Human Ecology, Vol. 24, No. 1, 1996

Pollution, Food Safety, and the Distribution of Knowledge

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Human perceptions of the relationship between pollution and food safety are often haphazard and contradictory, based on a variety of sources of information. Recent media events concerning seafood and coastal pollution have generated concern that an otherwise healthy food—fish and shellfish—has become dangerous. We assess consumer knowledge about seafood safety and coastal pollution using several methods, including tests of cultural consensus. We find that consumers view seafood as far more threatened by pollution than scientific analysis suggests, due in part to their perceptions about the dynamics of the marine environment. Finding variation in perceptions within our population based on income and other factors, we explore the use of the cultural consensus approach in large and heterogeneous populations.

KEY WORDS: intracultural variation; consensus analysis; pollution; risk.

INTRODUCTION

Jeremy Rifkin's *Beyond Beef* (1992) is yet another recent popular text questioning the journey foods make from the natural environment to the table. It joins the shelves with Upton Sinclair's *The Jungle*, Rachel Carson's *Silent Spring*, and Adele Davis's anti-carcinogenic cookbooks, along with stacks of transcripts from Congressional investigations and special reports of the Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA). These consumer concerns reflect similar concerns about pollution, which is not merely coincidental. Considered in light of the passage of foods from the natural environment to the table, pollution

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0300-7839/96/0300-0087$09.50/0

becomes an aspect of the consumption behaviors of earth, air, water, and the plants and animals that rely on them for growth. In short, what the planet consumes, we consume.

Unfortunately, these concerns have stimulated less systematic research about how humans actually perceived pollution and its relationship to food safety than sensationalist responses such as Rifkin's. In large part, public concern about pollution and food safety has generated confusion and contradictory consumer behaviors. On the one hand, FDA attacks on food labeling revealed widespread distortion and duplicity within the food industry, particularly in terms of fats, sodium, dyes, and other appearance-enhancers, and preservatives in various foods. On the other, representatives of the food system have capitalized on the confusion, inventing consumer products that create images of healthy eating without necessarily adding corresponding nutritional advantages. Such inventions include skin-free Kentucky Fried Chicken, Heart Smart menus, salad bars with fattening dressings and toppings, the McLean Burger at McDonalds, and the widespread practice of offering diet soft drinks to wash down double cheeseburgers and fried potatoes.

Over the past two decades, experiencing unprecedented growth, the seafood industry has been particularly challenged by these developments. Consumers of the mid-1980s witnessed discoveries in the health benefits of omega-3 fatty acids, in particular their purported role in combating heart disease. Other information about seafood's low-fat, low-cholesterol qualities spurred further consumer demand. Yet just as the industry seemed to be taking off, the celebrations of record per capita consumption levels were doused with a series of crises of information that caused consumers to reconsider eating large amounts of seafood. News items about coastal pollution—particularly medical waste purportedly laced with vials carrying the HIV virus—appeared in the late 1980s that caused rapid drops in seafood consumption throughout the United States. Since then, however, consumption has recovered somewhat, although not yet to its record 1987 levels.

THEORETICAL BACKGROUND

The dynamic condition of the seafood industry within the larger food system makes it a particularly fertile ground for examining human perceptions of the relationships between food safety and pollution and the broader issue of perceptions of risk. Tracing these relationships also provides an opportunity to engage recent work on the nature of cultural knowledge. In particular, we focus on the idea of culture as consensus (Romney *et al.*, 1986), using techniques derived from this approach to examine consumers' thinking about relationships between food safety and pollution. We are particularly interested in examining variation in knowledge about coastal pollution and seafood safety, and how knowledge varies by such factors as social class, residence, and ethnic background.

Much of the literature on cultural knowledge addresses the problem of intracultural variation regarding specific knowledge domains. When is variation simply idiosyncratic and when does it signal a distinct, alternative understanding? Are variations simply superficial manifestations of more deeply held, shared, and agreed upon cognitive schema, the way sentences with different meanings can express the same linguistic structures? The problem extends beyond the mere existence and significance of variation to questions of causality. Are significant variations (if they do exist) the result of differential access to knowledge based on such factors as gender, class position, ethnicity, or residence?

Different methodological, theoretical, and epistemological orientations lead to varying degrees of sensitivity to intracultural variation; recognizing that significant intracultural variation exists, of course, is a prerequisite to searching for the causes of such variation. Cultural consensus analysis views knowledge as consensus, or the idea that high degrees of agreement with a subject area (i.e., a "domain") represents a cultural model (Boster and Johnson, 1989; Romney *et al.,* 1986; Weller and Romney, 1987). This is not to say that cultural consensus methodologies cannot also be used to discover inter- and intracultural variation, but suggests only that certain domains or knowledge areas within cultures are shared. Others have studied intracultural variation with the use of the consensus model. For example, Weller *et al.* (1993) studied intracultural variation in beliefs about illness in four distinct Latin groups. Boster and Kempton (1993) have looked at variation in beliefs about global pollution among environmental vs. industry groups. Glazier (1992) studied beliefs about the damage caused by the *Exxon Valdez* oil spill in groups segregated by distance from the oil spill site. This also follows in the spirit of variation in knowledge between expert and novice groups (Boster and Johnson, 1990; Romney, 1980). In this paper, we attempt to specifically explain the link between political economic factors and variation in knowledge.

