NUCLEAR ENERGY: THE ACCURACY OF POLICY MAKERS PERCEPTIONS OF PUBLIC BELIEFS

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January 1979
WP-79-4

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PREFACE

The risks associated with alternative energy systems, and public perceptions of these risks, have become important constraints in the formulation of energy policies. An earlier research memorandum (RM-77-54) reported results of the application of an attitude measurement methodology to explore the beliefs held by a sample of the Austrian public with respect to nuclear energy; an extension of the study to include five alternative energy sources was described in WP-79-5. The present working paper reports use of the same questionnaire to measure the attitudes and underlying beliefs, again with respect to nuclear energy, of senior Austrian civil servants in a position to influence energy policies. The accuracy of their perceptions of the attitudes and beliefs of sub-groups of the public sample most PRO and CON the use of nuclear energy were examined and comparisons made between the policy makers own positions and those of the public.

ABSTRACT

The primary purpose of this study was to empirically test how accurate a group of policy makers were in their assessment of the beliefs and attitudes of the public with regard to the use of nuclear energy. The respondents (n = 40) were senior Austrian civil servants responsible for energy matters. The questionnaire used was the same as that employed earlier to measure the attitudes and underlying beliefs of the Austrian public (n = 224) and the sub-groups (n = 50) of this sample most PRO and CON the use of nuclear energy. The policy makers completed this questionnaire twice: once with respect to their own positions and, on the second occasion, in the role of a typical member of the Austrian public who was either PRO or CON the use of nuclear energy. This experimental design also permitted comparisons between the policy makers' own positions and those of the general public.

Public attitudes toward the use of nuclear energy were found, using factor analysis, to be based upon four underlying dimensions of belief: psychological (anxiety-inducing) risks; economic/technical benefits; socio-political implications; and environmental/physical risks. The policy makers' own attitudes were found to be significantly more favourable than those of the total public sample; this was primarily because the policy makers' beliefs about psychological risks made a significantly smaller negative contribution to attitude, and their beliefs about environmental risks made a significantly larger positive contribution.

The policy makers were able to shift their own (personal) responses in the directions indicated by their role-play assignments to accurately reproduce the overall attitudes of the PRO and CON groups on this controversial topic, although there was a tendency to overestimate the positive attitudes of the PRO nuclear public. In terms of the underlying belief dimensions however, there was a significant failure to recognise the extent to which issues of psychological significance contribute negatively to the attitudes of both PRO and CON public groups. The policy makers underestimated the negative value both groups assigned to these risks as well as the extent to which the public believed that nuclear energy would lead to such risks.

1. INTRODUCTION

Issues of technological policy are increasingly attracting public attention, a good example being plans for nuclear energy programmes. Experts responsible for making policy recommendations, and government itself, have been forced by events to take notice of public attitudes and opinions. The motivations for wishing to take public attitudes into account in policy decisions will depend very much upon the particular political system involved; such a discussion is beyond the scope of this report. For our purpose we will assume that the aim is to formulate socially viable technological policies, where viability refers not only to an ethically acceptable level of public risk, but also to social acceptability. This requires knowledge of what the relevant public attitudes are as well as an understanding of the belief and value systems which underlie these attitudes. A simple 'head count' of those pro and con a particular technological issue is not sufficient; the policies selected, and even the processes by which they are evolved, must be responsive to the real concerns of the public if a broad base of support is to be found.

Earlier reports in this series have included a pilot study which explored the beliefs and attitudes, with respect to nuclear energy, of a group of energy experts (Otway and Fishbein, 1976); an analysis of the beliefs and attitudes of a heterogeneous sample of the Austrian public on this same topic (Otway and Fishbein, 1977; Otway, Maurer and Thomas, 1978); and an extension of the latter study to the comparisons of beliefs held about five different energy sources (Thomas, Maurer, Fishbein, Otway, Hinkle and Simpson, 1978). The present report deals with the beliefs about, and attitudes toward, the use of nuclear energy held by a group of senior officials in Austria. The respondents were in a position to influence policy recommendations made to decision makers at the ministerial level. Throughout this report the respondents will be referred to as the "policy makers".

The particular policy question we have addressed is the possible role that nuclear energy might play in the Austrian economy. This present working paper reports a comparison between the policy makers and the public, and the degree of accuracy with which the policy makers perceive the public's beliefs and attitudes on the topic of nuclear energy. The policy makers' own beliefs and attitudes were measured with the same questionnaire as that used in the earlier study of the general Austrian public, thus allowing direct comparisons. The policy makers' perceptions of public viewpoints were estimated by having a sub-sample of the policy makers respond to the same questionnaire in the role of a typical member of the public (who would be) 'PRO' or 'CON' the use of nuclear energy. A comparison between these in-role responses and the scores

actually observed in corresponding sub-groups of the public sample gives an indication of the accuracy of the policy makers' view of public beliefs. The in-role responses also provide a basis for assessing the policy makers' perceptions of the issues underlying the public response to nuclear energy.

2. THE ATTITUDE APPROACH

Since the attitude model used in this study has been set out in some detail in the reports cited above, we will only summarise the main points relevant to the procedures and findings described in this paper[1/].

