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SOCIAL ISSUES AND ENERGY ALTERNATIVES: THE CONTEXT OF CONFLICT OVER NUCLEAR WASTE

FINAL REPORT

Michael K. Lindell

Timothy C. Earle

Ronald W. Perry

JUNE 1980

Work performed under contract DE-AC06-76RLO 1830

Human Affairs Research Centers

4000 N.E. 41st Street • Seattle, Washington 98105

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Prepared for the Waste Management Systems Studies Program
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Battelle Memorial Institute
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Energy and Environment Program
Seattle, Washington 98104

EXECUTIVE SUMMARY

In order to gain a satisfactory understanding of public attitudes toward issues in nuclear waste management, it is important to recognize the context in which the public views those issues. Nuclear waste, in the minds of the public, is just one aspect of the nuclear power issue. Nuclear power, in turn, is just one means of avoiding energy shortage. Energy shortage is but one of many significant social issues.

The data presented in this report are the results from a questionnaire which sought to place attitudes toward nuclear waste in a context of attitudes toward other aspects of nuclear power, other energy alternatives and other social issues. The sample of respondents was composed of members of seventeen geographically widespread, established groups which were expected to vary from pronuclear to antinuclear in their attitudes. The seventeen groups, which were subsequently assigned to six relatively distinct clusters, differed significantly in their level of involvement in activities in support of and opposition to nuclear power.

Respondents were asked to judge the importance of ten social issues. Some of these issues are closely related (e.g., environmental pollution and energy shortage) and others are weakly related--racial conflict and drug abuse, for example--to energy policy alternatives.

Comparisons between the importance ratings of nuclear supporters and opponents showed that both groups considered Energy Shortage to be an extremely important issue. Pronuclear respondents gave higher ratings to economic and crime related issues than did other respondents.

Antinuclear respondents, on the other hand, rated environmental and social justice issues higher than did the pronuclear respondents. Nuclear supporters and opponents differed most strongly over the importance of environmental pollution as a social issue.

Within the more restricted context of energy issues, respondents judged their level of agreement with a number of questionnaire items in five major context areas. These included the production potential of alternative electric power generation technologies, energy conservation, the risks of these technologies, comparison of risks among these technologies, and comparisons of risks and benefits for a given technology. Respondents were generally in agreement about the overall conseqences of continuation of the present energy situation and on the limitations of conventional sources of power--the sources that supply the bulk of our electricity today (coal, oil and hydroelectric). The disagreement centered instead on the production potentials offered by the alternate technologies that will be required to supplement conventional sources. Those that supported the nuclear alternative offered little support to other technologies; respondents who expected high energy production benefits from solar and wind (the antinuclear respondents) did not see them in nuclear.

Nuclear supporters and opponents differed quite significantly over energy conservation. Nuclear supporters believed that a heavy emphasis on energy conservation would be difficult to adjust to and would have serious adverse effects on themselves and upon the economy generally. Nuclear opponents did not believe that these problems would materialize. None of the clusters generally opposed a comprehensive conservation program, although nuclear opponents expressed stronger support.

The attitudes of respondents toward the risks associated with electric power generation technologies also differed significantly. As was expected, the antinuclear respondents expressed most concern about nuclear power. However, they perceived significant risks associated with two fossil fuel technologies--coal and oil--as well. Nuclear supporters expressed less concern about risks of electric power production technologies than did nuclear opponents. Antinuclear respondents strongly endorsed acceptance of responsibility for the effects of our wastes on future generations, regardless of technology. Pronuclear respondents less strongly endorsed acceptance of responsibility for wastes in general and were neutral on the issue of nuclear wastes. Antinuclear respondents indicated that the use of fuels (especially nuclear but also coal) should be limited until their wastes can be controlled; pronuclear respondents opposed limitations, particularly on nuclear power. Finally, nuclear opponents indicated that they felt that industry was not doing all it could to curb pollution.

A series of items presented explicit comparisons between the risks of coal and nuclear fuel cycles. Nuclear supporters strongly rejected any unfavorable comparison to coal. Nuclear opponents believed that pollution control for coal plants is cheaper and more effective than the technology needed for nuclear waste and disagreed with the statement that the hazards of wastes from a nuclear power plant are no greater than the hazards from pollutants from coal plants. Antinuclear respondents did not believe that the risks of either coal or nuclear were much less than the benefits; pronuclear respondents felt that the benefits were worth the risks in both cases.

In sum, the picture that emerges from the analysis of those most deeply committed on the nuclear issue, both supporters and opponents, is slightly different from that suggested by Melber, et al., (1977) after reviewing poll data. They proposed that there may be two different energy perspectives: one favoring any alternative that increases electric supply and another which resists increase in supply and favors conservation. Analysis of the most strongly pro- and antinuclear activists indicates that neither side favors oil or coal. Each side, however, has a favored technology which it prefers to have supplant the conventional technologies.

The nuclear supporters studied here do, of course, favor nuclear power. However, they believe that there are limited prospects for contributions from solar, wind and hydroelectric technologies. They also believe that there are serious disadvantages to conservation. Nuclear opponents, on the other hand, disagree that there are such limited prospects for solar and wind, although they are neutral on the prospects for increased hydro capacity. They also do not believe that conservation necessarily poses serious adverse consequences either for themselves or others.

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INTRODUCTION

Public attitudes toward nuclear power and nuclear waste are based on a wide range of specific concerns and interests. In their review of public opinion survey research Melber, Nealey, Hammersla and Rankin (1977) showed that opposition to nuclear technology focused on safety, nuclear wastes, costs, pollution, satisfaction with other energy sources and lack of perceived need for nuclear energy. Support for nuclear technology was shown to be based on several factors including fuel supply, costs, conservation of other resources and relative lack of pollution. These survey results demonstrate that, while the attitude of a given individual toward nuclear technology may be based on a single issue such as safety, the attitudes of other individuals may be based on an entirely different issue or set of issues. As a result of this complexity, any program of research primarily focused on a single aspect of nuclear power should investigate that aspect within a context consisting of samples from the broad range of public concerns about the interests in nuclear power.

Any particular object of study, such as public attitudes, can of course be viewed from several points of view and thereby be seen within a number of different contexts. Survey designers must therefore carefully select the contexts they use; those choices are based primarily on representativeness and utility. Representativeness refers to the degree of similarity between the issues addressed in the questionnaire and the context which the respondents associate with those issues. Utility refers to the degree to which the items provide the desired information. Addressed in this manner, the organized network of beliefs and attitudes

about nuclear waste issues can be assessed. This approach avoids the problem, common to the exclusive reliance on public opinion polls, of isolating attitudes which have important interrelations.

The incorporation of a context of nuclear power issues in a survey is important from the points of view of both respondents and investigators. The inclusion of items relating to all or most of those aspects of nuclear power and nuclear waste known to be of serious public interest reduces the chances that some respondents may be frustrated in their attempts to express their strong beliefs and, as a result of their frustration, attack the survey by providing frivolous or inaccurate information. For those who are conducting the survey, the context of items in which those of central interest are embedded provides the background against which the central items can be interpreted. Without such a background, the central items would be difficult to interpret. Conversely, the broader and more similar to everyday life the total set of items, the richer and more meaningful can be the interpretations drawn from the responses of central interest.

The primary focus of the present report is the context of public attitudes toward nuclear waste management. A companion report (Lindell, Earle, Hébert and Perry, 1978) based on data collected in the same survey, deals specifically with public attitudes toward nuclear waste disposal facilities. In order for the items assessing attitudes toward nuclear waste to be most useful, they were presented along with items relating to the context in which that issue is dealt with by the public. Nuclear waste is an aspect of nuclear power; nuclear power is a means for avoiding energy shortage; energy shortage is a significant social issue.

Assessment of respondents' attitudes at the two levels of context (nuclear power and energy shortage) surrounding the focal issue (nuclear waste) may improve our understanding of public response. Respondents who are concerned about nuclear waste but unconcerned about energy shortage are likely to differ significantly from those who are concerned about nuclear waste hazards and also very concerned about energy shortages. The former might be expected to support additional research and demonstration projects in nuclear waste management; the latter might oppose any additional support for nuclear technology.

As yet, no studies have attempted general explorations of the multi-layered contexts in which specific nuclear power/nuclear waste issues are embedded (see, however, Rankin and Nealey, 1978 for a study of the relationship between personal values and nuclear attitudes). Several investigators have probed individual strata: Bass, Bass & Shapira (1977) compared environmentalists' and business executives' attitudes and information about a limited variety of nuclear power issues. Public attitudes toward nuclear power and nuclear waste have also been the focus of many local, regional and national surveys (Melber, et al., 1977).

The comparison between nuclear and other electric power generation technologies has also occupied a number of investigators. The so-called objective or calculated risks of the nuclear fuel cycle (defined as the magnitude of the health and safety consequences times the probabilities of those consequences) have been compared by Inhaber (1979) with those of other sources of energy. In contrast to the Inhaber study, Fischhoff, et al., (1978) studied the perceived risks (i.e., the risks as judged by individual persons, both nonexpert and expert) of various activities and

technologies including nuclear power. Local, regional and national surveys have also been used to compare public opinion on nuclear technology with that on other energy alternatives (Melber, et al., 1977). To date, the very general context of the relations between public attitudes toward nuclear power and their attitudes on a wide variety of other social issues has not been explored.

Interrelationships among three layers of the context of nuclear waste management are investigated in the present report. First, public attitudes toward the general issue of nuclear power and nuclear waste are compared with their attitudes toward several other important social issues. As part of a larger questionnaire, a section consisting of ten items was designed to elicit respondents' judgments about the importance of ten social issues, ranging from inflation to racial conflict. Since the respondents were chosen on the basis of their attitudes toward nuclear power, possible differences in patterns of issue salience--the relative importance of the issues--between pro- and anti-nuclear respondents can be studied (Perry, Parker and Gillespie, 1976). Placing public attitudes toward nuclear power and nuclear waste within the larger context of attitudes toward other social issues enhances one's understanding of the priorities of both those who support and those who oppose nuclear power.

Just as nuclear power can be seen as one of several social issues, it can also be viewed within the more limited context of energy issues. By energy issues we mean problems of public energy policy relating to the whole range of energy alternatives. The section of the questionnaire designed to deal with energy issues consisted of thirty-three items, some

of which referred to specific energy technologies such as solar or coal while others referred to general problems of energy supply. The items dealing with energy issues were constructed so that comparisons could be made among the perceived risks of the various energy technologies, among the perceived benefits of the energy technologies and between the risks and benefits of individual technologies. Our understanding of public attitudes toward electric power generating technologies can thus be enhanced along with our understanding of how judgments of risk and benefit are made by pro- and anti-nuclear respondents.

RESPONDENTS

This section briefly reviews the steps followed in selecting the respondents for the sample and aggregating them into clusters ranging from strongly pronuclear to strongly antinuclear in attitude. The demographic characteristics of the sample are also reviewed, as well as data that support the reasonableness of the clusters. For a more extensive description of the characteristics of the sample, see the companion report by Lindell, Earle, Hebert and Perry (1978).

Sampling. Questionnaires were administered to members of seventeen groups which were expected to vary in their attitudes from strongly pronuclear to strongly antinuclear. The pronuclear and antinuclear groups were identified on the basis of their public stands on the issue of nuclear power. Groups expected to be neutral were selected on the basis of the apparent level of membership interest in energy issues and the absence of any prior policy explicitly supporting or opposing nuclear power.

Formation of Respondent Clusters. In order to provide a clearer understanding of the factors which distinguish pronuclear and antinuclear respondents, the seventeen groups of respondents were aggregated into six clusters. The method by which these groups were assigned to clusters was accomplished in two steps. First, the data from all of the respondents were entered into a stepwise multiple discriminant analysis in which the predictor variables were items from the energy issues portion of the questionnaire and the dependent variable was group membership. Next the matrix of dissimilarity indices among groups was used as the basis for forming clusters. Inspection of this intergroup distance matrix

indicated that some clusters of groups were readily identifiable. Other clusters, especially among the more neutral groups, were less clearly defined. Cluster sizes were made relatively homogeneous in size without distorting the differences among the clusters or the similarities within clusters.

Table 1 shows a list of the groups, identified by geographical region and a short label describing the group. This table also shows the cluster to which each of these groups was assigned. Clusters are assigned numbers from one to six, with cluster one being the most antinuclear and cluster six being the most strongly pronuclear.

Demographic Characteristics of the Respondents. In comparison to probability or quota samples obtained by polling organizations, our sample more heavily represents the middle--30 to 60--age categories, has a higher proportion of males, and is characterized by higher income and educational levels. Our sample, however, was not designed to be representative of the population in general. Instead, we wished to tap those people who tend to be politically active and therefore functionally important in matters related to energy use patterns and questions of waste management (Lemon, 1973, p. 186-207). Since the sample overrepresents those who tend to be most politically active (cf. Brown & Ungs, 1972; Hamilton, 1972), it appears that the sampling strategy fulfilled its purpose.

