Title: Exploring the Gap Between Measured and Perceived Quality

Author: Linwood Pendleton

Affiliations: School of International Relations and the Wrigley Institute for

Environmental Studies,

University of Southern California

Proposed Running Head: Measured and Perceived Quality

Please address all correspondence to:

Linwood Pendleton
University of Southern California
Allan Hancock Foundation 331
Los Angeles, CA 90089-0371
linwoodp@usc.edu
http://www.uscbeach.org

Title: Exploring the Gap Between Measured and Perceived Quality

Abstract

Even when information is made available through public campaigns, people may still retain inaccurate perceptions of environmental quality. We look at coastal water quality in Southern California via a telephone survey. Fewer than half of respondents are able to correctly rank two randomly chosen beaches in terms of water quality. A logit analysis of the rankings reveals that there are systematic factors underlying the accuracy of people's perceptions. It is also shown that failure to fully account for omitted variables in revealed preference valuation models may lead to false findings of statistical relationships between measured environmental quality and consumer choice.

Keywords

Environmental valuation

Revealed preference methods

Perceived quality

Exploring the Gap Between Measured and Perceived Quality

I. INTRODUCTION

Revealed preference methods for the valuation of quality assume that consumers have good, if not perfect, information about the quality of goods available to them. The assumption of the informed consumer is not limited to one or even a class of valuation models. While models could, in theory, be estimated on indices that reflect purely perceived quality attributes of goods, most analyses defer to technically measurable quality attributes. Hedonic methods assume that the prices of goods reflect the consumers' willingness to pay for measurable attributes of goods. Random utility methods assume that consumers choose among goods based on an accurate knowledge of measurable quality. Countless other quality valuation methods, both parametric and non-parametric, attempt to estimate demand for goods, prices of goods, or other aspects of economic behavior in terms of measurable attributes that somehow serve as technically objective metrics by which the economist can model the ways in which quality affects good choice.

Increasingly, it is becoming evident that consumers often do not have perfect information about many types of quality – especially qualities that relate to risk and the environment. Adamowicz et al. [1] found that perceived measures of wilderness area attributes in Alberta, Canada were only weakly correlated with actual measures. Viscusi [12] examines similar discrepancies in an experimental study of measured and perceived air quality. Further Viscusi[1] points out that "[d]ifferences in risk information and processing of it often lead the public to have quite different risk perceptions than government experts." Dozens of other unpublished studies of environmental quality also reveal a similar pattern – the gap between technically accurate and perceived environmental quality can be enormous.

Part of the problem is thought to be the fact that incomplete access to information or inaccurate but accessible information can lead to discrepancies between technically objective measures of quality and perceived levels of quality in goods. In an early study, Swartz and Strand [11] modeled demand for seafood as a function of perceptions of quality which, in turn, was thought to be directly related to newspaper reporting on the health impacts of Kepone (a possibly carcinogenic toxin that was shown to have polluted nearly the entire length of the James River in southeastern Virginia). Swartz and Strand hypothesized that people derived their information on seafood contamination principally from two sources: the government or the media (or the government through media). Perceptions in the Swartz and Strand model were simply reflections of information provided by one of these two sources. The accuracy of the information source, in this case, was the ultimate determinate of the accuracy of the consumers' perceptions.

The link between information and the accuracy of perceptions about quality has proven more complicated than envisioned by Swartz and Strand. Smith and Johnson [10] explored the links between information and perceptions of risk in the context of radon exposure in Maine. Using surveys, the authors employed a two-limit tobit analysis to examine whether the provision of information about actual levels of radon in a respondent's house influenced their participation in mitigating measures to reduce the risks of radon exposure. The respondents also were asked more qualitative questions about the perceived seriousness of radon as a health risk. The results revealed that access to information did indeed affect people's behavior and perceptions of risk, but the way in which these perceptions changed was a function of personal characteristics. Previous experience with other health risks, namely cancer, was shown to be particularly important in modulating the way in which information influenced perceptions of radon risk. While the authors provided evidence that consumers updated perceptions of risk based on new information, the authors were unable to show that measured risk and perceived risk ever converged.

