other groups. The counter information had the intended effect of decreasing risk perception for white males but

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[3] We also considered models with the number of seafood meals on the right hand side of the risk model. If the number of seafood meals is a factor affecting risk then the sign on the coefficient will be positive. In other words, the more meals eaten the greater the chances of getting sick. If the causality runs the other way the sign on the coefficient will be negative. Lower perceived risk will lead to greater seafood consumption. We find the sign on the seafood meals coefficient is negative and, therefore, drop the variable from the risk model.

had no effect on the other groups. The seafood inspection program had the intended effect of reducing risk perceptions for all groups with the exception of nonwhite males.

Other results are that the number of children decreases risk perceptions and the number of years schooling and household size increases risk perceptions for males. Income and risk perceptions are negatively correlated for nonwhite males. Tenure in the state of residence decreases risk perceptions for white females.

As in the risk perception model, the first demand model is the pooled model with gender and race dummy variables to determine if the magnitude of seafood consumption differs by demographic group (Table 5). The next four models are the sub-groups. In addition to those variables summarized in Table 1, the independent variables in the random effects Poisson demand model include a dummy variable for a stated preference scenario (SP), price of a seafood meal (PRICE) and a dummy variable for scenarios 5-9 in the second survey (SURVEY2). The coefficient vector in each model is statistically significant. The stated preference coefficient is statistically insignificant in the pooled model and insignificant in the split sample models providing weak evidence of hypothetical bias in the stated preference questions. The demand model behaves according to consumer theory with price having a negative effect on consumption in all models. Income has a positive effect on consumption in all but the nonwhite male model indicating that seafood is a normal good.

In the full sample, the minor and major fish kill scenarios lead to reduced seafood consumption. Seafood consumption decreases if the respondent received the counter information. The seafood inspection program scenario leads to increased seafood consumption. Seafood consumption increases with children and decreases with household size and North Carolina residence. White respondents consume less seafood while male respondents consumer more. This pooled model obscures differential results that arise when the four subgroups are estimated separately. A likelihood ratio test indicates that the coefficients of vectors in the subgroup models are statistically different than in the pooled model ($\chi^2 = 107.73$ [df=17]).

The minor and major fish kill scenarios have negative effects on seafood consumption in all sub-sample models (the minor coefficient in the nonwhite male model is statistically insignificant). But, the magnitude of each statistically significant coefficient is similar. The Pfiesteria brochure has the intended positive effect on consumption for males and a negative effect for nonwhite females. The counter information had the intended positive effect on the female groups. The seafood inspection program had the intended positive effect on consumption for each group. Other results are sparse. North Carolina residents eat less seafood except for nonwhite males. White females who have more children, education and smaller households eat more seafood.

Conclusions

In this paper we consider the effects of negative and positive risk information on perceived seafood risks and seafood consumption by gender and race. The data is from a Mid-Atlantic survey of coastal seafood consumers. We elicit risk perceptions in three risk scenarios with a dichotomous choice with a follow-up question format. We elicit revealed and stated preference seafood consumption in nine risk and price scenarios. We find that risk information (fish kills) and countervailing information have differential effects on different demographic groups. Analysis in four gender and race categories indicates that demographic groups respond to the positive and negative risk information in different ways.

Based on the information provided in our surveys, after controlling for other factors, only white males consistently accurately perceive, accept, and manage seafood risk. For example, only white males perceived a substantial probability of becoming ill from eating a month of seafood meals. Fish kill scenarios had no effect on the risk perceived by nonwhite males and white females. Initial information intended to ease Pfiesteria concerns actually increased perceived risk of nonwhite males, though it increased their estimates for likely seafood consumption. Oddly, the same initial Pfiesteria information decreased estimates of seafood consumption among nonwhite females. After hearing additional information intended to further ease Pfiesteria concerns, white males were the only group with decreased perceived risk, though this additional information did increase estimates of seafood consumption among white and nonwhite women. The proposed seafood inspection programs had no impact on perceived risk among nonwhite males, though it did, as with all other groups, increase their estimates of seafood consumption.

Apparently, only white males trust the information provided on seafood risk. White men may perceive less risk because they have more power and control over their lives, communities, and institutions. Subsequently, they have more trust in institutions associated with food safety, fisheries, and public health. As Slovic (1999) points out, "danger is real, but risk is socially constructed" (p.689). To truly inform people of seafood safety and risk, we need to build trust in less advantaged groups (Slovic 1999). Public health leaders should consider using different media and voices to convey information about seafood risk across diverse groups of people (Burger et al. 1999).