Activities of Respondents. It is important to provide data which support the validity of the results of the clustering procedure. Data on the activities of the respondents provide a satisfactory means of

TABLE 1. CLUSTER ASSIGNMENTS OF SURVEY GROUPS

Cluster	State	Type of Group	Anticipated Attitude
1	Massachusetts	Public-interest research	anti
	Massachusetts	Political education	neutral
2	Texas	Environmental action	anti
	Colorado	University social science class	anti
	Illinois	Political education	neutral
	Illinois	Environmental	anti
3	Colorado	Research	neutral
	Colorado	Environmental	anti
	Colorado	Computer Professionals	neutral
4	Texas	Recreational	neutral
	California	Public safety	neutral
5	Colorado	Business	pro
	Illinois	Business	pro
	California	Business	pro
6	Massachusetts	Labor	pro
	Texas	Utility employees	pro
	California	Nuclear technologists	pro

resolving this issue. Aggregation of groups into clusters is supported only to the degree that relevant activity measures differentiate among those clusters.

Respondents were asked to indicate if they had in the past year engaged in any of several activities which indicated opposition to environmental pollution. The total number of different activities was computed for each respondent. This produced a score for each respondent which could range from zero activities to seven activities reported. Similar activity inventories were requested for opposition to nuclear power, support for nuclear power and support for energy conservation. Respondents in antinuclear clusters were much more highly involved in antipollution activities and antinuclear activities than were the respondents in pronuclear clusters. Also, they were slightly more involved in conservation activities and much less involved in pronuclear activities. Hence, these activity measures, especially those concerned with support for nuclear power and opposition to nuclear power, provided strong confirmatory evidence of the programmatic validity of the classification of the respondent clusters. (Selltiz, Jahoda, Deutch and Cook, 1959; p. 157-158).

SOCIAL ISSUES

One broad context in which public attitudes toward nuclear technology can be discussed is that of social issues. Attitudes of the respondents toward nuclear power and nuclear waste are clearly related to significant and controversial social issues such as economic growth, environmental pollution and the need for additional electric power. Although it might be surmised that these issues would have great salience for those holding strong attitudes toward nuclear power, this particular aspect of public attitudes has not been previously studied.

This section addresses the relative importance of a variety of social issues to the sample of respondents. The method of study involved making comparisons among the importance ratings given a set of social issues by the respondents. Ten social issues, judged by the investigators to be both nationally important and controversial, were selected for study: 1) Inflation, 2) Environmental Pollution, 3) Overpopulation, 4) Crime and Juvenile Delinquency, 5) Poverty, 6) Unemployment, 7) Racial Conflict, 8) Energy Shortage, 9) Drug Abuse, and, 10) Economic Growth. Respondents were asked to indicate the level of importance they assign to each of the ten social issues. Some of the social issues (e.g., environmental pollution and energy shortage) are closely related to energy policy alternatives. For others, such as racial conflict and drug abuse, the connection to energy alternatives is weak. This wide range of social issues allows the relative importance of energy-related issues to be compared with that of non-energy-related social issues for both pro- and antinuclear respondents. In addition, general comparisons can be made between social issues considered important by pronuclear respondents and those considered important by antinuclear respondents.

The instructions for this section of the questionnaire stated that "People differ . . . in the importance which they attach to these issues," and that respondents should "indicate how important some commonly mentioned social problems are to (themselves personally)." Judgments were made on a seven point scale ranging from Very Unimportant (1) to Very Important (7).

Individual Issues

To clarify the following presentation, the ten social issues have been divided into two groups of five. The first group consists of those social issues considered to be most closely related to energy issues: Economic Growth, Inflation, Energy Shortage, Overpopulation and Environmental Pollution. The second group consists of those social issues less closely related to energy policies. These are Poverty, Racial Conflict, Unemployment, Crime and Juvenile Delinquency and Drug Abuse. Results for these two groups of issues are discussed in turn, followed by a general discussion based on all ten social issues.

Energy-Related Issues. The average importance ratings for the six respondent clusters on the five energy related social issues are displayed in Figure 1. In order to highlight comparisons between pro- and antinuclear respondents, the average importance ratings for the three most pronuclear clusters combined (clusters 4, 5 and 6) and for the three most antinuclear clusters combined (clusters 1, 2 and 3) are given in Figure 2. The energy-related social issues can be divided into three groups: 1) Those given higher importance ratings by pronuclear respondents, Economic Growth and Inflation (note that the difference between pro- and antinuclear clusters was greater for Economic Growth

ENERGY RELATED SOCIAL ISSUES (ALL CLUSTERS)

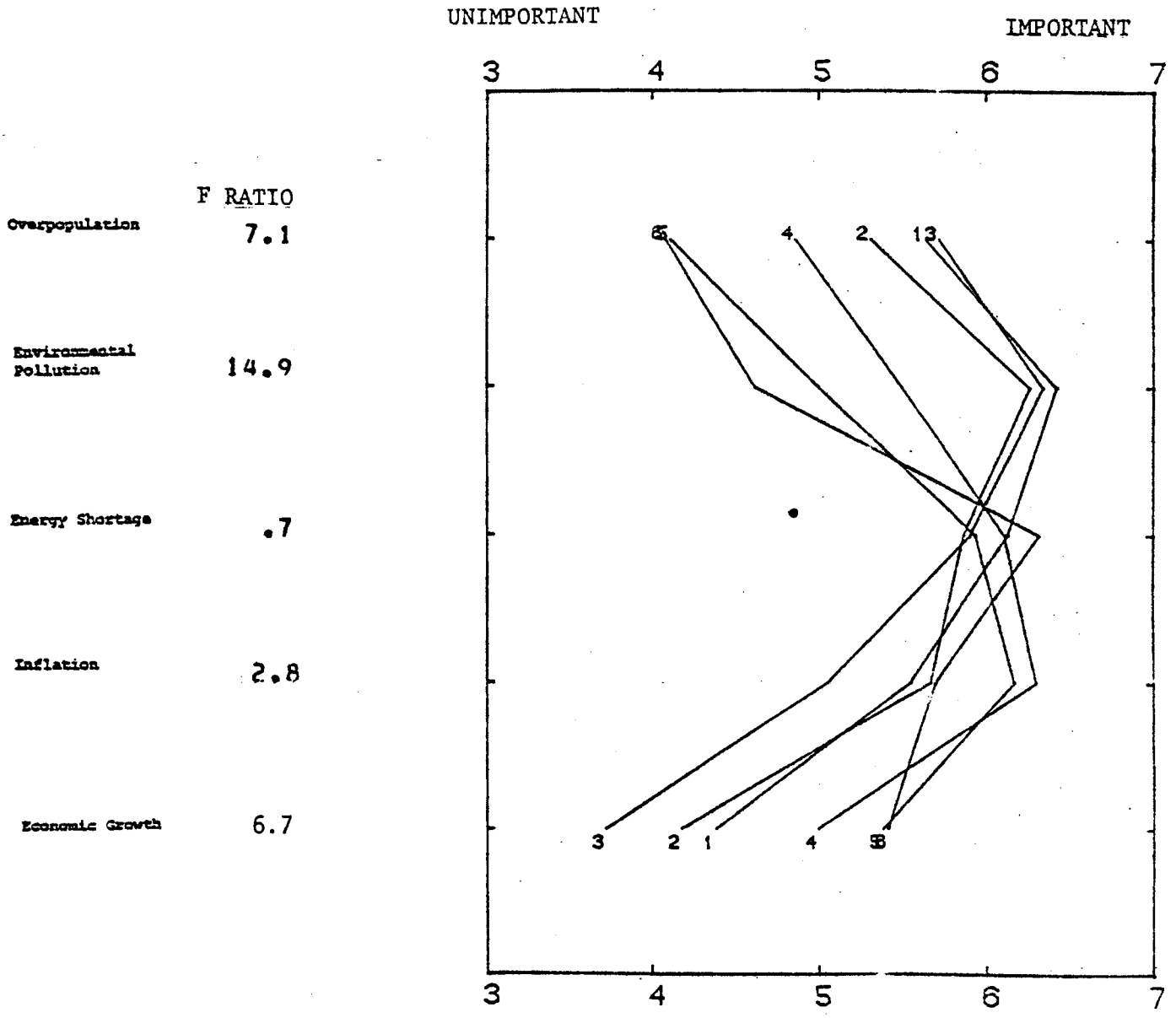
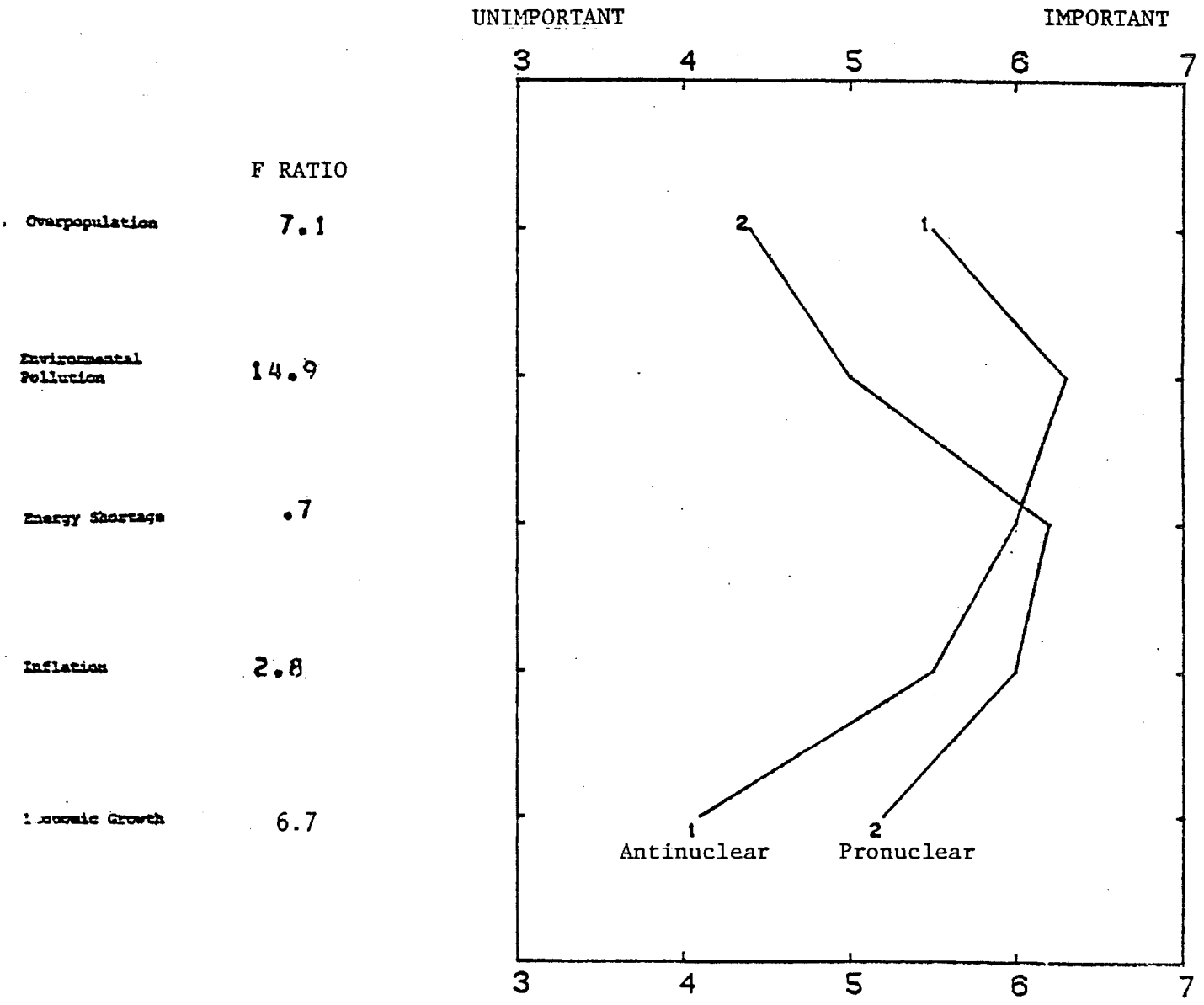


FIGURE 1

than for Inflation); 2) The issue for which ratings did not differ among clusters (Energy Shortage); and 3) Those given higher ratings by antinuclear respondents, Environmental Pollution and Overpopulation, the former produced a greater difference between pro- and antinuclear clusters.