1. Attitude is defined as the overall favourableness or unfavourableness of an object, where 'object' refers to any discriminable aspect of the individual's world.

2. Attitude is based on the beliefs and individual holds about the attitude object. The strength of each such belief is treated as a probability judgement that the attitude object is associated with some characteristic or attribute.

3. At any given time an attitude is determined by the sum, over the salient beliefs, of evaluations of the attributes, each evaluation being weighted by the strength of the belief (i.e., the subjective probability that the attitude object is characterised by that attribute).

In this research, attitudes have been measured directly using the semantic differential technique of Osgood, Suci and Tannenbaum (1957), and estimated by the method described

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[1/] A relationship between attitude and behaviour is implicit in most studies of attitude. In this paper, however, we are primarily concerned with beliefs and attitudes and a discussion of attitude and behaviour is beyond the scope of this report (see Bowman et al., 1978).

above[2/]. The semantic differential measure of attitude was used as a criterion with which to validate the set of beliefs; this was done by correlating the semantic differential measure with the estimated attitude. The beliefs used in the present study were the same as those used in the earlier study of public attitudes: They were based on previous research, a literature survey and in-depth interviews. The 39 belief items relating the use of nuclear energy to a series of possible attributes and consequences are listed in Table 1.

3. METHOD

3.1. Sample

The sample of policy makers consisted of 40 senior civil servants specialising in energy matters; 34 of the respondents were male, 6 female. To obtain estimates of the policy makers' perceptions of public attitudes PRO and CON the use of nuclear energy, they were randomly assigned to one of the two role-play sub-groups: ROLEPRO and ROLECON. Only 35 of the original group of 40 were available for the role-play part of the experiment.

The sample of the Austrian general public with which the policy makers were compared was a stratified sample controlling for geographic location (Vienna, provincial capital and rural), sex, age, and education. The number of usable interviews was 224. Details of the sample can be found in Thomas et al. (1978). Two sub-groups PRO and CON nuclear energy were formed within the public sample using the semantic differential measure of attitude as the criterion; the 48 respondents most favourable to the use of nuclear energy were termed the PROPUB Group, the 47 least favourable the PUBCON Group.

[2/] The particular attitude model used in this series of reports is that developed by Fishbein and his associates (see Fishbein and Ajzen, 1975). The way in which evaluations and belief strengths are combined to estimate attitude can be stated formally:

$$A_o \approx \sum_i^n b_i \, e_i$$

where A_o = the attitude toward the object 'o'

b_i = the strength of the belief which links the attitude object to attribute i

e_i = the evaluation of attribute i

n = the number of salient beliefs, i.e., those currently within the span of attention.

3.2. Questionnaire

A questionnaire identical to that employed in the study of the Austrian public (Otway and Fishbein, 1977) was used to measure the policy makers' own responses as well as their responses when playing ROLEPRO and ROLECON. For each of the 39 belief items the evaluation of each attribute was measured using a single, seven-point (+3 to -3) scale, where the end-points were labelled good-bad. The strength of belief linking each attribute to the use of nuclear energy was measured on a seven-point (+3 to -3) scale where the end-points were labelled 'likely-unlikely' [3]. Overall attitude toward the use of nuclear energy was measured on ten evaluative scales of the semantic differential method with end-points labelled in the customary way, i.e., good/bad, harmful/beneficial, etc.

4. PREDICTION OF ATTITUDE FROM BELIEFS AND ATTRIBUTE EVALUATIONS

In the earlier study of the Austrian public it was found that respondents' attitudes toward nuclear energy could be accurately estimated from a consideration of beliefs linking the use of nuclear energy with each of the 39 attributes and the evaluations of these attributes--the correlation between attitudes estimated and the same attitudes measured by the semantic differential was 0.63. Given the validity of the attitude model in this application, a factor analysis[4] of belief strength scores was used to explore the underlying dimensions which characterised the thinking of the public with respect to the use of nuclear energy. This factor analysis produced a clear factor structure relating the use of nuclear energy to four clusters of beliefs: psychological risks; economic and technical benefits; socio-political implications; and environmental/physical risks. Table 1 lists the 39 beliefs and indicates those which were associated with each factor (i.e., belief dimension).

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[3] Although construed as subjective probabilities, this measure of belief strength avoids the strict requirements of probability measures. The beliefs are not treated as a partitioned event space where probabilities would sum to 1. By using a bi-polar (+3 to -3) scale it is possible to encompass levels of probability that the attitude object is or is not associated with the attribute in question.

[4] Factor analysis is a generic term for a set of linear, parametric statistical methods which identify the minimum number of independent dimensions needed to account for the variance in a larger set of intercorrelated variables. We used the method of principle components followed by Varimax rotation. This technique produces underlying dimensions which are independent, i.e., orthogonal factors.