We need improved educational campaigns, with more use of newspapers and television advisories (Burger, Sanchez and Gochfeld, 1998) and face-to-face communications among community members (Burger et al. 2003; Bettman et al., 1987). These campaigns should be repeated frequently (McIntosh and Acuff, 1994) and target younger people (Burger, 2005). Health advisories should include the benefits and the risks associated with eating seafood and should include specific information pertaining to children, child-bearing age women, and pregnant women (Knuth et al., 2003).

Our results suggest that risk communication continues to be a challenge. Our primary risk communication device did not change risk perceptions and it changed behavior in the intended direction for males only. Worse, it changed behavior in the unintended direction for nonwhite females. Our secondary risk communication device changed risk perceptions for only one of four demographic groups, white males, and changed behavior for females only. Future research into risk communication and mitigation policy should consider the differential impact of risk information on demographic groups. This research should consider the joint role of gender, race and class on the effectiveness of risk communication instruments.

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Table 1. Data Summary

		Male				Female			
		White		Nonwhite		White		Nonwhite	
		Mean	STD	Mean	STD	Mean	STD	Mean	STD
AGE	Age, in years	46.34	15.44	37.19	12.12	45.27	14.3	42.73	14.06
CHILDREN	18 years of age or younger	0.63	1.00	1.07	1.75	0.58	0.97	0.82	1.00
EDUC	Schooling, in years	15.09	2.63	14.82	2.84	15.42	2.27	14.66	2.42
HOUSE	Household size	2.54	1.24	2.98	1.99	2.58	1.26	2.69	1.31
INCOME	Household income	65.63	25.96	58.96	27.62	57.74	27.39	44.86	22.92
NC	North Carolina resident	0.29	0.45	0.24	0.49	0.26	0.43	0.24	0.44
STATE	tenure in state	28.82	17.9	20.53	16.17	27.2	20.04	29.30	18.80
URBAN	Urban county	0.50	0.49	0.82	0.45	0.50	0.49	0.74	0.45
COUNTER	1 if received counter information	0.37	0.47	0.23	0.49	0.40	0.48	0.28	0.46
PFIEBROC	1 if received pfiesteria brochure	0.71	0.45	0.57	0.58	0.72	0.44	0.67	0.49
MAJOR	Major fish kill	0.56	0.49	0.44	0.58	0.46	0.49	0.50	0.52
MINOR	Minor fish kill	0.44	0.49	0.56	0.58	0.54	0.49	0.50	0.52
Cases		200		44		291		111	

Note: Weighted means.

Table 2. Risk Perception

		Baseline			Fish Kill			Fishkill with Seafood Inspection Program		
Question	Probability	SICK	Sample Size	% SICK	SICK	Sample Size	% SICK	SICK	Sample Size	% SICK
First	0.01	236	646	36.53	366	646	56.66	202	646	31.27
Second	0.001	36	104	34.62	22	74	29.73	27	127	21.26
Second	0.0001	42	92	45.65	22	67	32.84	25	107	23.36
Second	0.00001	43	103	41.75	11	65	16.92	27	113	23.89
Second	0.000001	66	111	59.46	31	74	41.89	38	97	39.18

Note: SICK is the number above the threshold probability

Table 3. Seafood Consumption

				Quantity		Price	
Scenario	Preference	Price	Quality	Mean	STD	Mean	STD
1	Revealed	Baseline	Baseline	5.41	5.12	10.84	4.81
2	Stated	Baseline	Baseline	5.45	5.25	10.84	4.81
3	Stated	Increase	Baseline	4.43	4.9	14.81	5.28
4	Stated	Decrease	Baseline	6.79	5.77	8.36	4.9
5	Revealed	Baseline	Baseline	4.84	4.55	10.84	4.81
6	Stated	Baseline	Baseline	4.82	4.58	10.84	4.81
7	Stated	Baseline	Fishkill	3.89	4.62	10.84	4.81
8	Stated	Baseline	Fishkill with Seafood Inspection Program	4.78	4.72	10.84	4.81
9	Stated	Increase	Fishkill with Seafood Inspection Program	3.77	4.32	15.09	5.32

Note: Weighted means.