The most important energy-related social issue for pronuclear respondents was Energy Shortage (also the most important of all the social issues), followed closely by Inflation, then Economic Growth and Environmental Pollution, and finally Overpopulation. Though antinuclear respondents agreed with their pronuclear counterparts that Energy Shortage was an important issue, Environmental Pollution was the most important energy-related issue (and most important overall). It was followed by Energy Shortage, Inflation, Overpopulation, and finally Economic Growth. The primary contrast between pro- and antinuclear respondents is the relatively high importance given by the former to economic issues (particularly Economic Growth) and the relatively high importance given by the latter to ecological issues (especially Environmental Pollution). This contrast does not mean that pronuclear respondents indicated that ecological issues were unimportant or that antinuclear respondents thought that economic issues were unimportant. Pronuclear respondents, for example, rate Economic Growth only slightly more important than Environmental Pollution; antinuclear respondents, however, gave Environmental Pollution a much higher rating than Economic Growth. Similarly, Inflation and Overpopulation were given equal ratings by antinuclear respondents, but pronuclear respondents rated Inflation much higher than Overpopulation.

ENERGY RELATED SOCIAL ISSUES (PRO VS ANTINUCLEAR)



Note: Antinuclear = "1"; Pronuclear = "2"

FIGURE 2

Non-Energy Related Issues. Figure 3 presents the average importance ratings for each cluster on the five non-energy-related social issues; the average ratings for the three most pro- and antinuclear clusters are displayed in Figure 4. A comparison between Figures 2 and 4 shows that non-energy-related issues (average rating of 4.8) were considered to be less important than energy-related issues (average rating of 5.4) by both pro- and antinuclear respondents. Two of the non-energy-related issues (Drug Abuse and Crime and Juvenile Delinquency) were given higher importance ratings by pronuclear respondents, while antinuclear respondents gave higher ratings on three issues (Unemployment, Poverty and Racial Conflict). Figure 3 indicates that cluster 1 was primarily responsible for the relatively high average ratings for antinuclear clusters on the three issues for which they had higher ratings than the pronuclear clusters.

For pronuclear respondents, the most important non-energy-related social issue was Crime and Juvenile Delinquency, followed by Drug Abuse and then Unemployment, Poverty and Racial Conflict. Antinuclear respondents gave approximately equally high ratings to Crime and Juvenile Delinquency, Unemployment, Poverty and Racial Conflict; Drug Abuse was of less importance. For these issues, the primary contrast between pro- and antinuclear respondents is the relatively high ratings given by the former to crime-related issues and the relatively high ratings given by the latter to social justice issues.

NON-ENERGY RELATED SOCIAL ISSURES (ALL CLUSTERS)

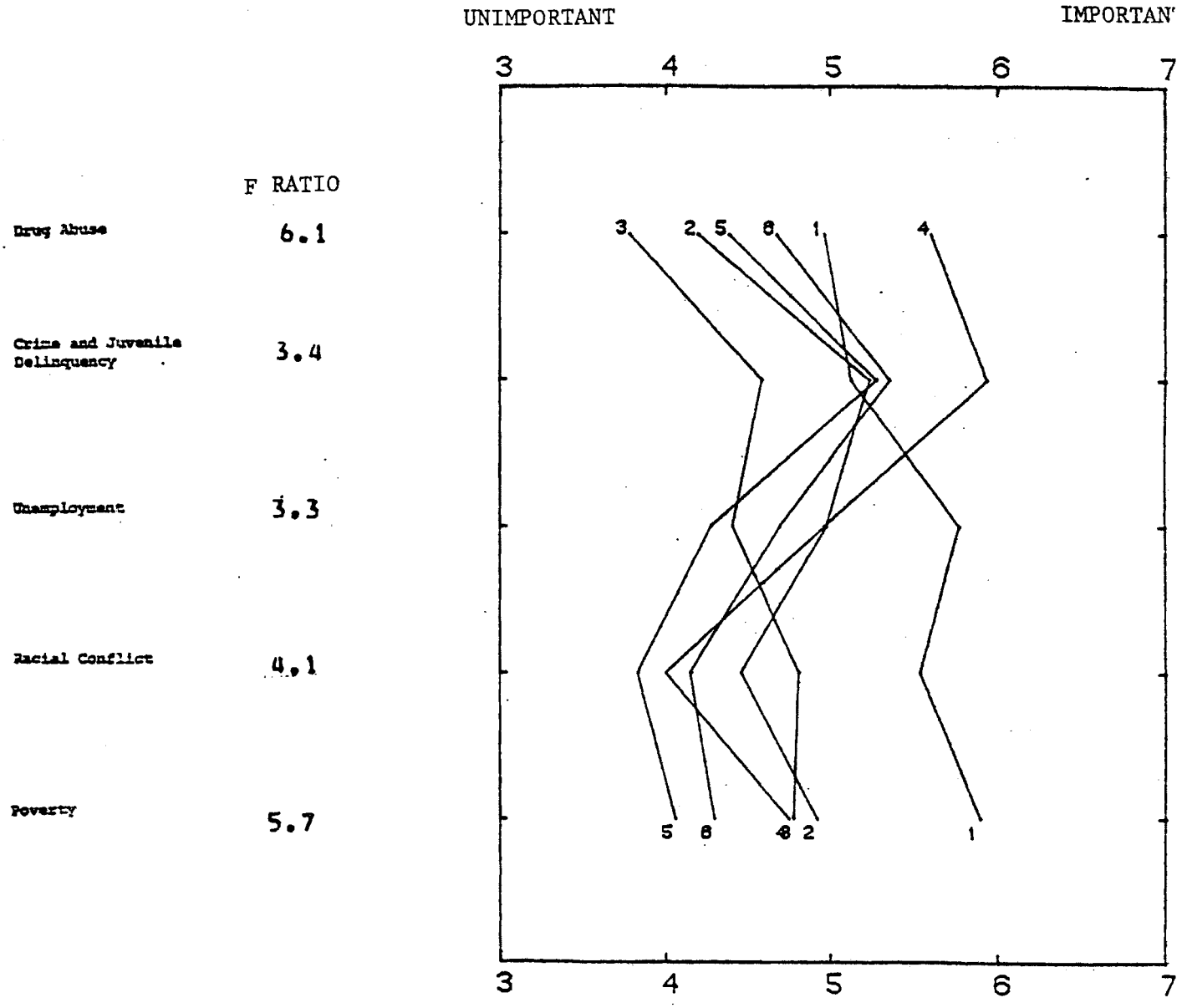


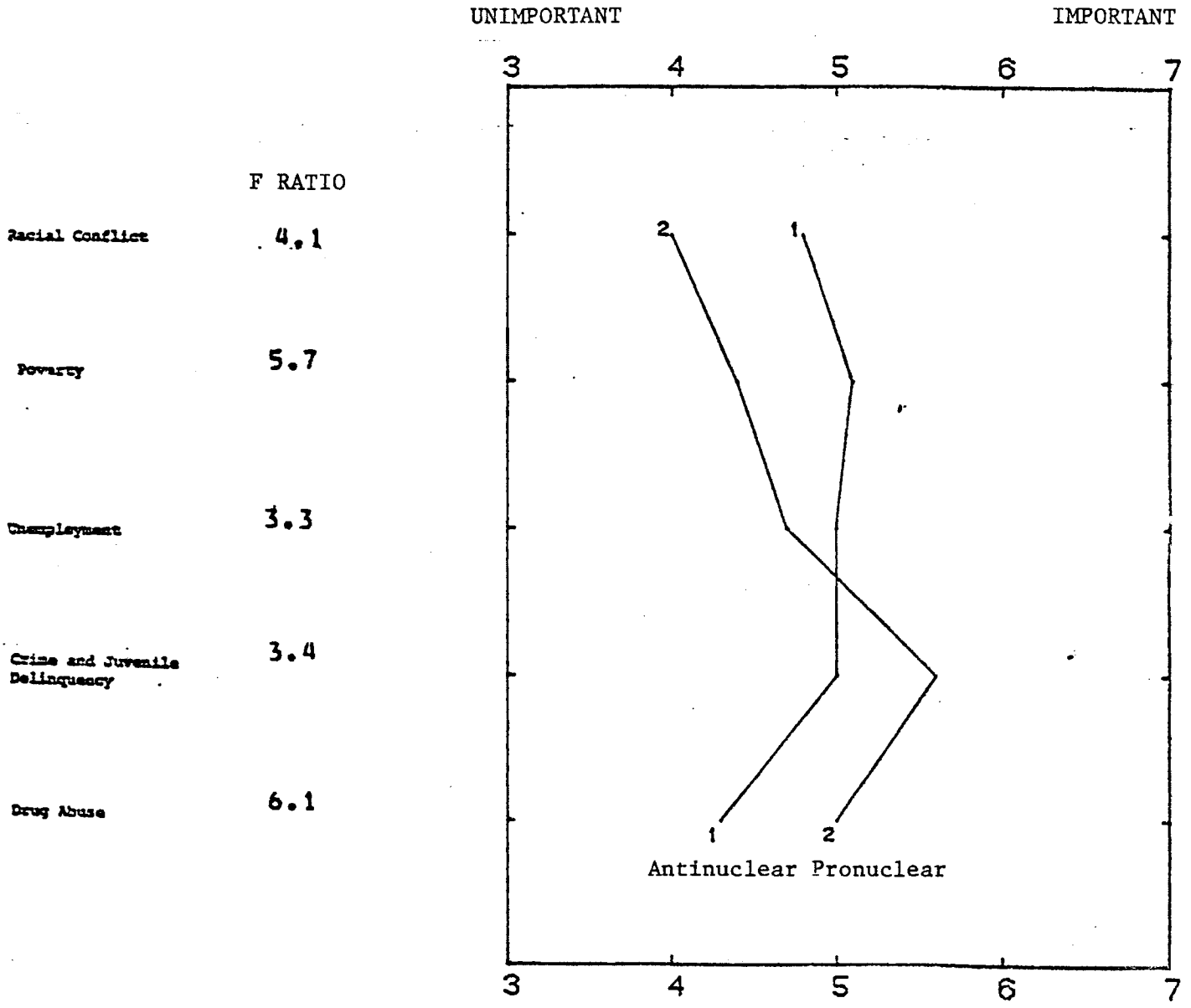
FIGURE 3

Predicted Group Membership

The preceding results have shown that many of the individual social issues items discriminate among the clusters of respondents. It is also important to show how well these items, as a group, adequately describe the attitudinal differences among the respondents. If the items in the survey discriminated perfectly, then it should be possible to accurately predict the cluster membership of every respondent solely on the basis of his responses. The statistical technique known as multiple discriminant analysis produces a predicted group membership by applying a set of weights to the score of each respondent on each of the items. The weighted sum of item scores for each respondent is compared to a classification criterion to produce the statistically "predicted" cluster membership of each respondent. This statistically predicted membership can be compared to the actual membership to determine the adequacy with which the questionnaire items have classified the respondents into their appropriate clusters. The obtained percentage of correct classification can be compared to the upper limit (perfect classification) and the expected lower limit (the number of correct classifications that would be expected by chance alone). While the upper limit is, of course, always 100%, the expected level of chance prediction depends on the number of groups. In the present case it is 16.7%. If the questionnaire items classified respondents at or near this level of accuracy, one would conclude that the items did not discriminate among the respondents: a blind roll of a die would do as well.

Table 2 presents the classification results of a discriminant analysis on the social issues items and the six clusters of respondents.

NON-ENERGY RELATED SOCIAL ISSUES (PRO VS ANTINUCLEAR)



Note: Antinuclear = "1"; Pronuclear = "2"

FIGURE 4

TABLE 2. DISCRIMINANT ANALYSIS CLASSIFICATION RESULTS

		Predicted Cluster Membership						Number of Cases
		1	2	3	4	5	6	
Actual Cluster Membership	1	40.6	34.4	9.4	6.3	0	9.4	32
	2	14.8	59.0	8.2	9.8	0	8.2	61
	3	15.2	54.5	24.2	0	3.0	3.0	33
	4	7.5	32.5	2.5	32.5	2.5	22.5	40
	5	0	10.5	10.5	15.8	5.3	57.9	19
	6	0	14.6	6.3	14.6	0	64.6	48

Percent cases correctly classified: 43.8%

Percent expected by chance: 16.67%

To illustrate the use of the table, note that cluster 1 has 32 members and that the discriminant function constructed from the responses of the members of all six clusters classified 46.9% of the members of cluster 1 into cluster 1, 34.4% into cluster 2, 9.4% into cluster 3 and 6.2% into cluster 4. The percent of correct classifications ranged from 5.3% for cluster 5 to 64.6% for cluster 6. Correct classification of cluster membership increases with homogeneity of responses within clusters and heterogeneity of responses among clusters. Cluster 6, the most strongly pronuclear group, was the best classified cluster; members of this cluster were similar to each other, although not different from other clusters. Many members of clusters 4 and 5 showed similar patterns of response to the social issues items and, thus, were also predicted to be members of cluster 6. These data indicate that nuclear supporters (clusters 4, 5 and 6) and nuclear opponents (clusters 1, 2 and 3) are quite distinct. Finer discriminations within these two basic classifications are considerably less reliable.