4.1. Prediction of Public Attitudes from Underlying Belief Dimensions

These findings suggest that four types of considerations, or issues, underlie public attitudes toward nuclear energy. To test this assumption 'factor summaries' were created for each belief dimension. These factor summary scores were calculated by taking the five items which loaded highest on each belief dimension. The five belief strengths were then summed, $\left(\sum_{i=1}^{5} b_i\right)$, as were the corresponding five attribute evaluations, $\left(\sum_{i=1}^{5} e_i\right)$. These two derived measures were then multiplied together: $\left[\left(\sum_{i=1}^{5} b_i\right) \times \left(\sum_{i=1}^{5} e_i\right)\right]$. These latter products were then summed over the four belief dimensions, i.e., $\sum_{j=1}^{4} \left[\left(\sum_{i=1}^{5} b_i\right) \times \left(\sum_{i=1}^{5} e_i\right)\right]$, to give a revised estimate of attitude. In support of the assumption that these four dimensions underlie the public's attitude toward nuclear energy, these new estimates of attitude, based now on four summary scores only, were found to correlate as highly with the semantic differential measure of attitude ($r = 0.66$) as did the estimates based upon all 39 beliefs.

4.2. Prediction of Policy Makers' Own Attitudes

In the case of the policy makers' attitudes it was found that the correlation between the semantic differential measure of attitude and the attitude estimates based upon all 39 beliefs was 0.89[5/].

While it would have been desirable to perform a factor analysis of the policy makers' belief scores, the ratio of beliefs to respondents was too small to permit meaningful results. Therefore, the factor structure obtained from the public sample was also tested to summarise the Ministry data.

[5/] Although it is possible that this higher correlation for the Ministry sample as compared with the public sample, could indicate the policy makers' higher level of education and familiarity with the topic, it is more likely that the difference in correlation merely reflects the fact that on the semantic differential the policy makers were asked to indicate their attitudes toward "the use of nuclear energy" while the public were asked to indicate their attitudes toward "nuclear energy". Since the wording of the belief statements referred to "the use of nuclear energy" the public sample's semantic differential attitude did not correspond directly to the beliefs measured.

To test the utility of this approximation, the 'factor summaries' described in Section 4.1. were also computed for the policy makers. The correlation between estimated attitudes (i.e., by summing over the four $\left[\left(\sum_{i=1}^{5} b_i \right) \times \left(\sum_{i=1}^{5} e_i \right) \right]$ factor summaries) and the semantic differential measure was 0.85, indicating the validity of this reduced belief set. Thus in the remainder of this paper only the factor summary scores will be considered

5. COMPARISON OF POLICY MAKERS AND THE AUSTRIAN PUBLIC

The first question of interest is the extent to which the policy makers' own beliefs and attitudes correspond to those of the general public. As expected, the attitudes of the policy makers toward the use of nuclear energy were significantly more favourable than those of the total public sample. This is true for both the direct measure of attitude (semantic differential) and the estimates based on the model[6/].

In order to better understand the bases for these differences 2-way analyses of variance (ANOVA) were conducted. The particular design contrasted the policy makers and the public with respect to all four belief dimensions on each factor, using $\sum_{i=1}^{5} b_i$, $\sum_{i=1}^{5} e_i$, and $\left[\left(\sum_{i=1}^{5} b_i \right) \times \left(\sum_{i=1}^{5} e_i \right) \right]$ as dependent variables[7/].

[6/] Semantic differential scores could range from ±15; the policy makers' mean score was 7.9, the public mean score was 1.3. Recall, however, that policy makers evaluated "the use of nuclear energy" while the public evaluated "nuclear energy". This problem is avoided when estimates based on the model are considered since all beliefs were about the use of nuclear energy. These latter scores could range from ±900; the policy makers' mean score here was 30.6, the public's was -97.8.

[7/] This can be described as a 2 x 4 matrix where each cell represents the combination of one level (e.g., policy makers) of one factor (group) with one level (e.g., environmental risk) of the other factor (belief dimensions). ANOVA essentially decomposes the total variance in the dependent measure in a way which permits testing the statistical significance of main effects (e.g., the effect of one factor, over all its levels, when all other factors are combined) and interactions between these effects (i.e., where one factor has a differential impact on the levels of another factor). The statistical signficance of the effect of factor (A) depends on the ratio of variance in the dependent measure which can be attributed to A and the variance which is treated as error. The variance attributed to A is the portion of total variance in the dependent measure due to variation between different levels of A (other factors combined); and the error in the portion of variance in the dependent measure due

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Table 2 summarises the three analyses of variance and presents the mean values of the factor summary scores for the policy makers and for the total public sample.

It can be seen that the main differences in the attitudes of the policy makers and the public were due to differential contributions from the psychological risk and environmental risk dimensions. The former dimension made an appreciable negative contribution to the public's attitudes but made only a small negative contribution to the policy makers' attitudes. In contrast, environmental risk issues made a large positive contribution to the policy makers' attitudes[8]. The policy makers and the public were in general agreement concerning economic/technological benefits and socio-political risks.

When these differences in attitude contribution were analysed in terms of the underlying beliefs and attribute evaluations, they were found to be more closely related to the pattern of belief differences than to attribute evaluations. For instance, although the policy makers and the public agreed in their beliefs that using nuclear energy would lead to economic/technical benefits and socio-political risks, there were significant differences in their beliefs concerning psychological and environmental risk. It is also interesting to note that the policy makers and the public agreed in their negative evaluations of socio-political risk and environmental risk, but that the policy makers had less unfavourable evaluations of psychological risks and less favourable evalutions of economic/technological benefits.