Much recent work in anthropology and related disciplines derives from a tradition that considers a wide range of behavior (including intracultural variation) as heavily influenced by political economic factors; specifically, knowledge is not merely variable or unevenly shared, but controlled and unevenly *distributed* as a component to various kinds of power relations (e.g., gender, class, age, etc.—Bourdieu, 1984; Holland, 1984; Mathews, 1987, 1992; Strauss, 1991). In the creation, dissemination and revision of information about pollution, we should expect contradictions to emerge because even those who recognize the negative consequences of certain pollutants may have some material interest in allowing others to contaminate the environment and the food they eat. In eastern North Carolina, for example, logging and lumber companies are often cited as major polluters, accused of (among other things) pouring dioxin into rivers and causing fish kills. More to the point, the recent expansion of hog farming has generated protests over groundwater contamination and air pollution. From recent disputes over clear-cutting and spotted owl controversies in the Pacific Northwest, most of us have been exposed to the jobs-for-forests trade-off that accompanies targeting lumber companies as environmental rapists. Within these debates lurk clear material interests: a lumberjack keeping his job, a service-and-information, paper hungry economy maintaining its supply of the pin-fed reams on which we print our drafts of journal articles, a herring fisherman on the Chowan River blaming declines in fish populations on increased levels of dioxin found downstream from a pulp plant. These material interests encourage us to overlook those bits of information that, though they may conflict with other beliefs or folk theories we cherish, assist us in reproducing the class positions we occupy.

At the same time, we are able to incorporate, remember, and reiterate conflicting or contradictory knowledge in a variety of ways. Strauss contends that "types of cognitive organization" (1991, p. 315) vary according to the contexts in which they are expressed and the extent to which they access well-articulated theoretical positions; they also reflect different learning processes and inspire different behaviors. While Strauss is only moderately successful in supporting her propositions of "compartments" of the mind, her examples illustrate the human mind's capacity to hold, express, and reinforce contradictory theoretical positions that entail alarmingly conflicting experiences.

In this paper, exploring these theoretical perspectives, we seek to discover whether or not knowledge is unevenly shared among groups that are distinct in terms of concrete political economic criteria (e.g., ethnicity, geographical residence, education, and income). Again, the rapid changes occurring in consumer knowledge of seafood and its relationship to pollution provide the setting against which we can assess what these approaches have to contribute.

THE CURRENT CRISIS OF SEAFOOD CONSUMPTION

Trends in Consumption. In the 60 years from 1909 to 1969, annual per capita seafood consumption rose above 11.5 lb only eight times; throughout this period, consumption hovered between 10.5 and 11.5 lb. From 1970 to

1990, however, seafood consumption rose by 31.3%, from 11.8 lb to 15.5 lb, reaching a record level of 16.2 lb in 1987 before dropping back to around 15 lb per capita (National Marine Fisheries Services, 1990).

Seafood consumption has not been evenly distributed across regions, across species, or across seafood products. First, in addition to the slow growth of inland markets, much of the increase has been due to rapid growth in seafood consumption in coastal regions along with disproportionate population growth in these regions (Murdock *et al.,* 1992). Growth in consumption has also been disproportionately concentrated in a few species. These are tuna and shrimp, primarily, followed by those species that have the flesh qualities desired by consumers: cod, pollock, salmon, catfish, clams, flounder, scallops, and crabmeat. Farm raised catfish and other cultured species are also growing in importance, many of which (e.g., striped bass, crawfish, telapia) were little known until recently. In addition, the increase in seafood consumption has taken place in primarily fresh and frozen products instead of canned or cured products. Canned products consumption—primarily of canned tuna and salmon—has remained relatively stable since about 1934; cured products (those that are dried, pickled, smoked, salted, etc.) have not risen above a pound per capita in any year since 1930. Through the 1980s we have also seen the birth of a number of seafood products that have taken advantage, primarily, of new forms of packaging, brand recognition, and the emphasis on convenience and new cooking technologies.

Increased Government and Consumer Scrutiny of Seafood. While the seafood industry has rejoiced in growth in consumption of seafood, this growth has been a mixed blessing. The high demand for fresh fish and shellfish has been accompanied by increased consumer concerns over the dangers of eating seafoods that have been contaminated by industrial pollutants, medical wastes, and biological toxins. A recent issue of *Consumer Reports*, for example, after a 6-month investigation that sampled seafood from fish markets and supermarkets around the country, opened with: "Nearly half the fish we tested was contaminated by bacteria from human or animal feces, most likely the result of poor sanitation practices at one or more points in the fish-handling process. Some species were contaminated with PCBs and mercury" (1992, p. 103). The article went on to report that 15% of the fish sampled was potentially hazardous, and 29% was spoiled; between 56 and 58% was acceptable.

The *Consumer Reports* study was only one of a series of negative media events. Again, like information consumers receive about food in general, information about seafood has been alarmist, reactionary, and confounded by confusing and contradictory findings. During the summer of 1988, cover stories about coastal pollution appeared in widely circulated news magazines such as *Time* and *Newsweek*, stimulating decreases in seafood consumption along the eastern seaboard. On NBC's January 31st, 1989 *The Today Show*, Lee Weddig of The National Fisheries Institute (NFI) debated consumer advocate Ellen Haas (Public Voice of Food and Health Policy) concerning the potential for seafood to cause illness and death. The debate centered around a legislative initiative to consider a federal seafood inspection program similar to that for poultry, pork, and beef. According to Haas, "less than 11% of all the fish that we consume is inspected. And when it comes to chemical contaminants, less than 1% is looked at for the kind of pollutants that can be found in fish." Industry spokesperson Weddig, on the other hand, maintained that the consumer was at no great risk, citing FDA, state and corporate inspections of seafood. Other news articles that have appeared over the past 4 years have cited the diversity of handling stages between fishermen and consumers as potential threats seafood safety (*Washington Post*, January 21, 1989), and the increasing wariness of seafood restaurants toward serving fish from some locations (e.g., the Boston Harbor) as opposed to others (*Raleigh News and Observer*, January 29, 1989; *USA Today*, April 10, 1989). Finally, early in 1992, cooks from seafood restaurants all across the country marched on Washington demanding that they consider a mandatory seafood inspection program because of the dangers of eating chemically contaminated seafood. Despite widespread concerns by the seafood industry about these negative media events and their impact on seafood consumption, very little research has been conducted on how consumers perceive seafood, how they respond to incidents of seafood pollution, how they understand pollution's effects on various fish and shellfish, how this varies by region and social class, and so forth. In this paper, we begin to address this problem as well as the theoretical problem posed earlier.