Summary. Comparisons between the importance ratings of pro- and antinuclear respondents showed that both groups considered Energy Shortage to be an extremely important issue. Pronuclear respondents gave higher ratings to economic and crime related issues than did other respondents. Antinuclear respondents, on the other hand, rated environmental and social justice issues higher than did pronuclear respondents. This pattern of issue saliences is related the conventional liberal (environmental, social justice) vs. conservative (economic, crime) political classification (Lipset, 1960; McClosky, 1958).

ENERGY ISSUES

Energy issues are only a subset of the social issues confronting the United States today. Within this more restricted context, public attitudes toward nuclear technology can be compared with attitudes toward other electric power generation technologies. More specifically, our interest here is in identifying the differences among alternative electric power sources as seen by nuclear supporters and opponents.

Comparisons among technologies are often based on assessments of the impacts of those technologies, particularly on indicators of potential risks and benefits. Experts calculate potential risks and benefits of specific technologies based on measurements and estimations of certain clearly defined criteria (see, for example, Inhaber, 1979). Such calculated risks and benefits, while subject to certain types of errors (Fischhoff, 1977), have the great virtue of being open to inspection and criticism; the criteria and methods are known, subject to argument and to possible change (U.S.N.R.C., 1978). In contrast to the experts, individual citizens typically do not base their assessments of risks and benefits on similar open, public procedures. Instead, the risk-benefit assessments made by the public are based on private, personal processes; these assessments are termed <u>perceived</u> risks and benefits and are here distinguished from the calculations of the experts.

Because of their private, personal nature, the criteria and methods used by most citizens to generate perceived risks and benefits are much less well known and understood than those used by experts. Recently, however, Slovic and his colleagues have devoted a series of reports to the study of perceived risk (Slovic, et al., 1979). These investigators

demonstrated that the public bases perceptions of risk in part on dimensions ignored by the formal procedures of experts. Such factors include the catastrophic potential of a hazard, the imaginability and memorability of the hazard, and qualitative aspects such as dread and the likelihood of a mishap being fatal.

Perceived risks and benefits are used in the present study to compare nuclear with other electric power generation technologies. This approach allows responses to questions about nuclear power to be placed in an appropriate context.

Thirty-three energy-issues items were included in the survey. Respondents indicated their judgments on each item by marking a seven-point scale labeled from Strongly Agree (1) to Strongly Disagree (7). In order to improve the clarity of the figures that follow, the mean responses of the clusters on certain items are reverse scored. Responses of "1" have been recoded as "7," and vice versa, in order to produce an exact mirror image of the original pattern of responses. Reverse scoring has been applied to those items for which agreement denotes pronuclear attitudes so that the most antinuclear clusters are always plotted on the left side of the figure and the most pronuclear clusters on the right. For reverse-scored items, the seven-point scales in the following figures should be interpreted as ranging from Strongly Disagree (1) to Strongly Agree (7). The results are presented in five main sections: 1) the production potential of electric power generation technologies; 2) energy conservation; 3) the risks of these technologies; 4) comparisons of risks among technologies; and 5) comparisons between risks and benefits for a given technology.

Energy Production

The perceived energy production potential of several technologies were explored by a series of items (see Figure 5). Each item required a judgment of the appropriate role of a particular technology in the production of the country's electric power. The technologies included nuclear, coal, oil, hydroelectric, solar and a combination of wind and solar. The first item in this group suggested that, as a consequence of continuing the energy situation as it is today ". . . the United States can anticipate serious power shortages in the next ten years." The most extreme pronuclear cluster strongly agreed, while all of the remaining clusters agreed. There was strong unanimity among the respondents, then, that the present energy situation, if unchanged, would produce serious negative effects in the future.

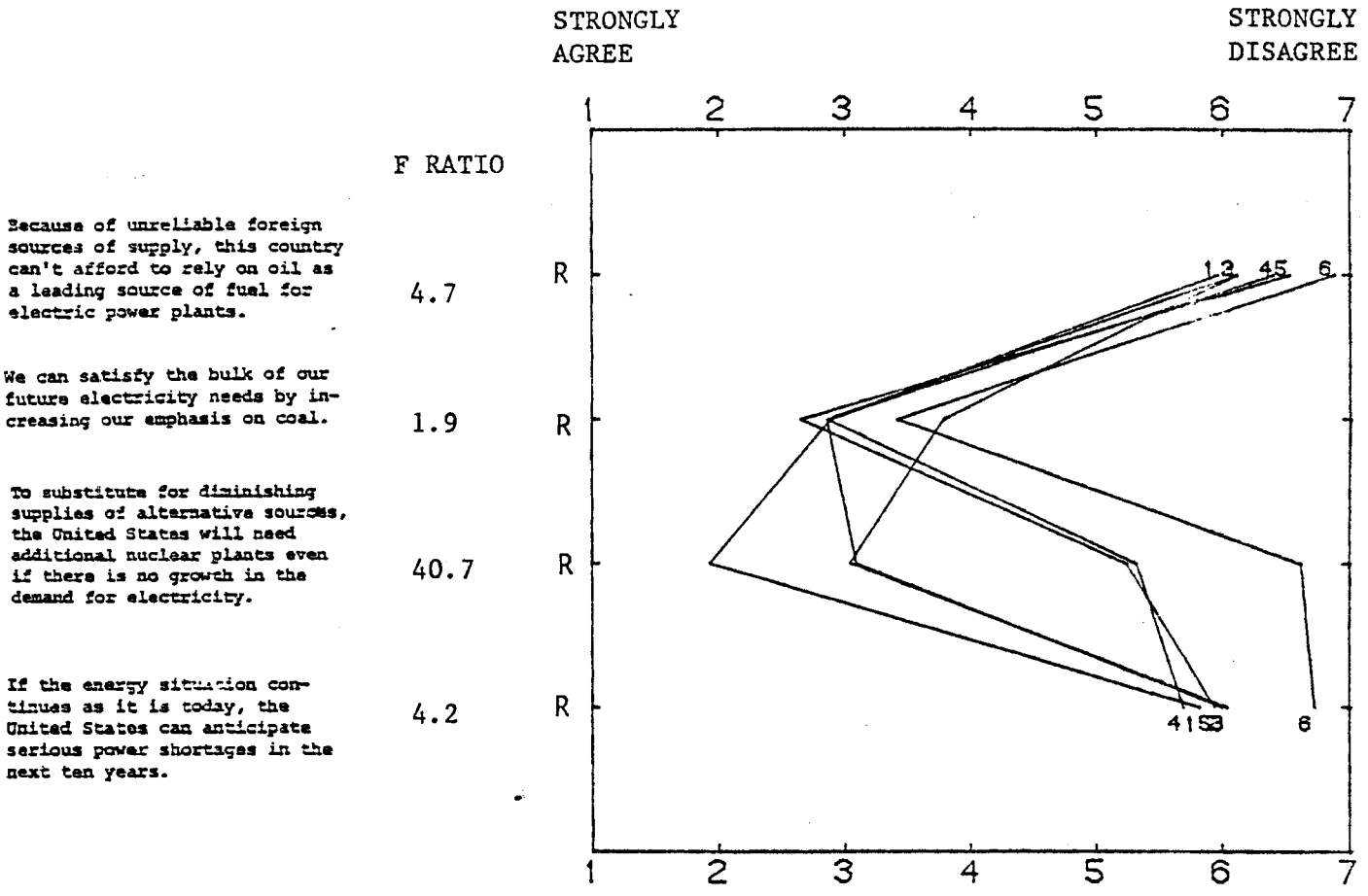
The role of nuclear technology was assessed by an item that suggested that additional nuclear plants will be needed "to substitute for diminishing supplies of alternative sources . . . even if there is no growth in the demand for electricity." This item, as expected, separated the respondent clusters more strongly than those referring to other technologies. The three strongest pronuclear clusters (4, 5 and 6) either agreed or strongly agreed; the most extreme antinuclear cluster (1) strongly disagreed, while the remaining clusters (2 and 3) were neutral. Supporters of nuclear power thus indicated that nuclear technology is a needed supplement to meet future energy needs. Extreme antinuclear respondents disagreed.

While the perceived need for nuclear power produced the greatest disagreement among respondent clusters, responses to coal showed a notable level of agreement among the respondents. In response to the statement that an increased emphasis on coal "can satisfy the bulk of our future energy needs," all clusters either disagreed or were neutral. The differences among the clusters were not statistically significant.

The unanimity of opinion regarding oil was almost as strong as that regarding coal. All clusters strongly agreed that, "because of unreliable foreign sources of supply, this country cannot afford to rely on oil . . . ." The three most pronuclear clusters were only slightly stronger in their agreement with this statement than were the three most antinuclear clusters.

The item dealing with hydroelectric power stated that increasing our hydroelectric capacity is "the most effective way to increase the supply of electric power . . . " (see Figure 6). Respondents' judgments on this item did not form a pattern with the simple interpretation. The two most pronuclear clusters along with neutral cluster 3 disagreed; the remaining clusters were neutral. Level of disagreement with this item may be positively related to level of familiarity with hydroelectric power. The cluster with the highest level of disagreement, cluster 6, included utility employees and nuclear technologists, persons likely to be aware of the limited potential for expansion of hydroelectric power. Cluster 4, on the other hand, the cluster with the lowest level of disagreement, consisted of recreational and public safety workers, persons whose occupations would not seem to lead to knowledge of hydroelectric power.

ENERGY PRODUCTION



NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

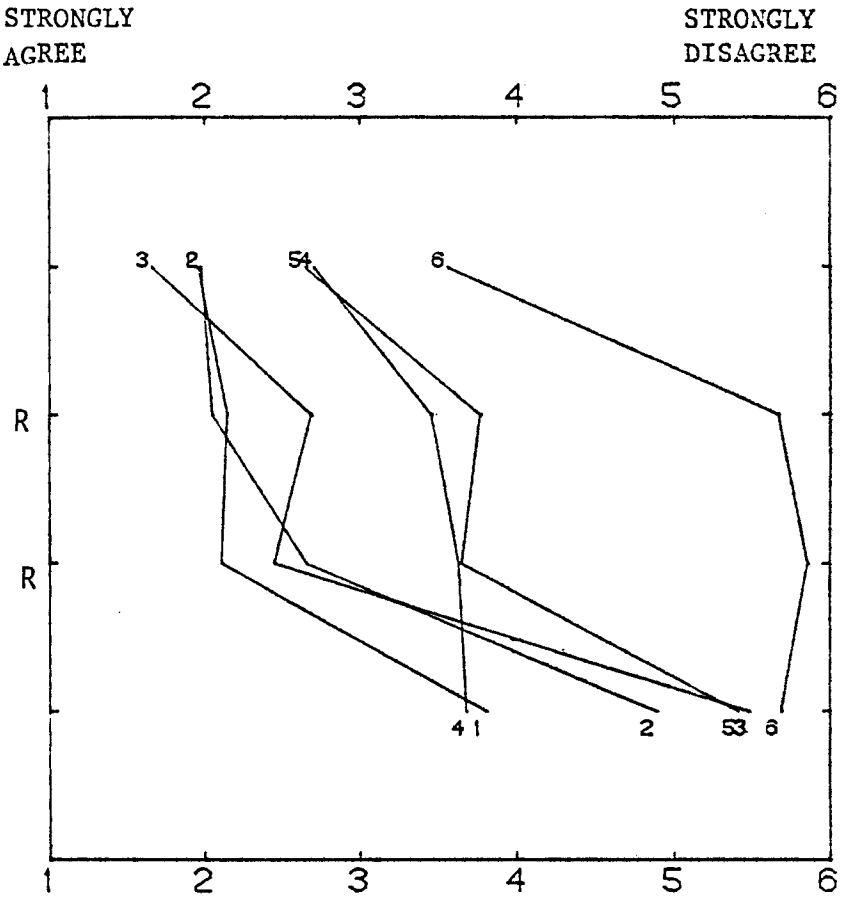
FIGURE 5

Solar power produced a clear pattern of disagreement between pro- and antinuclear clusters. The three most antinuclear clusters disagreed with an item that stated that solar power "cannot make a significant contribution to the supply of electric power in the United States in the next twenty years." The most extreme pronuclear cluster agreed with the item, while the remaining clusters were neutral. Beliefs in the twenty year contribution of solar power were thus negatively related to support for nuclear power.

Solar power was included in a second item which combined it with wind power. The item suggested that, because of the erratic availability of wind and sun, "we can't count on these sources as significant contributors to our energy needs." The addition of wind to sun and the elimination of any mention of a specific time period increased the disagreement somewhat. The three most antinuclear clusters disagreed with the item, the most strongly pronuclear cluster agreed and the remaining clusters were neutral. Support for nuclear power was thus negatively related to beliefs in the significance of the perceived role of both solar and wind power.

