PUBLIC ATTITUDES AND DECISION MAKING[1]

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PREFACE

Risks have emerged as an important constraint in the evaluation and selection of energy strategies. The work of the Joint IAEA/IIASA Research Project (IAEA: International Atomic Energy Agency) is oriented toward providing information on technological risks, and their social aspects, for use in decisions related to the management of risks. The emphasis of this research is upon energy systems.

This research memorandum presents preliminary results of an attitude survey undertaken with a heterogeneous sample of the Austrian public. Attitudes were elicited toward five types of energy system; results reported here pertain to attitudes toward the use of nuclear power and the cognitive structures underlying these attitudes. The measuring instrument used in this study was an extension of that used in a pilot study, published as RM-76-80, which is briefly summarized as part of this report.

ABSTRACT

Decision makers are increasingly being faced with the necessity of considering the relevant attitudes of various publics. This paper describes a method by which these attitudes may be measured. The model has the feature of synthesising the cognitive and evaluative components underlying attitude in a fashion that preserves the distinction between them. Results of a pilot study applying this model to attitudes toward nuclear power, and the risks associated with nuclear power are reported. Attitudes measured by the model correlated 0.66 and 0.74, respectively with measurements of the same attitudes using the semantic differential ($p < 0.001$, $N = 30$). An analysis of sub-groups pro and con nuclear power showed that differences between the groups were primarily due to the benefit-related attributes. These differences were found to be in the cognitive component: those pro nuclear power strongly believed that nuclear power was characterised by these beneficial attributes while those con were uncertain to somewhat negative. A similar analysis of sub-groups relatively favourable and unfavourable toward nuclear power risks suggests that those who believed that people are involuntarily exposed to these risks, and cannot control the outcome of this exposure, also tend to judge the risks as being unacceptable.

Preliminary results are reported of an application of this model, using a revised measuring instrument, to attitudes toward five different types of energy systems. The sample was a heterogenous group of 224 respondents residing in various parts of Austria. Results from this sample of the general public are reported only for attitudes toward nuclear power; they are generally consistent with the pilot study. A factor analysis of the beliefs underlying this attitude suggested four basic belief factors: beliefs about psychological risks, about economic and technological benefits, about socio-political risks and about environmental and physical risks.

INTRODUCTION

The existence of public debates about the acceptability of technologies suggest the difficulties which have been encountered in attempting to reconcile technological and social systems in public planning and decision processes. Technologists are often faced with the problem of equitably balancing complex technical data with the corresponding social attitudes. Aware of the importance of these attitudes, but unable either to measure them or to aggregate them with technical data, their recommendations are often based solely upon technical and engineering aspects. This, in effect, requires the ultimate decision makers, typically politicians, to assess the trade-offs between technical and social issues in a purely intuitive fashion.

This paper describes an approach to attitude measurement, based upon the work of Fishbein (1963, 1967) and his associates (Fishbein and Ajzen, 1975), that permits one to analyse the cognitive structure underlying attitudes. Figure 1 summarises the relations between beliefs, attitudes, intentions, and behaviours with respect to a given object*. It may be seen that a person holds many beliefs about an object; that is, he associates that object with a number of different attributes. It has been found that knowledge of a person's beliefs about an

