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The Role of Knowledge in the Public's Trust in Science about Offshore Oil and Gas Development

Final Technical Summary

Final Study Report

MMS
U.S. Department of the Interior
Minerals Management Service
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FINAL TECHNICAL SUMMARY

STUDY TITLE: A Design for a Time Series Study of a NIMBY Response

REPORT TITLE: The Role of Knowledge in the Public's Trust in Science about Offshore Oil and Gas Development

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KEY WORDS: Trust in science; Trust in government; Risk assessment; NIMBY; Receive-Accept-Sample Model; Political learning; Political knowledge; Egalitarianism; Individualism; Postmaterialism; Offshore oil development; Public opinion--California; Public opinion--energy.

BACKGROUND: The goal of this project was to conduct a series of preliminary analyses in order to help design a set of public opinion surveys and news-media content-analysis methods for a study of NIMBY responses to proposed offshore oil development projects along the California coast.

Another way to describe this project would be to say that in large part it is an application and testing of the "Receive-Accept-Sample," or RAS, model of opinion formation. Although this model has received a great deal of attention from public opinion scholars, it has not been used by researchers investigating risk perception, risk communication, NIMBYs, or attitudes regarding offshore oil drilling. The preliminary studies reported here test the RAS model in the context of attitudes toward offshore oil drilling.

Our approach to understanding the public's reaction to potentially risky technologies begins with a focus on the role of the public's knowledge. How much people know about potential hazards plays a critical—and poorly understood—role in their perceptions of risk. A few studies suggest that risk perceptions depend on information, but most studies point to the conclusion that deeply held values, cultural orientations, and other factors govern risk perceptions, and that knowledge about potential hazards has little or no influence.

John Zaller's (1992) "Receive-Accept-Sample" (RAS) model of opinion formation focuses on the critical role of political awareness and knowledge in the communication and persuasion process. The basic propositions of the RAS model are: (1) exposure to mass communication messages increases with political knowledge; (2) among those who have been exposed, acceptance of the message increases with knowledge if the message agrees with the person's values or "predispositions"; and (3) among those who have been exposed, acceptance of the message decreases with knowledge if the message is contrary to the person's predispositions. So acceptance of a persuasive, controversial message depends on the individual's political knowledge *and* on whether the message agrees or disagrees with the listener's predispositions. This has been described in previous studies as the "expertise interaction hypothesis."

In concrete terms, people who don't pay attention to politics will not be influenced by claims that offshore oil drilling is risky because they are not likely to hear those claims. Among those who do pay attention, pro-environmental people will be likely to believe the claims and pro-development people will be likely to reject them because of their prior beliefs. The people most likely to be persuaded by messages are those who have intermediate levels of knowledge and attention to politics. They pay enough attention to politics so that they hear some messages, but they don't know enough to recognize whether the messages are consistent with their prior beliefs.

Five measures of people's basic values were examined as possible predispositions in this project—egalitarianism, individualism, postmaterialism, liberal-conservative ideology, and party identification. Each of these measures has been identified as a likely cause of environmental attitudes in previous research. The predisposition that yielded the strongest results throughout this study is egalitarianism, the belief that material goods should be distributed more equally both within the U.S. and among nations.

OBJECTIVES: The specific objective of this project was to test the RAS model in several ways using a 1998 public opinion survey of Californians. The preliminary tests were intended to show whether the RAS model worked, and therefore whether this line of research should be pursued further. The tests were also intended to show which of several possible predispositions should be included in the survey being designed, and how well several indexes under consideration performed.

SIGNIFICANT CONCLUSIONS: We found expertise interactions in three important areas: (1) in people's attitudes of support or opposition to offshore oil drilling; (2) in people's trust in scientists working for the government, the oil industry, or environmental groups; and (3) in people's confidence in claims by university scientists that offshore oil drilling was either safer or riskier than previously believed.

With respect to attitudes toward offshore oil drilling, we found that the strongest opponents were those who were well informed and who were strong egalitarians, while the strongest supporters were those who were well informed but who rejected egalitarianism. These findings held up under a variety of controls in multiple regression models. Moreover, egalitarianism, knowledge, and their interaction explained attitudes toward offshore oil drilling far better than any of the "standard" variables used to explain environmental attitudes in previous research.

To examine people's trust in scientists working for the government, the oil industry, and environmental groups, a two-stage, least squares regression model was estimated. The model allowed us to disentangle the causal effects in the relationship between trust in experts and attitudes toward oil drilling. Loss of trust in institutions and the experts associated with them is one of the most commonly proposed explanations for the failure of people to believe expert risk assessments, and to accept technologies such as offshore oil drilling. The argument is that if people do not trust the government, big business, university scientists, or other sources of expertise, then they will reject the experts' assurances that risks are minimal and that they have no reason to worry. Recently, however, it has been suggested that the causal path might run in the opposite direction. That is, once a person has decided that something is dangerous, he or she may distrust any so-called expert who says otherwise. That is, distrust may be *caused by* exaggerated fears, rather than being a cause of them.

We found that attitudes toward oil drilling cause which set of experts people choose to believe. Drilling supporters are most likely to believe oil industry scientists, while drilling opponents are most likely to believe environmental group scientists. Trust in environmental group and oil industry experts, in contrast, has no impact on attitudes at all. There is some marginal evidence, however, that trust in government experts may influence people's opinions—a potentially important finding from MMS's point of view. We also found that the expertise interaction with egalitarianism and knowledge was again a prominent cause of attitudes.

In our third analysis of survey data, we used an experiment embedded in our 1998 survey to examine people's confidence in claims by university scientists that offshore oil drilling was either safer or riskier than previously believed. We found that people choose to believe scientists based on the content of the scientists' reports. People had confidence in the scientists when the scientists supported their prior beliefs, but not when the scientists' reports contradicted their beliefs. Greater education and knowledge did not make people more likely to believe scientists. Instead, as the RAS model predicts, greater education and knowledge makes people more likely to accept findings that agree with their predispositions and reject those findings that do not.

The final part of this project was a content analysis of the *Los Angeles Times* for the period April 1 to September 30, 1997. The original intent was to provide a baseline analysis of the information in the *Times* that would allow readers to estimate risks from a variety of threats, including any potential hazards associated with oil development. Contrary to our expectations, we found almost no detailed risk information on any subject. Although the *Times* is one of the most thorough newspapers in the United States, it did not offer its readers any systematic evidence that would allow them to evaluate risks from oil development or any other subject.

The results discussed here were used to help design a questionnaire and set of content analysis instruments for the next phase of this project.

STUDY PRODUCTS:

Smith, Eric R. A. N., *Energy, the Environment, and Public Opinion*. Boulder, Colorado: Rowman & Littlefield, 2002.

Smith, Eric R. A. N., *Recent Trends in Public Opinion toward Offshore Oil Development.* Report to the Minerals Management Service, U.S. Department of the Interior, December, 2002.

Smith, Eric R. A. N., *The Role of Knowledge in the Public's Trust in Science about Offshore Oil and Gas Development*. Report to the Minerals Management Service, U.S. Department of the Interior, February, 2003.

FINAL STUDY REPORT

The difficulty of communicating with the public about risks and engaging the public in an informed debate about potential hazards such as offshore oil development has been widely recognized as a central policymaking problem for government officials. The public clearly exaggerates some risks, while it underestimates others. People fear high-power electric transmission lines and offshore oil drilling, but feel safe about risky behaviors such as smoking and driving at high speeds. Moreover, expert testimony about actual risks seems to be ignored by the public (Committee on Risk Perception and Communication 1989; Stern and Fineberg 1996).

Understanding why the public exaggerates some risks and understates others is important for two reasons. First, high-risk behavior by the public—in areas such as smoking and automobile driving—constitutes a major public health problem. Second, the public's risk perceptions are one of the driving forces behind public policies regulating a wide range of potential hazards, including offshore oil development. In some cases, the public's understanding of the risks seems reasonable, yet in other cases, the public encourages high-risk policies or resists low-risk policies—apparently because the public misperceives the risks.

In this project, we sought to test and refine a new theory of risk perceptions that combines insights from two, previously unrelated theoretical approaches to public opinion. The specific goal of this project was to conduct a series of preliminary investigations to help design a new public opinion survey and an associated media content study to explore the public's understanding of and reactions to offshore oil drilling. Yet the results of the preliminary investigation offer both evidence that the theory works, and hope that risk communication campaigns can be effective.

In brief, we find that people's perceptions of risks associated with offshore oil development (and presumably other potentially risky technologies) stem from their basic values or worldviews in a way that depends on their political awareness. The basic values we investigated most carefully are egalitarianism and individualism. Egalitarians are people who believe in increasing social and economic equality. In contrast, individualists believe that people should be on their own, and not rely on others for material assistance. These two worldviews yield characteristic responses to hazards and threats in the world. Individualists tend to see lower risks than others see, and individualists are far more likely than others to accept risks in exchange for economic returns. Egalitarians are especially concerned with potential risks caused by what they see as inegalitarian institutions—big government and large corporations. They are also more likely to favor policies than reduce risks at the expense of economic growth. Consequently, these are the people who are most likely to fear offshore oil development, nuclear power, genetic engineering, and similar threats.

Risk perceptions depend on political awareness because people who pay attention to the news are more likely to hold opinions on specific issues (such as whether offshore oil drilling should be allowed) that match their worldviews. Poorly informed individualists and egalitarians hold fairly similar views on oil development issues because they generally fail to see the connections

between their values and their opinions. Well informed individualists and egalitarians, however, are guided by their values into believing that oil companies and offshore oil drilling are either good (the individualist view) or bad (the egalitarian view).

In this report, we test the theory that the combination of worldviews and political awareness explains the public's views in several ways. In the first section of the report, we show that the theory explains support for offshore drilling and nuclear power. In the second section, we show that worldviews and awareness can help explain the level of trust people have in scientific reports from oil industry experts, from environmental group experts, and from government experts. In the third section of the report, we show that the theory helps to explain why people react differently to scientific reports depending on the content of those reports (whether oil drilling is riskier or safer than previously believed). The findings reported in the second and third sections, of course, speak to the ability of MMS to explain oil drilling safety issues to the public.

In the final section of the report, we move away from our theory of risk perceptions to look at the amount of risk information that is available to the public. We show that one of the nation's most prominent newspapers, the *Los Angeles Times*, rarely gives the public sufficient information to allow it to estimate the risks associated with offshore oil development, or almost any other technology. The lack of news coverage of risk and safety issues helps explain why people turn to their basic values when trying to estimate how risky a technology is.

Theoretical Foundation

One way to describe this research project would be to say that in large part it is an application and testing of the "Receive-Accept-Sample," or RAS, model of opinion formation. Although this model has received a great deal of attention from public opinion scholars, it has not been used by researchers investigating risk perception, risk communication, NIMBYs, or attitudes regarding offshore oil drilling. The preliminary studies reported here and the overall project test the RAS model in the context of attitudes toward offshore oil drilling. We begin, therefore, with a discussion of the RAS model.

The Receive-Accept-Sample (RAS) Model of Opinion Formation

Our approach to understanding the public's reaction to potentially risky technologies begins with a focus on the role of the public's knowledge. How much people know about potential hazards plays a critical—and poorly understood—role in their perceptions of risk. Some studies suggest that risk perceptions depend on information (Hensler and Hensler 1979; Kuklinski *et al.* 1982; Maharik and Fischhoff 1993). But most studies point to the conclusion that deeply held values, cultural orientations, and other factors govern risk perceptions, and that knowledge about potential hazards has little or no influence (Douglas and Wildavsky 1982; Wildavsky and Dake 1990). In fact, Wildavsky (1991a, 15) flatly declares that "knowledge of actual dangers makes no difference whatsoever" in risk perceptions.

The problem with the studies of Wildavsky and others who claim that knowledge has no influence on risk perceptions is that it flies in the face of common sense and of studies of mass communication and attitude formation. People *do* learn from news coverage of issues and public

relations campaigns and their knowledge does influence their opinions in areas unrelated to risk perceptions (Chaiken *et al.* 1996; Neuman *et al.* 1992; Zaller 1989, 1992). So why not in the area of risky technologies also?

One answer may be that previous studies have not correctly conceived of the communications process influencing risk perceptions. Disputes over potential hazards are not like typical public relations campaigns in which only one side is running a campaign. To the contrary, in risk disputes two sides are running public relations campaigns, although opponents' campaigns may not look like conventional ones. Environmentalists and others who warn the public about potential hazards may lack the money to pay for television time or mass mailing. Nevertheless, these groups attempt to sway public opinion with press conferences, protests, letters to the editor, grassroots campaigning, and other methods. In short, in disputes over potentially risky technologies, two sides contest the facts in a controversial issue.

The two-sided nature of the conflict leads us to John Zaller's "Receive-Accept-Sample" model for interpreting mass communications campaigns on controversial issues (1989, 1992). Drawing on Converse (1962) and McGuire (1968), Zaller focuses on the critical role of political awareness in the communication and persuasion process. People who pay attention to politics, who are politically aware and engaged in thinking about politics will be most likely to receive any given political message. For example, people who follow politics closely should be the most likely to hear arguments and the safety or dangers of offshore oil development or nuclear power. It follows that the best measure of political awareness is political knowledge. Politically aware people learn more facts about politics. Consequently, although Zaller uses the term political awareness, in practice he measures it with knowledge indexes.

The basic propositions of the RAS model are: (1) exposure to mass communication messages increases with political knowledge; (2) among those who have been exposed, acceptance of the message increases with knowledge if the message agrees with the person's predispositions; and (3) among those who have been exposed, acceptance of the message decreases with knowledge if the message is contrary to the person's predispositions. So acceptance of a persuasive, controversial message depends on the individual's political knowledge *and* on whether the message agrees or disagrees with the listener's predispositions.[1]

In the context of risk research, an investigator who examines only the relationship between a person's knowledge and his or her perceptions of risk should not be expected to find anything. Greater knowledge does not necessarily make people more likely to perceive risks more accurately or accept scientists' pronouncements with greater confidence. After all, both sides in disputes over environmental technologies often have their own scientists offering competing claims. Instead, greater knowledge pushes people's opinions in the direction of their basic values or worldviews. As a result, if a sample consists primarily of environmentalists, then knowledge will seem to be associated with greater environmentalism. In contrast, if a sample

[1] There is more to the RAS model than sketched out here. I limit my discussion to these central elements of the model because a full discussion is beyond the scope of this report and because I do not have the time series data needed to test more elaborate versions of the model. The more elaborate versions of the model can only be tested with repeated public opinion surveys. The research described in this report is intended to help design the larger time series study.

consists primarily of pro-development respondents, then knowledge will seem to be associated with greater support for the potentially risky environmental technologies. A couple of previous studies have actually found this pattern, but they offered no theoretical explanation for it, and no one followed up on their work (Bright and Manfredo 1997; Reed and Wilkes 1979).

The question we must now address is, what are the relevant predispositions or values for explaining attitudes on environmental issues? To answer this question, we turn to cultural theory.

Douglas and Wildavsky's Cultural Theory

In a series of books and articles beginning in the 1980s, Mary Douglas and Aaron Wildavsky developed "cultural theory" to explain why people come to accept or reject environmentalism and why they choose which potential hazards to fear and which to ignore (Douglas and Wildavsky 1982; Douglas 1992; Wildavsky 1991b; Wildavsky and Dake 1990). Their theory, based in anthropological research, holds that patterns of social relationships are determined by two variables. The first, "group," is the extent to which people are incorporated into communities or other social groupings that control them. The greater the incorporation, the greater the group influence on individual decisions and the lesser the individual's choice. The second variable, "grid," is the extent to which external constraints limit individual choices and behaviors. The combinations of these two variables yield four patterns of social relationships and corresponding worldviews and values that characterize all societies.

Egalitarianism stems from high group control, but low external constraints. Egalitarians believe—as the label implies—in relative equality in the community. Individualism stems from low group control and few external constraints. Individualists believe that people should be on their own and not rely on others for material assistance. Hierarchicalism stems from high group control and strong external constraints. Hierarchicalists believe in strong social and moral guidance from their community leaders. Fatalism stems from low group control and strong external constraints. Fatalists see the world as threatening and uncontrollable, but feel they cannot turn to their community for help.

These four cultural biases or "worldviews" also yield four characteristic responses to hazards and threats in the world (Marris *et al.* 1998). Individualists tend to see lower risks than others see and individualists are far more likely than others to accept risks in exchange for economic returns. Egalitarians are especially concerned with potential risks caused by what they see as inegalitarian institutions—big government and large corporations. They are also more likely to favor policies than reduce risks at the expense of economic growth. Consequently, these are the people who are most likely to fear nuclear power, offshore oil development, genetic engineering, and similar threats. Hierarchicalists fear threats associated with social or moral breakdowns—for example, war, terrorism, mugging, pornography, or AIDS. Fatalists basically fear everything, for to them the world is a mysterious and threatening place.

Douglas and Wildavsky argue that every society has a mix of people with these four types of worldviews. When a particular worldview is especially prevalent a society, we can describe the

entire society in those terms, but in the United States there is a mix of at least three of the types (fatalism is rare). These worldviews fill the role of "predispositions" in the RAS model.

We will concern ourselves only with two worldviews in this study, individualism and egalitarianism. We limit ourselves to these for two reasons. First, the studies discussed above argue that egalitarians should be the most pro-environment and anti-egalitarians should be the most pro-development (anti-environment). In addition, individualists should be pro-development and anti-individualists should be pro-environment, although the differences should not be as large as the differences between people on the extremes of an egalitarianism scale. Second, our 1998 California data set (described below) includes a set of questions designed to measure these two worldviews, but not hierarchicalism or fatalism.