Another item involved the development of "new technologies (solar, fusion, geothermal)"; respondents indicated their willingness "to pay more for electricity to support the costs (of such development)." The variety of alternate "new technologies" listed in the item probably contributed to the relatively small differences among clusters. Only the most extreme pronuclear cluster was neutral; the remaining clusters either agreed to pay for development (clusters 1, 2, 4 and 5) or strongly agreed (cluster 3). The benefits of technological development, in

ENERGY PRODUCTION



	F RATIO
I would be willing to pay more for electricity to support the cost of developing new technologies (solar, fusion, geothermal).	9.7
The availability of wind and sun is so erratic that we can't count on these sources as significant contributors to our energy needs.	23.7
It is not possible for solar power to make a significant contribution to the supply of electric power in the United States in the next twenty years.	23.2
The most effective way to increase the supply of electric power is to increase our hydroelectric capacity.	10.2

NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

FIGURE 6

general, seem be be clear to most of the respondents; the benefits of any specific technology would, no doubt, have produced more disagreement.

It is significant that there was little disagreement among the clusters as to the the overall consequences of the energy situation as it exists today. All clusters agreed that serious shortages would result.

The results of the items designed to directly assess respondents' beliefs about the roles of alternative electric power generation technologies can be summarized by noting that support for nuclear power was: 1) positively related to belief in the need for nuclear power; 2) unrelated to beliefs in the benefits of coal, oil and hydroelectric power; and 3) negatively related to beliefs in the benefits of wind and solar power. The results thus indicate that pronuclear respondents tended to believe that nuclear power is a necessary substitute for--not just an addition to--other sources, and that the near-term contributions of the newer alternate technologies are likely to be relatively small. In contrast, antinuclear respondents tended to believe that the newer alternate technologies ought to have a prominent role and that nuclear power is unnecessary, even as a replacement for coal and oil.

In sum, all respondents tended to agree on the limitations of conventional sources of power--the sources that supply the bulk of our electricity today (coal, oil and hydroelectric). The disagreement centered instead on the production potentials offered by the alternate technologies that will be required to supplement conventional sources. Those that suppported nuclear power offered little support to other technologies; respondents who expected high energy production benefits from solar and wind (the antinuclear respondents) did not see them in nuclear.

Energy Conservation

Four items (see Figure 7) addressed issues related to conservation. The first proposed that "serious adverse effects on the American economy" would result from "a strong, effective national energy-conservation program." The respondents were widely separated on this item. The three most antinuclear clusters either disagreed (clusters 2 and 3) or disagreed strongly (cluster 1) with the item. Only the most extreme pronuclear cluster agreed, and the remaining clusters were neutral. Nuclear opponents clearly expect less serious adverse consequences to result from energy conservation programs than do pronuclear respondents.

The second conservation item referred to individual rather than collective consequences; that is, reference is specifically to personal consequences. "A heavy emphasis on energy conservation," the item suggested, "would produce a lot of undesirable changes in the way I live." The response to this item can be compared with the results on the item which dealt with negative social effects of energy conservation. This permits assessment of response differences when the benefit reductions are described as affecting the "American economy" rather than the respondent himself. In this case, there is no difference. The results for the "individual effects" item were almost identical to those for the "social effects" item: The three most antinuclear clusters disagreed; the most extreme pronuclear cluster agreed, and the remaining clusters were neutral. Again, energy-conservation programs represented smaller impacts for the antinuclear than the pronuclear respondents.

Another conservation item suggested that, given a twenty percent decrease in available electric power, "Most people could adjust very easily . . . ." The two most antinuclear clusters (1 and 2) indicated their support for conservation by agreeing with the statement. The most extreme pronuclear cluster showed strong disagreement. Cluster 4 agreed, while the two remaining clusters were neutral. Beliefs in the benefits of a significant conservation program were therefore negatively related to support for nuclear power.

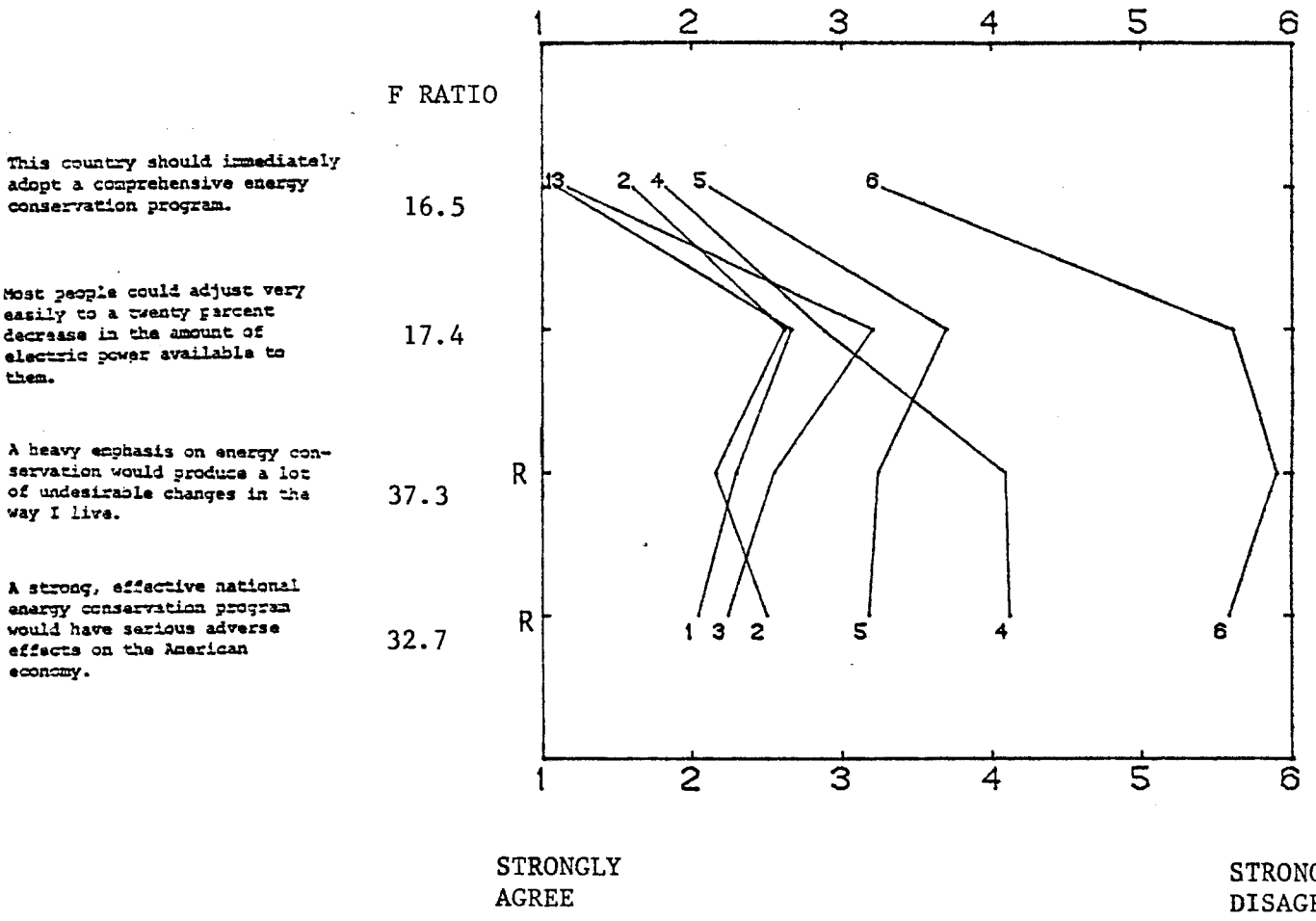
The last of the items dealing with conservation as an energy alternative proposed that "This country should immediately adopt a comprehensive energy conservation program." The four most antinuclear clusters strongly agreed, cluster 5 agreed and cluster 6, the most extreme pronuclear cluster, was neutral. Although there was some support for conservation across all clusters, antinuclear respondents indicated stronger support for conservation than did pronuclear respondents.

Risks

In order to sample a wide range of beliefs and attitudes, perceived risk was broadly defined to include several aspects of the possibility of negative impacts associated wih electric power generation technologies. Respondents were asked to indicate their views on: 1) the riskiness of individual technologies; 2) societal obligations related to the imposition of risks on future generations; 3) the necessity of waste control; and 4) the ability and willingness of industry to control pollution.

Individual Technologies. The individual technologies studied were nuclear, coal, hydroelectric and coal and oil combined; a non-specific

ENERGY CONSERVATION



NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

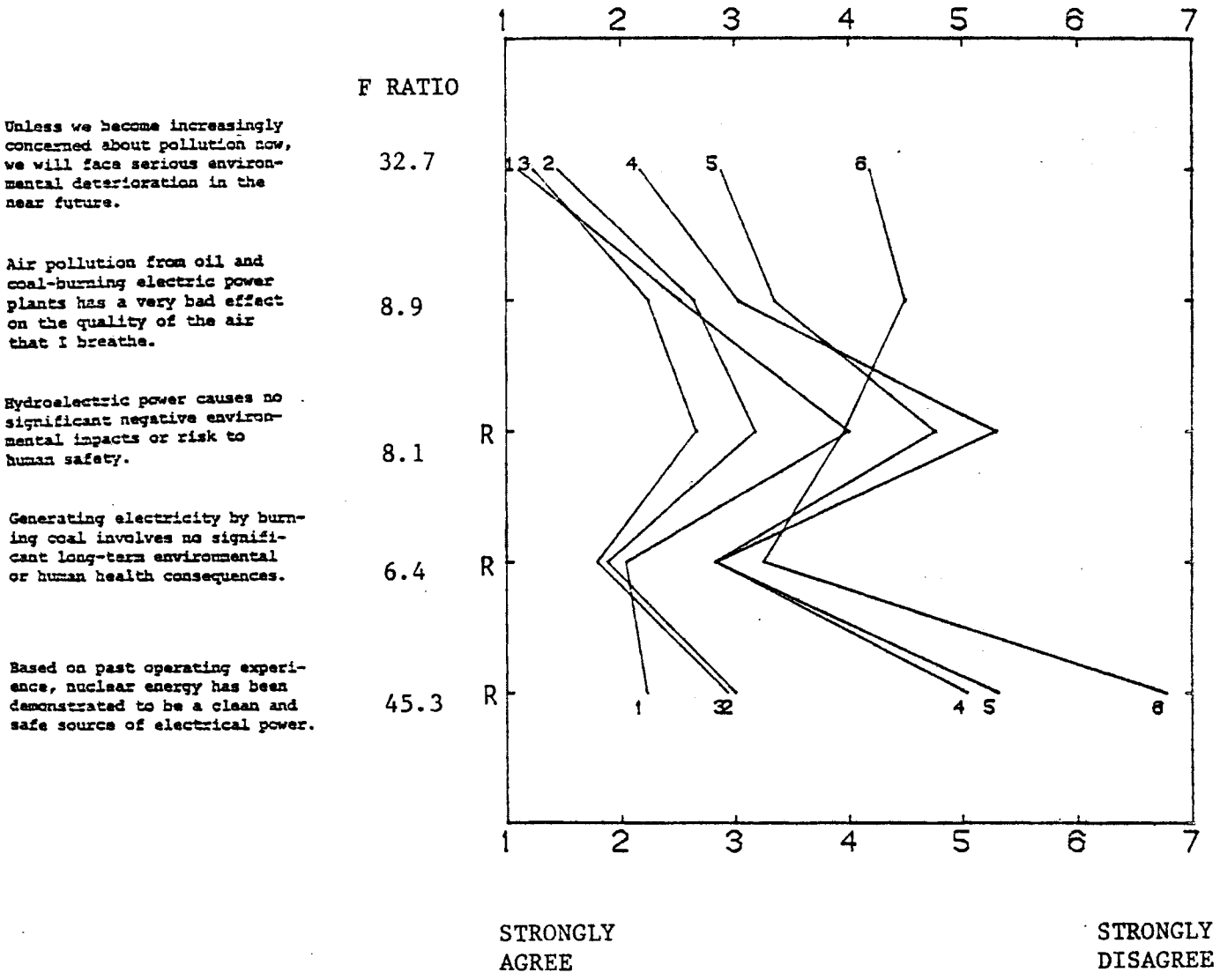
FIGURE 7

category was also included (see Figure 8). The item dealing with nuclear energy suggested that it "has been demonstrated to be a clean and safe source of electric power." As would be expected, this item strongly separated the pro- from the antinuclear respondents. The three most pronuclear clusters either agreed or strongly agreed that nuclear power is clean and safe, while the three most antinuclear clusters either disagreed or strongly disagreed. There was no middle ground on this item; no cluster had a mean response in the neutral area between 3.0 and 5.0.

In contrast to the disagreement over nuclear power, there was a fairly strong consensus on coal. Only the most extreme pronuclear cluster was neutral on an item that stated that coal "involves no significant long-term environmental or human health consequences." The remaining five clusters of respondents disagreed or strongly disagreed. Within the consensus, however, the three most antinuclear clusters believed that there were greater risks in coal than did the three most pronuclear clusters.