Incomplete information alone may not explain why measured quality and perceived quality do not converge, especially when the quality attribute reflects risk. Viscusi argued that the source of information, the ability to process information, and the severity of the potential risk are also important factors in creating a wedge between perceived and measured risk. Using experimental methods, Viscusi looked specifically at how information about air quality risks affected the probability that an individual would choose to reside in one area or another when these areas differ in air quality. Like Smith and Johnson [10], Viscusi found evidence that access to information about possible risks does influence people's perceptions of risk. Viscusi also found, however, that individuals place more weight on "worst case scenarios" and tend to discard "low risk" judgments of risk – a phenomenon the author refers to as an “alarmist response.” Furthermore, the author found that

> *“… people do not appear to refine their risk beliefs in a rational manner that ultimately will converge on an accurate risk assessment after being provided with successive sets of information reflective of underlying risk.”*[2]

While exact convergence between measured and perceived “absolute” levels of quality may be improbable for many types of quality, one might expect a greater chance of convergence for “relative” levels of perceived and measured quality across goods. Michael et al. [7] found that perceived levels of water quality at freshwater lakes was at least consistent with technical measures (Secchi readings). Standard models of good choice simply assume that consumers choose between goods of differing quality by comparing levels of utility that would be derived from the consumption of either good. The relative comparison is made obvious in the random utility models in which the probability of choosing any one good is a function of the relative utility of that good compared to all other choices. For instance, a standard RUM would model the probability of choosing good *j* as

$$\text{Prob (choose good j)} = \text{Prob}[v(Z_j, (Y\text{-}P_j)) - v(Z_i, (Y\text{-}P_i)) > \varepsilon_i\text{-}\varepsilon_j], \text{ for all } i \neq j \qquad [1]$$

where v(Z, (Y-P)) is the deterministic portion of an indirect utility function and ε_1, ε_2, …ε_m are identically and independently distributed random elements associated with the consumption of each good..

Unfortunately, even relative convergence may not exist for many types of risk and environmental quality. In their study of moose hunting, Adamowicz et al. [1] found that perceived measures of site quality and measured quality were not highly correlated for many site attributes. The lack of strong correlation between perceived quality and measured quality is made more perplexing by the fact that the respondents all should have had reasonably good knowledge concerning relative qualities at the 14 sites studied. The respondents surveyed were hunters that lived among the sites in question and were self-selected to participate in the survey.

The experience of Adamowicz et al. may indicate that the statistical properties of a quality may also influence the degree to which people are able to accurately assess quality in a good – even relative quality. The authors cite lack of variation in levels of quality across possible hunting sites as one reason for the weakness of correlation between perceived and measured attributes including site accessibility and congestion (ρ = 0.30 and 0.11, respectively.) On the other hand, correlation coefficients were higher for quality characteristics that varied more across sites. The correlation between measured and perceived levels of quality for "likelihood of seeing moose" was higher than for access or congestion (ρ=0.64). (The authors do not provide summary statistics for the quality attributes.) Obviously, it may be more difficult for consumers to discern among goods of varying quality if the difference in levels of quality across goods is small.

II. BACTERIAL CONTAMINATION AND RECREATIONAL WATER QUALITY

Recreational water quality offers an example in which informational issues associated with the measurement and perception of risk and environmental quality intersect. Most studies of recreational water quality focus on some type of bacteriological measure for water quality (e.g. fecal coliform, total fecal coliform, enterococcus, etc.)[3]. The reasons for a preoccupation with microbial contaminants in these studies are simple: microbial measures are readily available, the sources of microbial contaminants are usually well-known, and microbes are thought to pose a significant health risk to bathers. Unfortunately, actual levels of microbial water quality cannot be known from simple observation. Consumers, in this case bathers or potential bathers, must look elsewhere for information about water quality. Sources of information include rumor, personal experience with water quality, media reporting, non-profit educational campaigns, and governmental monitoring and reporting.

Many authors reason that consumers should have good information about recreational water quality because so much effort is invested in trying to get such information out to the public. Unlike many other types of environmental quality, but like many types of environmental risk, governmental and watchdog agencies have gone to great lengths to ensure that people develop preferences for the microbial character of water quality and further, that people have access to scientifically rigorous data about this type of contamination. In their study of the effects of water quality on land prices, Leggett and Bockstael [4] cite the water quality hotline in Anne Arundel County, Maryland and beach posting procedures as mechanisms that transmit water quality information to market participants. In California, State Law AB411 now requires that all beaches in California are monitored for water quality and that beaches are closed when levels of bacteria exceed predetermined levels. Furthermore, in Southern California, information concerning beach water quality also is accessible to potential beachgoers through a system of easily understood beach grades (ranking A through F with F being a failing grade). These beach grades are made available to the public through websites (e.g. http:www-healthebay.com, http:www.smbay.org, and www.surfrider.org), the WeatherChannel™, and local and regional newspapers. Other initiatives to inform the public have been sponsored by USEPA's Beaches Environmental Assessment, Closure, and Health (BEACH), and the World Health Organization/USEPA Expert Consultation of Safety of Recreational Waters.