We should also note that a number of other scholars treat individualism and egalitarianism as basic values in their studies without relying on cultural theory to justify them (e.g., Feldman 1988; Feldman and Zaller 1992; Sniderman with Hagen 1985). We present the cultural theory argument because of the attention brought to it by Wildavsky and Douglas.

Individualism and egalitarianism are not the only values that could serve as predispositions for the RAS model. Self-identified ideology, party identification, and other worldviews such as postmaterialism could might also work in principle. For our first test of the RAS model, however, we discovered that these values did not work. We concentrate, therefore, on individualism and egalitarianism.

A First Test: Explaining Support for Offshore Oil Drilling

As the first test of the RAS model, we attempt to model support for expanding offshore oil drilling and nuclear power. There are a variety of attitude and risk perception questions we could examine, but the general support/opposition question is presumably the most important one to decision makers.

Model and Data

To test the RAS and cultural models, we estimate a set of regression models explaining public opinion toward offshore oil drilling and nuclear power in California. Both sources of energy are controversial and both are regarded as potentially risky by some critics. Opponents of offshore oil drilling warn people about the dangers of oil spills. Opponents of nuclear power emphasize the potential for deadly radiation leaks and reactor meltdowns. Supporters of both types of energy respond that the technologies are safe and that the fears are exaggerated (Freudenburg and Gramling 1994; Wellock 1998). The situation, therefore, offers a good opportunity to see whether combining the insights of the RAS model and cultural theory can improve our understanding of public reactions to potentially risky environmental technologies.

The data for this report come from a March, 1998 public opinion survey of Californians conducted by the Field Institute.[2] The sample was a representative sample of 810 adult residents of the state. Respondents were selected by random digit dialing. Interviews were conducted in

[2] The Field Institute is located at 550 Kearny Street, Suite 900, San Francisco, California 94108.

either English or Spanish, as appropriate. The Field Institute is a nonpartisan, not-for-profit public opinion research organization established by the Field Research Corporation. This public opinion survey was funded by the University of California Toxic Substances Research and Teaching Program. Neither of these organizations is responsible for the analysis or interpretation of the data appearing here.[3]

The dependent variables are the two energy questions shown in table 1. "Don't Know" responses for both variables were recoded to the midpoints of the scales, yielding five-point scales with the high scores representing support for oil drilling and nuclear power. All the analyses shown here were reestimated omitting the small of number DK responses (6 percent for the offshore oil question, 5 percent for the nuclear power question). There were only trivial differences in the results.

The questions making up the egalitarianism and individualism indexes, also shown in table 1, were used by Richard Ellis and Fred Thompson (1997) in their study of cultural theory and environmental attitudes in the Pacific Northwest. The questions were used to construct simple additive indexes. The indexes were built by assigning the numbers 1-4 to the four possible answers to each question, adding up the answers, and subtracting two so that the resulting index ranges from 1 to 10. The reliability (Cronbach's alpha) of the egalitarianism index is 0.72; the reliability of the individualism index is 0.54.

[3] These survey data are included with this report, and are archived at the University of California's UCDATA, located at the U.C. Berkeley campus.

Table 1. Survey Questions

Energy Questions

Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly with the following statements? …

1. Oil companies should be allowed to drill more oil and gas wells in state tidelands along the California seacoast.
2. The building of more nuclear power plants should be allowed in California.

Egalitarianism Index

Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly with the following statements? …

3. The world would be a more peaceful place if its wealth were divided more equally among nations.
4. We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women.
5. What our country needs is a fairness revolution to make the distribution of goods more equal.

Individualism Index

Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly with the following statements? …

6. Competitive markets are almost always the best way to supply people with the things they need.
7. Society would be better off if there were much less government regulation of business.
8. People who are successful in business have a right to enjoy their wealth as they see fit.

Political Knowledge Index

Last, here are a few questions about the government in Washington. Many people don't know the answers to these questions, so if there are some you don't know, just tell me and we'll go on.

9. Do you happen to know what job or political office is now held by Al Gore?
10. Whose responsibility is it to determine if a law is constitutional or not . . . is it the president, the Congress, or the Supreme Court?
11. How much of a majority is required for the U.S. Senate and House to override a presidential veto?
12. Do you happen to know which party has the most members in the House of Representatives right now?"
13. Would you say that one of the parties is more [conservative/liberal] than the other at the national level? Which party is more [conservative/liberal]?

The political knowledge index consists of the questions recommended by Delli Carpini and Keeter (1996, 305-306) with one minor change. The last item they recommend (table 1, no. 13) is which party is more conservative. In this survey, a random half of the respondents were asked which party is more conservative and the other half were asked which party is more liberal. The two versions of the question are basically interchangeable. The resulting knowledge index is the total number of correct answers to the five questions. The reliability of the index is 0.70.
The core of our test of the combined RAS and cultural theories lies in the effects of the cultural values indexes and knowledge. Specifically, the essential elements of the model should be captured by the following regression equation:

$$\text{Opinion} = b_0 + b_1(\text{Egalitarianism}) + b_2(\text{Individualism}) + b_3(\text{Knowledge}) + b_4(\text{Egalitarianism x Knowledge}) + b_5(\text{Individualism x Knowledge})$$

That is, cultural theory says that egalitarianism and individualism should both influence attitudes toward energy development. Egalitarians should consider it risky and oppose it; individualists should find it safe and support it. The RAS model says that as knowledge increases, the effects of egalitarianism and individualism should also increase. Those with little political knowledge should not recognize the connection between their values and their opinions on offshore oil drilling and nuclear power, but those with a lot of political knowledge should recognize the connections and should bring their opinions in line with their worldviews. This means that there are interactions between the worldview and knowledge indexes. In the equation above, the interactions are assumed to be multiplicative.

Unfortunately the model specified above suffers the weakness that including more than one knowledge interaction term increases the likelihood that multicollinearity among the variables will hide any effects. The situation with individualism is particularly poor. As table 2 shows, the Individualism-Knowledge interaction term is strongly correlated with Knowledge ($r = 0.81$) and Individualism ($r = 0.59$). Such high correlations cause large standard errors in regression models and make it difficult to disentangle the separate effects of the variables. The high correlations alone do not prove that multicollinearity creates a problem for testing all the interaction terms in a single equation. A more formal test showed that the variance inflation factors (VIFs) for the interaction terms were all extremely high (Maddala 1988).

The multicollinearity problem is further compounded by the low reliability of the individualism index (alpha = 0.54). Possibly because of these reasons, or possibly because of a poorly specified model, none of the Individualism-Knowledge interaction terms worked in any of the models. We suspect that multicollinearity and the low reliability of the individualism index are the causes for this failure, but the answer cannot be inferred from these data. In any event, in the results that follow, the Individualism-Knowledge interaction term has been dropped.

In addition to the central variables of interest discussed above, we include a number of other variables that have been identified as possible causes of attitudes on environmental issues. The list begins with several demographic variables—age, education, income, gender, race, and ethnicity. Age, education, and gender have consistently been shown to influence attitudes on environmental issues. Income and race (white/black) have been shown to have effects in some cases, but not all. Because there is a reasonable number of Asians and Latinos in the sample, variables for being Asian or Latino are included as well. To these, two political variables are added, party identification and self-identified ideology. Both of these variables have also been shown to affect attitudes on most environmental issues (Davidson and Freudenburg 1996; Dunlap and Scarce 1991; Smith 2001; Van Liere and Dunlap 1980).

Findings

Because the egalitarianism and individualism measures are not in common use, we begin by presenting the distributions of these variables in figure 1. Here we see that the egalitarianism

index has a fairly uniform distribution with a mean score of 6.0, skewed slightly to the pro-egalitarian side. The individualism index is skewed even more toward the individualist side, with a mean of 7.4 and only seven percent of the respondents receiving scores of four or less. Clearly, both sets of ideas are popular, although the individualist views are substantially more popular among Californians.

Figure 1. The Distributions of Individualism and Egalitarianism

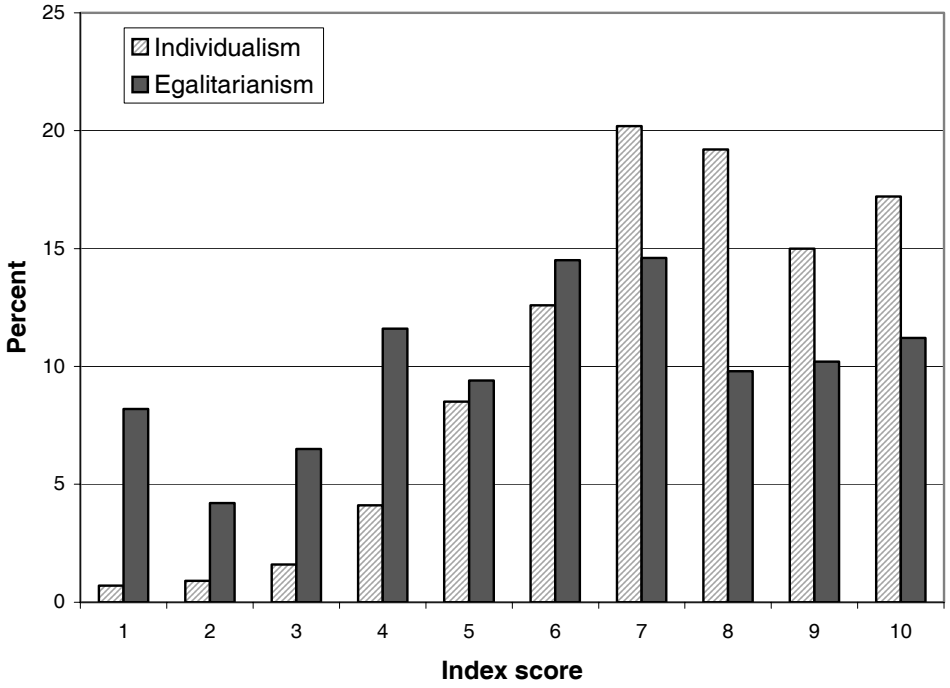

Table 2. Correlations among Key Variables

	KNOW	EGAL	INDIV	EGAL x KNOW	INDIV x KNOW	PARTY	IDEO	OIL	NUCLEAR
KNOWLEDGE	1.00								
EGALITARIANISM	-0.30	1.00							
INDIVIDUALISM	0.06	-0.30	1.00						
EGAL x KNOW	0.49	0.64	-0.28	1.00					
INDIV x KNOW	0.81	-0.44	0.59	0.18	1.00				
PARTY ID	0.13	-0.34	0.33	-0.25	0.32	1.00			
IDEOLOGY	-0.03	-0.26	0.28	-0.31	0.17	0.49	1.00		
OIL DRILL	-0.12	-0.10	0.20	-0.24	0.03	0.15	0.16	1.00	
NUCLEAR	0.08	-0.22	0.19	-0.16	0.19	0.19	0.11	0.20	1.00

Note: Entries are Pearson's product-moment correlation coefficients. All correlations except the Individualism-Knowledge coefficient are statistically significant at $p < 0.05$.
Minimum cell n = 640.

Table 2 presents the correlations among the key variables. Here we see not only the multicollinearity problem, but also that political knowledge is only weakly correlated with the two dependent variables—exactly as previous research would suggest. In the case of offshore oil drilling, the more knowledgeable are slightly against it ($r = -0.12$) and in the case of nuclear power, the more knowledgeable lean slightly toward it ($r = 0.08$). Although both coefficients are statistically significant, they are also both fairly small.

The data also show that the two cultural indexes are moderately correlated with attitudes on oil drilling and nuclear power. The Egalitarianism-Offshore oil coefficient is only -0.10, but the others are about twice as large. Moreover, the correlations are in the expected directions. Egalitarians oppose both types of energy development, while individualists support them.

Party identification and self-identified ideology also correlate with energy development attitudes in the expected directions. Republicans and conservatives are more likely to support both types of energy development than Democrats and liberals. On average these two measures do not correlate with the energy attitudes quite as strongly as the two cultural indexes, but the differences are fairly small.[4]

We turn now to the regression models, which yield the central findings of this section of the report. Tables 3 and 4 present the results of four regression equations for each of the dependent variables. The first equation includes only the demographic variables. The second adds party identification, ideology, and political knowledge. The third adds the individualism and egalitarianism indexes. The final equation adds the egalitarianism-knowledge interaction term. All the coefficients are unstandardized. The point of presenting the four versions of each model is to show the relative contributions of each set of variables as the model becomes increasingly comprehensive.

The first demographic equation for offshore oil drilling, shown in table 3, yields typical findings for a model explaining attitudes toward environmental issues. Older respondents are more likely than younger respondents to support additional drilling. The well-educated are more likely to oppose it than the poorly educated, and women lean against it more than men. Income, race, and ethnicity fail to achieve statistical significance. Overall the model performs poorly, explaining only two percent of the variance.

[4] In a critique of Rothman and Lichter's (1987) analysis of the liberal bias in news media on environmental issues, Plutzer, Maney and O'Connor (1998) argue that one should not compare the correlations of the single-item ideology index with the multiple-item ideology scales because multi-item scales tend to be more reliable. One might think that criticism is appropriate here as well. In fact, self-identified ideology questions are fairly reliable. We cannot estimate the reliability of the ideology item in this survey because it is only a single item and not part of a panel survey. However, using Wiley and Wiley's (1970) method to estimate reliability in panel models with the 1972-74-76 American National Election Panel Study, we found the ideology question to have a reliability of 0.67 in the first two waves and 0.68 in the third wave. Using a more elaborate latent variables model and a five-wave survey of Los Angeles and Erie, Pennsylvania residents, Feldman (1989) found that the reliability of the question varied from 0.65 to 0.72 at different times in his panel. These data imply that the ideology question is probably just a shade less reliable than the egalitarianism index and more reliable than the individualism index, with its Cronbach alpha of 0.54.

Table 3. OLS Regression Models for Offshore Oil Drilling

Variable	(1) b	(2) b	(3) b	(4) b
Intercept	2.11***	1.80**	1.30**	-0.10
	(0.21)	(0.25)	(0.41)	(0.53)
Age	0.06**	0.05*	0.01	0.01
(decades)	(0.03)	(0.03)	(0.03)	(0.03)
Education	-.10**	-0.06	-0.05	-0.06
	(0.04)	(0.05)	(0.05)	(0.05)
Income	-0.01	-0.02	-0.04	-0.04
	(0.04)	(0.04)	(0.04)	(0.04)
Women	-0.27**	-0.21**	-0.11	-0.12
	(0.09)	(0.09)	(0.10)	(0.10)
Black	-0.12	-0.03	0.08	0.05
	(0.20)	(0.20)	(0.24)	(0.23)
Asian	0.21	0.25	0.36*	0.35*
	(0.19)	(0.19)	(0.21)	(0.21)
Latino	0.21	0.24	0.20*	0.13
	(0.13)	(0.13)	(0.15)	(0.15)
Party Id		0.08**	0.08**	0.06**
		(0.03)	(0.03)	(0.03)
Ideology		0.06**	0.06*	0.05
		(0.03)	(0.04)	(0.04)
Knowledge		-0.06	-0.07	0.34***
		(0.04)	(0.05)	(0.11)
Individualism			0.10***	0.08***
			(0.03)	(0.03)
Egalitarianism			-0.01	0.23***
			(0.02)	(0.07)
Egalitarianism x Knowledge				-0.06***
				(0.02)
Adj R^2	0.02	0.06	0.09	0.11
N	755	748	604	704

* $0.05 < p < 0.10$
** $p < 0.05$
*** $p < 0.01$

In the second equation, we see that adding party identification, ideology, and political knowledge reduces the influence of age, education, and gender. Age is reduced to borderline significance ($p < 0.10$); education becomes insignificant; and gender weakens, but remains statistically significant. Thus it seems that party and ideology are more proximate to opinions on oil drilling than the demographics. The knowledge index fails to achieve significance, exactly as Wildavsky and others would have predicted.

One might suspect that including both education and knowledge creates a multicollinearity problem, which causes the two variables to fail to achieve significance. However, when each variable is included separately without the other, it fails to achieve the usual $p < 0.05$ significance level. Both fall in the less persuasive $p < 0.10$ range. This suggests that there is some multicollinearity, but not a great deal. The more important result here is that with party and ideology in the equation, education and knowledge have only marginal effects. Moreover, the contribution of party identification and ideology increases the explained variance to six percent.

In the third equation, adding the individualism and egalitarianism indexes pushes age, education, and gender into statistical insignificance. The effects of party identification and ideology remain unchanged. Of the two cultural bias indexes, only individualism is statistically significant. As cultural theorists would predict, it is positive. Individualists support oil development. Because of its contribution, the adjusted R^2 increases to nine percent. In the fourth equation, the adding the Egalitarianism-Knowledge interaction term causes a good deal of change. The demographic variables remain small and statistically insignificant (with the exception of Asian, which is of borderline significance). Party identification diminishes slightly, but remains significant.

Individualism, egalitarianism, knowledge, and their interaction all have large and significant effects. What may seem surprising is that egalitarianism has a positive effect. Yet the egalitarianism-knowledge interaction term has an offsetting negative coefficient. The unstandardized egalitarianism coefficient of 0.23 may seem larger than the interaction coefficient of –0.06, but the impact of the interaction is larger. Recall that the egalitarianism index has a 1-10 scale and the knowledge scale has a 1-5 scale. The interaction term, therefore, has a 5 x 10 = 50 point scale. So the potential impact of the interaction term is greater than the potential impact of the egalitarianism scale standing alone.[5] In other words, the more knowledgeable a egalitarian is, the more he or she opposes offshore oil drilling.