The item relating to hydroelectric power proposed that it "causes no significant negative environmental impacts or risk to human safety." As with the hydroelectric production item, no easily interpretable pattern of responses was produced. All but two of the clusters were neutral, but cluster 3 disagreed and cluster 4 agreed. Since clusters 3 and 4 were chosen to be relatively neutral on nuclear power, it is clear that the views of the total group of respondents toward nuclear and hydroelectric power are unrelated.

RISKINESS OF INDIVIDUAL TECHNOLOGIES



NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

FIGURE 8

Respondents' views on the risks involved in the predominant fossil fuel technologies were assessed by an item that suggested that pollution from coal and oil "has a very bad effect on the quality of the air that I breathe." The three most pronuclear clusters were neutral on this item, while the three most antinuclear clusters agreed. Thus those persons most concerned about hazards of nuclear technology were also the ones who most felt themselves to be personally affected by the adverse consequences of conventional power sources; nuclear supporters did not believe that this was a cause for great concern.

The final item relating to the risks of individual technologies was not tied to any specific technology. The item proposed that unless we become more concerned about pollution now, "we will face serious environmental deterioration in the near future." Only cluster 6, consisting of strongest nuclear supporters, was neutral on this item; the three most antinuclear clusters strongly agreed, while clusters 4 and 5 agreed. Except for the most strongly pronuclear respondents, then, pollution resulting from power generation was considered to be reason for some (or in some cases, much) concern.

With the exception of hydroelectric power generation, the items dealing with individual technologies reveal a consistent relationship between respondents' attitudes toward the risks associated with those technologies and their positions on nuclear power. The three most antinuclear clusters were consistently more concerned about risks than were the three most pronuclear clusters. The most strongly pronuclear group, cluster 6, was generally neutral or rejected the notion that risks from these technologies should be a matter of serious concern. Support

for nuclear technology was, not surprisingly, most strongly related to views on the risk of that technology; relationships between positions on nuclear power and views on the risks of coal, oil and coal combined and about pollution in general, while less strong, were significant.

Obligations to Future Generations. Three very similar items with only minor variations in wording suggested that our generation must accept responsibility for the effects of our wastes on future generations (see Figure 9). One item referred to nuclear wastes, the second to coal and the third to environmental pollutants in general. There was fairly strong consensus among the respondent clusters on our responsibility for nuclear wastes. The three clusters of nuclear opponents strongly agreed, clusters 4 and 5 agreed and only the most strongly pronuclear group, cluster 6, was neutral. The significance of this item to the antinuclear respondents is indicated by noting that it was the only item on which every member of cluster 1 produced the same extreme response (1-Strongly Agree).

Responsibility for wastes from coal-burning power plants produced a consensus similar to that for nuclear wastes. The most extreme pronuclear cluster was neutral, while the remaining clusters either agreed or strongly agreed.

The final waste-responsibility item referred simply to "environmental pollutants," Of the three parallel items, this one produced the most agreement among clusters. All six clusters either agreed or strongly agreed that "the present generation must assume responsibility for the environmental pollutants which is produces."

The general trend running through the responses to the items dealing with the responsibility of the present generation for its wastes is one of agreement that the responsibility should be accepted. Antinuclear respondents, however, indicated a consistently greater willingness for the present generation to accept responsibility for wastes than did pronuclear respondents. Significantly, the difference between anti- and pronuclear clusters in support of this acceptance decreased from the nuclear specific item to the coal specific item to the general item. The decrease in difference was due to movement by pronuclear respondents. Antinuclear respondents' endorsement of the present generation's responsibility was consistently strong. The pronuclear respondents, however, more strongly endorsed acceptance of responsibility for wastes in general than for coal wastes and endorsed acceptance of responsibility for nuclear wastes least of all. This result may be related to a belief on the part of nuclear supporters that the wastes from the nuclear industry--and the coal industry to a lesser extent--will have been treated with sufficient care that they will be much less of a threat than other chemical wastes. In such a case, obligations to future generations would have been more completely discharged in the case of nuclear or coal technology; the residual obligations would be correspondingly less. Lacking any further data on this point, this hypothesis must be considered purely speculative.

Necessity of Waste Control. Two similar items, one referring to the nuclear technology and one to coal, stated that use of those fuels should be curtailed until their waste products can be effectively controlled (see Figure 10). The nuclear power item specifically suggested that no more nuclear power plants should be built "until a highly effective waste

OBLIGATIONS TO FUTURE GENERATIONS

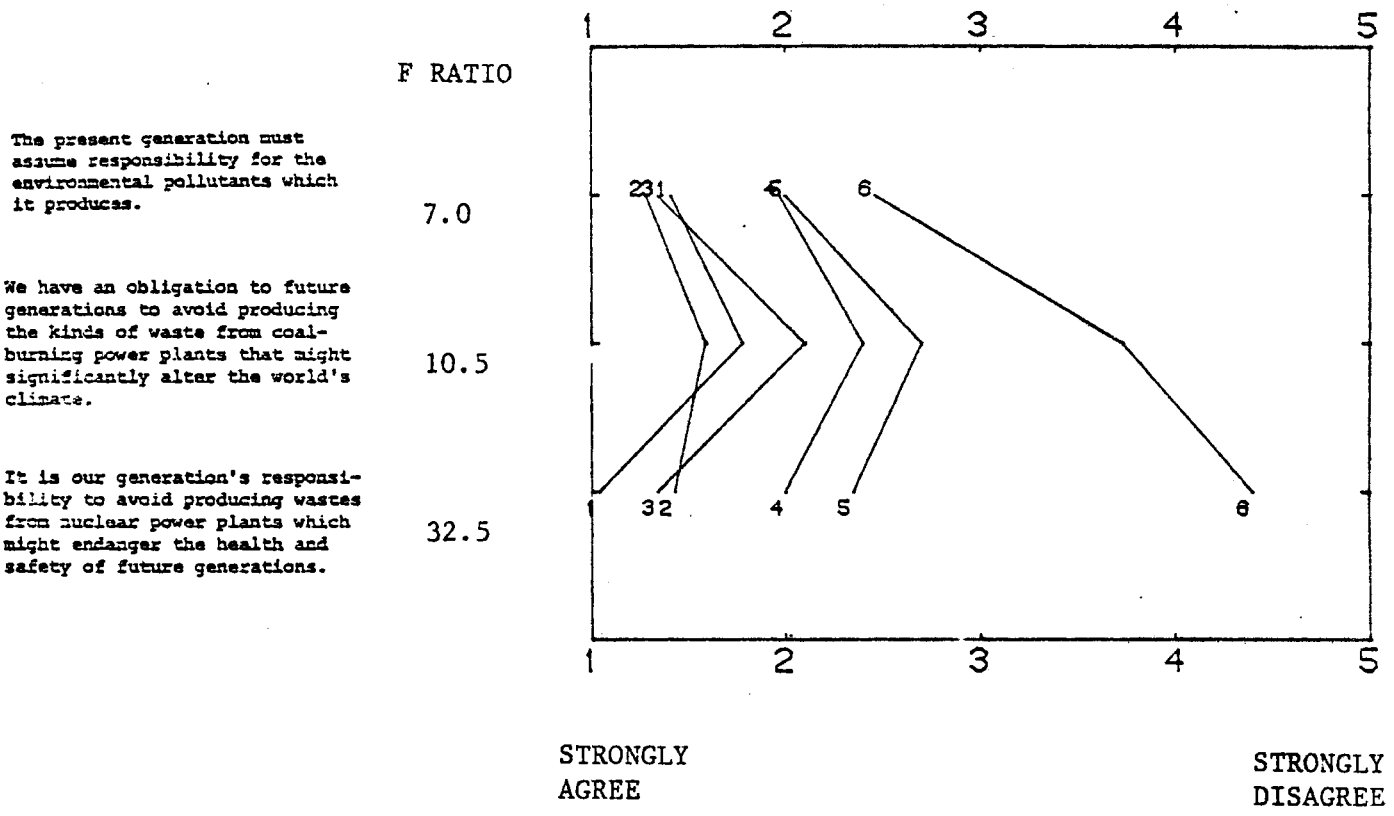


FIGURE 9

disposal system has been developed and thoroughly evaluated." This item, more than any other, strongly separated the pro- from the antinuclear respondents. While the most extreme pronuclear cluster strongly disagreed, the three most antinuclear clusters strongly agreed. Pronuclear cluster 5 disagreed, and cluster 4 was neutral.

The item dealing with coal proposed that our reliance on coal for electricity should not be increased "until highly effective pollution control devices can be developed and installed." Once again, members of the most strongly pronuclear cluster were isolated by their responses, though to a lesser degree than with the previous item. Only the most pronuclear cluster disagreed; the three most antinuclear clusters agreed, while the remaining clusters were neutral.

Another item dealing with risk-management issues suggested that "the electric power industry is able but unwilling to adopt the kinds of controls which can effectively curb pollution" (see Figure 11). The three most antinuclear clusters agreed that the electric power industry is not doing all that it can to protect us from its wastes; the most strongly pronuclear cluster disagreed, and the remaining two clusters were neutral. The antinuclear respondents indicated, then, that their concerns about pollution are not shared by the electric power industry.

An item concerned with "strict environmental pollution-control programs" stated that such programs, "will result in a lot of people losing their jobs." This item produced a clear division between pro- and antinuclear respondents. The three clusters of nuclear opponents