Finding statistically significant econometric relationships between water microbial quality measures and consumer behavior seems to indicate that consumers do have some understanding of water quality. Nevertheless, Legget and Bockstael [4] point out that microbial water quality indicators could be highly correlated with other aspects of water quality that matter to and are known by consumers. Without special care given to controlling for omitted variables bias, bacteriological methods could be proxies for something else entirely[4]. Still, little evidence exists to show that people's perceptions of water quality even remotely reflect the technical measures that analysts often use in valuing water contamination or clean-up.

The following sections of this paper explore the gap between measurable water quality attributes and the perceived quality of coastal ocean waters in Southern California. It is unlikely that anyone, other than a few local scientists, would have good information on absolute levels of water quality indicators. With this in mind, the analysis here focuses on issues of relative water quality. Specifically, respondents are asked to rank by water quality two randomly chosen, well-known beaches in Los Angeles and Orange Counties. The analysis focuses on the relative accuracy of perceptions of water quality (i.e. the degree to which technical rankings coincide with respondent rankings) and the factors that influence accuracy.

III. DATA AND METHODS

The 1999 Environmental Perceptions Survey was undertaken as part of the USC Beach Project to seek a better understanding of how Southern California residents experience and perceive their environment. Specifically, the survey questions were designed to elicit respondents' perceptions about environmental quality, beach recreation, and various other social issues relevant to Los Angeles County residents. The survey collected information about each individual's participation in outdoor recreation activities, particularly at the beach, as well as their perceptions about water quality air pollution, and crime. The survey also obtained information about respondents' socio-economic characteristics, ethnicity, and length of residence in the Los Angeles area.[5]

Households in Los Angeles County were contacted using random digit dialing. Initially, 4700 units were purchased for the following Los Angeles area codes: 310, 424, 323, 562, 626, 818, 213. Surveys were conducted in English and Spanish on weeknight evenings (Monday through Thursday) during July, August, and September of 1999. 403 household surveys were completed. A comparison of our results with data for 1998 from Los Angeles County's official website (http://www.co.la.ca.us/statistics.htm) shows that our survey represents all groups proportionally except Asian/Pacific Islanders (underrepresented) and Native Americans (over represented). Socio-economic, experience, and avidity data were collected for all respondents (See Table I).

Ranking the Responses

Water quality indices for local beaches used in the survey were created from the not-for-profit Heal the Bay's (HTB) Beach Reports for each week during the survey period. Beach reports are posted online weekly at http://www.healthebay.org. These beach grades are the only immediate and daily source of information about beach water quality that the public can access. Beaches are classified on a grade scale of F to A+ based on bacterial pollution levels present in the surf zone. Beach grades are derived from water quality data collected by local sanitation and health agencies. In this study, beach grades were determined for the week corresponding to the week the respondent was surveyed. When beaches had more than one sample station, we calculated two measures of water quality for that beach: mean of all sample stations and the worst grade for any sample station at a beach. Summer mean beach grades also were determined.

Means were found by converting letter grades to an integer numeraire (in exactly the same way a grade point average would be determined, F=0 through A+=4.5); all weeks during the summer were weighted equally. Table II gives mean water quality grades for the period June 1999 through August 1999 for the beaches studied.

Because it is likely that many respondents use non-technical sources of information regarding beach water quality. We also use two alternate measures of water quality at the beach. The first is a simple index of beach desirability from the California Beach Guide[8]. The California Beach Guide gives beaches in California a score from 1 "sun" (don't bother) to 5 "suns" (beach heaven). The authors write, "These rates represent nothing more than the informed opinions of two well-traveled beach bums" [8]. While perhaps more whimsical than strictly technical measures, the California Beach Guide is a reasonable hedonic index for the sum of beach all important attributes. The California Beach Guide index is a relatively time-independent measure of water quality. Second, we use the number of visible storm drains at each beach. This data was collected by our field researchers and is meant to determine whether or not respondent s adequately recognize the risks associated with such outflows.

To gauge people's ability to evaluate the quality of the water at the beach, we asked them to compare the water quality at two randomly chosen beaches. (See Table II for the list of beaches.) Specifically, we asked:

"**Which of these two beaches do you believe has the BEST WATER quality TODAY?"**

Each survey had a set of four randomly generated beaches associated with this question. The surveyor would read the name of each beach in order and ask the respondent if he or she had heard of that beach. Once two beaches were recognized, the rest of the list was ignored and the surveyor posed the question. Their responses were then evaluated using the beach indices described above. For each beach index, the respondent's answer was scored as correct if the respondent ranked beaches in a way consistent with the beach index and incorrect for wrong answers and answers of "don't know."