Table 4. Random Effects Probit Models of Risk Perception

	Full Sample		Male				Female			
			White		Nonwhite		White		Nonwhite	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	-0.662	-1.81	-1.347	-2.50	-2.249	-1.58	-0.571	-0.89	-0.425	-0.37
PROB	-17.827	-3.27	-59.251	-5.99	5.403	0.17	-3.037	-0.35	14.053	0.96
MINOR	0.064	0.73	0.271	1.64	-0.113	-0.23	0.007	0.06	0.090	0.38
MAJOR	0.302	3.37	0.298	1.96	-0.161	-0.37	0.198	1.25	0.706	3.11
PFIEBROC	0.169	2.00	0.059	0.39	0.628	1.69	0.199	1.49	0.112	0.42
COUNTER	-0.126	-1.53	-0.358	-2.76	0.313	0.69	-0.036	-0.27	-0.142	-0.62
SIP	-0.707	-8.77	-0.597	-4.27	-0.584	-1.45	-0.802	-6.10	-0.774	-3.37
AGE	0.003	0.84	0.003	0.50	0.000	0.00	0.009	1.63	-0.009	-0.78
CHILDREN	-0.168	-2.61	-0.269	-2.22	-0.651	-3.46	-0.032	-0.28	-0.050	-0.25
EDUC	0.037	1.94	0.063	2.16	0.165	2.13	0.034	1.04	0.010	0.16
HOUSE	0.125	2.27	0.241	2.72	0.546	2.97	-0.022	-0.21	0.126	0.79
INCOME	-0.003	-1.82	-0.003	-0.91	-0.021	-2.15	-0.003	-1.11	0.001	0.22
NC	0.126	1.28	0.211	1.52	-0.393	-0.89	0.087	0.52	0.298	1.10
STATE	-0.005	-1.82	0.002	0.45	-0.008	-0.68	-0.009	-2.18	-0.007	-0.77
URBAN	-0.046	-0.50	-0.008	-0.05	-0.322	-0.74	-0.077	-0.52	0.215	0.84
WHITE	–0.027	–0.28								
MALE	-0.106	-1.21								
ρ	0.361	10.88	0.274	4.60	0.152	0.96	0.404	7.70	0.361	3.78
LL Function	-1956.91		-612.78		-109.55		-828.34		-305.90	
LL(0)	-2024.26		-647.54		-130.44		-905.27		-339.55	
$\chi 2$	134.69		69.53		41.78		153.87		67.31	
Cases	646		200		44		291		111	
Observations	3072		986		213		1370		503	

Note: Weighted regressions.

Table 5. Random Effects Poisson Models of Seafood Demand

			Male				Female			
	Full Sample		White		Nonwhite		White		Nonwhite	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	2.090	8.01	2.001	3.73	2.500	1.95	1.796	4.33	2.371	3.79
SP	0.026	0.56	0.038	0.39	0.039	0.12	0.016	0.24	0.023	0.16
PRICE	-0.052	-20.45	-0.050	-9.81	-0.063	-4.33	-0.052	-12.25	-0.056	-8.35
INCOME	0.007	4.91	0.008	3.55	0.006	0.67	0.004	2.04	0.008	2.06
MINOR	-0.272	-6.83	-0.245	-3.14	-0.200	-1.35	-0.263	-3.79	-0.415	-3.51
MAJOR	-0.286	-6.98	-0.225	-3.01	-0.479	-2.31	-0.233	-3.25	-0.488	-4.20
PFIEBROC	0.019	1.29	0.174	5.53	0.255	2.39	-0.022	-0.92	-0.305	-6.62
COUNTER	0.061	4.78	-0.003	-0.09	-0.023	-0.40	0.080	4.05	0.100	2.04
SIP	0.229	6.34	0.179	2.96	0.305	1.71	0.219	3.43	0.352	2.99
SURVEY2	-0.185	-7.91	-0.246	-5.45	-0.422	-3.40	-0.170	-3.96	0.077	1.26
AGE	0.000	-0.05	-0.005	-1.06	-0.028	-1.22	0.004	0.94	0.008	1.08
CHILDREN	0.084	1.75	-0.045	-0.42	0.124	0.62	0.181	1.86	0.020	0.13
EDUC	0.016	1.16	0.003	0.14	0.109	1.08	0.042	1.89	-0.025	-0.73
HOUSE	-0.120	-3.03	-0.017	-0.21	-0.117	-0.65	-0.208	-2.57	-0.093	-0.75
NC	-0.452	-6.98	-0.232	-1.85	-0.695	-1.37	-0.544	-5.13	-0.536	-3.07
STATE	0.001	0.55	-0.001	-0.32	0.013	0.89	0.000	0.04	-0.003	-0.45
URBAN	-0.046	-0.74	0.147	1.10	-0.646	-1.16	-0.080	-0.76	0.041	0.25
WHITE	-0.138	-2.04								
MALE	0.165	2.77								
α	0.537	16.63	0.546	7.88	0.478	2.48	0.524	11.29	0.447	5.29
LL Function	-11950.63		-3701.796		-903.90		-5286.03		-2010.09	
LL(0)	-18651.88		-5743.02		-1507.91		-8526.69		-2808.23	
$\chi 2$	13403		4082		1208		6481		1596	
Cases	646		200		44		291		111	
Observations	5814		1800		396		2619		999	

Note: Weighted regressions.