Natural Hazards Research and Applications Information Center
Campus Box 482
University of Colorado
Boulder, Colorado 80309-0482

PSYCHOLOGICAL CONSEQUENCES OF RADON IN THE HOME

Margaret Gibbs
Susan Belford
Michael Edelstein

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In line with the purpose of the Boulder workshop in discussing communication of risk about hazards, this paper will first discuss the role played by a small nonprofit environmental agency in conveying information and assistance to the community about radon. The second part of the paper will report briefly on psychological findings related to radon in a sample from the community.

After radon was found in high levels on the Reading Prong in Pennsylvania, communities in Orange County in New York, also situated on the Prong, began to become concerned about possible radon levels in their own community. These concerns were allayed for most Orange County residents after a meeting in which scientists from the New York Department of Health and NYU spoke. Little actual incidence data was reported, but the impression was given that test sampling in the area had showed very low levels and that radon itself was not very dangerous. For instance, slides were shown of attractive Austrian women in a spa sought out for its high radon level.

Orange Environment, a small, struggling nonprofit agency, decided that more extensive radon sampling should be conducted in the area, for the purpose of assessing the extent of the problem, mapping the affected areas, and providing affected residents with information about dangers and mitigation. Orange Environment obtained batch rates for tests from a major radon testing service, and advertised the half-cost services to residents through the local paper. Results reported in this paper have been obtained from this sample of individuals who tested their homes.

Findings of the radon tests indicated that 23% of the 120 tests showed radon readings above a level of 4 picocuries per liter, the level generally accepted as requiring remediation. The range of readings was from a fraction of a picocurie to a high of 60 picocuries. Thus, although findings were not at the very high level found in Pennsylvania, Orange County clearly showed a sizable proportion of homes that need remediation. Also, no special pattern of correlation between readings and residence on the Reading Prong appeared, meaning that there is a broader need to test in the area than previously thought. Interestingly, the local newspaper reported the findings as showing little problem, and continued to state that the radon problem was limited to the Reading Prong.

Along with the test results, an explanation of the meaning of radon levels taken from a draft of the EPA's guidelines was enclosed. In addition, a meeting was held with those testing their homes at which remediation was discussed by the staff of Orange Environment knowledgeable in that area, including our environmental physicist.

Individuals seemed to find this meeting helpful.

An issue for an agency like Orange Environment is what role to attempt to play in educating the public and encouraging action about radon. Since Orange Environment is small, made up of a few interested volunteers, and has no funding, its resources to accomplish tasks that do not have public support is very small. In the face of media and governmental dismissal, it is easy to appear to be a Cassandra. As an example, one or two respondents to our psychological questionnaire objected to items that asked if they were upset or worried about radon. They suggested that such questions were reactive, making them worry when there was no reason to.

In contrast to response about naturally-occurring radon, the community has recently been mobilized over the issue of a "radon dump," i.e., a dump of radium-contaminated soil, planned for the area. The public outcry has been enormous, although the potential danger to the community is probably much less than from the pre-existing radon in the area. On this issue, Orange Environment has been consulted and asked to take action by members of the community. This issue affords an opportunity to study the difference between perceptions of natural and technological hazards; from the information so far it appears that technological hazards evokes more anger, worry, generalized stress and action.

The psychological study conducted on the participants of Orange Environment's radon testing was made possible by the quick response funding of the Natural Hazards Research Center in Boulder. The study hypothesized that exposure to radon in the home, even at the levels anticipated (and found) in the Orange County area, would be stressful and have emotional consequnces. Questions about emotional responses were included, as well as the Horowitz Impact of Event Scale. Questions also tapped demographic variables, perceptions of risk about radon and other environmental hazards and locus of control and social support.

Now that subjects have received their radon results, we are just beginning to collect data on their responses. The data that can be provided at this point deal with the issue of base rates. One of the problems of stress research is that of separating the effects of stress from the pre-existing personalities of the individuals involved. That is, skeptics about the negative effects of stress claim that victims of hazard are sometimes self selected, and that those individuals who show emotional reactions are those with pre-existing personality deficits. For instance, it is argued that those veterans who come down with PTSD are those who had pre-existing personality deficits, and that individuals who went to Viet Nam and those who saw combat were less stable than individuals who managed to avoid the experience, thus predisposing them to psychopathology. The literature does not support the skeptics' interpretation, but the argument is nevertheless

hard to discount. The basic dilemma of hazards research is that pre-test measures are not available for the victims. That is, we don't know when or where the earthquake, the toxic water crisis, or the plane crash is going to strike.

In this study, we did have base rate data available, and we compared the base rate responses of our experimental group with those of control subjects. We had two experimental groups of individuals who tested their homes. Each family was given two questionnaires; a total of 236 were handed out, and 76 were returned. The return rate was actally higher than the apparent 32% as some percent of the families had only one adult, and all families were given two questionnaires. Comparison of the responses of the two experimental groups obtained no more differences than would be expected by chance.