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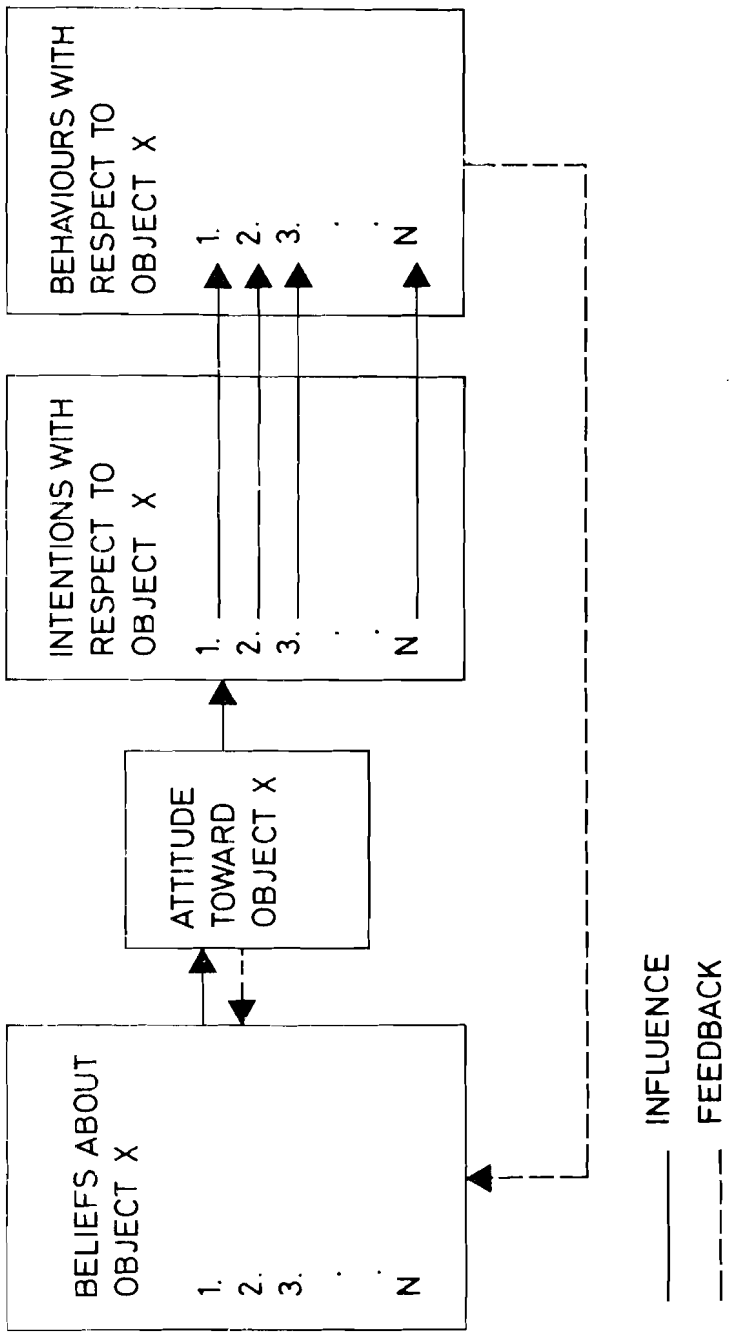
*Definitions: A belief is a probability judgement that links some object or concept to some attribute. For example, one might believe that Automobile A (an object) is expensive (an attribute). The strength of the belief is defined by the person's subjective probability that the object-attribute relationship exists, or is true. An attitude is an evaluative judgement that one likes or dislikes the object, that it is good or bad, that he feels favourable or unfavourable towards it. One may have attitudes towards concepts, people, institutions, events, behaviours, outcomes, etc. An intention is a probability judgement that links the individual to some specific action, i.e., the individual's belief that he will perform some specific behaviour. Behaviour is an observable action.

FIGURE 1

RELATIONS BETWEEN BELIEFS, ATTITUDES, INTENTIONS AND BEHAVIOURS



object and his evaluations of the associated attributes allows an accurate prediction of his attitude toward the object. A person's attitude toward any object is a function of his beliefs about that object weighted by these evaluations; however, it is the entire set of salient beliefs that determines the attitude and not any specific belief.

Once an attitude has been formed, a person is pre-disposed to behave in a consistent manner with respect to that object. Although his attitude does pre-dispose him to perform a set of behaviours, it does not pre-dispose him to perform any specific behaviour. It had previously been assumed that a person's attitude towards some object would influence some particular behaviour with respect to that object; it is now clear that attitudes towards an object may have little or no influence on any specific behaviour. Just as attitude is determined by the entire set of beliefs that a person holds, the attitude only serves to pre-dispose the person to engage in a set of behaviours that, when taken together, are consistent with the attitude. Figure 1 also shows that a person's intention to engage in a specific behaviour with respect to an object is viewed as the primary determinant of that behaviour. In contrast to the relations between beliefs and attitudes, and attitudes and intentions, we do assume a one-to-one relation between intention and behaviour, barring outside interventions*.