NECESSITY OF WASTE CONTROL

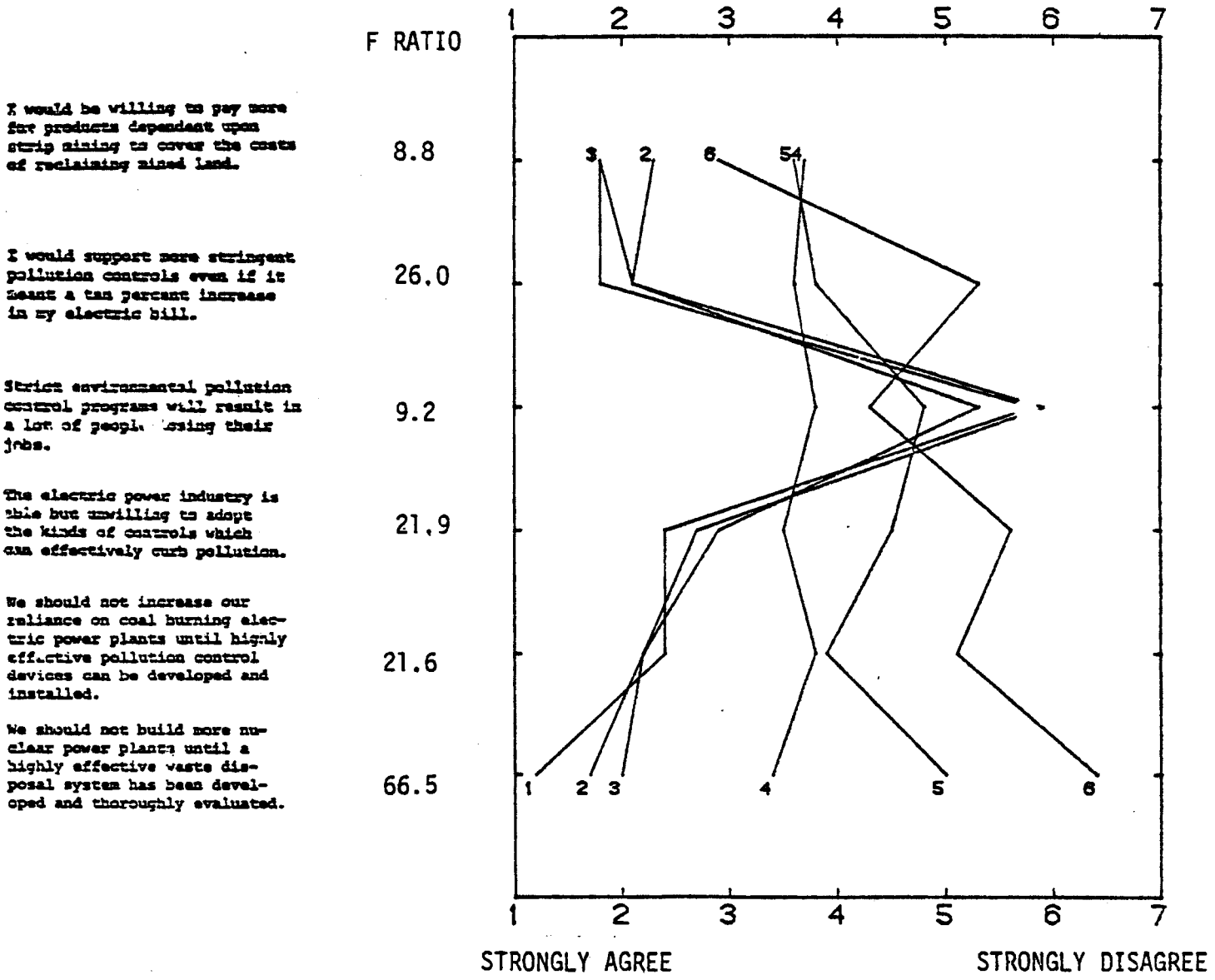


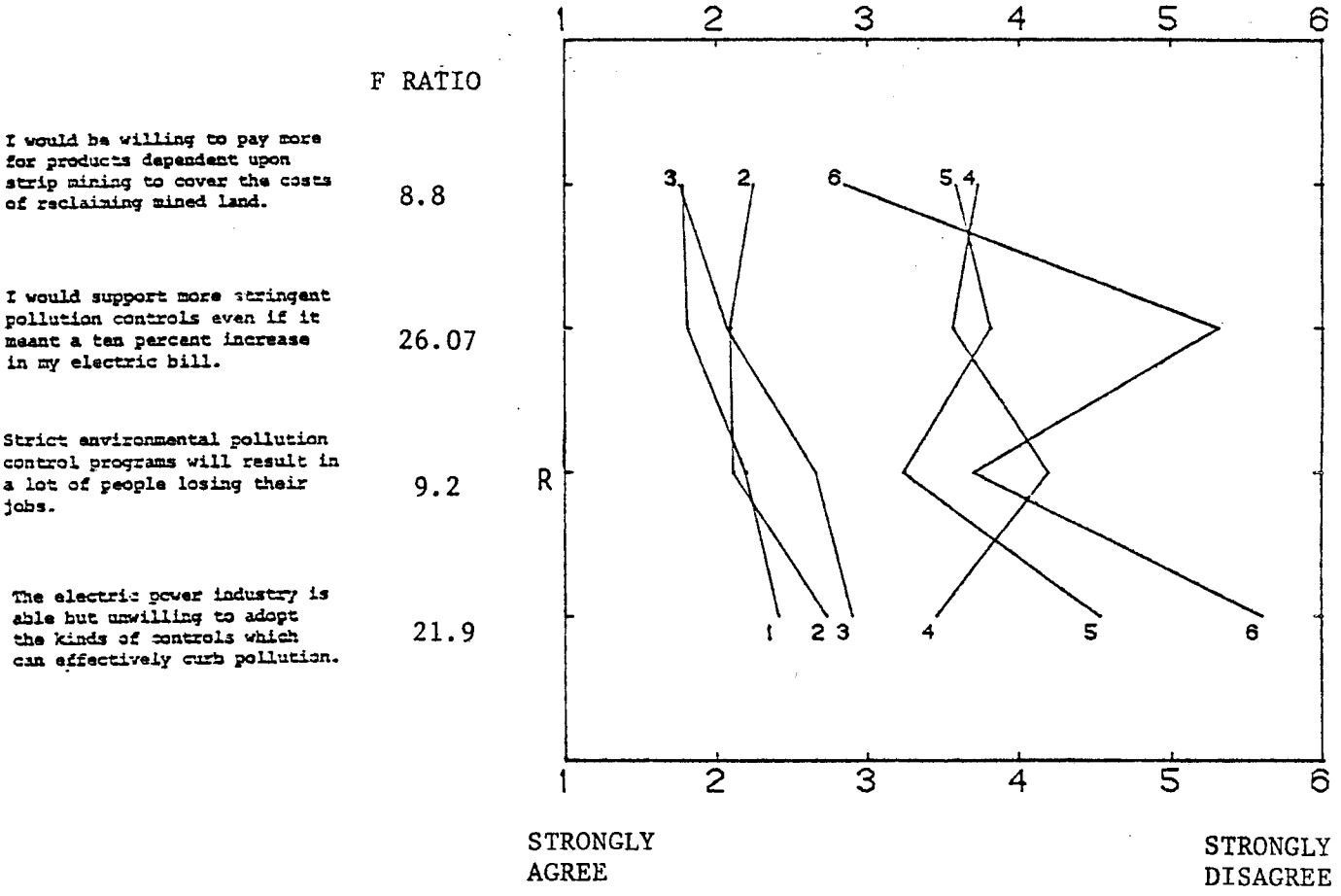
FIGURE 10

disagreed, while the three most pronuclear clusters were neutral. This result can be compared with those produced by the two items in this section that called for the strict control of nuclear wastes and coal pollution: antinuclear respondents indicated there that, until their wastes can be controlled, the use of both nuclear fuel and coal should be limited. Wastes and pollution thus represented greater risks for nuclear opponents than for nuclear supporters. The reverse is true for pollution control. Nuclear opponents do not believe that pollution control programs pose a threat of adverse economic side effects; nuclear supporters do believe that this will happen.

Two items referred to willingness of respondents to pay for pollution control programs. The first item questioned whether the respondent would support more stringent pollution controls "even if it meant a ten percent increase in (his) electric bill?" The three most antinuclear clusters either strongly agreed (cluster 1) or agreed (clusters 2 and 3); the most extreme pronuclear cluster disagreed, while the other two clusters were neutral. For antinuclear respondents, the benefits of increased pollution controls were worth an additional cost, for pronuclear respondents they were not.

The costs of reclaiming strip-mined land were the concern of the second item: Would respondents "be willing to pay more for products dependent on strip mining to cover (such costs)?" The results on this item are complicated somewhat by the response of the most pronuclear respondents in cluster 6 who agreed with the item. The three most antinuclear clusters also agreed (cluster 2) or strongly agreed (clusters 1 and 3). The two remaining clusters, however, were neutral.

NECESSITY OF WASTE CONTROL



NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

FIGURE 11

There is thus a bit of inconsistency in the relationship between degree of antinuclear views and degree of willingness to pay for the reclamation of strip-mined land. On the average, however, the three most antinuclear clusters were more willing to pay for reclamation than were the three most pronuclear clusters.

Summary. The attitudes of respondents toward the risks associated with electric power generation technologies can best be summarized in an outline of the most strongly pro- and antinuclear views; the responses of neutral clusters fell between the two extremes on all items. As was expected, the antinuclear respondents expressed most concern about nuclear power. However, they perceived significant risks associated with two fossil fuel technologies--coal and oil--as well. Pronuclear respondents expressed less concern about risks of electric power production technologies than did antinuclear respondents. The difference in level of perceived risk was greatest with regard to nuclear power. Antinuclear respondents strongly endorsed acceptance of responsibility for the effects of our wastes on future generations, regardless of technology; pronuclear respondents less strongly endorsed acceptance of responsibility for wastes in general and were neutral on the issue of nuclear wastes. Antinuclear respondents indicated that the use of fuels (especially nuclear but also coal) should be limited until their wastes can be controlled; pronuclear respondents opposed limitations, particularly on nuclear power. Finally, antinuclear respondents indicated that they felt that industry was not doing all it could to curb pollution.

Risk Comparisons

In the previous section respondents' views on the risks associated with several electric power generation technologies were explored, and comparisons were made among the responses made by nuclear supporters and opponents to risks seen in particular technologies. In the present section, results are presented for items in which explicit comparisons between technologies were made by the respondents themselves (see Figure 12). Specifically, respondents' views on the risks of different stages of the coal and nuclear fuel cycles were compared. In addition, the risks of nuclear technology were compared also with "other modern hazards."

Three items were used to compare the perceived risks of the use of coal (or coal and oil) in electric power generation with those of uranium. The first item compared coal mining with uranium mining. "The adverse environmental effects of coal mining are much less serious," the item proposed, "than those associated with the mining of uranium." This item generated relatively little variance among clusters; only the two most pronuclear clusters disagreed, while the four remaining clusters were neutral. In addition to general pro- and antinuclear attitudes, the large proportion of neutral responses may have been due to lack of familiarity with the effects of coal or uranium mining. Whatever the bases of respondents' beliefs, those who opposed nuclear power indicated uncertainty about the relative risks involved in mining coal and uranium while those who supported nuclear power rejected the assertion that the negative effects of coal mining are much less serious than those of uranium.

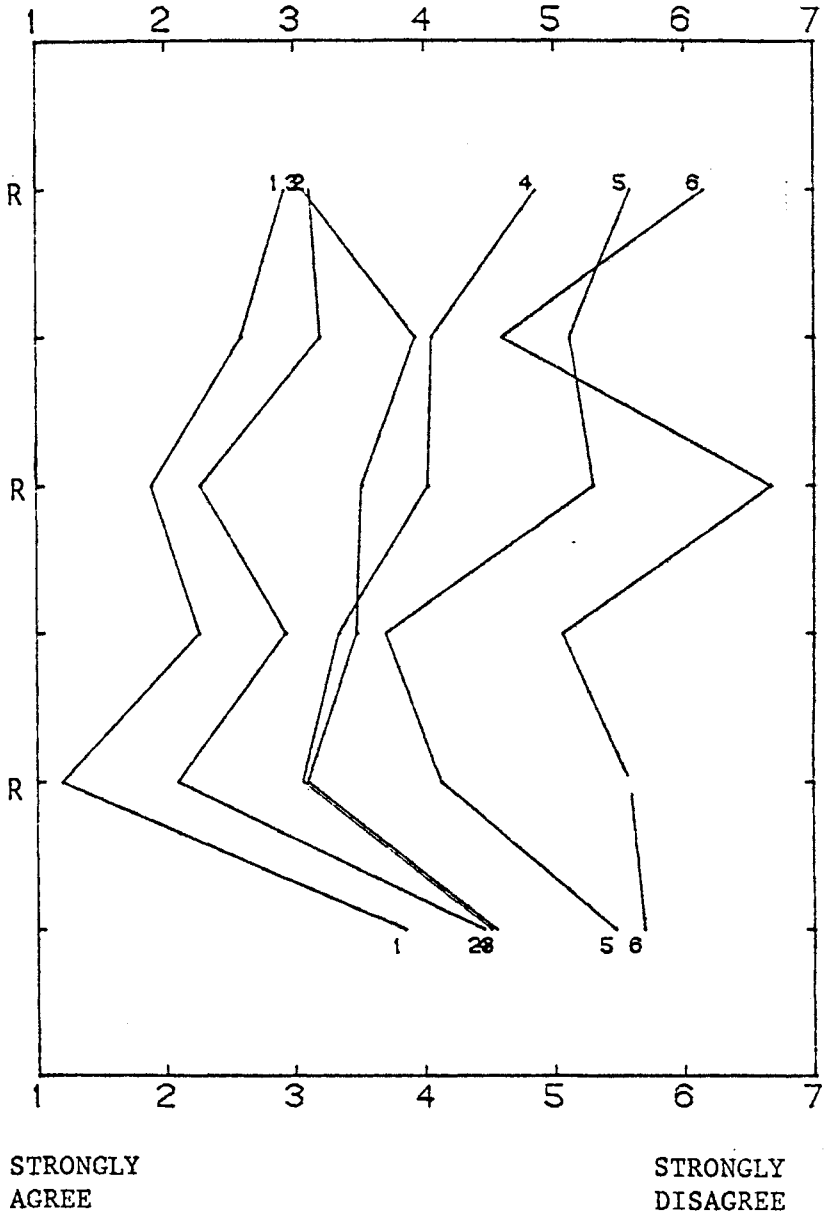
The second item compared nuclear wastes with coal pollutants: "The hazards associated with wastes from nuclear power plants are no greater," the item suggested, "than the hazards from pollutants from coal-burning power plants." There was a high degree of disagreement among clusters on this item. The most extreme pronuclear cluster (cluster 6) agreed, while the two most antinuclear clusters either disagreed (cluster 2) or disagreed strongly (cluster 1); the remaining clusters were neutral. Proponents of nuclear power tended to believe that nuclear wastes are no more hazardous than coal pollutants. Opponents of nuclear power indicated that, for them, nuclear wastes present greater hazards than coal pollutants.

The third and final item compared the technology needed to control coal and oil pollutants with that needed to control nuclear wastes. The item stated that the pollution control technology for coal and oil-burning power plants "is much cheaper and more effective" than the waste control technology for nuclear power plants. The two most antinuclear clusters agreed with the item, the most extreme pronuclear cluster disagreed and the remaining clusters were neutral. In general, the stronger the antinuclear views of a cluster, the stronger was their endorsement of the relative cost effectiveness of pollution control technology for coal and oil compared with waste control technology for nuclear power.