Factors Influencing the Divergence Between Measured and Perceived Water Quality

For this study, binomial logit analysis is used to explore the factors that might influence the accuracy of the rankings described above. Specifically, the logit analysis tests the hypotheses that personal characteristics, experience, media use, and statistical properties of measured quality influence the accuracy of the respondents' perceptions of quality.

Nineteen personal characteristics were examined in an attempt to isolate factors that were important in explaining the likelihood that respondents' perceptions of beach water quality corresponded to more technical measures of water quality. We also used two measures specific to the beach pair: number of beaches recognized (0,1, or 2) that were in Los Angles County and the numerical difference in beach water quality measures. (These attributes are summarized in Table I.) These factors can be roughly grouped in terms of the causal mechanism by which these factors influence the accuracy of perceptions. The categories considered are (1) *Information, Experience, and Familiarity*

Factors, (2) *Understanding and Interest Factors*, (3) *Culture and Demographics*, and (4) *Quality Attribute or Site Factors*. Certain factors may have causal links to environmental perceptions through more than one category; in these cases, the factor is listed more than once.

Information, Experience, and Familiarity Factors

As discussed earlier, much of the literature assumes that the divide between measured and perceived environmental quality in risk occurs, in part, because of a lack of full information on the part of the consumer. Five factors related to access to information prove important in explaining the agreement of measured and perceived quality: *Language*, *News Stories*, *Newspaper*, *Cable News*, and *Internet Use*. In principle, media access ought to give consumers a broad understanding of available environmental quality. People that read the newspaper (NEWSPAPER), frequently watch news on television (CABLE NEWS), or use the net (INTERNET USE) ought to be more informed about environmental quality. Moreover, respondents who remembered seeing or hearing news stories relating to water quality at the beach (NEWS STORIES) should be better informed about water quality than those who do not. (Although it may be argued that media coverage of environmental quality may be biased and less than fully comprehensive. Furthermore, newspaper coverage of environmental issues was found to vary among the region's top English and Spanish language newspapers[6]. As a result, LANGUAGE preferences or barriers may influence the kinds of information about environmental quality that are available to the respondent.

A subset of these information variables represents first hand experience with beach water quality: *Warning Signs* (seen signs warning NO SWIMMING) and *Closed* (witness beach closure). People that have seen WARNING SIGNS or have been to beaches that were CLOSED, have had direct and potentially biased "information" experiences. Finally, familiarity with the region and the beaches - *Years in SoCal* (Southern California), *Beach Visits*, and *County* (if the Beaches asked about were in LA or Orange County) - should contribute positively to a better knowledge of environmental water quality.

Understanding and Interest Factors

Even when information is available, the consumer may be unable to understand the information or simply uninterested in the information. Recognizing that technical information may be beyond the grasp of many, groups like Heal the Bay have created letter grades that translate basic technical measures into a system more familiar to beach goers. Nevertheless, choosing among beaches requires that people make comparisons across beaches. Since beach quality is given only historically (even the most currently available data are for a four week average of water quality ending the preceding week), potential beach goers must make predictions about daily beach water quality based on past trends. Forming expectations about quality may require certain cognitive skills that could be related to EDUCATION, AGE, or INCOME.

Because information is costly to obtain, and equally costly to process, the degree to which a consumer gathers and processes data may depend on how much they are interested in the good or site in question. It could be hypothesized that people who actually intend to visit the beach (BEACH PLANS), visit the beach frequently (BEACH VISITS), and go in the water at the beach (GO IN WATER) would have a greater incentive to make themselves fully informed about levels of environmental quality. Furthermore, people that belong to environmental organizations (ENVIRONMENTAL) might also be more likely to be sensitive to issues of environmental quality and thus should be more likely to inform themselves about environmental quality at beaches.

Culture and Demography

The demography of Southern California is in a constant state of change. From a policy perspective, it is important to understand how demographic and cultural characteristics influence people's perceptions of environmental quality and especially the extent to which people are informed about environmental quality. Seven demographic attributes are investigated here: AGE, CITIZEN, AFRICAN DECENT, MEXICAN DECENT, NATIVE AMERICAN, SEX, and INCOME. Not all of the seven turned out to be significantly correlated with any of the rankings, but each was used in several different models before being accepted or discarded for the final model.

Quality Attribute or Site Factors

Environmental quality differs from many other types of quality in that it is time-dependent. Water quality may be consistently good or bad at some locations, while other sites may have water quality that varies widely on a daily, weekly, or seasonal basis. When making comparisons among beaches, it is reasonable to assume that people could rank beaches more easily if these beaches (a) were familiar and (b) were quite different in terms of quality. We test these assumptions by looking at whether the beaches in question were in Los Angeles or Orange County (COUNTY) and how much the beaches differed in environmental quality (DIFFERENCES).

