Public Attitudes toward Nuclear Power

by Harry J. Otway

An earlier article (*Bulletin* Vol. 17, no. 4, August 1975) outlined the research programme of the Joint IAEA/IIASA Research Project on risk assessment and presented some preliminary results. This project is co-sponsored by the IAEA and the International Institute for Applied Systems Analysis, located at Laxenburg, near Vienna. Additional support is received from IAEA Member States who have indicated their interest in this research by seconding scientists, at no cost to the Agency, to work with the group for periods of one year or more. Secondments have been completed by scientists from the Federal Republic of Germany, Japan, United Kingdom, United States of America and Sweden. Additional secondments, or notice of intent, have now been received from France, Netherlands, Norway and South Africa.

The research on risk assessment is oriented toward understanding how societies judge the acceptability of new technologies and how information on risks, and the expected responses to them, may be used in decision making. This article will briefly review one specific research area, that of attitude formation, and will illustrate how established models and techniques may be applied in order to gain insight into the relative importance of the specific technological, psychological and social factors which determine attitudes toward nuclear power.

A THEORETICAL FRAMEWORK

A major difficulty in social psychology has been a failure to recognise that *beliefs, attitudes, intensions* and *behaviours* are different and distinct variables, with different determinants, but with stable and systematic relationships among them. Until very recently *attitude* had been used in a generic sense to refer not only to a person's affective, or evaluative, feelings about some object, but also to *beliefs* (cognitions) about the object as well as his *behavioural intentions* (conations) with respect to the object. Thus, much attitude research was confusing in that what were taken to be measures of attitude were, in fact, often measures of belief, intentions or behaviours.

Definitions: A *belief* is a probability judgement that links some object or concept to some attribute. The terms 'object' and 'attribute' are used in a generic sense and both terms may refer to any discriminable aspect of an individual's world. For example, one might believe that Automobile A (an object) is expensive (an attribute). The content of the belief is defined by the object and attribute in question, and the strength of the belief is defined by the person's subjective probability that the object-attribute relationship exists, or is true.

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An *attitude* is a bipolar evaluative judgement of the object. It is essentially a subjective judgement that one likes or dislikes the object, that it is good or bad, that he feels favourable or unfavourable towards it. The term 'object' is again used in a generic sense. 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. *Behaviour* is an observable action that is quantifiable on either a dichotomous (i.e., one did/did not perform some specific action) or a continuous scale (i.e., someone gave from $0 to $X to a charity).

ATTITUDE FORMATION

Figure 1 (from Fishbein and Ajzen, 1975) summarizes the relations between beliefs, attitudes, intentions, and behaviours with respect to a given object. It can be seen that a person holds many beliefs about any given object, that is, he associates that object with a number of different attributes.

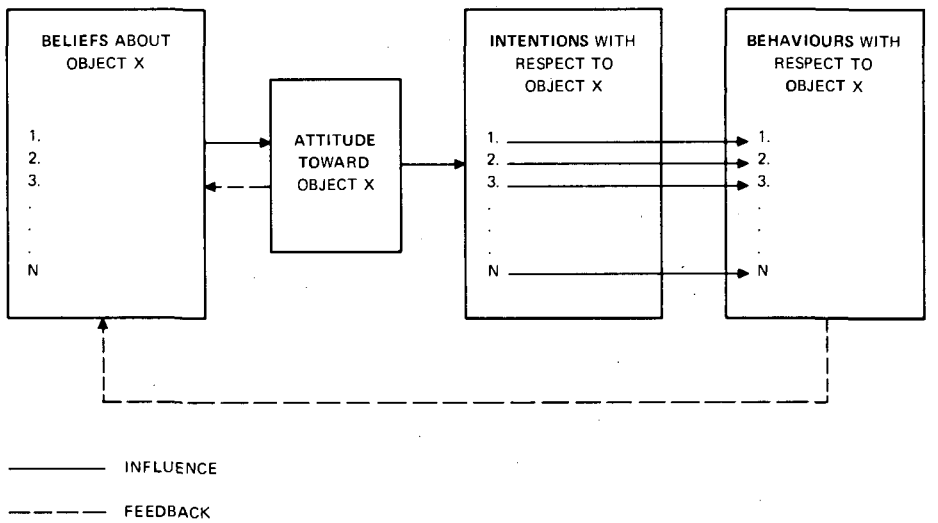
Social scientists have shown that knowledge of a person's beliefs about an object, and his evaluations of the object's attributes, allows an accurate prediction of his attitude towards the object. That is, a person's attitude toward any object is a function of his beliefs about that object, weighted by these evaluations; however, it is the entire set of salient beliefs that determines the attitude and not any specific belief. Research on attention span, apprehension, and information processing suggests that an individual is capable of attending to or processing only five to nine items of information at any given time; it has also been found that a person's attitude toward an object is likely to be determined by a relatively small number of salient beliefs.

Once an attitude has been formed, a person is predisposed to perform a pattern of behaviours with respect to the object. Once again, it must be noted that although his attitude does predispose him to perform a *set* of behaviours, it does not predispose him to perform any *specific* behaviour. This may be the most important finding to come out of social psychology in the past two decades. In contrast to the previous assumption 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 specific behaviours with respect to that object. Just as attitude is determined by the entire *set* of beliefs that a person holds, an attitude only serves to predispose the person to engage in a *set* of behaviours that, when taken together, are consistent with the attitude.