Across all three items, from fuel extraction to waste control, the pronuclear respondents consistently indicated that the risks associated with nuclear technology can be equated with those accompanying the use of coal (or coal and oil) in the generation of electricity. The risks of

RISK COMPARISONS

	F RATIO
The environmental and health hazards associated with coal plants are small compared to the consequences of doing without the electric power that they generate.	38.1
The benefits of the electric power from nuclear plants are much less than the environmental and health hazards associated with the waste materials that they produce.	4.8
Wastes from nuclear power plants are no more of a risk to me than a lot of other modern hazards.	48.4
The technology needed to control pollutants from coal and oil-burning power plants is much cheaper and more effective than the technology needed to control nuclear waste.	12.4
The hazards associated with wastes from nuclear power plants are no greater than the hazards from pollutants from coal-burning power plants.	30.8
The adverse environmental effects of coal mining are much less serious than those associated with the mining of uranium.	7.7



NOTE: REVERSE SCORED ITEMS DENOTED BY "R"

FIGURE 12

nuclear power, its advocates seemed to suggest, are no different in kind or magnitude from the risks of conventional power. While the antinuclear respondents were uncertain about the relative effects of coal mining versus uranium mining, they believe that the risks associated with wastes and the cost of waste control are much greater for nuclear power than for coal (or coal and oil). The risks of nuclear power, its detractors indicated, are different from and more serious than the risks of conventional power.

An attempt was made to compare the perceived risks of nuclear power with hazards other than coal. An item, which stated that "Wastes from nuclear power plants are no more of a risk to me than a lot of other modern hazards,", produced great diversity among clusters, with judgments distributed across the entire response scale. The most antinuclear cluster (cluster 1) strongly disagreed, the second most antinuclear cluster (cluster 2) disagreed, the two neutral clusters (clusters 3 and 4) were neutral, the second most pronuclear cluster (cluster 5) agreed, and the most pronuclear cluster (cluster 6) strongly agreed. This item is of particular interest not only because it separated the respondent clusters so well, but also because it placed nuclear wastes within a general context of personal risks. Within that context, each respondent was free to judge the riskiness of nuclear wastes relative to his or her own personal standards of risk. The results on this item show that the relationship between support for nuclear power and level of perceived personal risk from nuclear wastes was strong and negative. The greater a respondent's support for nuclear power, the lower his level of perceived personal risk from nuclear wastes tended to be.

The two types of risk-comparison items included in this section produced complementary results. The first type of item referred to general societal risks and the second type of item referred to personal risks. Despite the differences in context, the two types of items produced highly similar results: Nuclear risks were equated with conventional risks by pronuclear supporters; nuclear risks were considered to be greater than conventional risks by nuclear opponents.

Risk-Benefit Comparisons

After exploring the risks and benefits of several electric power generating technologies and comparisons of risks between technologies, in this final section we turn to comparisons between risks and benefits within technologies. Two technologies were studied, nuclear power and coal.

The risk-benefit comparison item dealing with nuclear power stated that "The benefits of the electric power from nuclear plants are much less than the environmental and health hazards associated with the waste materials that they produce." The results on this item are complicated somewhat by the fact that the most pronuclear cluster (cluster 6) indicated neutrality, while the second most pronuclear cluster (cluster 5) disagreed. The most antinuclear cluster agreed with the item, while the remaining clusters were neutral. As a group, the three most pronuclear clusters (clusters 4, 5 and 6) did indicate greater disagreement, on the average, than the three most antinuclear clusters (clusters 1, 2 and 3). Although the difference between pro- and antinuclear respondents on this item was not strong, there was a clear tendency for pronuclear respondents to see the nuclear balance as tilted

toward benefits, while the antinuclear respondents see the balance sloping toward risks.

The differences between nuclear opponents and nuclear supporters is sufficiently small that it suggests that the question may have been interpreted incorrectly by some of the respondents. More detailed examination of the responses to this item revealed that nearly as many members of cluster 6 strongly agreed (15) as strongly disagreed (22). Conversely, many of the members of cluster 1 strongly disagreed (7) rather than strongly agreed (16). Less than ten percent of either of the two most extreme clusters gave neutral responses. Such bimodal distributions make interpretation of the cluster means quite difficult and further discussion of the item potentially misleading.

As a comparison for the nuclear power item above, respondents were required to judge the relative risks and benefits of using coal to generate electricity. The item stated that "The environmental and health hazards associated with coal plants are small compared to the consequences of doing without the electric power they generate." In contrast to the nuclear power item, the present item separated the respondent clusters widely. The two most pronuclear clusters either strongly agreed (cluster 6) or agreed (cluster 5), the most antinuclear cluster (cluster 1) disagreed and the remaining clusters were neutral. Across all the clusters, degree of agreement with the item had a strong positive relationship with degree of support for nuclear power. In addition, the separation on the response scale between the three most pronuclear clusters and the three most antinuclear clusters was strong and clear: For pronuclear respondents the benefits of coal outweighed

the hazards, while for antinuclear respondents the hazards of coal outweighed the benefits.

Predicted Group Membership

The preceding results have shown that many of the individual questionnaire items discriminate among the clusters of respondents. As was the case with the Social Issues items, it is important to show how well these items, as a group, adequately describe the attitudinal differences among the respondents. Prediction of the cluster membership of each respondent was accomplished by means of a multiple discriminant analysis based upon the scores of each of the respondents on each of the items.

Table 3 presents the classification results of a discriminant analysis on the energy issues items and the six clusters of respondnets. The percent of correct classifications ranged from 46.9% for cluster 1 to 95.8% for cluster 6. Correct classification of cluster membership increases with homogeneity of responses within clusters and heterogeneity of responses among clusters. Cluster 6, the most strongly pronuclear group, was the best classified cluster; this cluster was internally homogeneous and different from the others. Note, however, that cluster 1, the most extreme antinuclear group, had the lowest percent of correct classifications. Simple extremity of views on nuclear power was not sufficient for high levels of discrimination on the basis of energy issues items. Cluster 6 was extreme and different from its neighboring clusters, while cluster 1 was extreme but not greatly different from its immediate neighbor. There seems to be no general relation between clusters (i.e., views on nuclear power) and percent of correct

TABLE 3. DISCRIMINANT ANALYSIS CLASSIFICATION RESULTS

Actual Cluster Membership	Predicted Cluster Membership						Number of Cases
	1	2	3	4	5	6	
1	46.9	40.6	9.4	3.1	0	0	32
2	13.1	65.6	8.2	8.2	3.3	1.6	61
3	9.1	18.2	57.6	6.1	6.1	3.0	33
4	0	12.5	5.0	65.0	10.0	7.5	40
5	0	5.3	0	10.5	68.4	15.8	19
6	0	0	0	4.2	0	95.8	48

Percent of cases correctly classified: 68.2%

Percent expected by chance: 16.67%

classifications. This indicates that the energy issues attitudes of all respondents, antinuclear, neutral and pronuclear, tended to be equally distinctive.

Across all clusters, the discriminant analysis correctly classified 68.2% of all respondents; an additional 19.3% of the respondents were classified into clusters one removed from their own; and 9.9% were classified into clusters two removed from their own. Only 2.6% of the respondents were classified into clusters three or more removed from their own. Of twelve such cells in the classification matrix, seven were empty (0.0%). These results indicate a relatively high success rate, and that the vast majority of the misclassification were into closely neighboring (and thus similar) clusters. In sum, the energy issues items effectively discriminated among the respondent clusters.

General Summary

The perceived risks and benefits of electric power alternatives were used to explore the context of attitudes toward nuclear power. Supporters and opponents of nuclear power responded to thirty-three items which referred to five categories of energy issues: the production potential of electric, risks of those technologies, power generation technologies, energy conservation, comparisons of risks among technologies and comparisons between risks and benefits of each technology. The results for the pronuclear respondents are summarized first, followed by those for the antinuclear respondents.

Pronuclear. Results indicated that pronuclear respondents did not believe the risks of electric power generation technologies warrant serious concern. They expressed less willingness (relative to antinuclear respondents) to have present generations accept responsibility for the future effects of pollutants and wastes, did not support limitations on the use of fuels that do not have fully controlled wastes and endorsed industry's efforts to curb pollution. Pronuclear respondents also felt that the risks of nuclear power are no greater than the risks of conventional power sources. These respondents tended to focus on the present rather than the future, and especially upon present and near term benefits. While pronuclear respondents acknowledged the need for change and new technological development in power generation, the only alternative to conventional sources--coal and oil--that they endorsed was nuclear power. For pronuclear respondents, benefits were worth the risks for both coal and nuclear power.

Antinuclear. These respondents were more strongly concerned about the risks of electric power generation technologies, were more inclined to see present generations assume responsibility for the future effects of pollutants and wastes, supported limitations on the use of fuels that do not have fully controlled wastes and suggested that industry could do more to curb pollution. For antinuclear respondents, the risks of nuclear power were believed to be greater than those of conventional power sources. These results indicate that risk was the important dimension for antinuclear respondents. These respondents tended to put a heavy emphasis on the future as well as the present. Antinuclear respondents were concerned with avoiding risks in the present, and they

were also concerned with avoiding an extension of present risks into the future. This concern for the future was expressed by these respondents in their agreement with the need for change and new technological development in power generation. The antinuclear respondents endorsed solar and wind power, conservation, pollution control, and reclamation of stripmined land, all of which are associated with reduction in levels of risk to health and safety. Antinuclear respondents, did not agree that risks are much smaller than benefits for either coal or nuclear technology.

DISCUSSION

The study of public attitudes toward nuclear power and nuclear waste within the contexts of other social issues and other energy alternatives has enhanced our understanding of those attitudes and how they were formed. It is instructive now to compare data produced by the six clusters of respondents in the present study with results obtained from national probability samples conducted by major polling organizations. To facilitate this comparison, a small number of questions with content very similar to questions covered in other surveys was included in the original design of the qustionnaire. The responses of the six clusters of respondents can thus be compared with the poll data summarized by Melber, et al. (1977). The questions common to both sources fall into the areas of electricity production, conservation and risks of individual technologies.

In contrast to samples drawn from the public at large, respondents in the six clusters were generally in strong agreement about the prospects of serious energy shortages in the next ten years. Harris (cited in Melber, et al., p. 202) found that only 44% of the general public regarded the potential level of shortage in the next ten years as "very serious." The difference between our result and the Harris data is almost surely due to the difference in sampling procedure. It is interesting to note that antinuclear and pronuclear respondents were in substantial agreement on this issue. Since the Harris data on expectation of energy shortage was not broken down by support for or opposition to nuclear power, it is not possible to determine whether this result differs from results from national probability samples.

The strength of the rejection of oil and, to a lesser extent, coal, as major energy sources is consistent with other data from Harris (see Melber, et al., p. 237). As with the responses on the seriousness of energy shortages, responses reported in the poll data were not tabulated separately for nuclear supporters and opponents and, consequently, the high level of agreement of these respondents in their rejection of these technologies has not been previously noted.

There are questions which have been asked previously for which the original polling organization has provided separate tables for nuclear supporters and opponents. One such item addressed the perceived contribution of solar technology in the next twenty-five years. The pessimism of the nuclear supporters concerning the contribution of solar and wind technologies, as reported here, is somewhat surprising in light of data presented by Cambridge Reports (1975, cited in Melber et al., p. 224) which showed small differences between pro- and antinuclear respondents.

Also inconsistent with previous reports is the belief on the part of the nuclear supporters that most people could not easily reduce electricity consumption. Cambridge Reports (cited in Melber, et al., p. 258) indicated that nuclear supporters were not greatly different from nuclear opponents in their belief in their ability to cut their own consumption by one-third. It is possible that the difference in the object being judged ("most people" rather than self) would account for the apparent discrepancy.

A result which is consistent with poll data is the indication that nuclear supporters generally believe that increased energy is necessary

to ensure economic growth. Nuclear opponents, by contrast, believe that conservation is compatible with economic growth (Cambridge Reports, 1975, cited in Melber, et al., p. 245). It is clear the respondents in the present sample equated effects on the economy in general with adverse impacts on their own lives.

Most of the discrepancies noted here could be accounted for by the methodological difference between the present study and most public opinion polls: the sampling procedure employed. However, it also seems quite likely that nuclear supporters identified by a behavioral indicator such as group membership would be more strongly committed to nuclear power and, similarly, more antipathetic toward conservation and "exotic" technologies than would respondents classified "pronuclear" by a less stringent measure such as the single item indicator of support for nuclear power typically used in the polls. The same rationale would, of course, apply to nuclear opponents as well.

In sum, the picture that emerges from the analysis of those <u>most deeply committed</u> on the nuclear issue, both supporters and opponents, is slightly different from that suggested by Melber, et al., (1977, p. 197) after reviewing poll data. Melber and her colleagues proposed that there may be two different energy perspectives: one favoring any alternative that increases electric supply and another which resists increase in supply and favors conservation. The present analysis of the most strongly pro- and antinuclear activists indicates that neither side favors oil or coal. Each side, however, has a favored technology which it prefers to have supplant the conventional technologies.

The nuclear supporters studied here do, of course, favor nuclear power. However, they also believe that there are limited prospects for contributions from solar, wind and hydroelectric technologies. They also believe that there are serious disadvantages to conservation. Nuclear opponents, on the other hand, disagree that there are such limited prospects for solar and wind, although they are neutral on the prospects for increased hydro capacity. They also do not believe that conservation necessarily poses serious adverse consequences either for themselves or others.

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