The way in which the beliefs linking the object to specific attributes combine with the evaluations of these attributes can be mathematically written as:

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*A discussion of the determinants of specific behaviours is beyond the scope of this paper; however, Fishbein (1967) has developed a theory in which two major variables (i.e., attitudes toward performing the behaviour and subjective norms concerning the behaviour) are viewed as the immediate determinants of an intention to perform a given behaviour. See also Ajzen and Fishbein (1973) and Fishbein and Ajzen (1975).

$$A_o = \sum_{i=1}^{n} b_i e_i \quad , \qquad \text{(Equation 1)}$$

where A_o = the person's attitude toward object o

b_i = the strength of belief i about object o; i.e., the subjective probability that o is related to some attribute i

e_i = the subject's evaluation of attribute i

n = the number of salient beliefs the subject holds about object o.

Although this model was derived from principles of learning theory, and, in particular, the notions of conditioning and mediated generalisation, it is structurally similar to Rosenberg's (1956) expectancy value model and Edwards' (1954) subjective expected utility model.

The indirect measure of attitude obtained from Equation 1 is the sum of the eb products. To verify that this is indeed a measure of attitude, correlations can be made between the Σ eb scores of the subjects and independent, direct measurements of the same attitude. Direct, global measurements of attitude can conveniently and reliably be made using the semantic differential method of Osgood, et al. (1957). The magnitude and statistical significance of this correlation coefficient provide a measure of the success of the model in estimating attitude and, in addition, ensure that the set of attributes used was adequate to describe the attitude object for the group tested. This test of validity is an important characteristic of the model*.

A PILOT APPLICATION OF THE MODEL

A pilot application of the model, to attitudes toward

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*Considerable empirical evidence to support this model can be found throughout the attitude literature in areas such as racial attitudes, family planning, politics. For a review, see Fishbein and Ajzen, 1975.

nuclear power, was carried out in order to test its utility in the area of attitudes toward technologies and their risks. A questionnaire was given to a group of thirty people in the USA affiliated with a university institute engaged in energy research. Almost all had university degrees and half had had extensive experience in the nuclear energy field. The average age of the group was in the mid-forties, two-thirds were male. All subjects were presented with a 32-page booklet with the standard instructions for using the semantic differential as the first two pages. Details of the experimental design may be found in Otway and Fishbein (1976).

The particular attributes used in formulating the questionnaire were developed primarily from previous research oriented toward identifying factors which influence the perception of technological risks or the technologies themselves (Otway, 1975; Otway, et al., 1975; Maderthaner, et al., 1976; Swaton, et al., 1976; Otway and Pahner, 1976; Pahner, 1976; Nowotny, 1976; Golant and Burton, 1969; Starr, 1969; Lowrance, 1976; Agrafiotis, de Larminat and Pages, 1977). The twelve attributes associated with nuclear power can be seen in Table I and the eleven attributes associated with nuclear power risks in Table II.

Attitude toward Nuclear Power

The Spearman rank order coefficient between the estimated and direct attitude scores was 0.66 ($p < 0.001$), which demonstrated the validity of this application.

In order better to understand the factors differentiating between people with favourable and unfavourable attitudes toward nuclear power, two sub-groups were formed from the total sample. Using the direct attitude measurement scores from the semantic differential as the criterion, the ten subjects with the highest scores formed the "pro" group and those with the ten lowest scores, the "con" group. Table I presents the mean algebraic eb scores, the mean belief strengths ($\bar{b}_i$), and the mean evaluations ($\bar{e}_i$) of each attribute for the pro and con groups. This