Because visualizing the collective impact of egalitarianism, knowledge, and their interaction is difficult, figure 2 presents a 3-dimensional histogram illustrating the effects. The axes on the "floor" of the figure are the egalitarianism and knowledge scores. The height of the histogram indicates level of support for offshore oil drilling. The floor is arbitrarily set at zero to make the figure easier to read, but the effects are the marginal effects controlling for all other variables in equation 4 of table 3.[6]

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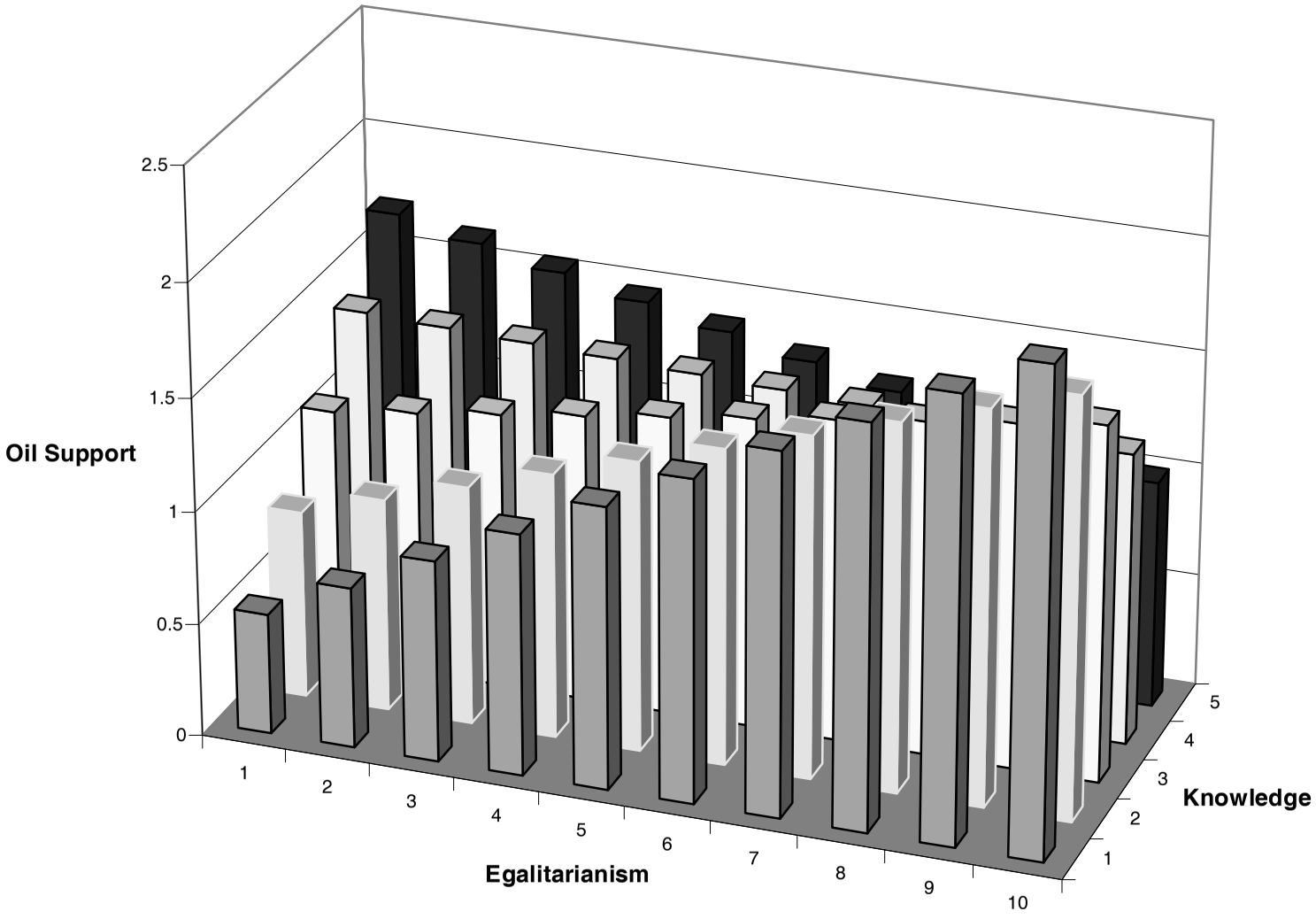
[5] Standardized coefficients do not work with interaction terms, but one can still think in terms of the relative impacts of the variables. In this case, the interaction term has a greater relative impact.

[6] More precisely, in figure 2 the height of the graph, y, is equal to 0.335 * (knowledge) + 0.234*(egalitarianism) - 0.063 * (Knowledge x Egalitarianism). These are the coefficients from equation 4 in table 3 extended to one more digit for accuracy.

In the low egalitarianism category (on the left side of the figure), as knowledge increases, support for offshore oil drilling increases as well. In contrast, among those with the highest egalitarianism scores (on the right side of the figure), as knowledge increases, support for offshore oil drilling declines. The cumulative result is that those with either high knowledge and low egalitarianism *or* low knowledge and high egalitarianism are the strongest supporters of offshore oil drilling. Those in the other two corners are the strongest opponents of offshore oil. This is the set of responses predicted by Zaller's RAS model.

Figure 2. The Joint Effects of Knowledge and Egalitarianism on Offshore Oil Opinions



Two final observations can be made about the offshore oil development equations. First, knowledge increases support for offshore drilling—once the effects of egalitarianism and individualism are taken into account. This is what scientists want: political awareness and knowledge lead people toward the scientists' views on safety issues. Yet it is not something we see unless we control for cultural predispositions and include the appropriate interaction terms. Second, the coefficients for individualism, egalitarianism, knowledge, and their interaction do most of the explaining in this model. Only party identification adds any independent explanatory power, and its coefficient is relatively modest. In light of the fact that these variables are not obviously connected to attitudes toward offshore oil drilling—or for that matter, to any environmental issue—this is a strong finding.

Table 4 reports the same set of equations for attitudes toward nuclear power with fairly similar results. In the first, demographic equation, only gender is statistically significant. Women are much more likely to oppose nuclear power than men. Age and education fail to predict attitudes toward nuclear power. When party identification, ideology, and knowledge are added in the second equation, gender remains significant and is joined by party identification. Republicans are more supportive than Democrats of nuclear power. Again, political knowledge has no impact on people's attitudes toward nuclear power. In the third equation, both individualism and egalitarianism influence attitudes toward nuclear power in the expected directions. Individualists support nuclear power; egalitarians oppose it. Gender remains a strong influence on attitudes. Party identification fades to borderline significance ($p < 0.10$), and being Asian makes one lean against nuclear power. The coefficient is only of borderline significance, but it is fairly large (-0.44).

Finally, we turn to the last equation. Gender still has a strong, significant impact. With the addition of the egalitarianism-knowledge interaction term, however, the knowledge coefficient becomes large and positive. The more knowledgeable tend to support nuclear power, just as they tend to support offshore oil drilling. However, the interaction term also shows that knowledgeable people lean toward their cultural predispositions. The coefficient on the interaction term is negative, indicating that the more knowledgeable an egalitarian becomes, the more he or she opposes nuclear power. As in the case of offshore oil drilling, the coefficient with the greatest potential impact in the model (because of its 1-50 range) is the egalitarianism-knowledge interaction with its coefficient of –0.04. This result shows that the patterns of responses to nuclear power and to offshore oil development are essentially the same.

Discussion of the Models

The RAS model and cultural theory work well in combination. Despite the claims made by Douglas and Wildavsky for the power of cultural theory (Douglas and Wildavsky 1982; Wildavsky 1991b), the coefficients and the explained variances from equation 3 in tables 3 and 4 are not strong. They are, however, substantially improved with the addition of the knowledge interaction terms—as the RAS model predicts.

Table 4. OLS Regression Models for Nuclear Power

Variable	(1) b	(2) b	(3) b	(4) b
Intercept	2.18***	1.77***	1.98***	1.01
	(0.24)	(0.28)	(0.47)	(0.62)
Age	0.03	0.02	-0.02	-0.02
(decades)	(0.03)	(0.03)	(0.04)	(0.04)
Education	0.04	0.06	0.08	0.08
	(0.05)	(0.05)	(0.06)	(0.06)
Income	0.06	0.03	-0.01	-0.01
	(0.04)	(0.04)	(0.05)	(0.05)
Women	-0.59***	-0.53***	-0.37***	-0.37***
	(0.10)	(0.11)	(0.12)	(0.12)
Black	-0.12	0.02	-0.05	-0.07
	(0.23)	(0.23)	(0.27)	(0.27)
Asian	-0.37*	-0.27	-0.44*	-0.44*
	(0.22)	(0.22)	(0.25)	(0.24)
Latino	-0.16	-0.07	-0.18	-0.23
	(0.15)	(0.15)	(0.17)	(0.17)
Party Id		0.08**	0.06*	0.05
		(0.03)	(0.04)	(0.04)
Ideology		0.04	0.04	0.03
		(0.04)	(0.04)	(0.04)
Knowledge		0.01	-0.02	0.26**
		(0.05)	(0.05)	(0.13)
Individualism			0.06**	0.06
			(0.03)	(0.03)
Egalitarian			-0.06**	0.11
			(0.03)	(0.08)
Egalitarian x Knowledge				-0.04***
				(0.02)
Adj R^2	0.05	0.06	0.08	0.09
N	755	748	604	604

* $0.05 < p < 0.10$
** $p < 0.05$
*** $p < 0.01$

The results presented in this report do not constitute a full test of the RAS model. The bulk of Zaller's work focuses on examining and explaining changes in attitudes over time. With the cross-sectional data used here, those questions cannot be addressed. Nevertheless, insofar as the RAS model can be tested, it does a good job of explaining attitudes toward potentially risky environmental technologies. This is certainly a direction risk researchers should pursue.

The findings presented here do not eliminate rival theories focusing on the role of knowledge in public opinion. In particular, Sniderman, Brody, and Tetlock (1991) have also argued that well-informed people tend to connect their basic values and opinions on specific issues more consistently than do the poorly informed. We have chosen to frame this research in terms of the RAS model, but the findings are also consistent with the approach of Sniderman and his colleagues. Which approach yields the more useful findings remains to be seen.

Finally, we should note that cultural theory may be better served by an improved measure of individualism. The reliability of the measure is relatively low and the measure does not perform well in explaining attitudes toward offshore oil development or nuclear power. This, too, is a subject for further research.

A Second Test: Explaining Trust in Experts

Our first test of the RAS model focused on explaining whether people supported or opposed offshore oil drilling and nuclear power. Our second test focuses on another important aspect of attitudes toward offshore oil drilling—which set of experts people choose to believe when they think about the safety of offshore oil drilling. We can illustrate the problem with an anecdote.

On February 3, 1988 in Fort Bragg, California, representatives of the U.S. Minerals Management Service organized a town meeting so that they could present a draft report and get public feedback. The report described the government's plans to lease offshore oil tracts and allow exploratory oil drilling and possibly production if oil were found. The government experts explained that the drilling would be clean, safe, and a boon to the local economy. They then sat and listened for the next fifteen hours as local residents heatedly disputed their claims about safety, and predicted disaster if the oil drilling were allowed. It was not. The Minerals Management Service responded to the public's concerns by postponing action. Eventually, the president ordered a moratorium on new offshore oil leases along the California coast and the leasing plans were scrapped (Freudenburg and Gramling, 1994).

In some fashion, the events of that meeting have been repeated thousands of times over the years. Government or industry experts tell the public what they believe the actual risks of some new technology are and the public responds by rejecting the experts' claims. Why does the public behave that way?

Loss of trust in institutions and the experts associated with them is one of the most commonly proposed explanations for the failure of people to believe expert risk assessments and accept new technologies (Binney *et al.* 1996; Bord and O'Connor 1990; Jenkins-Smith 1992; Laird 1989; Pierce *et al.* 1992). The argument is that if people do not trust the government, big business, university scientists, or other sources of expertise, then they will reject the experts' assurances

that risks are minimal and that they have no reason to worry. Some scholars further claim that trust in experts has declined in the last forty years and that the U.S. is becoming a less trusting society (Kasperson *et al.* 1999).

The lack of trust, according to this reasoning, explains why many Americans remain afraid of nuclear power plants, high power electric transmission lines, offshore oil drilling, genetically engineered foods, pesticides, and a host of other potential risks.
In a recent book, Howard Margolis (1996) raised doubts about the role of trust and distrust in risk assessments. Margolis suggested that the causal path may actually be in the in opposite direction. Once a person has decided that something is dangerous, he or she will distrust any so-called expert who says otherwise. That is, distrust may be *caused by* exaggerated fears, rather than being a cause of them. Margolis produced no direct evidence to support his claim; nevertheless, his argument is certainly plausible.

Moreover, some studies have indirectly supported Margolis's hypothesis. Although most researchers assume that trust causes attitudes and risk perceptions, a few studies have treated trust as a dependent variable caused by attitudes and risk perceptions (Arad and Carnevale 1994; Slovic 1999). No previous work, however, has attempted to sort out causal direction.

In this section of the report, we examine the relationship between trust in experts and attitudes toward a potentially risky technology, offshore oil drilling. Using our March 1998 public opinion survey data and two-stage, least-squares regression models to sort out causal direction, we find evidence that supports Margolis's hypothesis. Attitudes toward oil drilling cause which set of experts people choose to believe. Trust in environmental group and oil industry experts, in contrast, has no impact on attitudes at all. There is some marginal evidence, however, that trust in government experts may influence people's opinions—a potentially important finding from MMS's point of view.

The Background: Actual vs. Perceived Risk

Early psychometric studies of how people assess risks discovered that actual statistical risks are poor predictors of what people believe the risks to be (Covello 1983; Slovic 1987; Slovic *et al.* 1979). People wildly exaggerate some risks (e.g., dying from botulism or tornadoes), while they underestimate others (e.g., diabetes or stomach cancer). There are many reasons why people's beliefs about the likelihood of death or disaster do not match the statistical odds. One reason is that when experts claim that a technology is safe, many people seem to ignore or reject the advice because they do not trust the experts. Consequently, most risk perception researchers identify trust in institutions and their experts as one of the key variables explaining people's fears. As Wynne put it, (1992, 277-78), "the heart of risk perceptions and risk conflicts [is] not the issue of technical risk magnitudes, but rather trust in institutions." Risk perception scholars generally accept Wynne's claim (Covello 1992; Kraft and Clary 1991; Renn 1992a).

Margolis's critique of the accepted wisdom that distrust causes exaggerated perceptions of risk is simply that no one has ever produced any evidence about causal direction. We observe that trust and risk perceptions are correlated, but it might well be that people decide whether something is

risky and whether they support or oppose it, and then based on those opinions decide which set of experts to believe.

The Context: The Fight over Offshore Oil Drilling

The question of whether to permit more offshore oil drilling along the California coast has long been a controversial one. Resistance to offshore oil drilling began in response to the first offshore oil drilling operation in Summerland in 1896 (Wilder 1998). Ever since—long before the modern environmental movement—the oil industry has met resistance to its efforts to expand offshore drilling. The massive 1969 oil spill in the Santa Barbara Channel helped spark the modern environmental movement and made offshore oil drilling a controversial question for all Californians. The 1989 *Exxon Valdez* disaster and the running battle to preserve the moratorium on new offshore oil leases established by President Bush have kept the issue in the news (Smith and Garcia 1995; Wilder 1998).

Experts from both the oil industry and the U.S. Minerals Management Service have assured the public that offshore oil drilling is clean and safe. Experts from environmental groups have assured the public that oil drilling is anything but safe and clean. Consequently, the controversy over offshore oil drilling provides a good setting in which to examine whether trust in experts causes attitudes or vice versa.

Data and Measures

To examine the causal relationship between trust and attitudes, we use data from our March, 1998 representative public opinion survey of 810 California adults, described in the previous section. To measure attitudes toward oil drilling, we use the same question we used in the previous analysis, how strongly respondents agreed or disagreed with the statement: "Oil companies should be allowed to drill more oil and gas wells in state tidelands along the California seacoast." Oil was not very popular at the time. As figure 3 shows, only 20 percent of the sample favored it.

To measure trust in experts, respondents were asked, "How much confidence do you have in statements made by [government/oil industry/environmental group] scientists about potential health risks associated with living near an oil drilling site? Do you have a great deal of confidence, a moderate amount of confidence, only some confidence, or almost no confidence at all?" The order of the three versions of the question was randomly rotated. As figure 4 shows, people regarded environmental group scientists as the most trustworthy, followed by government scientists, followed by oil industry scientists. These results parallel those of many other studies. Distrust of industry scientists accompanies opposition to the industry, but which one is the cause and which is the effect?