The control group chosen was that of members of two chapters of the League of Women Voters. This group was chosen because we thought it would be comparable in education and environmental awareness to the radon testers. Approximately 120 questionnaires were distributed, and 35 were returned, a return rate of 29%. Comparison of the responses of the two control groups obtained no more differences than would be expected by chance.

Our hypotheses were, generally speaking, that the experimental group would not appear different from the control group on any dimension other than concern about radon, that is, that pre-selection on the basis of emotional adjustment would not occur in the experimental group. Specifically, we hypothesized that in terms of subjective adjustment, radon testers would resemble the control group in happiness, amount of worry, sense of control over their environment and trust of others, with the only difference hypothesized to be a greater worry about health and the health of any children in the family for those who tested their homes. We also hypothesized that scores on the Impact of Events Scale would be comparable, since the radon testers in the pretest did not know what their levels of radon were. We hypothesized that the main difference between groups would be one of attitude, that those who chose to have their homes tested would perceive environmental hazards, especially radon exposure, as more dangerous to society than control subjects.

Demographic differences between the experimental and control groups appeared. We were of course aware that the League of Women Voters sample was almost entirely female (32 females, 3 males) while the radon testers sample turned out to be composed of 27 females and 48 males. The groups also differed significantly on age (experimentals 40.2, SD 9.6; controls 50.4; SD = 13.4, $t = 4.44$, $p < .01$). Experimentals were more likely to be married (96% vs. 83%, $t = 2.41$, $p < .05$). Controls were more likely to have lived in their homes longer (12.9 years, SD 8.7, vs. 7.6

years, SD 7.8; $t = 3.16$, $p < .01$).

On the important dimension of education, however, the groups did not differ, with the mean for both groups falling into the category between "undergraduate degree" and "some graduate training". In addition, as will be presented later, both groups had similar attitudes about environmental hazards.

Table 1 summarizes the differences between the experimental and control groups. As predicted, no differences were obtained on the dimensions of past control, anticipated control, happiness, worry, trust or support from spouse and others. Contrary to prediction, there were also no differences in worry about health and health of children. Also not predicted was the nonsignificant trend for the radon testing sample to describe themselves as more competent than control subjects. On the Impact of Events Scale, the groups did not differ significantly on either the avoidance factor, the instrusion factor, or total score.

We tested our hypothesis that radon testers would perceive exvironmental hazards, especially radon, as more dangerous than would control subjects in the following way. We compared the ratings of control and experimental subjects on ten environmental hazards, such as pesticides, nuclear power, and cigarette smoke. The difference was nonsignificant, although experimental subjects did rate the hazards as more dangerous. When radon alone was examined, the difference between the experimental group and control group was significant. An analysis of covariance was performed, to test whether, separating out the factor of somewhat higher overall rating of environmental hazard by experimental subjects, the radon hazard alone was still perceived as more dangerous. The analysis was significant ($F = 7.3$, $p < .01$, $n = 89$), while comparing the group means on the covariate of overall perception of environmental hazard still showed a nonsignificant result ($t = .28$, $p = .78$).

The demographic differences between our experimentals and controls suggest the inclusion of another control group more comparable in gender and age composition. However, it is interesting that the two groups, contrary to prediction, perceived environmental hazards as equally dangerous. In some very basic attitudinal respects, our experimental and control groups are remarkably similar, and these similarities of attitude may, for the purposes of the study, be more central than age and gender. It would be of interest to contrast our experimental group with less educated, lower socioeconomic status groups in terms of attitudes and subjective mental health variables
h did not differentiate the two groups, and the only trend differentiating the two was for greater felt competence in the experimentals. Thus, to summarize, if we do eventually find stress reactions in our experimental group, our data suggest that these reactions cannot be attributed to

pre-existing emotional difficulties. Obviously, more extensive interviewing and testing would be necessary to completely rule out pre-existing difficulties as a factor, but the data are more solid than the data obtainable in almost all naturalistic stress studies. Our data suggest that the decision to have one's house tested for radon is not a function of being a worry wart, or an untrusting human being, but rather a simple function of one's perception of radon as more dangerous than other people see it.

Table 1

Question	Experimentals		Controls		
	M	SD	M	SD	t
past control over life*	2.6	1.0	2.8	1.1	.94
anticipated control	2.6	1.1	2.8	1.2	.72
happiness	2.3	1.3	2.5	1.0	.65
worry	4.1	1.7	4.6	1.8	1.38
worry about health	3.4	1.7	3.9	1.7	1.42
trust of others	3.3	1.6	3.3	2.4	.15
competence	2.0	0.8	2.4	1.2	1.73
social support	1.8	0.6	1.9	0.6	.45
support from spouse	1.1	0,3	1.0	0.2	1.21

*Items except for last two are scaled in opposite direction, so higher score indicates less of variable