TABLE I

COGNITIVE STRUCTURE UNDERLYING ATTITUDES TOWARD NUCLEAR POWER

DETERMINANT	Average Attitude Contribution $\overline{eb}$		Average Belief Strength $\overline{b}$		Average Evaluation $\overline{e}$	
	"pro"group	"con"group	"pro"group	"con"group	"pro"group	"con"group
provides good value for the money	7.00**	0.60	2.80**	0.20	2.50	1.90
enhances "quality of life"	6.40**	-0.40	2.50**	-0.40	2.50**	1.30
provides benefits which are essential to society	5.50*	0.50	2.10*	0.20	2.70	2.50
can be mis-used in a destructive way	-4.30	-4.90	1.70	1.90	-2.40	-2.20
uses principles and processes which are difficult to conceptualize	-3.50	-2.60	2.70	2.30	-1.30	-1.10
creates noxious wastes	-3.00	-5.50	1.90	2.10	-1.80	-2.20
can affect large numbers of people at the same time	-2.60	-3.70	1.90	2.20	-1.70	-2.20
consumes large quantities of natural resources	2.80	0.70	-1.20	-0.20	-2.00	-2.00
in the hands of big government or business	1.20*	-2.80	2.80	2.50	-0.40*	-1.00
presented a new and different mode of death	-0.60*	-3.90	1.50	1.70	-0.80	-1.50
offers social benefits which are not highly visible	-0.50	0.80	1.30	0.70	0.00	-0.30
seldom seen or contacted in daily life	-0.10	-0.40	1.10	2.20	0.00	-0.10

* difference significant at 0.10 level
** difference significant at 0.01 level

table allows identification of those aspects which most clearly differentiate between the two groups. The magnitude of the eb terms represents their contributions to the overall attitudes.

For the pro group the three attributes contributing most to attitudes concerned benefits, i.e., providing good economic value, enhancing the quality of life, and providing benefits essential to society. In contrast, the three attributes contributing most to the attitude of the con group were risk-related, i.e., waste production, the possibility of destructive mis-use of the technology, and the matter of catastrophic accidents.

For four attributes the differences between the eb values of the pro and con groups were statistically significant. For example, the perceived relationship between nuclear power and "big government or business" contributed positively to the pro group's attitude, negatively to that of the con group. The reason for this difference can be better understood from looking at beliefs and evaluations. It may be seen that both groups strongly believed that nuclear power is in the hands of big government or business. However, while the pro group evaluated this attribute positively, the con group evaluated it negatively.

The three additional items for which eb differences between the groups were statistically significant were all related to the benefits of nuclear power: providing benefits essential to society, providing good economic value, and enhancing the "quality of life". In all three cases both groups evaluated these attributes positively, although the con group valued enhancement of the "quality of life" significantly less than the pro group. However, for all three items the beliefs were the major factor contributing to these differences. More specifically, the pro group strongly believed that nuclear power offers these benefits while the con group tended to be uncertain to somewhat negative.

It is interesting to note that there were no significant differences between the groups on the eb scores of any of the items related to risk. Both groups believed that nuclear power is characterised by the attributes of affecting large numbers of people, creating noxious wastes, and possible destructive misuse. Although both groups evaluated these risk-related attributes negatively, the con group's evaluations for two of them were significantly more negative. This indicates essential agreement between the groups with respect to nuclear power risks, but suggests that differing attitudes toward nuclear power were primarily determined by strongly differing beliefs about its benefits*.

Attitudes toward Nuclear Power Risks

The second part of the questionnaire focussed specifically on attitudes toward "the risks associated with nuclear power". The Spearman rank order coefficient between the estimated and direct attitude scores was 0.76 ($p < 0.001$). Again, using attitude scores from the semantic differential as the criterion, two new sub-groups were formed from the total sample. The ten subjects with the most favourable attitude toward "nuclear power risk" were called the "risk" group; the ten with the most unfavourable attitudes were called the "risk averse" group. It should be noted that these two groups did not have the same membership as the pro and con groups described earlier, although there was some over-lap.

Table II presents the mean algebraic eb scores, the mean belief strengths (b_i) and the mean evaluations (e_i) for the "risk" and "risk averse" groups. Here we find that there were three items for which differences between algebraic eb scores were statistically significant.

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* In agreement with this result, many surveys on attitude toward smoking have found that smokers and non-smokers tend to agree on the risks associated with smoking; significant differences are found in their perceptions of the benefits.