SAMPLING, METHODS, AND INSTRUMENTS

This study draws upon a number of databases developed by the authors. These include: (1) judged similarity data about various species of fish in relation to one another, seafoods in relation to other foods, and kinds of pollution in relation to one another and in relation to various seafoods; (2) responses to a series of true–false statements derived from open-ended interviews about seafood and pollution; (3) a Frequency Recall Evaluation of Dietary Intake (FREDI) test, eliciting information from 122 informants about foods consumed in the 24 hours prior to the interview; and (4) in-depth interviews with consumers about their beliefs about food in general, seafood safety, and coastal pollution. While all these databases informed this analysis, we focus primarily on the true–false "test" in this argument, reserving the other databases for a lengthier treatment of food consumption.

We administered the true–false "test" to 142 randomly selected respondents, differentiated from one another by residence (rural vs. urban and coastal vs. inland), minority status, socioeconomic level, and a fourth feature we call access to "expert" information. Combining these variables, we arrived at the groups shown in Table I.

We first conducted a series of preliminary semi-structured interviews with informants from the areas to be sampled, eliciting types of pollution found in coastal and marine settings and asking informants to describe how these pollutants might affect seafood and marine life. Informants from all segments of the final sample design were interviewed. Using these interviews, three researchers independently developed a list of statements for the test of cultural consensus (see Appendix). The final 53 statements were the most common statements found on the three lists. We worded statements so that approximately half were stated in the negative (e.g., are not) while the other half were stated in the positive (e.g., are) in order to minimize any potential bias due to statement construction.

FINDINGS

The Nature of Agreement

Theories of intracultural variation lead us to expect respondents to disagree with one another based on indicators of social class position. To

Table I. Subsamples

1.	Inland rural upper income minority (N = 10)
2.	Inland rural lower income minority (N = 10)
3.	Inland rural upper income nonminority (N = 10)
4.	Inland rural lower income nonminority (N = 10)
5.	Coastal rural upper income minority (N = 10)
6.	Coastal rural lower income minority (N = 10)
7.	Coastal rural lower income nonminority (N = 10)
8.	Coastal rural upper income nonminority (N = 11)
9.	Urban upper income minority (N = 10)
10.	Urban lower income minority (N = 11)
11.	Urban upper income nonminority (N = 10)
12.	Urban lower income nonminority (N = 10)
13.	Students (N = 10)
14.	Scientist (N = 10)

test this, the true/false responses were subjected to a test of cultural consensus (Romney *et al.*, 1986). The insight that much of the variation between individuals is due to their differential knowledge of the culturally defined "truth" forms the basis of the cultural consensus model (Romney *et al.*, 1986, 1987; Weller, 1987). According to their model, if individuals share a common culture, if their answers are given independently, and if their level of knowledge is constant over all questions, then the expected average agreement between any pair of individuals is the product of their knowledge levels. In practice, one works backward from the patterns of agreement among individuals to estimate their competences through the use of minimum residual factor analysis. The cultural consensus model is an important development because it allows precise calculation of how much and what part of the pattern of agreement between informants is due to their shared knowledge of the cultural knowledge, reconstruction of the answer key from the responses to a series of questions, estimates of how many informants should be interviewed to achieve a given level of certainty about the ethnographic "facts," and so on. One unfortunate early problem with cultural consensus analysis is the use of the term "competence," which, without clarification, implies a value judgment about the intelligence of respondents or groups of respondents, particularly to those who are familiar with the use of the term in Elizabethan England, where to be competent was to have achieved a social status which commanded land and labor (Vickers, 1994). We avoid the use of the term here, speaking instead of agreement with (or fit) the consensus structure.

If the data fit the consensus model, the ratio of the first to second latent root in a minimal residual factor analysis should be relatively large (at least twice as large) and with no negative scores on the first factor. Figure 1 shows the distribution of factor loadings on each individual's fit to the consensus by the 14 subgroupings: the rule of thumb is, the longer the box plot, the less the consensus within the group. Table II shows the mean fit to the consensus of the overall analysis and by subgrouping, showing that the first factor loadings (with the exception of the coastal low-income minority group) are positive and relatively large. This reflects overall agreement among respondents in that the data fit the model: the first latent root is 7.2 times as large as the second. According to the criteria of the cultural consensus model, then, for the entire set of statements we could not conclude that alternate subcultural models exist, whether these models are based on income, ethnicity, residence, or related political economic factors.