Figure 3. Support for Offshore Oil Drilling

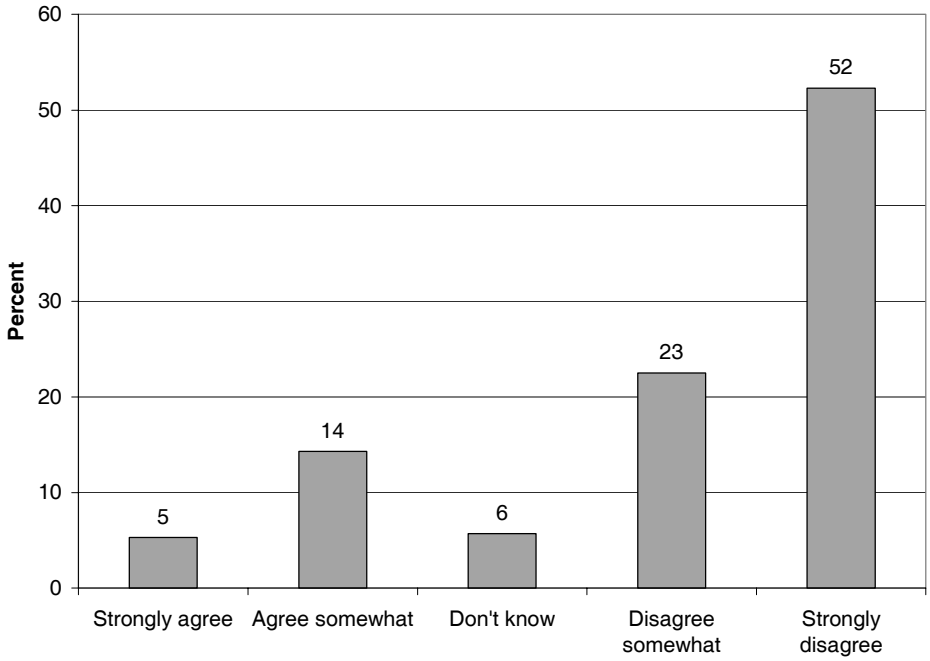
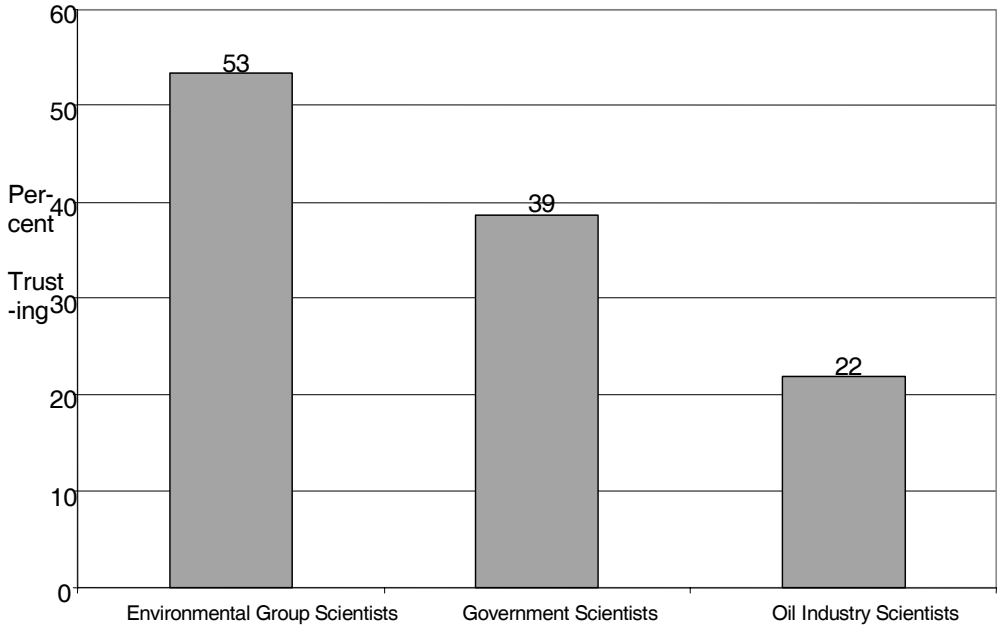


Figure 4. Trust in Experts



In order to answer the question of causal direction, we estimated a set of two-stage, least-squares regression models explaining public opinion toward offshore oil drilling and trust in each type of expert. The basic TSLS model, illustrated in figure 5, allows us simultaneously to estimate the causal effect of trust in experts on support for oil drilling, and of support for oil drilling on trust in experts (Maddala 1988).

The principal causes of attitudes toward offshore oil drilling (shown on the top and left side of figure 5) are hypothesized to be egalitarianism, knowledge, and their interaction—the same set of variables examined in our first analysis. As before, the interaction is assumed to be multiplicative:

$$\text{Opinion} = b_0 + b_1(\text{Egalitarianism}) + b_2(\text{Knowledge}) + b_3(\text{Egalitarianism x Knowledge})$$

In order to specify the oil drilling equation more fully and to assure that the model is identified, we included several other likely causes of environmental attitudes as independent variables. We used party identification and self-identified ideology because they have both been shown to affect attitudes on most environmental issues (Dunlap and Scarce 1991; Van Liere and Dunlap 1980). Individualism has also been shown to influence environmental opinions, although in the previous section we found that it does not seem play the central role that egalitarianism plays—a finding consistent with the work of other investigators (Ellis and Thompson 1997; Marris *et al.* 1998). We tested several versions of the model including both individualism and an individualism-knowledge interaction. None of the interaction terms produced statistically significant coefficients; consequently, we use individualism, but not its interaction with knowledge. In addition, attitudes on four broad environmental questions are included—whether standards of living should be cut to preserve natural resources, whether population growth should be slowed, whether industrial growth should be slowed, and whether nuclear power should be expanded (see Table 5 for question wording). These four variables are intended to tap into an overall sense of environmentalism. All of these variables have been coded so that the high scores represent strong pro-development (anti-environmental) opinions. Finally, one question about trust in experts was included in each TSLS model to test the hypothesis that trust causes attitudes toward offshore oil drilling.

Figure 5. Two-Stage, Least Squares Model of Attitudes toward Oil Drilling and Trust in Experts

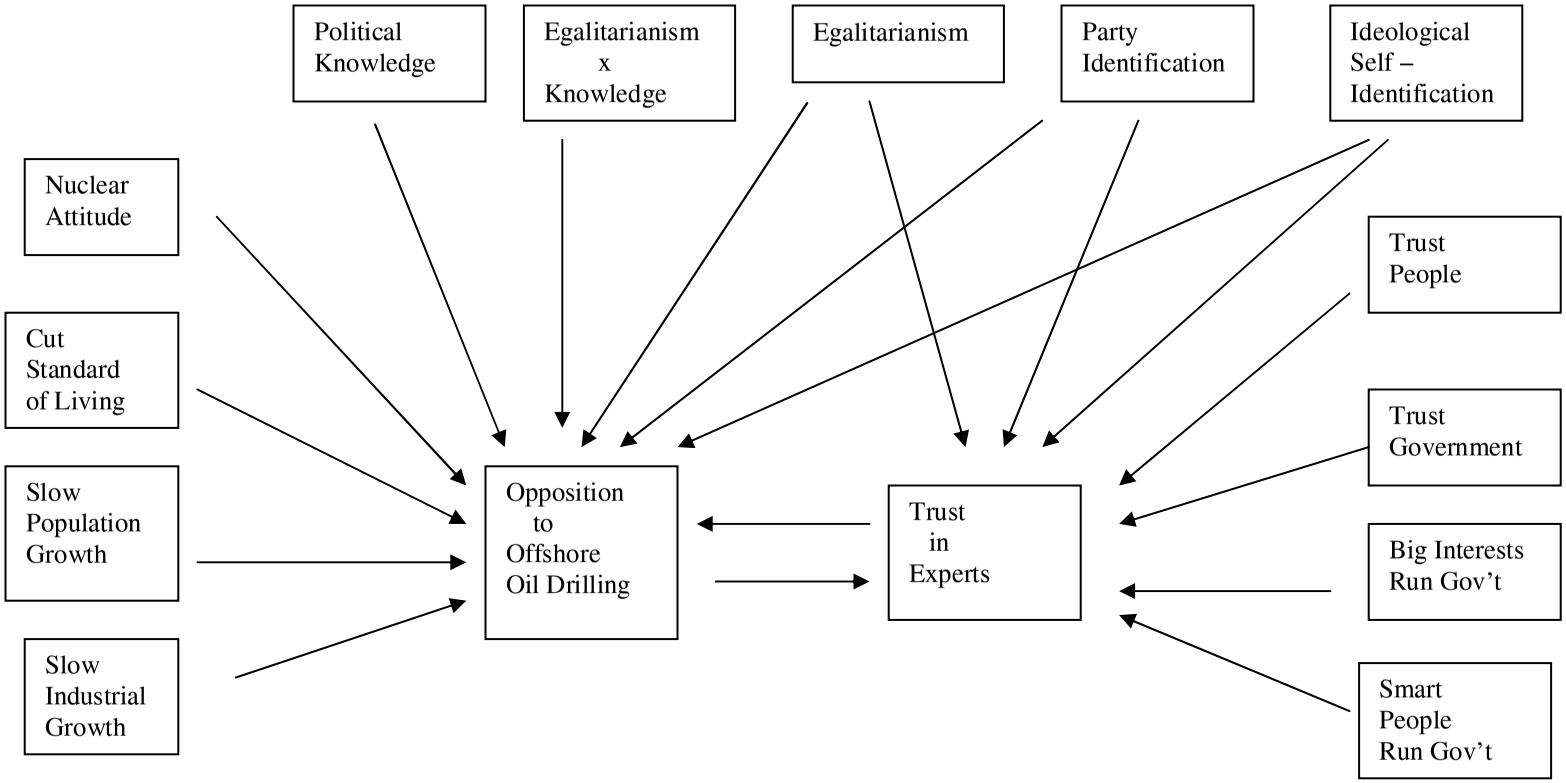


Table 5. Survey Questions used in the Trust Analysis

Environmental Attitude Questions

I would like to start by reading you a series of statements about the energy situation. I'd like you to tell me whether you agree strongly, agree slightly, disagree slightly, or disagree strongly with each of the statements as I read it. Here's the first one ...

1. The building of more nuclear power plants should be allowed in California.
2. I would prefer to cut back on my standard of living in order to conserve energy rather than to go on using up natural resources at the present rate.
3. Population growth and housing development in California should be slowed down to reduce energy needs.
4. The growth of industries requiring large amounts of energy should be slowed down to reduce energy needs.

Trust Questions

5. Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?
6. How much of the time do you think you can trust the government in Washington to do what is right--just about all of the time, most of the time, or only some of the time?
7. Would you say that the government is pretty much run by a few big interests looking out for themselves or that it is run for the benefit for all people?
8. Do you feel that almost all the people running the government are smart people who usually know what they are doing or do you think that quite a few don't seem to know what they are doing?

Our equation explaining trust in experts begins with four trust questions from the American National Election Studies—can most people be trusted, can the government in Washington be trusted to do what is right, is the government run by a few big interests, and are the people running the government smart? (These variables at shown at the right of figure 5; see Table 5 for question wording). The first question, can most people be trusted, should apply to all types of experts. The "few big interests" question presumably taps into people's feelings about large corporations such as those in the oil industry. The other two questions refer only to the government, not to oil industry or environmental group scientists. Still, any question about trust may tap into a generalized feeling of trust, so these questions were included in all equations. The questions are coded so that high scores represent trusting answers.

Previous research has shown that people tend to be more trusting of government when their party holds the White House (Citrin 1974; Citrin and Green 1986). Given the ideological character of the two major parties and the fact that environmentalism is more closely associated with Democrats than Republicans, party identification, self-identified ideology, and the individualism and egalitarianism indexes were also tested as independent variables in the trust equations. They only had effects in one of the equations, trust in environmental group scientists. Finally, attitude toward offshore oil drilling is included to test the hypothesis that one's attitudes cause trust in experts.

Findings

We turn now to the two-stage, least-squares models that are the focus of this study. TSLS is a method that allows investigators to estimate nonrecursive models without bias (Maddala 1988). If one were to use conventional ordinary least squares regression to estimate the model in figure 5, one would get biased results because trust in experts both causes and is caused by support for offshore oil drilling. The TSLS method eliminates this bias by using first stage OLS regression models to construct proxy variables for the two endogenous variables—trust in experts and support for offshore oil drilling. Those proxy variables, in turn, are used as independent variables in the second stage equations. The results are unbiased estimates of the effects of trust on support for oil, and vice versa.

Table 6 presents the results of our first TSLS model, which explains trust in environmental group experts and support for offshore oil drilling. The equations in Table 6 are the second stage equations, which use the proxy variables constructed in the first stage. Because the first stage equations have no substantive interpretation, they are not shown.[7]

Looking first at the measures of environmental attitudes in equation 1, we see that three of the four have statistically significant effects on support for offshore oil development—all in the predicted directions. The only variable that fails to influence attitudes toward oil development is the question about slowing the growth of industries that require large amounts of energy. Party identification does not have a significant effect. Self-identified ideology was removed from the model because its effect was so small (the t-value was less than 1.0) that including it worsened the fit of the model. As expected, the more individualistic people feel, the more likely they are to support offshore oil drilling. So far the results are as expected.

Next we turn to the set of egalitarianism, knowledge, and their interaction. Interpreting the multiplicative interaction terms is a bit tricky because our variables are not ratio level measures with fixed zero points. Any arbitrary change in the scale of one of the variables causes the coefficient and possibly the significance level of the other main effect variable to change. For example, if we were to change the knowledge scale from 1-5 to 0-4, the egalitarianism coefficient would change. Changing the scales of the two variables that go into the interaction term does not, however, affect the significance level of the interaction term itself. As a result, we need to focus on the interaction term itself and the joint effect of the three variables taken together (Allison 1977).

[7] In the first stage equations for this model, the adjusted R^2 for oil support was 0.16 and for trust in environmental experts it was 0.17.

Table 6. TSLS Model of Trust in Environmental Group Scientists and Support for Oil Drilling

Independent Variable	(1) Support Offshore Oil Drilling	(2) Trust Environmental Group Expert
Support Nuclear Power	0.12***	–
Cut Standard of Living	0.17***	–
Slow population growth	0.08**	–
Slow energy-consuming industries	0.03	–
Trust People	–	0.13
Trust Gov't	–	0.39**
Gov't for big interests or for all	–	0.20
People running gov't are smart	–	-0.06
Party Identification	0.04	–
Ideology	–	-0.11**
Individualism	0.07**	-0.03
Egalitarianism	0.22***	0.08**
Egalitarianism x Knowledge	-0.05***	-
Knowledge	0.20*	–
Trust Environmental group experts	0.03	–
Support oil drilling	–	-0.67***
Intercept	-0.65	3.48
N	636	636
Adjusted R^2	0.15	0.15

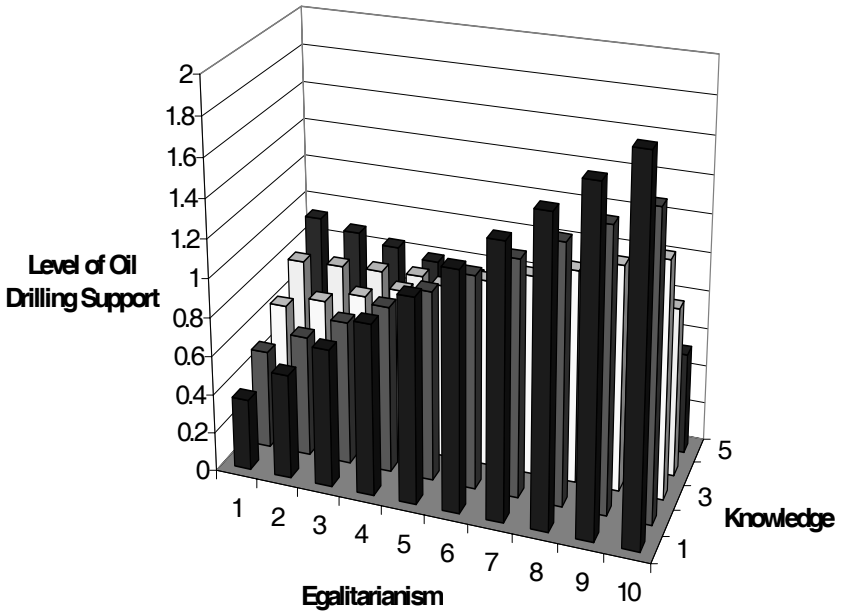
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

The key finding here is that the egalitarianism-knowledge interaction term has a negative, statistically significant coefficient. As either egalitarianism or knowledge increases, respondents become increasingly opposed to offshore oil drilling. The coefficient of -0.05 may seem small, but recall that the egalitarianism index has a 1-10 scale and the knowledge scale has a 1-5 scale. The interaction term, therefore, has a 5 x 10 = 50 point scale. So the negative interaction term coefficient offsets the positive egalitarianism coefficient. In sum, the more knowledgeable an egalitarian is, the more he or she opposes offshore oil drilling.

Because visualizing the joint impact of three variables is difficult, figure 6 presents a 3-dimensional histogram illustrating the effects. The axes on the "floor" of the figure are the egalitarianism and knowledge scores. The height of the histogram indicates level of support for offshore oil drilling. The floor is arbitrarily set at zero to make the figure easier to read, but the effects are the marginal effects controlling for all other variables in the first equation of Table 6.[8]

[8] More precisely, in figure 6 the height of the graph, y, is equal to 0.195 * (knowledge) + 0.225*(egalitarianism) - 0.054 * (Knowledge x Egalitarianism). These are the coefficients from Table 6 extended to one more digit for accuracy.

Figure 6. The Joint Effects of Knowledge and Egalitarianism on Trust in Environmental Group Experts



In the low egalitarianism category (on the left side of the figure), as knowledge increases, support for offshore oil drilling increases as well. In contrast, among those with the highest egalitarianism scores (on the right side of the figure), as knowledge increases, support for offshore oil drilling declines. The cumulative result is that those with either high knowledge and low egalitarianism *or* low knowledge and high egalitarianism are the strongest supporters of offshore oil drilling. Those in the other two corners are the strongest opponents of offshore oil. This is the set of responses predicted by Zaller's RAS model.

Finally we turn to trust in environmental group experts. Here we see that there is no effect whatsoever. The coefficient is almost zero and is far from being statistically significant. In this case, Margolis is right. Trust does not cause opinions.

We can describe the second equation, which uses trust in environmental group experts as the dependent variable, more easily. Only one of the trust variables, trust in government, has a large, statistically significant effect. The more people trust the government, the more they trust environmental group experts. Ideology also influences trust in environmental group experts. As people become more conservative, they become less likely to trust them. Similarly, as people become more egalitarian, they become more

likely to trust environmental group experts. Both of these coefficients are significant and both are in the expected directions.

The key finding here is the last coefficient. Attitude toward offshore oil drilling has a huge, statistically significant influence on trust in environmental group experts. For every one-unit increase in support for oil drilling, there is a two-thirds unit decrease in trust. Because both variables are measured with five-point scales, this is an enormous effect. Again, the data support Margolis.