TABLE II

COGNITIVE STRUCTURE UNDERLYING ATTITUDES TOWARD NUCLEAR POWER RISKS

DETERMINANT	Average Attitude Contribution $\overline{eb}$ "risk" group	Average Attitude Contribution $\overline{eb}$ "risk averse" group	Average Belief Strength $\overline{b}$ "risk" group	Average Belief Strength $\overline{b}$ "risk averse" group	Average Evaluation $\overline{e}$ "risk" group	Average Evaluation $\overline{e}$ "risk averse" group
can affect large numbers of people at the same time	-2.40**	-7.50	1.60*	2.90	-1.70*	-2.40
may take effect at a later time	-2.70	-5.30	1.90	2.60	-1.30	-2.00
people exposed to risks in a passive way	0.90**	-5.20	0.30**	2.30	1.20*	-2.10
imposed upon people involuntarily	-0.90**	-5.90	0.70*	2.30	-1.50*	-2.50
likely to be fatal	-0.10*	-3.70	-0.30	1.50	-1.80*	-2.60
not known to the average person with certainty	-2.10	-1.70	2.20	2.00	-1.00	-0.80
people have had no personal experience with these risks	-0.90	-1.50	2.30	2.50	-0.30	-0.60
people cannot imagine themselves exposed to these risks	-0.40	-2.40	0.60	0.50	-0.80	-0.60
determined by natural forces	0.30	0.70	-1.00	-1.20	-1.00	-0.40
not scientifically established with certainty	-0.50	0.50	0.00	0.40	-1.50	-2.00
determined by the actions of men and machines	1.90*	-1.30	2.30	2.60	0.80*	-0.40

* difference significant at 0.10 level
** difference significant at 0.01 level

The attributes concerning involuntary imposition of risks, passive exposure, and affecting large numbers of people contributed significantly more negatively to the attitudes of the "risk averse" group than to those of the "risk" group. It may be seen that these differences were primarily due to differences in beliefs. The "risk averse" group strongly believed that nuclear power risks are imposed on people involuntarily and that people are passively exposed to these risks. The "risk" group, however, was significantly less certain of this. Although both groups were quite certain that large numbers of people can be affected, this belief was significantly stronger for the "risk averse" group. Consistent with earlier findings, the two groups also differentially evaluated this attribute. Both evaluations were negative, but the "risk averse" group significantly more so. No other attributes were differentially evaluated at a significant level.

These findings suggest, at least for this sample, that those who believed that large numbers of people can be affected at the same time, that people are involuntarily exposed to nuclear power risks, and in a passive way, also tended to judge the risks as being unacceptable. These concerns can be viewed as psychological in nature since, for a given statistical expectation of physical risks, the number of people involved in a particular incident and the issues of consent and control are primarily matters of psychological interpretation.

A TEST OF THE MODEL

Given the significant results of the pilot study, the model was then tested with a heterogenous sample of 224 respondents residing in various parts of Austria. By eliminating the separate section on risk attitudes and providing more detailed risk- and benefit-related attributes relevant to the use of nuclear power, a set of 39 attributes was constructed. In order to explore possible differences in cognitive structures concerning nuclear and other energy systems, respondents were asked to indicate

their beliefs that each of five energy systems (i.e., nuclear, hydro-electric, solar, coal and oil) were characterised by these same attributes. In addition, each attribute was evaluated and semantic differential measures of attitude toward each energy system were obtained.

Preliminary Results

Data collection has just been completed, so only preliminary results related to attitudes toward nuclear power can be presented at this time. Consistent with findings of the pilot study, it was possible to predict respondents' attitudes toward nuclear power from a consideration of the beliefs linking nuclear power to each of the 39 attributes and their evaluations of these attributes. The Pearson correlation coefficient between attitudes estimated from the model and direct measures of these attitudes was 0.66 ($p < 0.001$, $df = 223$).

Given the validity of this application of the model, the cognitive structure underlying these attitudes may be examined. To simplify interpretation, a factor analysis of the 39 beliefs was conducted using data from the total sample*. Preliminary analysis suggest there were four factors underlying the 39 beliefs. The items defining each of these factors may be seen in Table III.

The first factor was characterised by beliefs relating the use of nuclear power to risk-related attributes of psychological significance. For example, the belief loading highest on this factor was that using nuclear power will expose one to risks without his consent. The belief with the second highest loading was that, once exposed to these risks, the individual has no

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*Factor analyses of the eb products and the evaluations of the attributes are in progress; results of these and other analyses will be reported in future papers to be authored by Dagmar Maurer and the present authors.

control over them. This factor was labelled "beliefs about psychological risk". The second factor was characterised by beliefs associating the use of nuclear power with various benefits, such as increasing the standard of living and leading to new forms of industrial development. This factor was labelled "beliefs about economic and technological benefits".