In summary, the policy makers were significantly more favourable toward the use of nuclear energy than were the general public. This was primarily because the policy makers did not associate the use of nuclear energy with psychological risks, and believed that the use of nuclear energy would not lead to environmental risks; in contrast, the public strongly believed that the use of nuclear energy would lead to psychological risks and was less certain that it would not cause environmental damage.

7/contd. to variation within each level of A. Since error is derived from variation within levels of a factor it is important to differentiate between instances where the effects of different levels of a factor are measured on different (and randomly assigned) individuals and on the same people by repeated measures. Clearly, in the latter case underlying consistencies in the response can be expected and have to be taken into account. This can be done by analysis of variance. It should be noted that repeated measures were used in all the factorial designs in this study.

8/ The positive contribution to attitude made by a risk dimension is due to the belief that the use of nuclear energy will not lead to negatively valued risks. This double negative results in a positive contribution to attitude.

6. COMPARISON OF POLICY MAKERS' OWN AND ROLE-PLAY RESPONSES

The ultimate goal of this study was to discover those patterns of attribute evaluations and beliefs which the policy makers perceived as typical of members of the general public who are PRO and CON the use of nuclear energy (i.e., the PUBPRO and PUBCON Groups). However, before making a direct comparison between these perceptions (the role-play responses) and the actual findings for the general public, it is instructive to examine the role-play responses in relation to the policy makers' own positions.

The overall effects of playing ROLEPRO and ROLECON are reflected in measures of attitude as estimated[9/] from the sum of the evaluation x belief strength products over the four belief dimensions. Table 3 shows that both group membership (ROLEPRO/ROLECON) and role-play (SELF/ROLE) had a significant main effect on this measure of attitude, and that the interaction between these variables was also significant. Examination of the mean values of attitude in the four cells of Table 3 clarifies the interaction effect; it can be seen that in the SELF condition there was no significant difference in attitude between the two groups--evidence that the policy makers were randomly assigned to ROLEPRO and ROLECON groups[10/]. When responding in-role the differences in attitude between those playing PRO and CON were significant. Further, since the policy makers' own attitudes were more favourable than those of the public, the change in attitude from own position to role response was greater for the ROLECON group than for the ROLEPRO group.

The detailed comparisons of policy makers' own responses with those they made in-role were based on a 2 (ROLEPRO/ROLECON) x 2 (SELF/ROLE) x 4 (Belief Dimensions) analysis of variance of the three factor summary scores, i.e., the evaluation associated with each belief dimension ($\sum e$), the belief strength relating each belief dimension to the use of nuclear energy ($\sum b$), and the product of these two variables $[(\sum e \times \sum b)]$ representing the contribution of each belief dimension to the overall attitude. A summary of these three analyses of variance is given in Table 4 and a detailed breakdown of the mean values is shown in Table 5.

[9/] Semantic differential measures of attitude were not obtained in the role play condition.

[10/] This difference in mean attitude is neverthelss larger than might be expected. It can be attributed to the chance placement of two individuals with initial viewpoints which were strongly CON in the ROLECON group.

Table 4 shows that there were significant main effects for all three factor summary scores--the only exception being the absence of a difference between the SELF and ROLE conditions for attribute evaluations. Most important for this discussion, however, are the significant two-way interactions of ROLEPRO/ROLECON with SELF/ROLE for all three dependent variables (i.e., the three factor summaries) and the significant three-way interaction for belief strength measures (ROLEPRO/ROLECON x SELF/ROLE x Belief Dimensions).

Looking first at the contribution of each belief dimension to the overall attitude it can be seen that there are no significant differences in the SELF responses of the ROLEPRO and ROLECON groups. When responding in-role the ROLEPRO group tended to shift in a positive direction on all belief dimensions, but not significantly so. However, as shown by the analysis of the estimated attitude scores, the net effect of these non-significant shifts on each of the four belief dimensions had a cumulative significant effect on overall attitude. For the ROLECON group the shift from SELF to ROLE response was in the negative direction, and significant, on all four belief dimensions. Thus, in contrast to the SELF responses, there were significant differences in the role responses of the two groups.

These different contributions to attitude were due primarily to the fact that when role playing, the respondents made greater shifts in belief strengths than in attribute evaluations. Although both ROLEPRO and ROLECON groups shifted their evaluations of risks and benefits in the direction appropriate to their assigned roles, none of these changes were significant. A similar pattern of response shift was found with respect to the beliefs of the ROLEPRO group; however, for the ROLECON group, shifts on three of the belief dimensions were statistically significant. The policy makers assigned to play the CON role shifted their own beliefs with respect to psychological risks and environmental risks, as well as economic/technological benefits; they did not significantly shift their beliefs about socio-political risks.

In summary, the results suggest that the policy makers were able to shift their own responses in directions appropriate to the roles they were assigned. Since the policy makers' own positions tended to be favourable toward the use of nuclear energy, the shift from SELF to ROLE was always greater for those assigned to the ROLECON group.