The results for the second TSLS model, which uses trust in oil industry experts as the trust variable, are presented in Table 7. In broad outline, these results parallel those for the first model. In the equation explaining support for offshore oil development, three of the four environmental attitude measures are statistically significant in the expected direction—people who support nuclear power, and who oppose cutting the standard of living or slowing population growth in order to conserve energy tend to favor offshore oil drilling. Neither party identification nor individualism is significant Egalitarianism, knowledge, and their interaction have huge effects. Finally, trust in oil industry experts has no effect on support for further oil drilling. The coefficient is larger in this equation than in the first TSLS model, but it is far from statistically significant ($p < 0.23$).

In the second equation of the model, only one of the four trust variables has a statistically significant effect and another just misses at ($p < 0.09$). The most influential variable in this equation is attitude toward oil drilling. People who support more offshore oil drilling trust the oil industry's experts. As the first equation shows, however, trusting the oil industry experts does not cause support for oil development.

Table 7. TSLS Model of Trust in Oil Industry Scientists and Support for Oil Drilling

Independent Variable	(1) Support Offshore Oil Drilling	(2) Trust Oil Industry Experts
Support nuclear power	0.09**	–
Cut Standard of living	0.15***	–
Slow population growth	0.06*	–
Slow energy-consuming industries	0.04	–
Trust People	–	0.24**
Trust Gov't	–	0.08
Gov't for big interests or for all	–	-0.22*
People running gov't are smart	–	-0.18
Party Identification	0.03	–
Individualism	0.05	–
Egalitarianism	0.22***	–
Egalitarianism x Knowledge	-0.05***	–
Knowledge	0.20*	–
Trust Oil Industry experts	0.31	–
Support oil drilling	–	0.46***
Intercept	-0.96	1.20
N	636	636
Adjusted R^2	0.15	0.04

* p < 0.10 ** p < 0.05 *** p < 0.001

Table 8. TSLS Model of Trust in Government Scientists and Support for Oil Drilling

Independent Variable	(1) Support Offshore Oil Drilling	(2) Trust Oil Industry Experts
Support Nuclear Power	0.09*	–
Cut Standard of living	0.21***	–
Slow population growth	0.08*	–
Slow energy-consuming industries	0.03	–
Trust People	–	0.11
Trust Gov't	–	0.57***
Gov't for big interests or for all	–	-.13
People running gov't are smart	–	-.11
Party Identification	0.05*	–
Individualism	0.08**	–
Egalitarianism	0.24***	–
Egalitarianism x Knowledge	-0.06***	–
Knowledge	0.21*	–
Trust oil industry experts	0.31*	–
Support oil drilling	–	0.38***
Intercept	-1.58**	2.21***
N	636	636
Adjusted R^2	.14	.07

* p < 0.10 ** p < 0.05 *** p < 0.001

The results of our final TSLS model, which uses trust in government experts, largely match the earlier models, but with one tantalizing difference. In this case, the influence of trust on support for oil drilling in the first equation almost reaches statistical significance at $p < 0.06$ (see Table 8). Support for oil drilling in the second equation also clearly causes trust in government experts. The two coefficients are also in the same direction. The first equation tells us that the more people trust government experts, the more likely they are to support oil drilling. The second equation tells us that the more people support oil drilling, the more likely they are to trust government experts. Given that government experts do claim that offshore oil drilling can be conducted in a safe, clean, and environmentally-friendly fashion, the directions of the coefficients make perfect sense. Moreover, the two variables are both measured on 1-5 scales and the coefficient for trust causing attitude toward oil drilling, 0.31, is essentially the same size as the coefficient for attitude toward oil causing trust in government experts, 0.38.[9] Because the coefficient for trust influencing attitude does not quite reach the $p < 0.05$ significance level, we should not conclude that the effect exists. Nevertheless, it is hard not to speculate that the public gives government experts greater credence because the government experts are supposedly neutral.

The other aspects of the government-experts model match the first two models. In the offshore oil drilling equation, egalitarianism, knowledge, and their interaction do the bulk of the explaining. In the trust equation, trust in the government, and of course attitude toward oil drilling, are the principal causes of trust in government experts.

Discussion of the Trust Analysis

We believe that several important conclusions can be drawn from our analysis of trust in various sources of expertise. First, trust in experts seems largely to be a consequence of opinions, rather than a cause of them. At least in the cases of advocacy groups such as environmentalists and the oil industry, people choose which set of experts to trust based on their prior policy preferences, not based on the qualifications of the experts. Only in the case of government experts, who are presumably neutral, does trust in experts seem to influence attitudes. Even there, however, support for oil drilling caused trust in government experts—who tell us that oil drilling is safe.

This conclusion raises the question of whether the role of trust in risk perceptions is terribly important. If trust and risk perceptions go hand in hand, then perhaps we should spend less time trying to explain how trust causes risk perceptions and more time trying to explain both trust and risk perceptions.

Second, our analysis implies that many studies of risk perception and the NIMBY (not in my backyard) syndrome have misunderstood the role of trust. Previous investigations have primarily looked either at trust in the corporate sponsors of a potentially hazardous project or technology or at trust in the government, which was the sponsor in many cases (e.g., nuclear power). Researchers have rarely examined trust in the environmentalists, scientists, or political activists on the other side of NIMBY disputes. That is, they have

[9] An F-test rejects the hypothesis that the two coefficients differ in size from one another.

focused on why some people oppose projects and technologies, not on why other people support them. Previous research, therefore, has shown only one side of the picture. Yet when one considers the question of trust on both sides, our findings seem perfectly sensible. Casual observation of politics at any level suggests that a basic characteristic of heated political disputes is that neither side trusts the other--and that includes the experts that the other side offers to support its position. The literature on risk perception and NIMBY responses makes that point about critics of potentially hazardous technologies. They do not trust government and industry experts. Our evidence suggests that distrust also characterizes the *supporters* of those technologies. They don't trust the environmental group experts. In short, there really are two sides to these sorts of conflicts, despite the fact that past research has focused on the anti-technology side (Smith and Marquez 2000).

Third, Ellis and Thompson (1997) recently found that egalitarianism predicts environmental attitudes better than either party identification or self-identified ideology. For the case of attitudes toward offshore oil drilling, our findings strongly support theirs. The models we initially estimated all had party identification and ideology. We dropped those variables from some of our models because they performed so poorly that they reduced the explanatory power of the TSLS models. Although party identification and ideology were retained in some equations, they always yielded weaker coefficients than egalitarianism. Moreover, unlike egalitarianism, the impacts of party identification and ideology did not rise when we added knowledge interaction terms. In short, egalitarianism seems to be a key variable in explaining environmentalism.

Fourth, our data support the expertise interaction hypothesis. Using the RAS model with egalitarianism as the predisposition yields a more powerful explanation than using egalitarianism alone. In each of our three models, the interaction term was strong and highly significant. This test alone does not stand as sufficient proof that the expertise interaction hypothesis is correct, but it adds weight to the case in favor of it.

A Third Test: Explaining Confidence in Claims about Environmental Risks[10]

One common feature of policy disputes in many areas is that experts make competing scientific claims to the public. With offshore oil drilling, for example, one set of experts claims that oil companies can drill for oil in a safe and environmentally-friendly manner. Another set of experts denies that claim, insisting that the evidence shows that oil drilling poses risks both to people and the environment. How do people decide which scientific claims and which set of experts to believe?

One factor influencing people's decisions about which claims to believe may be the extent to which the content of the messages matches their existing beliefs and opinions. That is, people may tend to accept scientific claims that support their views and reject scientific claims that contradict them. This hypothesis is not new. Psychologists

[10] This section of the report was co-authored with Juliet Carlisle. It is based on E. Smith and J. Carlisle, "Confidence in Expert Claims about Environmental Risks," a paper delivered at the annual meeting of the American Association for Public Opinion Research, Montreal, Canada, May 17-20, 2001.

working on "social judgment theory" explored the influence of prior beliefs on the persuasiveness of messages in the 1960s and 1970s. More recently, Zaller developed his "receive-accept-sample" (RAS) model to explain how people's basic values, or predispositions, and their political awareness interact to influence the learning of political attitudes. We build on their work.

We draw on three theoretical approaches to analyze the results of an experiment embedded in a public opinion survey of Californians. The theories are Douglas and Wildavsky's cultural theory, Inglehart's postmaterialism theory, and Zaller's "Receive-Accept-Sample" model of attitude formation and the associated expertise interaction hypothesis. We use variables from these theories to explain how much confidence survey respondents have in an experimentally manipulated report by university scientists that offshore oil drilling is either safer or riskier than previously thought.

We find that whether the results of the scientific report match people's ideological predispositions strongly influences whether they have confidence in the report. This holds with self-identified ideology, egalitarianism, individualism, and postmaterialism. We also find that whether the results of the scientific report match people's opinions on offshore oil drilling has a huge impact on their confidence in the report. Moreover, as people becoming more politically knowledgeable, the relationship between their attitudes toward oil drilling and their confidence in the scientists' claims strengthens. In short, we find that people are likely to believe scientific reports that confirm their beliefs and reject scientific reports that conflict with their beliefs—a pattern of responses that clearly limits the influence of science in public policy debates.

Theoretical Background

The central hypothesis we investigate in this section of the report is that acceptance of a scientific report depends on whether the contents of the report are consistent with one's prior beliefs. That hypothesis was the subject of a good deal of research by psychologists in the 1950s and 1960s. Psychologists working on social judgment theory developed two important findings. First, they found that the likelihood of people accepting persuasive messages depended on the discrepancy between their beliefs and the beliefs advocated in the messages (Sherif and Hovland 1961; Sherif *et al.* 1967). The model can best be explained in spatial terms. Messages that advocate views that are close to the listener's views tend to be accepted. Messages that advocate views that are somewhat more distant fall into a non-commitment range. Messages that advocate views that are quite distant from the listener's views are rejected. In short, the greater the discrepancy between the message and the recipient's opinion, the less likely the message will be believed (Sherif *et al.* 1958, 1961; Eagly and Chaiken 1993).

The second relevant finding from social judgment theory is that the acceptance, non-commitment, and rejection regions vary depending on a person's "ego-involvement" with the subject of the messages. The more a person is committed to a particular opinion, the narrower the acceptance range and the larger the rejection range (Sherif and Cantril 1947; Hovland, Harvey, and Sherif 1957; Sherif and Sherif 1967). In other words, the more we

care about an issue, the more likely we are to reject information that conflicts with our views. Although ego-involvement is defined in terms of the importance and centrality of a subject to a person, in practice it is most commonly operationalized as the "memberships in or identifications with groups that [are] known to actively support particular positions on various social or political issues" (Eagly and Chaiken, 369).

Social judgment theory dealt with persuasive messages, rather than scientific reports, but the psychological processes must certainly be similar, if not identical. That is, we assume that people treat reports about scientific findings and persuasive messages in the same way.

There are two critical differences between social judgment theory and the RAS model (or perhaps we should say the portion of the RAS model we discuss here). First, social judgment theory focuses on ego involvement, while the RAS model focuses on political awareness and knowledge. Ego involvement is specific to an issue. Awareness, as Zaller measures it, is a general characteristic. The implication from social judgment theory is that the RAS model might predict better if it were to use a knowledge scale with items relevant to the debate in question. This, of course, may turn on whether attentive publics exist, a subject which has been the subject of recent research (Iyengar 1990; Krosnick 1990; Zaller 1986). We do not pursue that question in this report, but it certainly seems worth pursuing. Second, social judgment theory focuses primarily on ordinary opinions as anchors, while the RAS model uses core values as predispositions. Zaller's (1992, 22-23) definition of predispositions is fairly general and one could reasonably argue that ordinary opinions should be counted as predispositions. Nevertheless, Zaller and others who have used the RAS model have focused their attention on basic values such as liberal-conservative ideology and individualism. One question we will address here is whether an opinion can serve as a predisposition in the RAS model.

Data and Measures

To examine the causal relationship between message content and attitudes, we analyzed the results of an experiment included in our March, 1998 public opinion survey of California adults. Our dependent variable was an experimentally manipulated question. Respondents were randomly divided and asked one of two versions of the following question. The questions differed only in whether they described offshore oil drilling as safer or riskier than previously thought.

A group of university scientists recently declared that because of new technology, offshore oil drilling is much [*safer / riskier*] than previously thought. How much confidence do you have in this claim – a great deal of confidence, a moderate amount of confidence, only some confidence, or almost no confidence at all?

The issue tapped by the experiment is whether confidence in the university scientists depends on the content of what they say.

We examined five possible core values as predispositions—self-identified ideology, egalitarianism, individualism, postmaterialism, and party identification. In addition, we tested a question asking about people's support for or opposition to oil drilling.

We began with self-identified ideology because of the strong association between environmentalism and liberalism. Many studies have shown that most people do not organize their political opinions along ideological lines (Converse 1964; Kinder 1983; Smith 1989). Yet self-identified ideology has proven useful in explaining a variety of attitudes and behaviors. Zaller (1992, chap. 6), for example, uses ideology as a predisposition to help explain attitudes on a range of policy issues. Consequently, we believe that it merits examination. Ideology is measured on a seven-point scale with strong liberals scored '0' and strong conservatives scored '7'. We also included our measures of egalitarianism and individualism for reasons explained in the previous sections.

For our next predisposition, we turned to the work of Inglehart and his colleagues on postmaterialism (Abramson and Inglehart, 1995; Inglehart 1977, 1987, 1990). Inglehart argues that people develop values and assign priorities to their values during their formative years from childhood into early adulthood. Because of the changing nature of the times across the 20th century, people from different generations develop different values. People who grew up during the early part of the century were socialized during times of widespread poverty and war. In contrast, people who grew up in the post-war years were socialized during a period of prosperity and peace. They grew up without having to worry about basic material needs such as whether they would have enough to eat or have to go off to war. As a result, Inglehart claims, pre-war generations tend to emphasize material values, while post-war generations emphasize postmaterial values—freedom, self-expression, and quality of life. Inglehart and his colleagues argue that the rise of postmaterialism helps to explain the rise of environmentalism since the 1960s.

We measured respondents' value priorities using the method developed by Inglehart. Respondents were asked to rank order four goals in terms of importance—fighting rising prices, maintaining order in the nation, giving people more say in government decisions, and protecting freedom of speech. The first two goals are considered materialist; the second two are postmaterialist. The items are used to construct a four-point scale by combining the rankings. In the resulting index, postmaterialists were scored '4' and materialists '1' (see the coding appendix for details).

We also tested party identification as a predisposition because of its well known role as a "perceptual screen" (Abramson 1983, chap. 5 ; Campbell *et al.* 1960, chaps. 6-7). When people pay attention to politics, their party identifications supposedly filter the information they receive. Strong Democrats, for example, are likely to believe claims made by Democratic politicians and be skeptical of claims made by Republicans. Because environmentalism is more strongly associated with the Democratic Party than with the Republican Party, we concluded that party identification might influence people's evaluations of scientists' findings on environmental issues.

To our surprise, party identification did not have any effect in any of the models we estimated. Not only were none of the coefficients statistically significant, they had t-values of less than 1.0. Moreover, the coefficients were all close to zero. For these reasons, we have excluded party identification from all the analyses shown in this section. Nevertheless, we still believe that the failure of party identification is worth mentioning because it so often has a major impact on other variables.

Finally, we included a measure of people's opinions on offshore oil drilling as a predisposition. As we noted above, researchers using the RAS model have generally explored core values as predispositions. Nevertheless, confidence in scientific reports on offshore oil drilling is far more closely linked to opinions on offshore oil drilling than to core values such as ideology or egalitarianism. Because we think the RAS model should work with proximate opinions as well as with background values, we include opinions also. We measured opinion on offshore oil drilling with the same question used earlier in this report (see table 1).

Findings

We begin with a look at our dependent variable. As figure 7 shows, Californians generally have more confidence in expert claims that offshore oil drilling is riskier than they have in claims that it is safer than previously thought. Nearly 50 percent of the respondents express a great deal or moderate amount of confidence in expert claims that offshore oil drilling is riskier than previously thought, but only about 35 percent express that same confidence when told that that oil drilling is safer than previously thought. In short, bad news about offshore oil drilling is well received.