The third factor was labelled "beliefs about socio-political risks". At first glance it may seem surprising that beliefs about the production of noxious wastes and the transport of dangerous substances were associated with socio-political risks. However, the storage and transport of nuclear wastes was viewed in relation to the need for physical security measures and possible mis-use of the technology by terrorist groups. As noted by Weinberg (1972), the storage of long-lived radio-isotopes places unprecedented requirements upon the stability of the socio-political institutions charged with their care. Consistent with this, these concerns were also seen as leading to dependencies upon elite groups of technical experts and the concentration of political power in the hands of big industrial enterprises. The fourth factor was characterised primarily by concerns about environmental damage, e.g., air and water pollution; it was termed "beliefs about environmental and physical risks".

Although only preliminary, these results are of interest because they suggest that risks and benefits cannot be viewed as lying along a single bi-polar dimension. Rather, risks and benefits appear to be viewed independently. Moreover, in support of the hypothesis proposed by Otway and Pahner (1976), people do not seem to perceive risks along a single dimension but instead they distinguish among their physical-environmental impacts, the psychological characteristics of the risk situation and their potential effects upon social and political systems.

Differential Analysis of Groups Pro and Con

Again, the semantic differential attitude scores were used

TABLE III

FACTOR I: BELIEFS ABOUT PSYCHOLOGICAL RISKS

Factor Loading	Belief Statement: The Use of Nuclear Power will...	Average Attitude Contribution $\overline{eb}$ pro	Average Attitude Contribution $\overline{eb}$ con	Average Belief Strength $\overline{b}$ pro	Average Belief Strength $\overline{b}$ con	Average Evaluation $\overline{e}$ pro	Average Evaluation $\overline{e}$ con
.81	mean exposing myself to risk without my consent	-1.12**	-6.94	0.62**	2.52	-2.30*	-2.72
.77	lead to accidents which affect large numbers of people at the same time	-1.80**	-8.18	0.60**	2.74	-2.54*	-2.95
.76	mean exposing myself to risks which I cannot control	-2.50**	-7.65	1.08**	2.64	-2.48	-2.75
.72	be a threat to mankind	-1.92**	-6.72	0.86**	2.66	-2.12	-2.52
.71	be risky	-0.76	-2.30	0.58**	2.74	-0.80	-0.78
.70	lead to hazards caused by material failure	-1.16**	-5.89	0.52**	2.16	-2.20	-2.48
.69	have a delayed effect on health	0.20**	-5.26	0.38**	2.00	-2.16	-2.38
.64	increase the rate of mortality	3.40**	-3.68	-1.38**	1.40	-2.16	-2.30
.61	lead to changes in man's genetic make-up	2.52**	-2.94	-1.12**	1.22	-1.80	-2.08
.55	lead to hazards caused by human failure	-1.28**	-4.16	0.58**	1.94	-2.02	-2.04

* difference significant at 0.05 level
** difference significant at 0.01 level

TABLE III CONT.

FACTOR II: BELIEFS ABOUT ECONOMIC AND TECHNICAL BENEFITS

Factor Loading	Belief Statement: The Use of Nuclear Power will...	Average Attitude Contribution $\overline{eb}$ pro	Average Attitude Contribution $\overline{eb}$ con	Average Belief Strength $\overline{b}$ pro	Average Belief Strength $\overline{b}$ con	Average Evaluation $\overline{e}$ pro	Average Evaluation $\overline{e}$ con
.80	raise the standard of living	3.02**	0.02	1.56**	0.03	2.16**	1.12
.77	increase Austrian economic development	3.97**	0.46	1.77**	0.18	2.06	1.62
.69	provide good economic value	2.26	0.82	1.78**	0.42	1.32	1.44
.67	increase my nation's prestige	3.10**	-1.70	1.64**	-1.06	1.60**	0.48
.66	lead to new forms of industrial development	3.82**	1.50	2.16**	1.08	1.88*	1.16
.65	lead to technical "spin-offs"	2.54	1.24	1.94**	0.62	1.44	1.58
.63	increase employment	2.84**	-1.86	1.20**	-0.87	2.00	2.28
.60	increase the development of methodologies for medical treatment	4.42*	1.71	1.80**	0.46	2.60	2.50
.56	reduce the need to conserve energy	0.36	-0.67	1.08	0.92	-0.14*	-1.06

* difference significant at 0.05 level
** difference significant at 0.01 level

TABLE III CONT.

