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# Conventional Wisdom on Risk Communication and Evidence from a Field Experiment

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A recent comprehensive review of the literature identified a number of facts and principles governing risk communication. This paper evaluates several of these propositions using recent evidence from a field experiment in communicating the risks from radon in homes. At this point in the research, data relates primarily to the response of risk perceptions to different information treatments and different personal characteristics. The effect of various causal factors is sensitive to the particular test of risk perception applied. No information treatment was clearly superior for all tasks. An important implication of these findings is that risk communicators must determine what specific task or tasks the information program should enable people to do.

**KEY WORDS:** Risk communication; risk perception; radon.

## 1. INDOOR RADON RISKS

The U.S. Environmental Protection Agency (EPA) estimates that radon causes more cancer deaths per year (8000–40,000) than any other pollutant under its jurisdiction. Radon is a colorless, odorless gas that occurs naturally. It moves through the soil and becomes trapped in buildings. Since exposure occurs primarily in people's homes, conventional regulatory approaches are not appropriate. This situation has led EPA to turn to risk communication as a way of encouraging voluntary reductions in risk.

EPA has initiated several studies to investigate how people understand and react to new information on indoor radon risks. A general objective of these studies is to determine which approaches are most effective in communicating risk information. We report here some preliminary results from one of these studies that shed light on certain elements of the "conventional wisdom" on risk communication.

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## 2. THE NEW YORK RADON STUDY

New York State's Energy and Research Development Authority (NYSERDA) sampled single-family homes to determine state-wide exposures to radon. NYSERDA placed three radon monitors in each of about 2300 homes. The first of these (placed in the living area) was to be sent back for analysis after 2–3 months, and the others were to be returned and analyzed after being in the homes for a year. This protocol would enable NYSERDA to judge whether the 2–3 month readings were acceptable approximations of annual averages. The homes were selected randomly within seven areas representing major geological formations across the state.

When homeowners agreed to participate in the study, they were promised the radon readings for their own homes, but it was not clear what information they would receive to interpret those readings. New York State officials were concerned about motivating households to take appropriate remedial actions without creating undue anxiety. This situation provided an opportunity to evaluate the effectiveness of alternative designs for the information materials used in communicating the risks from radon.



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EPA provided the resources to inform these 2300 homeowners about potential health risks and ways of reducing these risks. Several alternative information "treatments" were designed to test the effectiveness of different formats. Telephone surveys provided data on changes in knowledge, perceptions, and intentions. The surveys were designed to answer three questions:

1. How much did people learn about radon and its associated risks?
2. To what extent are perceived risks consistent with objective measures of risk?
3. How much more mitigation is undertaken by those at higher risk, after controlling for other factors that might influence the perceived benefits and costs of mitigation?

The results reported here are based on homeowner reactions to the interim readings and information materials.[3] Homeowners were discouraged from taking action until the annual results were available, so we cannot yet address the third question of who mitigated and why.

The research design focused on testing two issues. First, do people respond better to risk information that is quantitative rather than qualitative? And second, do people respond better to a directive format that gives explicit instructions about what they should do under given circumstances (hereafter called "command" tone), or to a format encouraging judgment and evaluation in what might be considered a *Consumer Reports* framework (hereafter called "cajole" tone)?[4] These considerations yielded four different radon risk information booklets incorporating the various combinations of quantitative/qualitative and command/cajole material.

We collected baseline data on participants' knowledge and risk perceptions during the summer of 1986. Homeowners who had returned the two-and-one-half month monitors received their radon concentration results and information materials in December 1986. Shortly thereafter we interviewed the participating homeowners a second time to find out what they had learned and how they had reacted to the information they received.

## 3. SOME CONVENTIONAL WISDOM ON RISK COMMUNICATION

Covello *et al.* derive a number of facts or principles of risk communication from the literature.[1] We take these propositions to represent the "conventional wisdom" on the subject. However, Stallen and Coppock cite pairs of mutually contradictory recommendations for risk communication policies from this literature.[2] Ideally, one would like to devise empirical tests of such propositions rather than relying on anecdotal evidence or intuition. The New York radon study has generated field data relating to several of these propositions.

### 3.1. Subtle Differences in the Way Risks Are Expressed Can Have a Major Impact on Perceptions and Decisions

With the exception of those with radon readings less than one pCi/L, homeowners received one of five brochures containing substantially the same information in different formats.[5] We have analyzed responses to the baseline and followup surveys in three areas: performance on a radon quiz, congruence between objective and subjective risks, and willingness to pay for additional information. There is no single brochure that performs best in all three areas.