Figure 7: A Great Deal & Moderate Amount of Confidence in Expert Claims that Offshore Oil Drilling is Safer or Riskier than Previously Thought

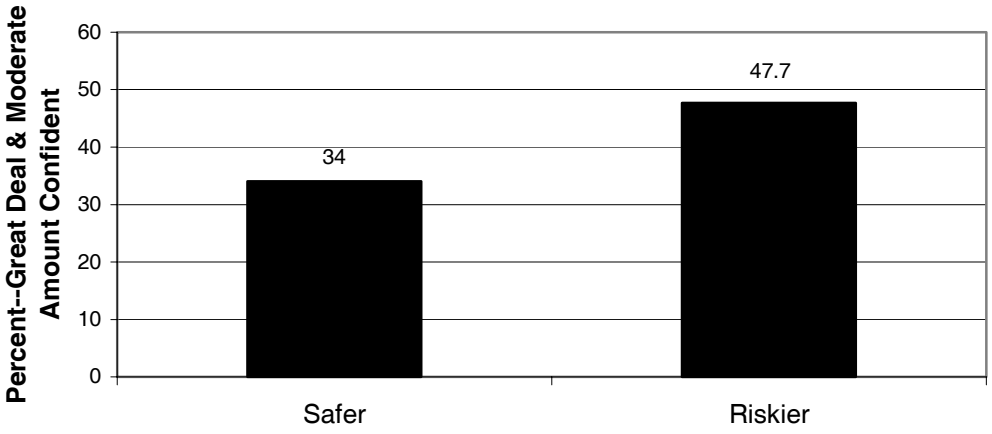
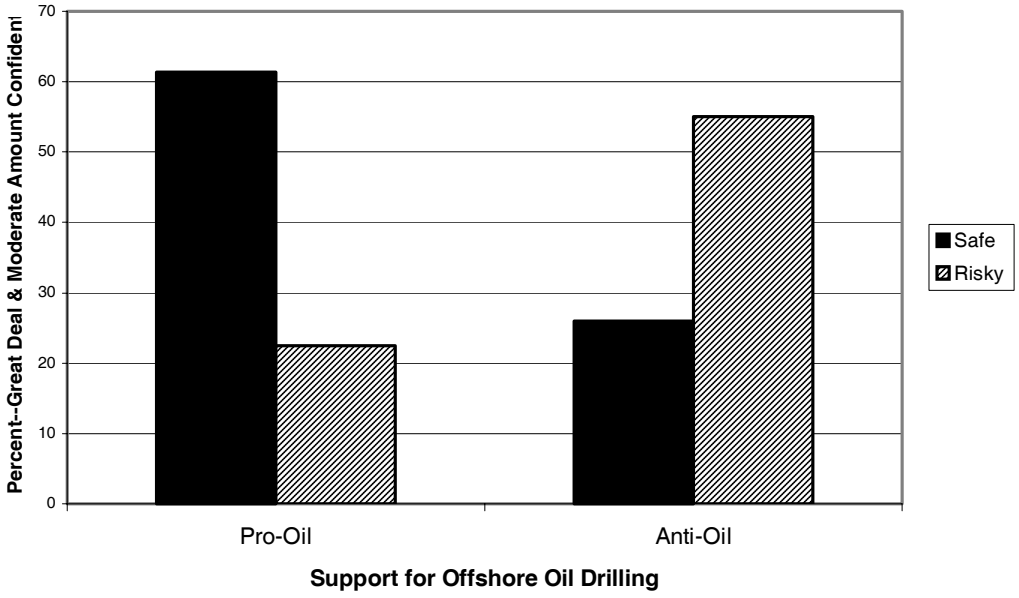


Figure 8: Support for Offshore Oil Drilling and Confidence in Expert Claims that Offshore Oil Drilling is Safer or Riskier than Previously Thought



Our hypothesis about ideology is that liberals will be more likely to believe that offshore oil drilling is riskier than previously thought, while conservatives will be more likely to believe that it is safer. Our results, shown in figure 8, demonstrate that indeed political ideology is associated with confidence in scientific claims regarding offshore oil drilling. Whereas 45 percent of conservatives express a great deal of confidence in scientific claims that oil drilling is safer, only 32 percent of moderates and 15 percent of liberals feel the same way. In addition, 61 percent of liberals and nearly 50 percent of moderates express a great deal or moderate amount of confidence in expert claims that drilling as riskier, whereas only about 40 percent of the conservatives do so. In short, our bivariate results indicate that political ideology does color one's confidence in scientific claims regarding the environment.

The same patterns appeared for individualism, egalitarianism, and postmaterialism. As individualism increased, respondents expressed more confidence in the report that offshore oil drilling is safe and less confidence in the report that it is risky. Egalitarianism and postmaterialism worked in the opposite direction. As they increased, respondents expressed more confidence in the report that offshore oil drilling is risky and less confidence in the report that it is safe (data not shown). In sum, at the bivariate level, predispositions seem to have a strong influence on which scientific claims people accept or reject.

Multivariate Models

We now turn to a series of regression models to help explore the effect of message content on people's responses. We begin with a simple model to serve as a baseline for comparison. The assumption underlying the model is that message content has no effect on whether people find the message believable. To accomplish this, we use our risk question as the dependent variable and we ignore whether the question told respondents that offshore oil drilling was "riskier" or "safer" than previously thought. If respondents ignored the riskier/safer content of the question and replied solely on the basis of their trust in university scientists, then this model would be perfectly appropriate.

For independent variables, we began with the five-point education scale and the five-point political knowledge index we used in previous sections. The hypotheses are that better educated and better informed people should be more likely to accept the claims of scientists. We next included questions measuring trust in people and trust in government (items 5 and 6 in Table 5). The hypotheses are that trusting people will be more likely to trust scientists. In our initial investigation, we estimated models that included two additional trust questions drawn from the American National Election Studies—whether the government is run by a few big interests and whether the people running the government are smart (items 7 and 8 in Table 5). Not only did these two questions not reach statistical significance, they had t-values less than 1.0, which caused the explanatory power of the model to fall. As a consequence, we deleted them from this and all models in this section of the report.

Finally, we included our four measures of predispositions—self-identified ideology, egalitarianism, individualism, and postmaterialism. We did not expect that these variables would have any impact. We included them to test whether some groups (liberals or conservatives, for example) might be especially likely to trust or distrust scientists and to show that they have little explanatory power because the model does not take question content into account. As noted above, in our initial efforts we included party identification as well. Because it did not have any effect in any of the models, we reestimated all models without it.

The results, presented in the first column of Table 9, show that only three variables had statistically significant impacts. Confidence in the scientists' claims increased with political knowledge and with trust in the government, and it declined as people became more individualistic. No other variable was even close to being statistically significant. Overall, the model performed poorly, explaining only four percent of the variance.

Table 9. Regression Models Testing the Content Hypothesis

Variable	(1) b	(2) b
Intercept	1.77***	1.57***
	(4.77)	(3.41)
Education	0.04	0.10*
	(0.04)	(1.80)
Knowledge	0.09**	-0.01
	(2.53)	(0.13)
Trust People	0.11	0.11
	(1.22)	(1.25)
Trust Gov't	0.18**	0.16**
	(2.42)	(2.36)
Ideology	0.03	0.12***
	(1.25)	(3.33)
Individualism	-0.07***	-0.00
	(3.07)	(0.08)
Egalitarianism	0.02	-0.03
	(1.17)	(1.14)
Postmaterialism	-0.02	-0.10*
	(0.36)	(1.82)
Form		-0.11
		(0.17)
Education x Form		0.09
		*(1.21)
Knowledge x Form		0.21***
		(3.16)
Ideology x Form		-0.15***
		(3.08)
Individualism x Form		-0.12***
		(2.72)
Egalitarianism x Form		0.12***
		(3.42)
Postmaterialism x Form		0.22***
		(2.69)
Adj R^2	0.04	0.16
N	560	560

* $0.05 < p < 0.10$
** $p < 0.05$
*** $p < 0.01$
(t-values in parentheses)

In order to take the riskier/safer content of the question into account, we estimated a second model with a set of interaction terms, shown in column 2. To construct the interaction terms, we multiplied respondents' scores on the education, knowledge, and predisposition variables by a dummy variable identifying which form of the question the respondent answered. We scored the form variable '0' if the question said that oil drilling was safer than previously believed and '1' if the question said that oil drilling

was riskier. Consider, for example, the way education is coded in the second equation in Table 9. The essential elements are:

$$\text{Confidence} = b_1 (\text{Education}) + b_2 (\text{Education x Form})$$

For respondents who were asked whether they had confidence in the scientists' report that oil drilling was safer, Form = 0. The second term in the equation has no effect because (Education x Form) is zero. So education has a small positive effect when people are told that oil drilling is safe (although it only comes close to statistical significance, it does not quite reach the $p < 0.05$ level). For each step up the educational ladder, people became 0.10 units more confident in the scientific report.

For respondents who were asked whether they had confidence in the scientists' report that oil drilling was riskier, Form = 1. The second term in the equation comes into play. In this case, education has no effect on confidence in the report. The Education coefficient of 0.10 is cancelled out by the (Education x Form) coefficient of –0.09. We can see this by substituting '1' into the equation for Form and simplifying:

$$\begin{aligned} \text{Confidence} &= b_1 (\text{Education}) + b_2 (\text{Education x } 1) \\ &= (b_1 + b_2) (\text{Education}) \\ &= (0.10 - 0.09) (\text{Education}) \\ &= 0.01 (\text{Education}) \end{aligned}$$

That is, the first set of variables in the second equation show the effects of the independent variables when people are told that the scientists declare that offshore oil drilling is safer than previously believed. The second set of variables—the interactions—show the change in effects when people are told that oil drilling is riskier than previously believed.

The second model clearly shows that the content of the scientists' message mattered. Individualism was no longer significant, but ideology was. The more conservative one is, the more confidence one is likely to have in a report that offshore oil drilling is safe. Moving down to the interaction terms, we see that knowledge is fairly large and statistically significant. The more knowledgeable one is, the more likely one is to have confidence in a claim that offshore oil drilling is risky. Finally, all of the predisposition variables are statistically significant in the expected directions. The more conservative or individualistic one is, the less likely one is to accept the scientists' claim that oil drilling is risky. The more egalitarian or postmaterialist one is, the more likely one is to accept the claim that oil drilling is risky. Moreover, all of these effects are fairly large. A change from one end of the scale to the other on the individualism, egalitarianism, and postmaterialism indexes accounts for roughly a full point change on the 4-point confidence scale.

Two more points need to be made about the second model. First, the adjusted R^2 of 0.16 reveals a substantial jump in explanatory power over the first model. Adding the interaction terms gives us a far better understanding of how people responded to the messages. Second, the four predispositions—ideology, egalitarianism, individualism, and postmaterialism—all work simultaneously in this model. In a good deal of previous work, these variables have been examined separately. Although these variables are certainly related to one another, here we see that they are all tapping unique sources of variance. Multicollinearity did not wash them out.

The Expertise Interaction Hypothesis

The second equation in Table 9 shows that content does influence whether people accept scientific reports. The next question is whether the expertise interaction hypothesis predicted by the RAS model holds for confidence in scientific claims. The expertise interaction hypothesis is that the greater one's political knowledge, the more closely one's attitudes will match one's core values. We hypothesize that the greater one's political knowledge, the more likely one will be to accept scientific reports only if they match one's predispositions.

There are two ways to use our experimental survey data to test the expertise interaction hypothesis. First, we can divide our sample into two subsets: (a) respondents who were asked the "safer" version of the experimental question, and (b) respondents who were asked the "riskier" version of the question. We can then analyze the two subsets using regression models with (Predisposition x Knowledge) interaction terms to see whether greater knowledge makes people more likely to accept scientific findings that are consistent with their predispositions and reject findings that are not consistent. That is, we can include variables of the form:

$$\text{Confidence} = b_1 (\text{Ideology}) + b_2 (\text{Ideology x Knowledge})$$

The expertise interaction hypothesis claims that the influence of predispositions will increase with knowledge, causing the absolute magnitude of b_2 to be large.

Second, we can analyze the entire data set as a whole by adding (Predisposition Knowledge x Form) interaction terms. These three-way interaction terms would allow us to analyze the entire data set at once. We have chosen the first alternative because, as we shall show, people respond differently to the "safer" and "riskier" versions of the question. That difference would not be observed if we were to analyze the data without partitioning it.

One difficulty we face in testing the expertise interaction hypothesis (even when we separate the two types of questions in our experiment) is that including all the interactions in a single regression equation would increase the likelihood of having serious multicollinearity. This is the same problem we encountered in our examination of support for offshore oil drilling in the first section of this report. In our data set, the correlations (Pearson r's) among the core values range from 0.28 to 0.35. The

correlations between each core value and its corresponding (Predisposition x Knowledge) interaction term range from 0.61 to 0.79. The correlations between the Knowledge index and the Knowledge interaction terms range from 0.47 to 0.81. These correlations are so high that when we included any two interaction terms in the model, none of them was statistically significant. Moreover, the variance inflation factors (VIFs) for the interaction terms were all very high, indicating multicollinearity. We therefore decided to examine one expertise interaction term at a time.

The regression models we use to test the expertise interaction hypothesis are extensions of the models presented in Table 9. The independent variables are education, political knowledge, the two trust measures, and the four predispositions—ideology, egalitarianism, individualism, and postmaterialism. Because we are analyzing the two versions of the question separately, we drop the dummy variable for questionnaire form and the form-interaction terms. In each equation, we add a (Predisposition x Knowledge) interaction term to test the expertise interaction hypothesis for a different predisposition.

Before looking at the data, we need to consider the issue of how to conduct statistical significance tests. One way to conduct significance tests is to analyze the two versions of the question in isolation and compare each interaction coefficient to zero. A second way is to compare corresponding coefficients across data sets. That is, we can test to see whether the Ideology x Knowledge coefficient in the "safer" data subset differs from the one in the "riskier" subset. This latter significance test takes into account the content of the question by asking, as knowledge increases, do people respond differently to different message content. We report both significance tests in tables 9 and 10. Tests against zero are indicated with asterisks, and tests of differences in coefficients are indicated with pound signs.

We begin our look at the data with the subsample of respondents who were asked whether they had confidence in the scientists' claims that offshore oil drilling was safer than previously thought. The data, shown in Table 10, reveal little initial support for the expertise interaction hypothesis. Three of the expertise interaction coefficients are quite small. The only large one, the Postmaterialism x Knowledge term in equation 4, is opposite of the direction we would expect. Postmaterialists supposedly lean in a pro-environmental direction, yet here we see that as knowledge increases postmaterialists are likely to have more confidence in the scientists' claim that oil drilling is safe. Because of the large, negative coefficient for the Postmaterialism coefficient, -0.35, postmaterialists do, on balance, lean in a pro-environmental direction. Nevertheless, the strongest pro-environmental views are held by the least informed postmaterialists, contrary to the expertise interaction hypothesis.

The results from the subsample of respondents who were asked whether they had confidence in the scientists' claims that offshore oil drilling was riskier than previously thought, shown in Table 11, paint a different picture. Here we see that all four expertise interaction coefficients are in the expected directions. Conservatives and individualists become less confident in the scientists' claims of riskiness as knowledge increases, while egalitarians and postmaterialists become more confident. Although none of the four

interaction coefficients is significantly different from zero at the customary $p < 0.05$ level, the Ideology x Knowledge term and the Individualism x Knowledge coefficients are close at $p < 0.07$ and $p < 0.06$ respectively. More important, both coefficients are statistically different from their counterparts across data sets. That is, as knowledge increases, the data show that people respond differently depending on whether the claim is that offshore oil drilling is safer or riskier than previously thought. As the expertise interaction hypothesis claims, whether people accept claims made by scientists depends on the respondents' knowledge and basic values.

Table 10. Regression Models Testing the Expertise Interaction Hypothesis for Respondents Told that Oil Drilling is Safer

	(1)	**(2)**	**(3)**	**(4)**
Variable	**b**	**b**	**b**	**b**
Intercept	1.91**	2.27**	1.59**	2.39**
	(3.47)	(3.43)	(2.54)	(3.82)
Education	0.10*	0.09*	0.09*	0.10*
	(1.81)	(1.80)	(1.81)	(1.92)
Knowledge	-0.07#	-0.17#	0.03	-0.20
	(0.75)	(1.12)	(0.22)	(1.64)
Trust People	0.14	0.13	0.13	0.14
	(1.15)	(1.09)	(1.08)	(1.18)
Trust Gov't	0.10	0.11	0.11	0.09**
	(1.03)	(1.11)	(1.05)	(0.94)
Ideology	0.05	0.11**#	0.11**#	0.12**#
	(0.53)	(3.33)	(3.30)	(3.55)
Individualism	0.00#	-0.08	-0.01#	-0.01#
	(0.15)	(1.06)	(0.19)	(0.19)
Egalitarianism	-0.02#	-0.02#	-0.00	-0.02#
	(0.96)	(0.84)	(0.05)	(1.10)
Postmaterialism	-0.11*#	-0.11**#	-0.11*#	-0.35**
	(1.92)	(2.00)	(1.96)	(2.27
Ideology x Knowledge	0.02#			
	(0.73)			
Individualism x Knowledge		0.02 #		
		(1.10)		
Egalitarianism x Knowledge			-0.01	
			(0.33)	
Postmaterialism x Knowledge				0.07*
				(1.68)
Adj R^2	0.07	0.08	0.07	0.08
N	282	282	282	282

(t-values in parentheses)
Tests of statistical significance for coefficients different from zero:
* $p < 0.05 < p < 0.10$ ** $p < 0.05$

Test of statistical significance for coefficients different from corresponding coefficient in Table 11:
# $p < 0.05$

Table 11. Regression Models Testing the Expertise Interaction Hypothesis Told that Oil Drilling is Riskier

Variable	(1) b	(2) b	(3) b	(4) b
Intercept	0.76	0.06	1.89**	2.02**
	(1.26)	(0.08)	(2.72)	(2.79)
Education	0.01	0.01	0.01	0.00
	(0.11)	(0.16)	(0.11)	(0.06)
Knowledge	0.38**#	0.57**#	0.07	0.04
	(3.67)	(2.91)	(0.53)	(0.29)
Trust People	0.08	0.07	0.09	0.09
	(0.65)	(0.57)	(0.74)	(0.76)
Trust Gov't	0.18*	0.21**	0.20**	0.20**
	(1.87)	(2.23)	(2.13)	(2.08)
Ideology	0.15	-0.02#	-0.03#	-0.04#
	(1.44)	(0.53)	(0.72)	(1.01)
Individualism	-0.11**#	0.04	-0.12**#	-0.12**#
	(3.41)	(.46)	(3.53)	(3.72)
Egalitarianism	0.08**#	0.08**#	0.00	0.09**#
	(3.12)	(3.08)	(0.05)	(3.32)
Postmaterialism	0.12*#	0.12*#	0.11*#	-0.10
	(1.94)(1.87)	(1.82)	(0.55)	
Ideology x Knowledge	-0.05#			
	(1.87)			
Individualism x Knowledge		-0.04*#		
		(1.89)		
Egalitarianism x Knowledge			0.02	
			(1.15)	
Postmaterialism x Knowledge				0.06
				(1.31)
Adj R^2	0.19	0.19	0.19	0.19
N	278	278	278	278

(t-values in parentheses)

Tests of statistical significance for coefficients different from zero:
* $p < 0.05 < p < 0.10$ ** $p < 0.05$

Test of statistical significance for coefficients different from corresponding coefficient in Table 10:
# $p < 0.05$

One last point needs to be made about the models presented in tables 9 and 10. The models explain more variance when the scientists' message is that offshore oil drilling is risky than when the message is that it is safe. The models in Table 10 explaining responses to scientists' claims that offshore oil drilling is safer than previously thought have adjusted R^2 values of 0.07 and 0.08. The models in Table 11 explaining responses to the claim that oil drilling is riskier all have adjusted R^2 values of 0.19, more than twice as high. We presume this results from the fact that the oil-drilling-is-risky message draws more attention and elicits a stronger response than the oil-drilling-is-safe message.