Given the presence of overall agreement, the question becomes: are there any systematic reasons why some statements yield high agreement and others low agreement? To address this question, we compared state-

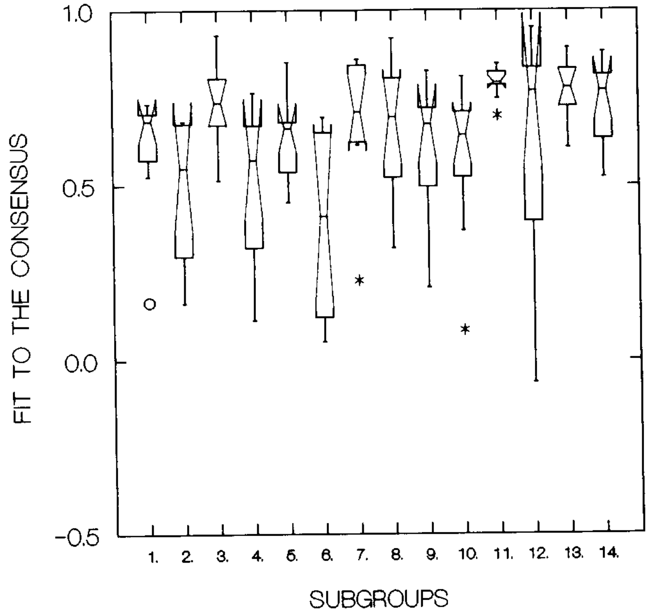

Fig. 1. Box plots of fit to the consensus by subgroup.

Table II. Summary Statistics for Consensus Analysis of Total Sample

	Mean fit to the consensus	SD
Rural inland		
Minority upper income	.609	.170
Minority low income	.497	.198
Nonminority upper income	.739	.118
Nonminority low income	.512	.219
Rural coastal		
Minority low income	.389	.281
Minority upper income	.639	.219
Nonminority upper income	.662	.220
Nonminority low income	.694	.190
Urban coastal		
Minority upper income	.616	.189
Minority low income	.578	.204
Nonminority upper income	.790	.043
Nonminority low income	.619	.346
Students	.774	.088
Scientists	.739	.116

ments in which 90% agreed vs. statements eliciting less than 75% agreement. The lowest limit was 50% for a single statement. The Appendix shows a breakdown of the questions yielding each type of agreement.

First, those statements that generated disagreement within the sample were of two kinds: (a) statements about *specific* characteristics of fish, shellfish, or pollutants (2, 10, 11, 12, 20, 37, 38, 39, 45, 53); and (b) statements about the habits or integrity of the seafood industry or industry in general (1, 25, 30). By contrast, those statements that elicited high agreement concerned far more general relationships between seafood safety and pollution (6, 9, 15, 16, 34, 44, 49, 52) or, less often, concerned consumer knowledge about or attitudes toward seafood (35, 40, 43).

The fact that more general statements, reflecting cause and effect and personal opinion, yielded higher consensus than statements requiring more knowledge and detail is not surprising. These results confirm earlier research that, without detailed information or first-hand experience, people link pollution to the most extreme of negative outcomes. Glazier (1992), for example, found that North Carolina residents had higher agreement about the effect of the *Exxon Valdez* oil spill than did Alaska residents because, in the face of no experiential knowledge, North Carolinians consistently assumed the worst.

We interpret these findings to mean that consumers do seem to agree that there are direct relationships between seafood safety and pollution, but the exact nature of these relationships remains unclear. They admit, as well, to their ignorance along these lines, while disagreeing about their faith in industry to address the problems that exist. One general principle that summarizes their beliefs might read: *whatever can go wrong, will go wrong*. Although some questions regarding the potential risks of eating seafood elicited higher levels of agreement than others, the majority of respondents believed that seafood is highly susceptible to contamination from a variety of sources. This is a general belief, however, which is revealed in examining statements that ask for finer distinctions. They tend not to discriminate between different types of pollution, believing that the presence of any kind of pollutant will have negative effects on human health. There is some indication that they believe different species will be affected differently by pollutants (see 17 and 29, for example), yet those statements requiring finer distinctions tend to generate disagreement, as they are asked to choose between the effects of one pollutant over another or the resistance to pollutants of one species as compared to others.

These findings reflect the primitive state of the seafood industry compared to other food industries in the United States, along with the fact that much of the growth in seafood consumption has occurred relatively recently. Knowledge about seafood, especially specific knowledge, remains in an incipient state of development. When combined with knowledge about pollution and specific pollutants, which is often presented to the public in highly politicized contexts (e.g., the debate between Weddig and Haas mentioned above), consumers' knowledge bases become even less consistent within and between groups. We turn now to comparisons between the groups in terms of the extent to which members of each group share knowledge.

Expert Comparison

Comparing the responses of the scientists (the "experts") to the rest of the groups further confirms the idea that those interviewed tend not to make fine distinctions among various components of a marine environment tainted by pollution. Scientists primarily differed from nonscientists in response to four statements:

1. People rarely change their seafood eating habits even though they may have read or heard something bad. Scientists: *F*; Nonscientists: *T*.
2. Larger fish are more likely to carry pollutants than smaller fish. Scientists: *T* Nonscientists: *F*.
3. The dumping of medical waste in the ocean does not cause widespread damage to either fish or humans. Scientists: *T*; Nonscientists: *F*
4. Much of the pollution dumped into coastal and ocean waters has no effect on the flavor of seafood. Scientists: *T*; Nonscientists: *F*.

With the exception of the first statement, in which scientists assume people will change behavior in light of the evidence, the next two statements suggest that scientists perceive the ocean as a larger, more diverse, and more changing environment than do nonscientists. As compared to scientists, also, the novices have more faith in their own sensual powers to determine whether or not a seafood has been adversely affected by a pollutant, believing that pollutants will affect the flavor of fish and shellfish. In fact, during our interviewing, some respondents voiced the belief that seafood that tasted bad had been tainted by a pollutant of some kind. That is, coastal pollution was often used as a scapegoat for any damage to seafood, even that that occurs during the many ex-vessel stages of handling, where much of the spoilage and poor flavor is acquired (National Academy of Sciences, 1991).