6.1. Bases for Role Play Response Shifts

The results discussed above show that the policy makers were able to take the PRO or CON role and to respond to questions about attribute evaluations and beliefs associated with the use of nuclear energy. In virtually every case (the only exception being beliefs about socio-political implications) there were

significant differences between responses in the PRO and CON roles. However, for the PRO role, these in-role responses were not significantly different from the policy makers' own positions. In the CON role the differences between SELF and ROLE responses were significant for three of the belief dimensions.

Given these differences in response shift in PRO and CON role conditions, it is worth exploring whether the policy makers made their in-role responses essentially in terms of their own positions or independently of these positions. If the policy makers made in-role responses which were anchored in their own positions, i.e., a more or less constant shift from SELF to ROLE, then one would expect an appreciable correlation between SELF and ROLE responses. If, on the other hand, they made their role responses independently of their own positions, then only low correlations between SELF and ROLE responses could be expected.

In order to test the notions, two correlations were computed for each respondent: The correlation between SELF and ROLE belief strength responses over the 20 items comprising the four factors; and the correlation between SELF and ROLE attribute evaluations over the same 20 items. These correlations (after conversions to z' scores) were examined in a 2 (ROLEPRO/ROLECON) x 2 (EVALUATION/BELIEF) ANOVA. Table 6 presents the summary of this ANOVA as well as the average SELF-ROLE correlations for those in the ROLEPRO and ROLECON groups. Note first that, on average, the policy makers relied significantly on their own positions in playing the role of the public ($\bar{r}$ = 0.53). It is interesting, however, that the policy makers were more likely to use their own positions as a base to estimate the attribute evaluations of the public than to estimate their belief strengths; there was a significantly higher correlation between SELF and ROLE responses for evaluations ($\bar{r}$ = 0.61) than for belief strengths ($\bar{r}$ = 0.44).

For beliefs and evaluations considered together, the role-play shift was quite similar for the ROLEPRO ($\bar{r}$ = 0.56) or ROLECON ($\bar{r}$ = 0.50) groups. The correlations between SELF and ROLE in both conditions were also approximately the same for attribute evaluations ($\bar{r}$ = 0.60 and 0.62 for ROLEPRO and ROLECON respectively). However, in estimating public beliefs there was a tendency for those in the ROLECON group to rely less on their own positions ($\bar{r}$ = 0.36) than did those in the ROLEPRO group ($\bar{r}$ = 0.51).

To summarise, when playing the public roles the policy makers essentially used their own positions as anchors for estimating the positions of the public. They did so to a greater extent for attribute evaluations (perhaps reflecting a perceived commonality of values within their society) than for beliefs. It was shown earlier that in the ROLECON condition the policy makers changed their beliefs to a greater extent than in the ROLEPRO condition. It can now be seen that,

although not statistically significant, those assigned to the ROLECON group also tended to make more qualitative changes in their own beliefs than those assigned to the ROLEPRO group. In other words, the policy makers tended to see their own views and feelings with respect to using nuclear energy as being more similar to those members of the public who are pro nuclear energy (i.e., PUBPRO) than to those who are opposed (PUBCON).

The next section will examine the accuracy of the policy makers' perceptions of the public.

7. ACCURACY OF THE POLICY MAKERS' PERCEPTIONS OF PUBLIC PRO AND CON POSITIONS

The first comparison between the policy makers' role responses and the public was made, using analysis of variance, on overall attitude toward the use of nuclear energy as estimated from the four belief factors. Table 7 shows the summary of the analysis of variance as well as the means of the four cells included in the analysis. Only the PRO/CON main effect was significant. The absence of a significant main effect due to the difference between the public and the policy makers in-role, as well as the absence of an interaction, provides evidence that the policy makers quite accurately perceived the overall attitudes of the public groups. Although there was a tendency for the policy makers assigned the PRO role to overestimate the positive attitudes of the PUBPRO group, this difference did not reach statistical significance. This tendency is nevertheless interesting since it indicates that, despite the fact that the policy makers in the ROLEPRO condition shifted their own responses less than those in the ROLECON condition, these relatively small shifts results in overestimates of the PUBPRO attitudes. In contrast, the large shifts in the own responses of the ROLECON group resulted in accurate estimates of PUBCON attitudes.

The major comparison between the public and the policy makers' in-role was made using the three factor summary scores, i.e., Σe, Σb, $[(\Sigma e) \times (\Sigma b)]$, for each of the four belief dimensions. The overall summary of the main and interaction effects is given in Table 8, and the breakdown of cell means and differences in Table 9. Table 8 shows that all but one of the main effects were significant, the exception being an absence of difference between the public and the policy makers' in-role responses for $[(\Sigma e) \times (\Sigma b)]$.[11/]

[11/] This corresponds to the results shown in Table 7 concerning the accuracy of the role play perceptions with respect to the overall attitude estimate, i.e.,

$$\sum_{j=1}^{4} \left[\left(\sum_{i=1}^{5} e_i \right) \times \left(\sum_{i=1}^{5} b_i \right) \right]$$

Most relevant to this discussion, however, are the findings that there were neither significant PRO/CON x PUBLIC/POLICY-MAKERS interactions nor significant 3-way interactions for any of the three factor summary scores. These findings show that those policy makers assigned to the two role-play groups (ROLEPRO and ROLECON) were equally accurate in their perceptions of the public's positions. In other words, the policy makers appeared to be equally capable of playing in the PRO or CON roles. Once again, however, there was a slight, but nonsignificant, tendency for those in the ROLEPRO group to see the public as being somewhat more positive toward nuclear energy than they in fact were.