An Opinion as a Predisposition

We now turn to our last hypothesis, that people's opinions on the issue of offshore oil drilling act as predispositions influencing whether they will accept or reject scientists' claims about the safety of offshore oil drilling. To test this hypothesis, we simply repeat the expertise interaction analysis, using opinion about oil drilling and an Opinion x Knowledge interaction term. The results from these models are presented in Table 12. The first column shows the model estimated among respondents who were asked about their confidence in a report that offshore oil drilling was safer than previously thought, and the second column shows the model estimated among respondents who were asked about their confidence in a report that offshore oil drilling was riskier than previously thought.

Looking at the first column showing the responses of people who were told that oil drilling is safe, we see that education and political knowledge have opposite effects. Increased education makes one more likely to believe in reports that oil is safe, but increased political knowledge makes one less likely to believe the reports. Neither measure of trust has any effect. Conservatives are more likely to accept the claims of safety than liberals. Finally, the expertise interaction hypothesis is supported. The coefficient for the interaction between attitude toward offshore oil drilling (with support scored high) and knowledge is large and positive. As supporters of offshore oil development become more politically knowledgeable, they become more likely to accept the scientists' claim that offshore oil drilling is safe.

Table 12. Regression Models Testing the Expertise Interaction Hypothesis with Attitude toward Oil Drilling

	Oil Safe	**Oil Risky**
	(1)	**(2)**
Variable	**b**	**b**
Intercept	2.01***	0.71
	(4.03)	(1.37)
Education	0.05**#	-0.01#
	(2.19)	(0.24)
Knowledge	-0.17**#	0.44***#
	(2.41)	(5.72)
Trust People	0.17	0.08
	(1.54)	(0.68)
Trust Gov't	0.05	0.24**
	(0.51)	(2.70)
Ideology	0.10***#	0.00#
	(3.26)	(0.08)
Individualism	-0.03	-0.09***
	(1.14)	(3.00)
Egalitarianism	-0.00#	0.07***#
	(0.15)	(2.84)
Postmaterialism	-0.09*#	0.12**#
	(1.74)(2.08)	
Support OffshoreOil	-0.08	0.18
	(0.75)	(1.65)
SupportOffshore Oil x Knowledge	0.09***#	-0.12***#
	(3.12)	(4.04)
Adj R^2	0.19	0.30
N	282	278

t-values in parentheses
Tests of statistical significance for coefficients different from zero:
* $p < 0.05 < p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Test of statistical significance for coefficients different from corresponding coefficient in opposite column: # $p < 0.05$

The second column in Table 12 largely mirrors the first. Education is not significantly different from zero, but it is significantly different from the education coefficient in the first column. Increasing political knowledge, in contrast, makes respondents far more inclined to believe the scientists' claim that offshore oil drilling is riskier than previously believed. Here we see that trust in government has a positive, significant effect. Individualists are likely to reject the scientists' claims. Egalitarians and postmaterialists are likely to accept them. Finally, the interaction term is large and negative, as predicted by the expertise interaction hypothesis. As knowledge increases among supporters of offshore oil, they become less likely to accept the report that oil drilling is risky. The size of this coefficient is worth emphasizing. Both attitude toward offshore oil drilling and political knowledge are scored on 1-5 scales. So the resulting interaction term ranges from 1 to 25. Consequently, the difference between the high knowledge supporters of oil and low knowledge opponents is -

.012 x 25 = -3.0. The dependent variable is a four-point confidence scale, so the potential effect here is dramatic.

Our final observation about Table 12 is that, once again, the model predicting responses to the report that offshore oil drilling was risky predicted better (as measured by explained variance) than the model predicting responses to the report that offshore oil drilling was safe. We believe that the threat implied in the risky message engaged respondents' attention better, resulting in the higher adjusted R^2.

Discussion of Message Content Analysis

Our experiment has shown that people's predispositions influence their confidence in scientists' claims, at least in the case of opinions regarding the safety of offshore oil drilling. This holds with self-identified ideology, egalitarianism, individualism, and postmaterialism, although not with party identification. This finding is not surprising because we have only extended previous research showing that predispositions influence whether people accept persuasive messages to the special case of a persuasive message from university scientists. There are, however, some interesting findings that go beyond expectations.

First, we show (in Table 9) that ideology, egalitarianism, individualism, and postmaterialism all simultaneously influence confidence in scientists. That means they are tapping into different, unique sources of variance. Previous studies have generally examined fewer core values. Moreover, many have focused exclusively on different types of values, for example, looking only at materialism-postmaterialism or only at individualism and egalitarianism. Our study demonstrates that examining these values simultaneously have benefits. More work clearly needs to be done to sort out how they relate and how they explain people's attitudes.

Second, we show that ordinary opinions about the desirability of offshore oil drilling can serve as predispositions in the RAS model. The expertise interaction hypothesis does not require that the predispositions be core values. The model operates at a lower, day-to-day level as well, guiding people in deciding what news reports to believe about offshore oil drilling and, we presume, about other issues as well.

Third, we offer more support for the expertise interaction hypothesis, which has come under recent criticism (Goren 2000). Previous studies have looked at change over time and cross-sectional surveys. We show support for the hypothesis with an experiment built into a public opinion survey. Although our results are certainly not definitive, they add to the case in favor of the expertise interaction hypothesis.

Finally, we should point out that our results do not bode well for the influence of science on public policy debates. Those who are most likely to be aware of the scientists' view—the politically knowledgeable—are least likely to be swayed by the scientists' findings. This is not a conclusion that is likely to bring joy to the hearts of the scientific community or policy makers who must attempt to persuade the public to accept scientific findings.

The Absence of Public Risk Information[11]

In the previous two sections of this report, we examined people's trust in scientists and their confidence in scientific reports. We found that people's reactions to scientists and their findings depend on people's political predispositions and their political knowledge. Yet before we generalize our findings too hastily, we must ask how likely are people to have opportunities to learn about scientific findings. The answer, the evidence shows, is not as much as one might suppose.

We need to preface this section of the report with an explanation. Initially, we intended to conduct a content analysis of newspapers to show how much scientific information people could learn about a variety of risks—including risks associated with offshore oil development. We began with a content analysis of the *Los Angeles Times*, one of the nation's premier newspapers and presumably one of the most informative. Our intention was to compare different types of scientific information about risks from a variety of potential hazards, including as oil development. However, we had to abandon this design because, as we shall show, the total amount of risk information was so small that comparisons would be meaningless. This section, consequently, does not focus on risks associated with oil development. The lack of information about risks associated with oil development, however, does have implications for the public's attitudes regarding oil development. We shall explain this point at the end of this section.

Risk Perception

The starting point for risk perception research is that people misperceive risks. People exaggerate the statistical odds of some potential causes of injury or death, while they underestimate others. They worry about getting cancer from electric power transmission lines, while they puff away at their cigarettes. The risk perception literature is filled with studies showing how the public's beliefs about risks differ from expert assessments (Lichtenstein *et al.* 1978; Mertz *et al.*, 1998; Slovic *et al.* 1979). These differences inevitably lead to questions about the public's rationality. Can the public think about risks in a rational manner? Why do they reject the experts' assessments?

Three general explanations have dominated the debate over the public's disagreement with expert risk assessments.[12] Cultural theorists maintain that people's world views and deeply held values determine what they see as risky (Douglas and Wildavsky 1982). According to this view, the debate may superficially be about the risks posed by various hazards, but at a deeper level ideological views guide people's risk perceptions. People decide that a potential hazard is risky not because of scientific evidence, but because of their approval or disapproval of capitalism, egalitarianism, or other values. The experts' assessments of risk are simply not relevant.

[11] This section of the report was co-authored with William Herms. It is based on an unpublished paper, "The Absence of Public Risk Information and the Implications for Theories of Risk Perception."
[12] This account follows that of Margolis (1996, chapter 2).

Researchers following the psychometric paradigm argue that the general public's understanding of risk is multi-dimensional (Slovic 1992). Their studies show that when people think of risks, they think of more than just the statistical odds of injury or death; they think about their dread of the hazard, their ability to control the hazard, whether the risk is undertaken voluntarily, and other characteristics. These factors weigh far more heavily in people's risk perceptions than the actual statistical odds of injury or death. According to this view, expert assessments of risk are relevant, but they play only a minor role in people's risk perceptions.

A third explanation is that trust in sources of knowledge plays a critical role in how people evaluate risks (Margolis 1996). Both cultural and psychometric risk theorists have raised this argument (Raynor and Cantor 1987; Slovic 1993). If one cannot trust the corporate, government, or scientific sources of claims about the risks associated with potential hazards, then that information is ignored in calculating risk assessments. According to this argument, the decline of trust in America has led people away from relying on experts in assessing risks. Experts may be heard, but they are ignored.

What all three explanations neglect is the role of information about risk. Are people actually aware of the scientific findings on risk and do they really reject them? We think not. We argue that an overwhelming majority of people lack the information needed to form risk estimates because the data are not available to the general public. People do not ignore expert advice, as previous explanations suggest. Instead, people are not aware of expert advice because they never have the opportunity to hear it. As a consequence of their lack of knowledge of expert assessments, people may fall back on their cultural biases or their perceptions of other risk dimensions as other theories claim, but this does not mean that they are *rejecting* expert advice on risks. By and large, the public is unaware of expert views about risk.

Our argument stems from early risk communication research. In a recent paper, Fischhoff (1995) summarized seven stages in the development of the field with seven statements describing the prevailing beliefs at each time:

1. All we have to do is get the numbers right
2. All we have to do is tell them the numbers.
3. All we have to do is explain what we mean by the numbers.
4. All we have to do is show them that they've accepted similar risks in the past.
5. All we have to do is show them that it's a good deal for them.
6. All we have to do is treat them nice.
7. All we have to do is make them partners.

Our argument fits in the second and third stages. The conclusion of risk communication researchers at the time was that simply telling people the numbers did not work. Our response is that investigators underestimated the enormity of that task.

Theory

Our approach to questions about the rationality of risk perceptions begins with Anthony Down's (1957) observation that the only political information most people have is "free information"—that is, facts and ideas learned without any effort or learned because they come packaged in entertaining forms. For example, one might learn about the risks of airline travel and related public policies by reading a newspaper account of a plane crash because the story is fun to read (although one would never admit it). According to Downs, the public depends on free information because people realize their political actions will have little or no influence on the outcome of public policy decisions. The cost of obtaining meaningful information (for example, hours spent reading about candidates or public policies in libraries) outweighs any benefit that may be derived from putting that information to use. As a result, rational individuals living in a society where most information is costly to obtain opt for political ignorance rather than incurring the costs associated with information gathering. This leaves the public dependent upon free information.

We apply the same reasoning to information about risks. The cost of obtaining risk information is high. Few members of the general public are willing to spend hours reading scientific reports about the risks associated with sun-tanning, radon in homes, food irradiation, or any other subject. The likelihood of being able to use that information in day-to-day life is, after all, miniscule. Of course, for a few people the value of the risk information may be high enough to motivate them to learn about some risks. For example, if one's parent or sibling died of skin cancer, one might decide that it is quite rational to spend time learning about the causes of skin cancer—including sun tanning. Most readers will know of people who learn a great deal about a particular threat because of a personal connection. But in general these people are learning only about a single type of hazard, not about the wide range of hazards that many risk researchers use in their studies (for example, see Table 13). Consequently, the overwhelming majority of people will be rationally ignorant about all but a few risks, and will rely on free information.

Table 13. Risks Ranked in Two Typical Risk Perception Studies

Mertz et al.	**Marris et al.**
Cigarette smoking	Food colorings
Motor vehicle traffic	Nuclear power
Asbestos	Genetic engineering
Sun tanning	Mugging
Burning fossil fuels	Microwave ovens
Chemical pollution in the environment	Car driving
Chemicals in the workplace	Sunbathing
Alcoholic beverages	Terrorism
Environmental tobacco smoke	Ozone depletion
Crime and violence	Accidents in the home
Dioxins	AIDS
Outdoor air pollution	Alcoholic drinks
Depletion of the ozone layer	War
Breast implants	
Prescription drugs	
Contraceptive pills	
Nuclear power reactors	
Radon in homes	
Medical X-rays	
Food irradiation	
Electric and magnetic fields	
Food additives	
Pesticides in foods	
Waste incinerators	
Nuclear waste	
Indoor air pollution	
Mercury in dental fillings	
Non-prescription drugs	
Tap water	

Source: Claire Marris, Ian H. Langford, and Timothy O'Riordan, "A Quantitative Test of the Cultural Theory of Risk Perceptions: Comparison with the Psychometric Paradigm." *Risk Analysis*, 18 (1998): 635-47; and C. K. Mertz, Paul Slovic, and I. F. H. Purchase, "Judgments of Chemical Risks: Comparisons Among Senior Managers, Toxicologists, and the Public." *Risk Analysis* 18 (1998): 391-404.

If people rely almost exclusively on the free information provided in newspapers and on television, researchers should ask, what is the informational content of the news? More directly, do the news media routinely report the results of scientific assessments of risks faced by the public? If they do, then the public can be said to reject expert advice. If they do not, then the public must surely be unaware of expert assessments of various risks.

Our data show that although there is a great deal of information about potential risks, almost none of it comes in any form that will help people answer the sort of questions about risk that researchers pose to the public in many risk perception studies. News coverage of real or potential hazards rarely includes the sort of information that allows people to calculate risks or to compare risks from different sources.

Data and Methods

Among all forms of popular news media, newspapers certainly carry the largest amount of information about real or potential risks which people face. If we are to find the kind of information individuals need to assess risks and decide how to avoid premature death, then newspapers should be the first place to look. With this in mind we went to a major American newspaper, the *Los Angeles Times*, and used content analysis to discover how much risk information its readers receive.

We coded all stories containing any information about real or potential deaths or offering any information on risks that could potentially cause death in the National, Metro, and Lifestyle sections of the principal Los Angeles edition of the *Times*.[13] The stories were selected by having the coders read the entire content of all stories in those sections looking for relevant information. That is, we did not rely on the *Los Angeles Times Index* or a cursory review of article titles and first paragraphs. The topics of the stories with risk information ranged from simple murders to academic and government studies of the causes of cancer and other diseases.

Under the supervision of the principal investigator, two coders read and independently coded all stories from the first two months of the study period. The few differences in evaluations were resolved and coding standards were refined. After that, each coder independently coded two of the remaining four months of newspapers.

Data were collected for a six-month period from April 1 to September 30, 1997. We had initially intended to code an entire year of news stories, but chose to discontinue the effort after six months because of the overwhelmingly one-sided result of our search. A quick look at our findings below will show why an additional round of data gathering was not deemed necessary.

Stories with risk information were initially divided into three categories by causes of real or potential death—homicide, accident, and disease. For each story, we also coded whether any of the following five types of additional risk information were included:

> (1) *Absolute Probability*: Probability described in terms of an absolute ratio (e.g., the odds of dying from a disease are 1 in a million).
>
> (2) *Probability Relative to a Baseline*: Probability described as relative to some previously measured baseline (e.g., smoking triples odds of dying from cancer).
>
> (3) *Absolute number of Deaths*: A numerical description citing the number of deaths over some period of time (e.g., 500 per year).

[13] The business and sports sections and the Sunday supplements were excluded. A preliminary review of these sections showed that they carried news risk-related only on rare occasions. Only the Los Angeles edition of the paper was coded; the nearly identical editions prepared for outlying areas (e.g., the Ventura County edition of the *Times*) were omitted. Obituaries were excluded.