Variation Within Agreement

Although the data "fit" the consensus model, as shown in Fig. 1, there is variation in the extent of each group's fit to the first factor. This figure is a box plot showing the median, quartiles, range, and outliers for the distribution of first factor loadings by subgroup. What becomes evident is that the magnitude and variability of these loadings is related to subgroup membership. Table III shows the results of an ANOVA of an individual's fit to the consensus for each of the 14 groups, revealing significant difference among the groups. A Tukey Multiple Comparisons test provides some indication of the source of these differences. The table confirms that the primary difference lies between the coastal rural lower income minority group and the upper income nonminority group, scientists, students, and the coastal rural lower income nonminority group. In addition, there is a difference between the inland rural lower income minority group with the urban upper income nonminority and student groups. Finally, there was a difference between the inland rural lower income nonminority group and the urban upper income–nonminority group. Thus, differences appear due to income and minority status.

While we have isolated the influence of minority status and income, other factors may also influence the variation observed. Formal education,

Table III. Tukey HSD Multiple Comparisons for Mean Fit to the Consensus[a]

		$\bar{X}$ Difference	Probability
Comparison of coastal rural lower income minority with:			
Coastal rural lower income nonminority		.273	.043
Coastal rural upper income nonminority		.305	.015
Inland rural upper income nonminority		.350	.002
Urban lower income nonminority		.306	.021
Urban upper income nonminority		.402	.000
Scientists		.350	.002
Students		.385	.000
Comparison of inland rural lower income minority with:			
Urban upper income nonminority		.293	.025
Students		.277	.049
Comparison of inland rural lower income nonminority with:			
Urban upper income nonminority		.278	.046
ANOVA all groups	*DF*	*F*-Ratio	Probability
	13	3.894	0.000

[a]Significant differences reported.

for example, may have an influence in terms of an individual's awareness of environmental and other issues that would affect both the nature (e.g., liberalism) and acquisition of knowledge. Those more formally educated may also be more familiar with taking true–false tests. A simple correlation between education and fit to the consensus (r = .333; p < .001) suggests that education does in fact have some effect. We also found, not surprisingly, that educational levels were positively related with nonminority status and higher incomes (see Table IV). From the analysis above concerning variation in levels of education, both minority status and, particularly, income were found to be important explanatory variables. Table V shows the result of a two-way ANOVA using both minority status and income to help in understanding intracultural variation. As with education, these two variables (but not their interactions) help in accounting for 16% of the vaiance for the model in which fit to the consensus is the dependent variable. Once again, however, income is the most prominent explanatory variable in the model.

Alternative Folk Models

Although differences exist, do higher degrees of variation within groups suggest the presence of a folk model distinct from the other? In exploring this, we ran separte consensus analysis for each of the subgroups. The disaggregated analysis shown in Table VI suggests considerably higher shared understanding among the nonminority informants, particularly the upper income nonminority informants (i.e., the ratio of the first to second factor for their groups is 2 to 3 times that of the others). This reflects shared understanding of the more detailed statements concerning specific species and natural and manmade processes as well as increased familiarity

Table IV. Tukey HSD Multiple Comparison for Mean Education

	$\bar{X}$ Difference	Probability
Comparison of urban upper income nonminority with:		
Coastal rural lower minority	4.4	.002
Inland rural lower income nonminority	5.0	.000
Urban lower income minority	4.036	.005
Comparison of inland rural upper income nonminority with:		
Coastal rural lower minority	3.5	.039
Inland rural lower income nonminority	4.1	.006

Table V. Two-Way ANOVA with Fit to the Consensus as Response Variable and Minority Status and Income as Explanatory Variables

	DF	*F*-Ratio	*p*
Minority status	1	9.4	0.003
Income	1	13.2	0.000
Minority status*income	1	0.02	0.84
Multiple *R*: 0.401	Multiple R^2:	0.161	

with true–false tests. The separate analysis reveals that, at least for the coastal rural lower income minority group, the observed difference between this group and the others was due more to a lack of agreement and an unfamiliarity with true–false testing than to the existence of any competing models (see Table VI). As is evident, the ratios, mean fits, and standard deviations vary dramatically from the *original* sample, which excluded the students and scientists. This table shows the influence of income and education on the mean fit and the magnitude of a single factor solution. More important, however, is the low ratio of the low income minority subsample. In this case, the cultural consensus test revealed that subcultures may be present, but that differences between them (i.e., intracultural variation) may have been diluted by the total sample. A further disaggregation of the low income minority subsample reveals the root of the violation in the model. The same table shows that although the inland and urban subsamples for low income minority groups represent single factor solutions, the coastal subsample clearly violates one of the conditions of the consensus model.

Table VI. Consensus Analysis Run Separately for Specific Subgroupings

	Ratio	$\bar{X}$	SD
Minority	4.001	.526	.214
Nonminority	12.377	.637	.231
Upper income	5.787	.609	.222
Lower income	6.414	.545	.238
Minority low income	2.842	.500	.209
Nonminority low income	7.895	.554	.280
Minority upper income	7.200	.596	.168
Nonminority upper income	15.339	.721	.129
Inland minority low income	4.764	.528	.189
Coastal minority low income	1.458	.487	.132
Urban minority low income	4.293	.568	.222
All original subgroups	6.150	.574	.234

But how similar are the patterns of responses among the various disaggregated subgroups? Figure 2 is a multidimensional scaling of the intercorrelations of the keys from selected disaggregated subgroups. Subgroup answer keys were derived based on methods described in Romney *et al.* (1986). Basically, answer keys are derived by working backwards from the patterns of response. Answers to statements on which there is high agreement are assumed to represent the culturally correct answer. Answers to questions in which the "correct" answer is less clear are weighted in a Bayesian manner by the responses of individuals who were consistently correct on answers to other statements. This figure suggests some of the previous findings by showing variation as a function of different subgroup partitions. The scientists are clearly the most distinct subgroup in terms of the overall pattern of response. The different minority subgroups also represent a distinct cluster. However, as indicated by previous analysis, the upper income minority group is more similar to the main cluster of subgroups than are other minority subgroup partitions.