As can be seen in Table 9, it is only with respect to the contribution of the psychological risk dimension to attitude that the policy makers were inaccurate to a significant degree. Those in the ROLEPRO group saw this dimension as contributing positively to attitude while, in fact, it made a negative contribution to PUBPRO attitudes. Likewise, the ROLECON group significantly underestimated the negative contribution of this dimension to the attitudes of the PUBCON group. These inaccuracies with respect to the psychological risk dimension were the result of inaccurate perceptions of both attribute evaluations and belief strengths; that is, in both the ROLEPRO and the ROLECON conditions the policy makers underestimated the negative values the public groups placed on psychological risks as well as the degree to which the public groups believed that the use of nuclear energy would lead to such risks.

The policy makers also were inaccurate in their perceptions of the public on two other belief dimensions: Regardless of whether they were playing ROLEPRO or ROLECON, the policy makers tended to underestimate the negative values the public groups placed on environmental/physical risks as well as the public's beliefs that the use of nuclear energy would lead to economic/technical benefits. Although both these latter differences were significant, they did not result in significant differences in terms of the contributions of these two dimensions to overall attitude.

8. SUMMARY AND CONCLUSIONS

The main objective of this experiment was to test the accuracy of Austrian energy policy makers' perceptions of the beliefs and attitudes of public groups with respect to the use of nuclear energy. This was done by asking the policy makers to fill out a questionnaire in the role of a typical member of the public who was PRO or CON the use of nuclear energy. The same questionnaire had been used earlier to obtain data on the beliefs and attitudes of similar sub-groups of the Austrian public, thus allowing direct comparisons to be made. In addition, the policy makers completed the questionnaire from their own points of view, which also permitted comparisons

of the policy makers' own positions with those of the public. Perhaps not suprisingly, the policy makers tended to have more favourable overall attitudes toward the use of nuclear energy than did the Austrian public in general.

Four major, independent dimensions were found to underlie public attitudes toward the use of nuclear energy: psychological risks (anxiety); economic/technical benefits; socio-political implications; and environmental/physical risks. Analysis in terms of these dimensions indicated that the difference in overall attitudes between policy makers and public was primarily due to the fact that, for the public, psychological risks made a large negative contribution to attitude and environmental risks made a minimal positive contribution. A similar analysis of the policy makers' own responses, however, found that psychological risks made only a minimal negative attitude contribution while environmental issues contributed substantially in the positive direction.

The policy makers made in-role responses that were different from their own. Those assigned the PRO nuclear role shifted in the positive direction while the opposite effect was observed for those assigned the CON nuclear role. The latter shifts were significantly greater since the policy makers' own beliefs and attitudes were more similar to those of the PRO nuclear public than to the CON public. Indeed, despite the differences between the public and the policy makers' own positions, the policy makers were able to accurately estimate the overall attitudes of the general public. This was true irrespective of whether they were asked to estimate the attitudes of members of the public who were PRO or CON the use of nuclear energy, although there was a tendency for the policy makers to overestimate the positive attitudes of the PRO nuclear public.

In terms of the four belief dimensions the policy makers were able to satisfactorily reproduce the beliefs, values and attitudes of public groups PRO and CON the use of nuclear energy. This was particularly true with respect to the attitudinal contributions made by economic/technical benefits, socio-political risks and environmental/physical risks. The accuracy of the policy makers' perceptions was somewhat diminished, however, by their failure to recognise the extent to which issues of psychological significance contribute negatively to both PRO and CON public attitudes. More specifically, the policy makers underestimated the negative values that both public groups placed on these risks and the extent to which the public believed that the use of nuclear energy would lead to such risks.

In summary, the policy makers had quite accurate perceptions of the overall attitudes of opposing groups on this controversial topic. Further, they demonstrated a good understanding of the belief and value systems which underlie the attitudes of each group. It would be interesting to know whether

these generally good perceptions are actually reflected in policy recommendations and the degree to which the respondents view public opinion as a legitimate input to the decision process.

TABLE 1

THE ORIGINAL SET OF BELIEFS ABOUT THE USE OF NUCLEAR ENERGY AND THE FOUR BELIEF DIMENSIONS DERIVED FROM FACTOR ANALYSIS

FACTOR I: PSYCHOLOGICAL RISKS

* means exposing myself to risk without my consent,
* leads to accidents which affect large numbers of people at the same time,
* means exposing myself to risk which I cannot control,
* is a threat to mankind,
* is risky,

leads to hazards caused by material failure; - has a delayed effect on health; - increases the rate of mortality; - leads to change in man's genetic make-up; - leads to hazards by human failure.

FACTOR II: ECONOMIC AND TECHNICAL BENEFITS

* increases the standard of living,
* increases Austrian economic development,
* provides good economic value,
* increases my nation's prestige,
* leads to new forms of industrial development,

leads to technical "spin-offs"; - increases employment; - increases the development of methodologies for medical treatment; - reduces the need to conserve energy; - symbolises the industrial way of life; - satisfies the energy need in the decades ahead; - decreases dependence on fossil fuels; - increases the extent to which society is consumer-oriented.