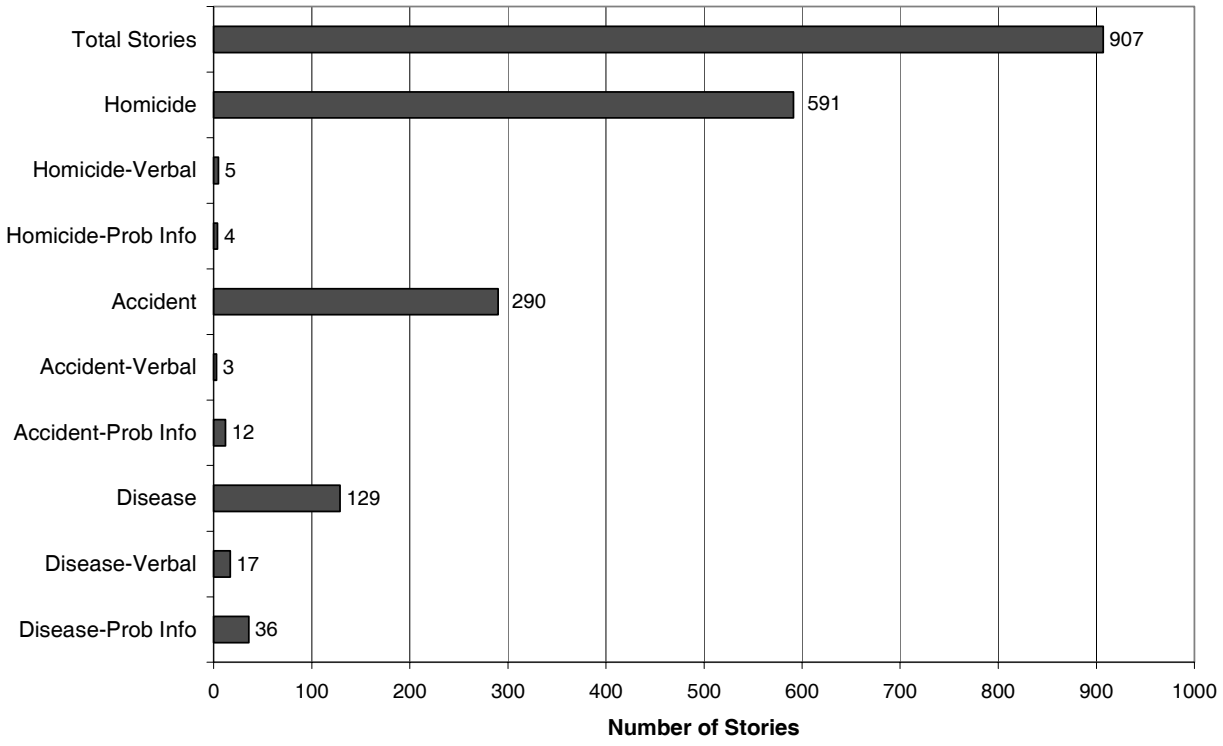
(4) *Comparison of Probabilities*: A numerical description that establishes a probability relationship between different causes of death (e.g., the odds of dying in an automobile accident are fifty times higher than the odds of dying in an airline crash).

(5) *Verbal Description*: Any non-quantitative description that conveys probability information that may be used in risk assessment (e.g., a disease is "common" or "rare").

These five types of risk information are critical to risk assessments because they are required to answer questions typically posed by risk perception researchers. Does smoking cigarettes pose a high health risk? How about asbestos, sun tanning, dioxins, nuclear power reactors, radon in homes, or mercury in dental filings? To answer such questions, one needs knowledge of statistical probabilities or other information such as deaths per year that can be translated into probabilities.

In our analysis, we combined the first four types of information into a single category (labeled "Prob Info" in figure 9). We did this because these types of information can be used to calculate actual risks and because the numbers in the individual categories were so low. Verbal descriptions of risk (labeled "Verbal" in figure 9) remain separated out because, although they have some information value, they obviously do not provide enough information to allow readers to calculate probabilities.

Figure 9. Risk Information in the Los Angeles Times



Findings

Figure 9 presents our main findings. The top bar shows that 907 stories contained risk information in the six-month study period. The bars marked Homicide, Accident, and Disease show the numbers of stories about those kinds of deaths or potential deaths. Under each of those three categories are two bars marked Verbal and Prob Info. Those show the number of stories with different kinds of risk information out of each category. Of the 591 stories about homicides, for example, five had verbal descriptions of the probabilities of being murdered, and four had at least one of the four kinds of detailed information about probabilities described above.

Examination of figure 9 yields two obvious conclusions. First, the public receives a great deal of information about homicides, fatal accidents, and diseases – to the tune of over nine hundred articles in a one hundred and sixty three-day period. Second, the public receives hardly any information that can help them to calculate, even in a rough manner, the actual risk associated with any particular hazard.

The little risk information that the *Los Angeles Times* provides generally comes in the form of descriptions of absolute numbers of deaths over some period of time or verbal generalizations (e.g., a form of cancer is "rare"). Neither sort of information gives readers much help with the sort of questions asked by some risk-perception researchers. The number of deaths over time is certainly a useful guide, but it requires readers to have some sense of population sizes in

order to calculate probabilities. For example, a person might have to ask, "Should I be more worried about a disease that killed 3 people in Los Angeles last year or one that killed 127 people in the United States?" Verbal descriptions are, of course, necessarily vague.

The number of stories offering some type of probability information was quite small. Combining stories that include absolute probabilities, probabilities relative to a baseline, numbers of deaths, and comparisons of probabilities yields only 52 stories in the six-month period. To be sure, the *Times* prints a large number of stories about deaths or possible causes of deaths, and readers do use those stories to infer risks. That process has been described in numerous studies of the social construction of risk (Douglas and Wildavsky 1982; Hilgartner 1992; Renn 1992b). Yet that process can be quite misleading. Inferring risks from counts of different types of deaths reported in the news media is a poor method for estimating actual probabilities of dying. After all, a reader might reason, "If the *Times* reports more stories about homicides than about deaths associated with smoking cigarettes, then my risk of dying from my cigarette habit must be smaller than my risk of being murdered."

In sum, the *Los Angeles Times*—one of the nation's most prominent newspapers—publishes a remarkably small number of stories that can be used by readers to determine the probabilities of death associated with various hazards.

Interpreting the findings

We have suggested that the number of news stories in the *Los Angeles Times* containing risk information is so small that they provide an insufficient basis for people to learn about risks. We think that common sense alone should persuade scholars that 52 stories about a wide range of potential hazards is insufficient for learning. However, we can further support our claim by discussing two standards for comparison.

Consider first the list of items, shown in Table 13, which survey respondents were asked to assess in two recent articles in the journal *Risk Analysis*. Subjects in studies by Mertz *et al.* and Marris *et al.* were asked to evaluate the risks posed by 36 potential threats.[14] Of the 36 hazards identified in Table 13, only eight were discussed in any of the 52 articles with actual risk information. So how would one learn about the risks associated with medical X-rays, mercury in dental fillings, or radon in homes? Not by reading the *Los Angeles Times*. Moreover, none of the 52 stories offered a comprehensive list of hazards and associated risks. To learn about risks, readers must piece together scattered bits of information from a series of stories. A simple list, such as those regularly seen by risk researchers, would have made learning far easier. Yet in all likelihood very few members of the general public have ever seen such a list. For the public, learning about risks is a daunting task.

Consider second the amount of media attention to a subject required for the public to learn anything. Table 14 offers a selection of factual items about which national surveys have asked in recent years. Canadian Prime Minister Jean Chretien (at the bottom of Table 14) was mentioned in eleven articles in the six-month study period in 1997, but was identified by only two percent of the public the following year. Chretien was identified in more news articles

[14] There are 42 items on the two lists, but 6 items appear on both lists.

than offered probability information about *any* type of hazard in the same period, yet he remained virtually unknown. Two notches higher on the list, we find the Chief Justice of the United States Supreme Court, William Rehnquist. Despite being a member of the Supreme Court since 1986 and being regularly identified in news stories about U.S. Supreme Court decisions (88 times in the *Los Angeles Times* in 1998), Rehnquist remained largely unknown to the American public in 1998 (a situation which may have changed somewhat since his prominent role in the election of President Bush). Perhaps even more surprising to readers who do not follow public opinion literature, two years after he had led the Republican Party to take control of Congress for the first time in forty years, half the public could not say what job Newt Gingrich held in 1996. Yet these findings are not surprising to those who study public opinion. Study after study since the 1950s have confirmed that there are huge, gaping holes in the public's basic knowledge of politics (Delli Carpini and Keeter 1996; Smith 1989). Downs was right. A great number of people are rationally ignorant about politics.

Table 14. The Public's Knowledge of Selected Facts

Year	Item of Knowledge	Percent Who Know
1998[a]	Al Gore was the Vice President of the U.S.	89%
1998[a]	Republicans held a majority in the U.S. House	67%
1999[a]	Kosovo was site of ethnic Albanian-Serbian conflict	66%
1995[c]	Lance Ito was the judge in the O.J. Simpson murder trial	64%
1998[a]	Republicans held a majority in the U.S. Senate	56%
1996[f]	Newt Gingrich was Speaker of the U.S. House	50%
1999[d]	Dennis Hastert was Speaker of the U.S. House	30%
1980[e]	Definitions of *liberal* and *conservative*	42%
1996[f]	What the federal minimum wage was	42%
1991[g]	What majority is needed to override a presidential veto	37%
2000[i]	Madeline Albright was U.S. Secretary of State	33%
2000[i]	Vladimir Putin was President of Russia	18%
1989[b]	What percentage of Americans live below poverty line	18%
1998[a]	William Rehnquist was Chief Justice of the United States	11%
1991[h]	Canada was America's largest foreign trading partner	8%
2000[i]	Jean Chretien was Prime Minister of Canada	2%

Sources: (a) 1998 American National Election Survey; (b)1989 National Survey of Political Knowledge, quoted from Michael X. Delli Carpini and Scott Keeter, "Measuring Political Knowledge," paper delivered at the Midwest Political Science Association Meeting, Chicago, Illinois, April 1992; (c)Princeton Survey Associates, *News Interest Index Poll,* The Roper Center, 9–12 February 1995; (d) Gallup/CNN/USA Today Poll, quoted in PollingReport.Com (www.pollingreport.com/speaker.htm); (e)Norman R. Luttbeg and Michael M. Gant, "The Failure of Liberal-Conservative Ideology as a Cognitive Structure," *Public Opinion Quarterly* 49 (Spring 1985): 85; (f)The Pew Research Center for the People and the Press, "TV News Viewership Declines," 13 May 1996, p.76; (g)1990–91 National Election Study surveys, quoted from Michael X. Delli Carpini and Scott Keeter, "Measuring Political Knowledge," paper delivered at the Midwest Political Science Association Meeting, Chicago, Illinois, April 1992; (h)*Gallup Poll Report,* No. 307, April 1991, p.30; (i) Frank Newport, "Americans Don't Necessarily Like Russia, but Tend to See Russia's Relationship to U.S. as Friendly." Gallup Poll Release, 6 June 2000.

If the public cannot remember what job Newt Gingrich holds after a torrent of news coverage, why should we expect them to know whether food irradiation or radon—neither of which was mentioned in the 6-month study period in the *Times*—poses the greater health risk?[15] In short, it takes a staggering amount of media coverage for the public to learn any given set of facts. Moreover, no matter how many news stories appear, a great portion of the public will still not learn even the simplest of facts. By this standard, the number of news stories containing risk information is too small to provide a sufficient basis for any real learning.

Our findings clearly apply to the sort of risk perception studies in which researchers present lists of potential hazards to subjects, and ask the subjects to rank order them in terms of risk or estimate the number of deaths per year stemming from each type of hazard (e.g., Mertz *et al.* 1998 ; Marris *et al.* 1998). Those studies require a huge amount of knowledge on the part of the subjects, knowledge which we argue they do not have.

Do our findings also apply to narrow risk communication campaigns directed, for example, at communities considering whether to allow the construction of a potentially risky facility near by? In such situations, people are not being asked to assess risks from a variety of sources. Rather, they are being asked to assess the risk from a particular source (the facility in question). Here, too, we believe our findings are relevant. Public relations campaigns consisting mostly of newspaper ads and direct mail (and occasionally of television ads as well) may seem effective, but the volume of messages going out is generally far smaller than necessary for the public to learn much. Only about a third of all Americans say they read the newspaper every day, and many of them would no doubt skip over articles or advertisements about the safety or risks of a proposed facility in their communities.[16] Direct mail campaigns are even less effective because many people throw junk mail away without bothering to open it. When one considers the amount of news coverage given to Newt Gingrich after the Republicans took control of the House of Representatives in 1994 and looks at his low name recognition, one should recognize that the typical risk communication campaign is a meager effort indeed.

In sum, teaching the public any given set of facts—including facts about risks—is a daunting challenge. To put it in Fischhoff's terms, telling people the numbers and explaining what they mean are overwhelming tasks. Those strategies, we suggest, were not failures because people rejected the expert advice on risk; rather, they were failures because most people never heard the messages.

Implications for Risk Perception Theories

Although our findings do not challenge any existing theories of risk, they do suggest that some adjustments to previous arguments may be in order. In particular, the often-heard claim that the public rejects expert assessments of risks seems contrary to the evidence. Based on our findings and on numerous previous studies showing that the public has a low level of knowledge about politics, it seems far more likely that the public is simply unaware of expert judgments about risk (Delli Carpini and Keeter 1992; Smith 1989).

[15] This finding is based both on our content analysis and on an archival search on www.latimes.com.
[16] Data from the 1996 American National Election Study (www.umich.edu/~nes).

Cultural theorists in particular have argued that the people think about risks in a primitive manner that ignores modern science (Douglas and Wildavsky, 1982, chap 2). We disagree. People may indeed rely on their cultural biases when they think about risks, and no one doubts that risks may be socially selected for attention, but there is no evidence that the people learn what the experts think and then reject their advice. To the contrary, as Doble (1995) shows, when the public takes the time to learn about technical issues, their considered views swing around to match those of scientists.

Finally, we should mention the role of trust in risk perception. Both cultural and psychometric risk theorists have suggested that trust in sources of expertise plays a critical role in risk communication. That seems plausible in cases when the volume of risk messages being carried by the media is so high that we can presume that a large percentage of the public hears the messages. For example, it seems reasonable to assume that trust plays a role in people's perceptions of the risks of smoking. But in cases with few risk messages—offshore oil drilling, for example—we doubt that trust plays a role. Again, when the public does not hear the experts, the expert's views play no role in risk perceptions.

Conclusion

We will begin our concluding comments with a brief summary of our findings. In the work presented in this report, we found that people's perceptions of risks associated with offshore oil development stem from their worldviews in a way that depends on their political awareness. We focused primarily on egalitarianism and individualism. Egalitarians are people who believe in increasing social and economic equality. In contrast, individualists believe that people should be on their own, and not rely on others for material assistance. These two worldviews yield characteristic responses to hazards. Individualists tend to see lower risks than others see, and individualists are more likely than others to accept risks in exchange for economic returns. Egalitarians are especially concerned with potential risks caused by what they see as inegalitarian institutions—big government and large corporations. They tend to favor policies than reduce risks at the expense of economic growth. Consequently, these are the people who are most likely to fear offshore oil development and other technological threats.

Risk perceptions depend on political awareness because people who pay attention to the news are more likely to hold opinions on specific issues (such as whether offshore oil drilling should be allowed) that match their worldviews. Poorly informed individualists and egalitarians hold fairly similar views on oil development issues because they generally fail to connect their values and their opinions. Well informed individualists and egalitarians, however, are guided by their values into believing that oil companies and offshore oil drilling are either good (the individualist view) or bad (the egalitarian view).

In this report, we test the theory that the interaction of worldviews and political awareness explains the public's views in three ways. In the first section of the report, we showed that the theory explains support for offshore drilling and nuclear power. In the second section, we showed that worldviews and awareness can help explain the level of trust people have in scientific reports from oil industry experts, from environmental group experts, and from

government experts. In the third section of the report, we showed that the theory helps to explain why people react differently to scientific reports depending on the content of those reports (whether oil drilling is riskier or safer than previously believed).

In the final section of the report, we turned our attention to the amount of risk information that is available to the public. We showed that one of the nation's leading newspapers, the *Los Angeles Times*, rarely gives the public sufficient information to allow it to estimate the risks associated with offshore oil development, or any other technology. The lack of news coverage of risk and safety issues helps explain why people turn to their values when trying to estimate technological risk.

Collectively, these findings make a good case that using Zaller's RAS model with measures of the egalitarian and individualist worldviews helps explain risk perceptions and associated attitudes toward potential technological hazards. Yet these findings are only a partial test because the RAS model predicts change over time, while the findings in this report only examine cross-sectional data gathered at a single time. More work needs to be done to test the model further. Three specific steps would seem to be worth taking.

First, test the model using panel surveys so that we could measure change in individuals over time. In panel surveys, the same respondents are interviewed two or more times so that individual change can be measured. In both this research and Zaller's (1989) original work, only cross-sectional data were used. Tracking individual change over time would yield far more powerful results. Moreover, given the rapidly changing energy situation since early 2000, this route seems particularly promising.

Second, attempt to improve the measures of egalitarianism and individualism. The individualism index, in particular, had a relatively low reliability in this study. Improving the reliability of the indexes should increase the power of the tests.

Third, integrate measures of news media content into the analysis. Past research using the RAS model has used national-level measures of news media content to discover whether people are responding to what they hear or read in the news. An individual-level study should be able to measure the impact of the news media more accurately. At the very least, some measures of the presumed independent variable—what the news media have to say about energy issues—must be included to test the model fully.

In sum, these initial results are promising, but more work needs to be done both to understand the public's risk perceptions, and to learn how to use that knowledge to communicate with the public more effectively.

CODING APPENDIX

Variables not described in the text are described here:

Education: (1) Less than high school; (2) high school or trade school; (3) some college; (4) college graduate; (5) postgraduate education.

Knowledge: The number of correct answers to the following questions –(a) Do you happen to know what job or political office is now held by Al Gore? (b) Whose responsibility is it to determine if a law is constitutional or not . . . is it the president, the Congress, or the Supreme Court? (c) How much of a majority is required for the U.S. Senate and House to override a presidential veto? (d) Do you happen to know which party has the most members in the House of Representatives right now?" (e) Would you say that one of the parties is more conservative (liberal) than the other at the national level? … Which party is more conservative (liberal)?" Because of the tiny number of respondents scoring '0', those respondents were recoded to '1'.

Ideology: (0) Strong liberal; (1) liberal; (2) weak liberal; (3) moderate; (4) weak conservative; (5) conservative; (6) strong conservative.

Postmaterialism: (1) Strong materialist; (2) weak materialist; (3) weak postmaterialist; (4) strong materialist. The scale was constructed according to Inglehart's method from rankings of the following four statements: "Which one thing do you think should be America's highest priority, the most important thing it should do? (a) Maintain order in the nation; (b) Give people more say in government decisions; (c) Fight rising prices; (d) Protect freedom of speech.

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.