The cajole/qualitative brochure provided the best improvement in responses to quiz questions; the two quantitative brochures provided better congruence between objective and subjective risks; and the command and EPA brochures significantly reduced homeowners' demand for additional information. We conclude that the way information on health risks is presented has a measurable impact, but that performance varies depending on the particular measure of effectiveness employed.

### 3.2. People Have Difficulty Interpreting Probabilistic Information: They Like to Know How a Risk Can Affect Them Personally

The quantitative brochures provided information on the likely range of lung cancer cases per 1000 people exposed to various levels of radon. The cajole/quantitative brochure also demonstrated how to adjust these population risks to conform to the household's actual exposure. The evidence on whether people had difficulty with the probabalistic information is of two kinds: whether receiving the numerical probabilities helped in identifying how serious their problem was on the colored risk chart, and whether the numerical probabilities promoted better conformity between objective and subjective risks.

Although homeowners who received the NYSERDA brochures generally were more successful in

[3] The results summarized here are discussed in detail in Smith et al.[3]

[4] See Adler and Pittle for the source of this terminology.[4]

[5] In addition to the four experimental brochures, treatments included an EPA brochure and a one-page fact sheet.

identifying their correct placement on the risk chart than those receiving the EPA brochure, the quantitative brochures were not more effective than the qualitative brochures. However, those with higher readings were more likely to identify the "wrong" position on the risk chart, and those receiving one of the command versions were more likely to identify the "right" position. Right was defined as the placement associated with the population risk related to their exposure. These results may imply that those at higher risk who were encouraged to adjust for individual circumstances actually identified a more appropriate place on the risk chart than the population risk implied.

Although the evidence on correct placement is ambiguous, the evidence on risk perception is quite clear: the quantitative information treatments were statistically significant in reducing discrepancies between objective and perceived risks.

### 3.3. Individual Biases and Limitations May Lead to Distorted and Inaccurate Perceptions of Risk Problems

Ideally one would like to know in advance which personal characteristics are associated with what kinds of perceptual problems. If these characteristics are shared by an identifiable group, then information treatments could be designed and targeted for that group's specific needs. The New York study sheds some light on this issue.

The baseline survey obtained data on age, sex, income, education, number of children, years lived at address, ease with working with numbers, and responses to a set of attitude and personality questions. Table I indicates which of these variables was statistically significant for various tests. Education is significant in three of the four principal tests. In each case the sign is as expected. Holding other factors constant, including information treatment, better-educated respondents were more likely to do better on quiz questions, use the risk chart correctly, and have a smaller discrepancy between objective and subjective risks.

Age and response to an attitude question about health concerns are significant in two tests. Older people are less willing, and people with health concerns are more willing, to pay for more information. Older people were also more likely to do poorly on the radon quiz, while people with health concerns were more likely to overstate their actual risk.

The remaining personal characteristics were significant in only one test. Women were more likely than men to use the risk chart correctly. Whites overstated their risks less than nonwhites. As expected, higher-income respondents were more willing to pay for additional information.

While these results confirm the conventional wisdom that personal characteristics matter, they do not offer encouragement that such characteristics might serve to identify target "publics" for particular information programs. Moreover, the effect of such characteristics varies among risk responses. It is not clear which of these tests is most relevant from a public health or risk management perspective.

### 3.4. Risks from Dramatic Causes of Death (e.g., Cancer) Tend to be Overstated

This proposition is usually interpreted to mean that people's assessment of the probability of dying from

**Table I.** Effects of Personal Characteristics[a]

| | Age | Sex | Income | Education | Race | Ask doctor |
|---|---|---|---|---|---|---|
| Performance on radon quiz | − | | | + | | |
| Correct use of risk chart | | − | | + | | |
| Diff. between obj. and subj. risk | | | | − | − | − |
| Willingness to pay for more information | − | | + | | | + |

[a]Notes on definitions of variables: Sex: dummy variable = 1 if male; race: dummy variable = 1 if white; ask doctor: dummy variable = 1 if respondent indicated that the statement "you always ask your physician a lot of questions or regularly read articles about health" described himself very or fairly well.

cancer is greater than the technical risk assessment would predict. However, the technical risk estimate is typically a statistical construct that does not account for individual differences in exposure or vulnerability. Furthermore, the risk perception literature emphasizes that people find certain ways of dying more repugnant than others. Preferences about cause of death and other risk characteristics appear to be expressed in the form of perceived likelihood of occurrence.