FACTOR III: SOCIO-POLITICAL RISKS

* leads to rigorous physical security measures,
* produces noxious waste products,
* leads to the diffusion of knowledge that facilitates the construction of weapons by additional countries,
* leads to dependency on small groups of highly specialised experts,
* leads to transporting dangerous substances,

increases the likelihood that a technology is misused in a destructive way by terrorist groups; - gives political power to big industrial enterprises.

FACTOR IV: ENVIRONMENTAL AND PHYSICAL RISKS

* does exhaust our natural resources,
* increases occupational accidents,
* leads to water pollution,
* leads to air pollution,
* makes Austria economically dependent upon other countries,

leads to a long-term modification of the climate.

MISCELLANEOUS: BELIEFS NOT LOADING ON ANY FACTOR

involves a technology that I can understand; - leads to the formation of groups advocating extreme political positions; - leads to a police state.

* beliefs used to represent the factor

TABLE 2

COMPARISONS OF POLICY MAKERS AND TOTAL PUBLIC SAMPLE

A. Summary of Analyses of Variance

	ATTRIBUTE EVALUATION $\sum_{i=1}^{5} e_i$	BELIEF STRENGTH $\sum_{i=1}^{5} b_i$	PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$
MAIN EFFECTS			
POLICY MAKERS VS. PUBLIC (A)	NS	**	**
BELIEF DIMENSION (B)	**	**	**
INTERACTION			
A x B	**	**	**

B. Mean Values of Factor Summaries for each Belief Dimension

	ATTRIBUTE EVALUATION Range = ±15		BELIEF STRENGTH Range = ±15		PRODUCT Range = ±225	
BELIEF DIMENSION	POL. MAK.	PUBL.	POL. MAK.	PUBL.	POL. MAK.	PUBL.
Psychological Risk	-8.4	-10.1*	0.7	8.6**	- 9.9	-94.7**
Econ./Technol. Benefits	5.7	7.4*	4.2	5.5	39.7	45.7
Socio-Political Risk	-4.3	- 5.0	9.8	10.9	-45.0	-56.8
Environmental Risk	-8.8	- 9.9	-4.9	-1.0**	45.8	8.04**

* difference significant $p < 0.05$
** difference significant $p < 0.01$
NS difference non-significant

TABLE 3

MEAN VALUES OF BELIEF-BASED ATTITUDE
OF POLICY MAKERS

(Range of Values = ±900)

	SELF (n=35)	ROLE (n=35)	
ROLEPRO (n=17)	52.6	163.9	*
ROLECON (n=18)	9.8	-259.4	**
	NS	**	

* difference significant $p < 0.05$
** difference significant $p < 0.01$
NS difference non-significant

SUMMARY OF ANALYSIS OF VARIANCE

MAIN EFFECTS:	ROLEPRO/ROLECON (A)	$p < 0.01$
	SELF/ROLE (B)	$p < 0.01$
INTERACTION:	A x B	$p < 0.01$

TABLE 4

SUMMARY TABLE OF ANALYSES OF VARIANCE FOR POLICY MAKERS IN SELF AND ROLE CONDITIONS

	ATTRIBUTE EVALUATION $\sum_{i=1}^{5} e_i$	BELIEF STRENGTH $\sum_{i=1}^{5} b_i$	PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$
MAIN EFFECTS			
ROLEPRO/ROLECON (A)	*	**	**
SELF/ROLE (B)	NS	**	*
BELIEF DIMENSIONS (C)	**	**	**
2-WAY INTERACTIONS			
A x B	**	**	**
A x C	NS	**	*
B x C	NS	**	*
3-WAY INTERACTION			
A x B x C	NS	**	NS

* significant effect $p < 0.05$
** significant effect $p < 0.01$
NS non-significant

TABLE 5

MEAN VALUES OF EVALUATIONS AND BELIEF STRUCTURES FOR THE POLICY MAKERS' OWN AND IN-ROLE RESPONSES

BELIEF DIMENSION		ATTRIBUTE EVALUATIONS $\sum_{i=1}^{5} e_i$ SELF Range = ±15	ATTRIBUTE EVALUATIONS $\sum_{i=1}^{5} e_i$ ROLE Range = ±15		BELIEF STRENGTHS $\sum_{i=1}^{5} b_i$ SELF Range = ±15	BELIEF STRENGTHS $\sum_{i=1}^{5} b_i$ ROLE Range = ±15		PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$ SELF Range = ±225	PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$ ROLE Range = ±225	
PSYCHOLOGICAL RISK	ROLEPRO	-8.7	-7.4	NS	-0.1	-1.7	NS	4.2	32.1	NS
	ROLECON	-8.2	-10.1	NS	1.3	11.5	**	-23.1	-130.8	*
		NS	*		NS	**		NS	**	
ECONOMIC/TECHNICAL BENEFTIS	ROLEPRO	5.5	9.7	NS	3.7	6.2	NS	39.1	83.4	NS
	ROLECON	5.8	2.6	NS	4.7	-1.8	**	40.1	-5.6	*
		NS	*		NS	**		NS	**	
SOCIO-POLITICAL RISK	ROLEPRO	-3.8	-2.0	NS	8.9	8.6	NS	-38.9	-7.7	NS
	ROLECON	-4.7	-6.7	NS	10.6	11.9	NS	-50.8	-80.6	*
		NS	*		NS	NS		NS	**	
ENVIRONMENTAL/ PHYSICAL RISK	ROLEPRO	-8.5	-6.3	NS	-4.7	-4.8	NS	48.3	56.1	NS
	ROLECON	-9.2	-8.6	NS	-5.1	4.1	**	43.5	-42.4	*
		NS	*		NS	**		NS	**	