FACTOR II: BELIEFS ABOUT ECONOMIC AND TECHNICAL BENEFITS CONT.

Factor Loading	Belief Statement The Use of Nuclear Power will...	Average Attitude Contribution $\overline{eb}$ pro	 con	Average Belief Strength $\overline{b}$ pro	 con	Average Evaluation $\overline{e}$ pro	 con
.54	symbolize the industrial way of life	0.70	-0.04	0.74	0.74	0.84**	-0.10
.53	satisfy the energy need in years ahead	5.12*	3.22	2.14*	1.44	2.42*	1.83
.41	decrease the dependence on fossil fuels	1.76	0.87	1.74	1.46	0.62	0.57
.40	increase the extent to which society is consumer oriented	1.53**	-1.28	0.61	0.84	0.64**	-0.91

FACTOR III: BELIEFS ABOUT SOCIO-POLITICAL RISKS

.70	lead to rigorous physical security measures	5.59	6.66	2.38	2.58	2.24	2.60
.68	produce noxious waste products	-5.59**	-8.28	2.08*	2.80	-2.38**	-2.94
.67	lead to the diffusion of knowledge that facilitates the construction of weapons by additional countries	-1.28*	-3.92	1.22*	2.00	-1.16	-1.76
.63	lead to a dependency on small groups of highly specialized experts	-1.55*	-3.64	1.22**	2.36	-1.00	-1.56

* difference significant at 0.05 level
** difference significant at 0.01 level

TABLE III CONT.

FACTOR III: BELIEFS ABOUT SOCIO-POLITICAL RISKS CONT.

Factor Loading	Belief Statement: The Use of Nuclear Power will...	Average Attitude Contribution $\overline{eb}$ pro	Average Attitude Contribution $\overline{eb}$ con	Average Belief Strength $\overline{b}$ pro	Average Belief Strength $\overline{b}$ con	Average Evaluation $\overline{e}$ pro	Average Evaluation $\overline{e}$ con
.61	lead to transporting dangerous substances	-3.18**	-6.86	2.24	2.74	-1.36**	-2.54
.56	increase the likelihood that a technology will be misused in a destructive way by terrorist groups	-2.57**	-6.20	0.95**	2.14	-2.36	-2.76
.52	give political power to big industrial enterprises	-0.06**	-4.54	0.36**	1.68	-1.84	-2.24

FACTOR IV: BELIEFS ABOUT ENVIRONMENTAL AND PHYSICAL RISKS

.60	exhaust our natural resources	2.46	2.64	-1.72*	-0.94	-1.22	-1.76
.60	increase occupational accidents	1.46**	-2.28	-0.96**	0.89	-1.68	-2.18
.58	lead to water pollution	1.46**	-3.56	-0.48**	1.20	-2.24*	-2.72
.57	lead to air pollution	2.64**	-1.48	-0.90**	0.48	-2.06**	-2.72
.55	make Austria economically dependent upon other countries	1.40**	-2.30	-0.44**	1.16	-1.16	-1.72
.45	lead to long-term modification of the climate	2.46**	-2.58	-1.36**	0.70	-1.00**	-1.94

* difference significant at 0.05 level
** difference significant at 0.01 level

TABLE III CONT.

MISCELLANEOUS: BELIEFS NOT LOADING ON ANY FACTOR

Belief Statement	Average Attitude Contribution $\overline{eb}$		Average Belief Strength $\overline{b}$		Average Evaluation $\overline{e}$	
The Use of Nuclear Power will...	pro	con	pro	con	pro	con
involve a technology that I can understand	1.72	0.48	0.92**	-0.26	1.76	1.26
lead to the formation of groups advocating extreme political positions	2.00**	-2.38	-0.58**	0.91	-2.26	-2.24
lead to a police state	3.30	1.90	-2.22**	-0.24	-1.66	-1.56