In trying to devise a quantitative test of this hypothesis, it is important to discriminate between the perceived message and the perceived risk. Risk perceptions result from combining preexisting attitudes and knowledge with the information treatment. We have modeled this problem as a Bayesian process that specifies the perceived seriousness of risk in the followup survey to be the weighted average of the baseline seriousness and the perceived message in the information treatment. Letting the (unobserved) risk message be a function of information treatment and individual characteristics, we obtained maximum likelihood estimates of the relevant parameters. One of several models tested provided the following results:

$$\begin{aligned} \text{SRISK}_f = {} & 0.277 + 0.294\ \text{SRISK}_b \\ & + 0.016\ \text{RADON} \\ & - 0.085\ \text{COQUANT} \\ & - 0.028\ \text{COQUAL} \\ & - 0.087\ \text{CAQUANT} \\ & - 0.060\ \text{CAQUAL} - 0.037\ \text{EPA} \\ & - 0.004\ \text{EDUC} - 0.006\ \text{AGE} \\ & - 0.161\ \text{RACE} + 0.004\ \text{YEARS} \\ & + 0.001\ \text{TIME} + 0.039\ \text{DOCTOR} \\ & + 0.499\ \text{MILLS} \\ \log(\text{L}) = {} & -672.05 \end{aligned}$$

The subscripts $f$ and $b$ indicate the respondents subjective risk in the followup and baseline surveys, respectively; RADON is the radon reading; the next five variables are dummies indicating the four NYSERDA brochures and the EPA brochure (the fact sheet is the omitted treatment); YEARS is years resided at address; TIME is length of time spent reading the materials; DOCTOR is an attitudinal dummy indicating concern about health; and MILLS is a correction for selection bias. Only COQUAL, EPA, and EDUC fail to have statistically significant parameters. Note that people with higher radon readings are likely to perceive risks as more serious, and the quantitative and cajole treatments tend to reduce concern relative to those who received the fact sheet.

These coefficients suggest an average perceived risk message about 10 times larger than the technical risk estimates, adjusted for life expectancy (based on age and sex) and length of exposure. This comparison relies on numerous assumptions and imperfect measures of risk perceptions. Nevertheless, the data seem to indicate a systematic upward bias in the way that respondents decoded the risk information they received.

### 3.5. When Informed About a Particular Hazard, People's Concerns Will Generalize Beyond the Immediate Problem to Other Related Hazards

Both the baseline and followup surveys contained a question about the seriousness of risks the household faces from auto accidents, hazardous wastes, and radon. Seriousness was measured on a 1–10 scale. Table II compares responses to this question before and after the respondents received information on their radon test results and one of the information treatments.

Respondents initially perceived their personal risk from radon and hazardous wastes to be about equally serious, with auto accident risk being considerably more serious. The radon readings for this sample of New York homes were generally quite low. Respondents' perceptions changed in the appropriate direction, with mean radon seriousness falling by 20%. The respondents received no new information on hazardous waste or auto accident risks. Nevertheless, the perceived seriousness of these risks also declined in the followup survey. The decline in perceived hazardous waste risk was more than twice that of auto accidents, perhaps because the characteristics of hazardous waste risk are more similar to radon. The evidence here appears to confirm the conventional wisdom, although the literature has focused on increases rather than decreases in perceived risks.

## 4. CONCLUSION

Evidence from the New York social experiment generally confirms the qualitative propositions of the

**Table II.** Mean Seriousness of Risks from Various Sources

| | Baseline | Followup | Difference(%) |
|---|---|---|---|
| Auto accidents | 5.7 | 5.3 | 7% |
| Hazardous waste | 4.3 | 3.6 | 16% |
| Radon | 4.2 | 3.4 | 20% |

conventional wisdom. An important exception is that numerical probabilities demonstrably improve performance on tasks involving comparing relative risks, evaluating the seriousness of risk exposures, and adjusting population risks for individual circumstances. Furthermore, we have obtained new insights by treating the conventional wisdom as hypotheses subject to specific quantitative tests.

At this point in the research, we have data primarily on the response of risk perceptions to different information treatments and different personal characteristics. The effect of various causal factors is sensitive to the particular test of risk perception applied. No information treatment was clearly superior for all tasks. Neither was there a single set of personal characteristics that identified a group with a clearly defined set of perceptual problems. Again, different personal characteristics were important for different perceptual tasks.

The most important implication of these findings is that risk communicators must determine what specific task or tasks the information program should enable people to do. The usual strategy of simply reducing anxiety may not be consistent with educating the public about risk facts, helping them to identify their personal risks, or helping them to improve their perceptions about relative risk exposures. In short, the conventional wisdom that risk communication itself is a complicated, hazardous undertaking is quite correct.

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