This comparison between total and disaggregated analyses suggests that cultural consensus analysis can help locate intracultural variation. Yet we need to remain sensitive to the underlying reasons, based on theory, for such variation. As we noted earlier, this can be achieved, in part, through a sampling design informed by appropriate theory. As we have

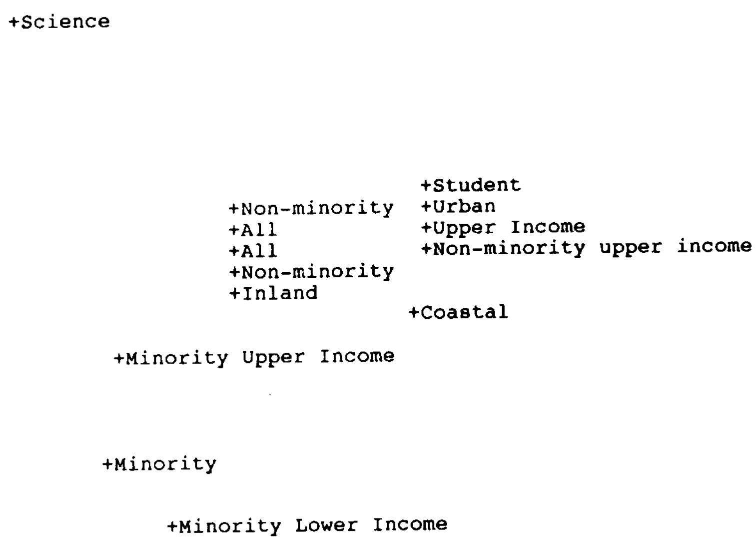

Fig. 2. Multidimensional scaling of answer keys for different subgroups.

seen, groups of informants that do not fit the model can *appear* to be part of a larger groups that in fact does meet the criteria for "fit."

SUMMARY AND CONCLUSION

Whatever consensual representative positions we have gleaned from our measures can be paraphrased like this:

> Isn't it too bad? Pollutants exist, they infect the environment, they contaminate our fish and shellfish, and we may or may not be able to trust the food industry to protect us from this. Really, though, how can they, when we never know where our fish come from? They probably don't know where the fish come from either. The best we can hope for is that they'll take it off the shelves or won't serve it if there's some reason to suspect it comes from polluted waters. Sure, we can try to cut down on some pollution, such as our household trash and litter, but some pollution we just can't stop. That's the price of progress. At least, if fish get contaminated in one place we can catch them from another. The best we can do is smell and taste it, figure out for ourselves whether or not it's been exposed.

Such a message sends the signal to the food industry that, at least for the time being, fishers, farmers, processors, grocers, and restaurateurs really need not worry that the public will reject their foods based on their understandings of the relationship between food safety and pollution. The ambiguity that exists allows for the continued harvest and sale of fish and shellfish that have come from waters known to be polluted, creating complacency within the food system that is as likely to backfire as to allow the continued ignoring of quality control mechanisms. Also, the industry might even benefit by educating the public concerning the true risks of seafood consumption. The most comprehensive recent studies of the relationship between seafood safety and coastal pollution suggest that consumers of seafood are in far less danger than those we interviewed believe (National Academy of Sciences, 1991; National Fisheries Institute, 1991). Yet educational programs, developed and disseminated without judicious consideration, may also backfire; in Taiwan, when the nuclear power industry attempted to educate Taiwanese about the potential hazards of nuclear energy, they succeeded in alarming the Taiwanese more than calming their fears of living alongside nuclear power plants (Smith, 1990). Our analysis also illustrates that degrees of knowledge sharing vary within and between different income, ethnic, and residence groups, and that the primary determinant of this variation is income and minority status and, to some extent, education. Does this mean there is little or no "knowledge" out there about seafood safety and pollution? In fact, we concluded above that our respondents were unsure about specific relationships between seafood safety and pollution, while being relatively certain about the general relationships between pollution and seafood safety. This represents one of the strengths of the cultural consensus approach: that it is able to measure the extent to which knowledge is shared within and between groups, as well as offer some substantial information about the nature of that knowledge.

But we have also shown that one must be sensitive to underlying factors likely to influence knowledge, exercising care in sampling accordingly. We agree with Weller *et al.* (1993, p. 122) when they state: "Only with a diversity of samples and a standard protocol can one determine variability in beliefs and make theoretical formulations regarding the distribution and diffusion of belief systems." It is only in the search for diversity and contrast, combined with theoretical propositions concerning the causes of diversity and contrast, that we can gain any insight into the nature of knowledge acquisition, distribution, sharing, and hence cultural models. Of course, recognizing the importance of income and access to knowledge as causal ingredients in intracultural variation dates back to the culture as ideology writings of Marx and Weber. In a recent critique of hermaneutics, Keesing (1987) summarizes these influences in the context of attacks on interpretive anthropology's notion of cultures as "texts." Ironically, given the radical differences between positivism and interpretive anthropology, many of Keesing's criticisms of the idea of cultures as texts apply to idea of culture as consensus because of similar assumptions about the sharing of meanings. Referring to the notion of sharing or consensus, Keesing notes:

> Modern Marxists have explored the ways in which ideologies disguise and hide the realities of economic relationships and have asked whether and how they lead the subordinate to share meanings with those who dominate them. Here we can come back to the question of the distribution of culture-as-knowledge and the sharing of meanings. Cultural ideologies, whether about women's virtue, patriotic duty, free enterprise, or pollution and caste, amy be shared (at least in surface observance) even though they sustain the interests of some and work against the interests of others. We must, however, dig beneath surface consensuality to seek counterideologies and cultural expression of subaltern struggle. The overlay of consensuality, viewed uncritically, can make an anthropology of meaning insidious as well as politically naive. (1987, p. 166)

In the case of pollution and seafood safety, we find systematic variation within an overall agreement structure in which the observed variability is clearly political economic in nature. What are the implications of such a finding? Clearly there is variation in knowledge with respect to the health dangers of eating seafood that may have an impact on an individual's understanding of associated risks. In a world where industry may not have the best interests of consumers in mind, those who least understand are those who are most at risk.

ACKNOWLEDGMENTS

This work was sponsored by a grant from the Sea Grant program, National Oceanic and Atmospheric Administration.

APPENDIX A. TRUE–FALSE STATEMENTS

The boldfaced T or F indicates the response most often given by the 122 respondents. As noted in the text of the paper, those statements with high agreement (>90% of respondents agreed) are marked with two asterisks; those statements eliciting disagreement (<75% of respondents agreed) are marked with one asterisk. Responses to question 12 were equally split between T and F.

T **F** 1.* If a seafood is being sold in a supermarket or restaurant, it must be OK.

T **F** 2.* Seafood that have shells are more protected from the affects of pollution than those that don't.

T **F** 3. Heavy metals dumped in the estuaries and the ocean do not accumulate in species at the top of the food chain.

T **F** 4. People cannot catch hepatitis and other viruses from shellfish found near sewage outfalls.

T F 5. Herbicide runoff from farm fields often kills sea grass which, in turn, alters marine habitats.

T **F** 6.** Most pollutants do not affect sea life habitats, thus they have no affect on species' ability to reproduce.

T **F** 7. You have to live within 25 miles of a factory that produces hazardous wastes for its fumes to affect your health.

T F 8. Seafood that lives near shore is more likely to suffer from the affects of pollution.

T F 9.** The dumping of human and industrial waste in the coastal waters can cause sores or lesions in some marine species.

T F 10.* The kinds of fish that live in rivers, marshes, and sounds are more likely to be hurt by industrial waste than those found in the open ocean.

T **F** 11.* Tar balls are rarely ingested or eaten by marine fish and mammals, and are thus not much of a problem.

T F 12.* The damage to marine life by oil spills has little to do with the grade of oil.

T F 13. We rarely eat contaminated fish, since they usually die before they are even caught.

T F 14.* People rarely change their seafood eating habits even though they may have read or heard something bad.

T F 15.** The dumping of phosphates and detergents into coastal water can lead to the depletion of oxygen in the water and the killing of fish.

T F 16.** Besides being unsightly, trash on the beach can be harmful to humans.

T F 17. Fish that don't move or migrate very much tend to be those species most affected by pollution.

T F 18. Most of the oil that gets into ocean waters comes from runoff and marine transport.

T F 19. Pesticides and chemicals that get into the water do not concentrate in the flesh of the fish we eat.

T F 20.* Larger fish are more likely to carry pollutants than smaller fish.

T F 21. Oil spills usually don't affect seafood because the spills kill the fish before they are caught and sold.

T F 22. Most of the effects of an oil spill are after a year.

T F 23. Pollution very seldom causes deformities in fish.

T F 24. Only fish and shellfish that are near the original point of an oil spill will be affected.

T F 25.* Industry rarely uses municipal sewage systems for the dumping of waste.

T F 26. Heated waste water from power and industrial plants tends to kill off bottom-dwelling species in the immediate area.

T F 27. The dumping of medical waste in the ocean does not cause widespread damage to either fish or humans.

T F 28.* All marine species are affected in the same way by heavy metals and pesticides.

T F 29. Some sea life is more resistant to pollution than others.

T F 30.* The integrity of seafood companies will keep them from selling us tainted seafood.

T F 31. Pollutants such as PCBs and dioxins do not accumulate in the fat cells of larger fish.

T F 32. The oil from spills often washes up on the beach, but says in the sand only briefly, therefore limiting the amount of toxic hydrocarbons into the food chain.

T F 33. U.S. industries can pollute rivers and streams and still remain in business.

T F 34.** The dumping of sewage into the ocean can contaminate fish and make us sick if we eat them.

T F 35.** Most people don't know where the seafood they eat was caught.

T F 36. Much of the pollution dumped into coastal and ocean waters has no effect on the flavor of seafood.

T F 37.* Fish that roam the deep ocean waters are less affected by the different kinds of ocean and coastal pollution.

T F 38.* Medical waste is more likely than sewage to affect seafood.

T F 39.* The ocean is buffered against large shifts or changes in pH (acidity) due to air pollution.

T F 40.** Most people don't think much about the possible dangers of eating seafood.

T F 41. The ocean is so vast and deep that the dumping of trash offshore will not be a problem any time soon.

T F 42. Following a major environmental accident, even if you haven't heard anything bad about the seafood for a while, it does not necessarily mean it is OK to eat.

T F 43.** Seafood is nutritious.