* difference significant at 0.05 level
** difference significant at 0.01 level

as the criterion to form sub-groups, of 50 respondents each, pro and con nuclear power. The mean algebraic $\underline{eb}$ scores, the mean belief strengths ($\bar{b}_i$), and the mean evaluations ($\bar{e}_i$) for each of the 39 attributes are also given in Table III. It can be seen that there are many significant differences between the groups on the $\underline{eb}$ scores, the individual beliefs, and the attribute evaluations. While it is interesting to examine the significant item-by-item differences reported in Table III, a more parsimonious analysis is based on the factors described above. Scores for each factor were computed by averaging the $\overline{\underline{eb}}$, $\bar{b}$ and $\bar{e}$ scores of the five items which loaded highest on each factor. These scores were calculated for both pro and con groups. Table IV summarises the differences between the two groups with respect to the four factors.

Recall that the magnitude of the $\underline{eb}$ terms represents their contributions to the overall attitude. Looking at Table IV it can be seen that, consistent with the findings of the pilot study, attributes concerning benefits contributed most to the attitudes of the pro group while attributes concerning risks, and in particular psychological risks, contributed most to the attitudes of the con group. Further, and also consistent with the findings of the pilot study, these differences are due primarily to differences in cognitions, or beliefs, rather than attribute evaluations. Results from this sample of the general public indicated significant differences on all four belief factors.

More specifically, the pro group was quite certain that using nuclear power will lead to economic and technological benefits (Factor II, $\bar{b} = 1.78$), while the con group was essentially uncertain about such benefits (Factor II, $\bar{b} = 0.13$). Although both groups believed that using nuclear power will lead to psychological and socio-political risks, the con group was significantly more certain in both cases than was the pro group. It was only with respect to environmental and physical risks that those cognitive differences were qualitative as well as quantitative. That is, while the pro group did not believe that

TABLE IV

SUMMARY OF COMPUTED FACTOR SCORES+

FACTOR	-9 $\overline{eb}$ +9	-3 $\overline{b}$ +3	-3 $\overline{e}$ +3
I: Psychological Risks	-1.62** -6.36	0.75** 2.66	-2.05 -2.34
II: Economic and Technical Benefits	3.23** 0.22	1.78** 0.13	1.80* 1.16
III: Socio-Political Risks	-1.20* -3.21	1.83* 2.50	-0.73* -1.24
IV: Environmental and Physical Risks	1.88** -1.40	-0.90** 0.56	-1.67 -2.22

* difference significant at 0.05 level
** difference significant at 0.01 level

+ obtained by averaging across the five items loading highest on each factor

the use of nuclear power involves environmental and physical risks (Factor IV, $\bar{b}_i$ = -0.90), the con group associated the use of nuclear power with these risks (Factor IV, $\bar{b}_i$ = 0.56).

CONCLUDING REMARKS

Although only preliminary, these findings illustrate the complex nature of the cognitive structure underlying public attitudes toward nuclear power and its use. Not only are beliefs about the benefits of nuclear power relatively independent from beliefs about nuclear power risks, but people can believe that the use of nuclear power will lead to some types of risks (e.g., socio-political) without believing that it will lead to others (e.g., environmental).

For the sample of the public interviewed in this study, beliefs about psychological risks were responsible for the greatest differential contribution to attitudes pro and con. For the con group, the beliefs about psychological risks and socio-poltical risks together contributed more to attitude than did the combined environmental risk and economic benefit beliefs. This tends to support the suggestion (Otway, 1977) that the nuclear controversy is highly symbolic in nature with the psychological and socio-political implications of nuclear power being the crucial underlying issues rather than its environmental risks.

It should be clear that if decision makers wish to take public attitudes into account it will not be sufficient to simply view people as pro or con a particular technology. If a public is con primarily because of their concerns for the technology's potential socio-political risks, the decision maker faces a very different problem than if the basis for the public's con position is their concern for the environment. Moreover, it must be realized that there is not one, but many different publics, and these publics will vary in size and import.

Attitude research can identify different publics and provide information about the basis for the pro or con attitudes that are held by these publics. There seems to be little question that information of this type should be used by decision makers. How, and to what extent, this information should enter into decision processes are questions that decision theorists will have to answer.

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