IV. RESULTS

Accuracy of Perceptions

By any measure, most respondents in this survey did not rank beaches in a manner consistent with the four potential measures of beach water quality. Accuracy is assessed in the following way: correct = ranking consistent with "objective measure ranking", incorrect = ranking inconsistent with "objective measure" or "don't know" (77 observations out of 403 surveyed)[7]. Using this definition of accuracy, respondents rankings were consistent with:

a) **24.81%** of respondents were correct if beaches were ranked by **daily Heal the Bay grade** s(both when sample stations were averaged over beaches and when worst grades for all sample station at a beach were used).
b) **32.75%** of respondents ranked beaches correctly according to the **June through August mean Heal the Bay grades** (and 31.76% worst grades for all sample stations at a beach).
c) **30.77%** of respondents ranking matched **California Beach Guide** rankings.

d) **21.59%** of respondents correctly ranked beaches by the **number of storm water drain outlets** (used as a proxy for water quality)..

These findings demonstrate that the public's perceptions of water quality do not correspond well with most technical measures of water quality. The fact that respondents' perceptions more closely match historical averages, however, support the assumption that people may base perceptions of water quality more on past trends than current measures. This argues for the use of historical quality measures in studies involving time and state-dependent quality.

Table IV gives the results of the logit analyses. The influence of the explanatory factors (*Information, Experience, and Familiarity Factors*, *Understanding and Interest Factors*, *Culture and Demographics*, and *Quality Attribute or Site Factors*) is remarkably similar despite the fact that these measures are not always highly correlated. (See Table III.) Following the literature, access to information consistently increases the probability that respondents will rank beaches in a manner consistent with "objectives measures." Reading the newspaper and the number of stories about water quality one has seen or heard significantly increase the probability that a respondent's ranking will be consistent with technical rankings, but watching cable news and using the internet were generally insignificant explanatory factors. The impacts of INTEREST AND UNDERSTANDING variables, however, are mixed. Younger people and respondents who said they entered the water when they went to the beach were more likely to rank beaches consistently with "objective measures. Other INTEREST AND UNDERSTANDING characteristics, however, were not significant explanatory variables. Specifically, members of ENVIRONMENTAL organizations were less likely to rank beaches according to objective measures. Generally, CULTURAL AND DEMOGRAPHIC characteristics did not play a large role in explaining the accuracy of beach rankings. We failed to find any specification in which demographic characteristics were significant in explaining the accuracy of perceptions. Worries that demographic dynamics could affect the degree to which beach goers are informed about water quality seem to be unfounded.

Adamowicz et al. [1] speculate that the lack of correlation between perceived and measured quality in their study of moose hunting was caused, in part, by a lack of variation in quality across sites. The results of the current study show that respondents are more likely to rank beaches consistently with “objective measures” when the DIFFERENCES in those measures are large.

VI. DISCUSSION

Even when technically accurate data is available to the public, people may not have accurate perceptions of environmental quality. Inaccurate perceptions about environmental quality cause problems for managers, consumers, and analysts. If the actual attributes of any given amenity do not proportionately influence perceptions of its quality, efforts to clean up the environment may fail to improve social welfare or even consumer behavior. Consumers could be directly and adversely affected by inaccurate perceptions of environmental quality. In some cases, consumers may make decisions based on inaccurate perceptions of quality that lead to unnecessary or undesired exposure to environmental or health hazards. Even when exposure to hazards is avoided by on-site warnings, post-hoc realization of true environmental quality may be too late for most consumers to avoid welfare loss. Inaccurate perceptions make it difficult if not impossible for consumers to make utility maximizing choices about environmental goods.

The accuracy of one's perceptions of environmental quality depends on access to information and experience. Some people may not seek out or use information on environmental quality, even when it is publicly available. Others may have trouble understanding complicated information about environmental quality. For those with incomplete information, perceptions could be based on other factors that may be bad proxies for water quality. For instance, respondents in the survey used in this paper ranked the primary sources of coastal water pollution as 1. trash, 2. industry, 3. sewage, and 4. storm water. In fact, we know that storm water is the primary source of bacteriological water contamination in Southern California [9]. Furthermore, many of the cleanest beaches in Los Angeles and Orange Counties are in the immediate vicinity of sewage treatment plants and refineries (e.g. Manhattan Beach and Dockweiler State Beach opposite the Hyperion Sewage Treatment Plant).