* difference significant $p < 0.05$
** difference significant $p < 0.01$
NS difference non-significant

TABLE 6

AVERAGE SELF-ROLE CORRELATIONS FOR EVALUATIONS AND BELIEF STRENGTHS

	ATTRIBUTE EVALUATIONS	BELIEF STRENGTHS	OVERALL SELF-ROLE
ROLEPRO (n=17)	0.60	0.51	0.56
ROLECON (n=18)	0.62	0.36	0.50
TOTAL (n=35)	0.61	0.44	0.53

Note: All correlations statistically significant at $p < 0.05$

SUMMARY OF ANALYSIS OF VARIANCE

MAIN EFFECTS:	ROLEPRO/ROLECON (A)	NS
	EVALUATION/BELIEF (B)	$p < 0.05$
INTERACTION:	A x B	NS

TABLE 7

MEAN VALUES OF BELIEF-BASED ATTITUDE
OF PUBLIC GROUPS AND POLICY MAKERS IN-ROLE

(Range of Values = ±900)

	PUBLIC (n=95)	POLICY MAKERS IN-ROLE (n=35)	
PRO (n=65)	52.3	163.9	*
CON (n=65)	-275.5	-259.4	NS
	**	**	

* difference significant $p < 0.05$
** difference significant $p < 0.01$
NS difference non-significant

SUMMARY OF ANALYSIS OF VARIANCE

MAIN EFFECTS:	PRO/CON (A)	$p < 0.01$
	PUBLIC/POLICY MAKERS IN-ROLE (B)	NS
INTERACTION:	A x B	NS

TABLE 8

SUMMARY OF ANALYSES OF VARIANCE FOR
PUBLIC GROUPS AND POLICY MAKERS IN-ROLE

	ATTRIBUTE EVALUATION $\sum_{i=1}^{5} e_i$	BELIEF STRENGTH $\sum_{i=1}^{5} b_i$	PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$
MAIN EFFECTS			
PRO/CON (A)	**	**	**
PUBLIC/POLICY MAKERS IN-ROLE (B)	*	*	NS
BELIEF DIMENSIONS (C)	**	**	**
2-WAY INTERACTIONS			
A x B	NS	NS	NS
A x C	NS	**	**
B x C	**	*	*
3-WAY INTERACTION			
A x B x C	NS	NS	NS

* significant effect $p < 0.05$
** significant effect $p < 0.01$
NS non-significant

TABLE 9

MEAN VALUES OF EVALUATIONS AND BELIEF STRENGTHS FOR PUBLIC GROUPS AND POLICY MAKERS IN-ROLE

BELIEF DIMENSION		ATTRIBUTE EVALUATIONS $\sum_{i=1}^{5} e_i$			BELIEF STRENGTHS $\sum_{i=1}^{5} b_i$			PRODUCT $(\sum_{i=1}^{5} e_i) \times (\sum_{i=1}^{5} b_i)$		
		PUBLIC GROUPS	POLICY MAKERS IN-ROLE		PUBLIC GROUPS	POLICY MAKERS IN-ROLE		PUBLIC GROUPS	POLICY MAKERS IN-ROLE	
		Range = ±15			Range = ±15			Range = ±225		
PSYCHOLOGICAL RISK	PRO	-10.3	-7.4	*	3.7	-1.7	**	-38.1	32.1	**
	CON	-11.9	-10.1	*	13.5	11.5	**	-162.9	-130.8	**
		**	**		**	**		**	**	
ECONOMIC/TECHNICAL BENEFITS	PRO	9.0	9.7	NS	9.1	6.2	*	80.9	83.4	NS
	CON	5.8	2.6	NS	0.4	-1.8	*	1.7	-5.6	NS
		**	**		**	**		**	**	
SOCIO-POLITICAL RISK	PRO	-3.6	-2.0	NS	9.2	8.6	NS	-34.8	-7.7	NS
	CON	-6.1	-6.7	NS	12.5	11.9	NS	-79.9	-80.6	NS
		**	**		**	NS		**	**	
ENVIRONMENTAL/ PHYSICAL RISK	PRO	-8.5	-6.2	**	-4.8	-4.8	NS	44.3	56.1	NS
	CON	-11.1	-8.6	**	3.0	4.1	NS	-34.5	-42.4	NS
		**	**		**	**		**	**	

* difference significant $p < 0.05$
** difference significant $p < 0.01$
NS difference non-significant

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