T F 44.** Sea life can swallow trash, causing them to die.

T F 45.* Fish that live on or near the bottom are the least likely to suffer the affects of pollution.

T F 46. Pollution is only harmful near its source, since the ocean is so big and the pollutants get dispersed rather quickly.

T F 47. Sediments generated from erosion due to development can limit the growth and productivity of bottom-dwelling species.

T F 48. Humans are at the top of the food chain and are therefore most likely to suffer from problems associated with concentration of toxic pollutants.

T F 49.** Ocean pollution will cause an increase in the cost of seafood to consumers.

T F 50. Pesticides do not have an impact on crustacean populations such as crabs, even though they are close relatives of insects.

T F 51. Oil spills only hurt fish that swim near the surface.

T F 52.** Although not always directly lethal, pesticides can affect the reproduction success of many marine organisms.

T F 53.* Oysters and clams are those species least affected by the different kinds of ocean and coastal pollution.

REFERENCES

Belshem, M. (1991). Cancer, control, and causality: Talking about cancer in a working-class community. *American Ethnologist* 18(1):152-172.

Boster, J. S. (1986). Exchange of varieties and information between Aguaruna manioc cultivators. *American Anthropologist* 88:428-436.

Boster, J. S., and Johnson, J. C. (1989). Form or function: A comparison of expert and novice judgement of similarity among fish. *American Anthropologist* 91(4):866-889.

Bourdieu, P. (1984). *Distinctions: A Social Critique of the Judgment of Taste* (translated by Richard Nice). Cambridge University Press, Cambridge.

Carson, R. (1963). *Silent Spring.* Basic Books, New York.

Consumer Reports (1992). Is Our Fish Fit to Eat?

D'Andrade, R. (1972). A propositional analysis of U.S. American beliefs about illness. In Basso, K., and Selby, H. (eds.), *Meaning in Anthropology.* University of New Mexico Press, Albuquerque, pp. 155-180.

Foucault, M. (1971). *History of Sexuality* (Vol. 1). Vintage Books, New York.

Garro, L. C. (1988). Explaining high blood pressure: Variation in knowledge about illness. *American Ethnologist* 15(1):98-119.

Geertz, C. (1973). Thick description: Toward an interpretive theory of culture. In Geertz, C. (ed.), *The Interpretation of Cultures: Selected Essays.* Basic Books, New York, pp. 3-30.

Gramsci, A. (1971). *Selections from the Prison Notebooks.* International Publishers, New York.

Griffith, D. C., Johnson, J. C., Murray, J. D., and Kemp, S. (1988). *Social and Cultural Dimensions of Consumer Knowledge Among Seafood and Seafood Analog Consumers in the Southeast: Implications for Consumer Education.* Technical Report to the Gulf and South Atlantic Fisheries Development Foundation.

Holland, D. (1987). Culture sharing across gender lines. *American Behavioral Scientist* 31(2):234-249.

Jameson, K., and Romney, A. K. (1990). Consensus on semiotic models of alphabetic systems. *Journal of Quantitative Anthropology* 2(4):289-304.

Johnson, J. C., and Griffith, D. C. (1985). Perceptions and Preferences for Marine Recreational Fish. UNC Sea Grant Technical Report 85-01.

Keesing, R. (1987). Anthropology as interpretive quest. *Current Anthropology* 28(2):161-176.

Matthews, H. (1987). Intracultural variation in Belrich about gender in a Mexican community. *American Behavioral Scientist* 31(2):219-233.

Matthews, H. (1992). The directive use of morality tales in a Mexican community. In D'Andrade, R., and Strauss, C. (eds.), *Human Motives and Cultural Models.* Cambridge University Press, Cambridge.

Mintz, S. (1985). *Sweetness and Power.* Vintage Books, New York.

National Academy of Sciences (1991). *Seafood Safety.* NAS: Institute of Medican, National Academy Press, Washington, D.C.

National Fisheries Institute (1991). Seafood Safety. NFE Papers.

National Marine Fisheries Service (1990). *Fisheries Statistics of the United States, 1990.* U.S. Government Printing Office, Washington, D.C.

Rifkin, J. (1992). *Beyond Beef.* Basic Books, New York.

Romney, A. K., Weller, S. C., and Batchelder, W. H. (1986). Culture as a consensus: A theory of culture and informant accuracy. *American Anthropologist* 88:313-338.

Sinclair, U. (1981). *The Jungle.* Bantam Books, New York (originally published in 1906).

Smith, K. (1990). Fear and loathing of nuclear power. *Science* 4977(250):28.

Steffler, V. J. (1972). Some applications of multidimensional scaling to social science problems. In Romney, A. K. *et al.* (eds.), *Multidimensional Scaling, Theory and Applications* (Vol. 2). Seminar Press, New York.

Strauss, C. (1990). Who Gets Ahead? Cognitive Responses to Heteroglossia in American Political Culture. *American Ethnologist* 17(2):312-328.

USA Today (April 10, 1989). Seafood Safety Creates Ripples Among Restaurateurs, Price, Safety Put damper on Seafood Sales.

U.S. Congress (1986). Hearing before the subcommittee on health and the environment of the Committee on Energy and Commerce, House of Representatives, p. 116.

Vickers, D. (1994). *Farmers and Fishermen.* University of North Carolina Press, Chapel Hill.

Williams, R. (1977). *Marxism and Literature.* W. W. Norton, New York.

Washington Post (January 21, 1989). On the Safe Side of Seafood: The Tricky Business of Policing the Fishing Industry; Catch as Catch Can: From Boat to Market, the Convoluted Tale of How a Fish Lands on Your Table.