The high degree of colinearity between environmental quality measures and other attributes complicates our ability to use revealed preference models to value "objective measures" of environmental quality. Even when respondents hold inaccurate perceptions of environmental quality, we may still find significant estimated coefficients on environmental quality measures in random utility models of site choice or hedonic models of derived demand for quality. Is this a case of the valuation models picking up weak signals in a noisy world or a problem of environmental attributes being correlated with omitted variables? Table III shows the degree to which water quality measures are correlated with beach site attributes for 14 beaches in Southern California. High water quality is positively correlated with natural areas and surf spots, but negatively correlated with bike paths and public access ways. Revealed preference models that are not fully specified may be finding false relationships between consumer demand (or utility) and objective measures of environmental quality. Hedonic analyses, especially of home prices, are particularly susceptible to omitted variable problems since most explanatory attributes are housing or neighborhood attributes and environmental variables are usually limited to the one or two measures of interest [7]. Leggett and Bockstael [4] use several land use attributes and other measures that may indicate sources of bacteria, but do not include other environmental amenity attributes that could be correlated, e.g. wildlife attributes, terrain, size or type of water body, southern/northern exposure, etc.). Because the environmental quality attributes we set out to value may be poorly known by consumers and further may be highly correlated with omitted attributes that are known by consumers, analysts must be careful not to mistake a significant econometric result from a revealed preference method for an indication that a measure of environmental quality is an important argument in the consumers' utility function. When environmental quality may be incompletely or inaccurately known by the consumer, complementary tests, including stated preference analyses, focus groups, or other perception studies need to accompany the revealed preference analysis to substantiate the analyst's findings.

References:

1. W. Adamowicz, J. Swait, P. Boxall, J. Louviere and M. Williams,. Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation, *Journal of Environmental Economics and Management* **32,** 65-84 (1997).

2. C.D. Ditwiler, Environmental Perceptions and Policy Misconceptions, *American Journal of Agricultura Economics*.**8,** 477-483 (1973).

3. W. Foster and R.E. Just, Measuring Welfare Effects of Product Contamination with Consumer Uncertainty, *Journal of Environmental Economics and Management* **17**, 266-283 (1989).

4. C. Leggett, and N. Bockstael, Evidence of the Effects of Water Quality on Residential Land Prices, *Journal of Environmental Economics and Management* **39**,121-14 (2000).

5. C. Marris, I Langford, T. Saunderson and T. O'Riordan, Exploring the "Psychometric Paradigm": Comparisons Between Aggregate and Individual Analyses, *Risk Analysis* **17**, 303-312 (1997).

6. C. Marris, I.H. Langford and T. O'Riordan, A Quantitative Test of the Cultural Theory of Risk Perceptions: Comparison with the Psychometric Paradigm, *Risk Analysis* **18**, 635-647 (1998).

7. H. J. Michael, K.J. Boyle, and R. Bouchard, Does the Measurement of Quality Affect Implicit Prices Estimated from Hedonic Models? *Land Economics* **76, 283-298 (2000)**

8. P. Puterbaugh, and A. Bisbort, *California Beaches: The Only Guide to the Best Places to Swim, Play, Eat and Stay on Every Beach in the Golden State*, Foghorn Press, Santa Rosa, CA (1999).

9. SMBRP (Santa Monica Bay Restoration Project), *An Epidemiological Study of Possible Adverse Health Effects of Swimming in Santa Monica Bay*, Santa Monica Bay Restoration Project, Los Angeles, CA. (1996).

10. V.K. Smith and F.R. Johnson, How Do Risk Perceptions Respond to Information? The Case of Radon, *The Review of Economics and Statistics* **LXX**, 1- 8(1988).

11. D. G. Swartz, and I.E. Strand, Jr, Avoidance Costs Associated with Imperfect Information: The Case of Kepone, *Land Economics* **57**, 139-1501981.

12. W.K. Viscusi, Alarmist Decisions with Divergent Risk Information, *The Economic Journal*. **107**, 1657-1670 (1997).

Table I: Summary of Data Collected

Variable	Mean	Standard Deviation
Age	41.297	16.491
African Decent	0.095	0.294
Beach Plans (planned to go to the beach sometime that summer)	0.568	0.496
Beach Visits (how often they go to the beach during a typical summer)	1.717	1.232
Cable (weekly frequency of cable news watching)	0.305	1.026
Citizen (US)	0.748	0.435
Closed (seen/heard of beaches closed because of water quality)	0.684	0.465
County (number of beaches recognized in LA County)	0.702	1.541
Difference in Average HTB Grades (between the 2 beaches recognized)	0.571	0.953
Difference In Daily HTB Grades (between the 2 beaches recognized)	0.907	1.485
Difference in Ratings (between the 2 beaches recognized)	1.220	1.211
Education	0.571	0.495
Go in the Water (does respondent enter the water at the beach)	0.419	0.494
Income	2.670	1.808
Internet Use (weekly frequency)	1.682	1.777
Language (English or Spanish)	0.208	0.407
Mexican Decent	0.256	0.437
Native American	0.040	0.196
Sex	0.575	0.495
News Stories (could remember seeing/hearing news stories about water quality at the beach in the last 12 months)	0.648	0.478
Newspaper (weekly frequency)	2.231	1.592
Warning Signs (could remember signs warning "No Swimming")	0.426	0.495
Years in Southern California	25.115	17.247

Table II: Water Quality Data

Beach	County	Heal the Bay Average June 99 - Nov 99	Heal the Bay Minimum June 99 - Nov 99	Heal the Bay Maximum June 99 - Nov 99	Beach Guide Rating	# of Storm Drains
Doheny State	OC	4.14	1.50	4.50	5	6
Huntington City	OC	3.85	2.67	4.33	4	6
Laguna	OC	4.40	4.12	4.50	5	2
Leo Carillo	LA	4.50	4.50	4.50	5	5
Longbeach City	OC	3.61	1.25	4.30	2	3
Manhattan	LA	4.46	4.25	4.50	5	19
Newport	OC	4.26	3.63	4.50	5	0
Redondo	LA	4.07	2.83	4.33	2	0
San Clemente City	OC	3.89	3.50	4.40	5	14
Santa Monica	LA	3.73	0.90	4.50	4	3
Seal	OC	3.54	1.00	4.50	4	0
Surfrider	LA	3.35	1.00	4.50	4	1
Venice	LA	3.95	1.12	4.25	3	2
Zuma	LA	3.46	1.00	4.50	5	10
Mean		3.944	2.38	4.44	4.143	5.07
Standard Deviation		0.377	1.41	0.09	1.099	5.69

Table III: Attribute Correlations

	Average HTB Summer	Worst HTB Summer	CA Beach Guide	# of Storm-Drains
Abut to Natural Area	*0.5772*	0.4184	0.3284	-0.1443
Beach Attendance	0.0297	0.1674	*0.5049*	0.2573
Beach Club	-0.3536	-0.4868	*-0.6711*	-0.1917
Bike Paths	*-0.5649*	-0.1886	*-0.5134*	-0.2832
Diving Allowed	*0.5022*	0.4871	0.1771	-0.1114
Fishing Allowed	0.1891	*0.5123*	0.0597	-0.2003
Handicap Access	0.1771	0.1771	-0.3284	*-0.5066*
Harbor Adjacent	-0.2463	-0.3179	*-0.8359*	-0.2975
Maintenance Facilities	-0.4100	-0.4075	*-0.5134*	0.2556
Marina Adjacent	-0.4014	-0.3832	*-0.5484*	-0.3753
Pier	-0.4314	-0.4164	*-0.5134*	-0.0437
Power/Sewage Plant Adjacent	-0.0575	-0.1618	*-0.5484*	0.0138
Public Access	*-0.5381*	-0.3860	-0.3284	-0.3917
Rocky Beach	*0.5772*	0.0286	0.3284	0.0022
Surfing	*0.5033*	*0.5986*	*0.5659*	0.1236
Volleyball Nets (#)	0.1846	0.3205	0.1955	0.5538
Average HTB Summer	1	*0.7600*	*0.5274*	0.2532
Worst HTB Summer	*0.7600*	1	0.4414	0.0423
CA Beach Guide	*0.5274*	0.4414	1	0.4681
# of Storm-Drains	0.2532	0.0423	0.4681	1

Table IV: Regression Results
(standard deviation in parenthesis)

	Average HTB Daily	Average HTB Summer	Worst HTB Daily	Worst HTB Summer	CA Beach Guide	# of Storm-drains
Age	-0.010 (0.013)	-0.022[b] (0.013)	-0.020[a] (0.014)	-0.012 (0.013)	-0.036[d] (0.015)	-0.023[a] (0.015)
Beach Plans	0.066 (0.335)	-0.369 (0.319)	0.138 (0.344)	-0.811[d] (0.327)	-0.506[a] (0.346)	-0.556[a] (0.349)
Beach Visits	-0.077 (0.140)	-0.153 (0.133)	-0.269[b] (0.147)	-0.094 (0.135)	-0.080 (0.144)	0.085 (0.140)
Cable News	-0.041 (0.136)	0.111 (0.121)	-0.056 (0.150)	0.228[b] (0.123)	0.121 (0.133)	0.152 (0.122)
Citizen	0.224 (0.586)	-0.292 (0.553)	-0.876[a] (0.597)	-0.112 (0.566)	-0.088 (0.585)	-0.480 (0.608)
Closed	0.021 (0.348)	0.432[a] (0.331)	0.221 (0.363)	0.313 (0.336)	0.558[a] (0.357)	0.053 (0.358)
County	-0.079 (0.201)	0.036 (0.192)	-0.029 (0.207)	-0.010 (0.197)	0.259 (0.206)	0.408[b] (0.216)
Differences	0.406[d] (0.159)	0.066 (0.390)	0.261[c] (0.111)	0.085 (0.154)	0.573[d] (0.147)	-0.016 (0.027)
Environmental	-0.822[a] (0.588)	-0.573 (0.470)	-1.039[b] (0.630)	-0.887[b] (0.506)	-0.381 (0.487)	0.243 (0.478)
Go In Water	-0.215 (0.315)	0.272 (0.296)	0.298 (0.324)	0.604[c] (0.305)	0.562[b] (0.322)	-0.299 (0.326)
Income	(0.095) -0.028	(0.090) -0.055	(0.099) 0.186[b]	(0.090) 0.091	(0.095) 0.070	(0.093) 0.032
Internet Use	0.058 (0.092)	0.058 (0.087)	0.035 (0.096)	0.091 (0.089)	0.070 (0.094)	0.049 (0.092)
Language	0.551 (0.639)	-0.384 (0.609)	-0.011 (0.654)	-0.123 (0.620)	-0.514 (0.643)	-1.136[a] (0.736)
Newspaper	0.096 (0.097)	0.163[b] (0.092)	0.117 (0.101)	0.037 (0.092)	0.137[a] (0.099)	0.047 (0.098)
News Stories	0.117 (0.352)	0.714[c] (0.342)	0.310 (0.369)	0.646[b] (0.346)	0.915c (0.382)	-0.026 (0.362)
Sex	0.016 (0.295)	0.124 (0.279)	-0.225 (0.300)	-0.188 (0.281)	-0.262 (0.298)	-0.321 (0.299)
Warning Signs	-0.095 (0.283)	0.161 (0.268)	-0.162 (0.291)	0.413[a] (0.273)	0.213 (0.288)	0.459[a] (0.291)
Years in So.Cal.	0.001 (0.013)	-0.007 (0.012)	0.017 (0.014)	0.003 (0.013)	0.005 (0.014)	0.024[b] (0.014)
Constant	-1.054 (0.852)	0.041 (0.831)	-0.782 (0.886)	-0.882 (0.854)	-1.598[b] (0.864)	-0.578 (0.852)
# Observations	265	269	265	269	269	269
Log likelihood	-157.916	-171.7362	-151.228	-166.5488	-152.759	-151.314
Prob. > X^2	0.7523	0.1443	0.0539	0.0205	0	0.1299

[a] significant at 15% level
[b] significant at 10% level
[c] significant at 5% level
[d] significant at 1% level

Symbols

Prob = probability function

P_j = price of good j

P_i = price of good i

ε_i =lower case sigma subscript i

ε_j = lower case sigma subscript j

ε_m = lower case sigma subscript m

r = rho

Acknowledgments

Funding from the Southern California Sea Grant, the Wrigley Institute for Environmental Studies, and the USC Sustainable Cities Program supported this research. D.G. Webster and Nicole Martin provided countless hours of research assistance. Additional assistance was provided by Jessica Morton, Miwa Tamanaha, and Kristin Sipes. Rebecca Orozco conducted newspaper archival reviews.

Footnotes:

[1] Viscusi [12] p1658

[2] Viscusi [12] p1670

[3] The number of studies using microbial measures of water quality is so large that a review of these studies is beyond the scope of this paper. See Leggett and Bockstael (2000) for a recent study.

[4] Legget and Bockstael (2000) offer a hedonic treatment that examines possible omitted variables. Pendleton and Shonkwiler (2001) offer a latent variables approach for dealing with this kind of naturally occurring collinearity.

[5] A copy of the survey is available from the author.

[6] A survey of newspaper articles from the period 1/01/99 to 5/31/99 showed that the L.A. Times averaged 5.4 articles about water quality each month compared to 1.0 articles/month for La Opinión, the areas largest Spanish language newspaper.

[7] Not shown are regressions in which we include as incorrect" those that do not recognize any beaches given or are otherwise unwilling to give a ranking (90 observations out of 403 surveyed). The estimated coefficients using this second definition are consistently of the same sign and usually within one order of magnitude.