This is nothing more than a recognition of the fact that a person's attitude may be expressed in a variety of ways. For example, person A might express his liking for person X by inviting him to the theatre. However, individual B, with a different attitude towards the theatre, but the same favourable attitude toward person X, might invite X to his home. It has taken more than 50 years to break down the fallacy of a one-to-one relation between attitudes and behaviours; this assumption has been a major factor impeding progress in understanding attitude formation.

We must recognize that Figure 1 does not imply that there is no relationship between attitude towards an object and intentions to engage in various behaviours with respect to that object. Rather, it suggests that if one were interested in the *totality* of intentions a

Figure 1. Schematic presentation of conceptual framework relating beliefs, attitudes, intentions, and behaviours with respect to a given object.



person held with respect to some object, knowledge of a person's attitude would be a useful predictor. That is, the more favourable the person's attitude, the more positive and the fewer negative behaviours he would intend to engage in.

In other words, if a person's attitude toward some object were to become more positive, one would expect an increase in the number of positive behaviours he intends to engage in with respect to that object. There is no guarantee, however, that it will increase the person's intention to engage in any particular behaviour. For example, an increase in a person's favourable attitude toward the theatre may increase his intention to attend the theatre more often but may not affect his intentions with respect to buying a season ticket.

Figure 1 also shows that a person's intention to engage in a specific behaviour with respect to an object is the primary determinant of that behaviour, i.e., the single best predictor of whether or not a person will engage in a particular behaviour is his intention with respect to *that* behaviour. In addition, it is assumed that there is a one-to-one relation between intention and behaviour, barring outside interventions. A person's attitude towards an object will *not* be related to any specific behaviour the person engages in with respect to the object, but it should be related to his overall *pattern* of behaviours.

DETERMINANTS OF SPECIFIC BEHAVIOURS

Two major variables have been found to serve as the determinants of a behavioural intention: (1) the person's attitude towards performing the behaviour in question and (2) his subjective judgement that most people who are important to him think he should

or should not engage in the behaviour. It has been found that the relative weights of these determinants vary. Some people (such as authoritarians) may place more weight on normative influences, while others (such as introverts) may place more weight on their own attitudes.

Space limitations prevent a detailed discussion of the model for the formation of specific intentions and behaviours. Those interested in this topic should consult Fishbein (1967) or Fishbein and Ajzen (1975).

MATHEMATICAL FORMULATIONS

For the quantitatively oriented, the above can be put in mathematical form. Using the Fishbein (1963, 1975) formulation, the relations of Figure 1 may be written:

$$A_o = \sum_{i}^{n} b_i e_i$$

where A_o = the person's attitude towards concept o.

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

e_i = the subjects' evaluation of attribute i.

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

The equation shows how attitudes are determined by a person's beliefs and his evaluations of the associated attributes. Attitude creates a pre-disposition to engage in a *pattern* of behaviours in a consistent manner, but it is not possible to state which particular behaviours will be affected.

EMPIRICAL STUDIES

In experimental applications of the model, the first requirement is to elicit the attributes of the object in question. The most common technique is an open-ended questionnaire given to a subset of the group to be studied. From the responses to the questionnaire, the modal salient beliefs of the group can be determined. These beliefs then form the basis for the construction of statements for evaluating the relevant attributes (e_i in the equation). Next statements of belief are constructed that link the specific object to the various attributes (b_i in the equation). The evaluations are usually made on a seven-place bi-polar scale (+3 to -3; good-bad).

For example, in evaluating an attribute, a sample statement might be: "A person is friendly". Here the attribute being evaluated is "friendly"; and it is being evaluated without regard to a specific person (object). The subjects make their evaluations on a scale, which might look like this.

good (+3) : : : : : : (-3) bad

In evaluating the strength of belief that a specific attribute is related to a specific object, the judgement is measured on a scale which employs a probabilistic element, such as "John is friendly":

probably true (+3) : : : : : : (-3) probably false.

Were attitudes toward other objects (persons) to be estimated at the same time, the evaluation of the attribute "friendly" would remain constant. It would only be necessary to determine the degree of belief for each object, e.g. "Mary is friendly". By summing the products b times e ($\sum^{n}$ be) over the n salient beliefs, an estimate of attitude is obtained.

INTERNAL CONSISTENCY

It is also necessary to verify that Σ be from the model indeed provides a measure of attitude. This may be done by rank-ordering the subjects of the experimental group in terms of their Σ be attitude scores and comparing this with rank-orderings obtained from a direct measurement of attitude.

One of the more convenient and reliable measuring instruments for direct attitude scaling is the semantic differential of Osgood (1952) and Osgood, Tannenbaum and Suci (1957). Here the subject is presented with pairs of adjectives. Each adjective has been selected to represent the extreme of a "semantic continuum" (e.g., good – bad, wise – foolish, clean – dirty). The subject then rates the particular object, or concept, by placing a check mark on each continuum at the point which he feels best describes the object. A seven-place, bi-polar scale, similar to that shown earlier, is normally used. This technique follows from the observation that the basic function of ordinary language is the communication of meaning. Extensive studies in 26 different cultures have demonstrated the reliability of this method. The semantic differential provides a direct, or overall, measurement of the attitude toward an object; the Σ be scores from the model provide the same measure of attitude but, in addition, also allow identification of the specific attributes which determine that attitude.

To summarise, rank-order correlations between the Σ be attitude scores and the direct attitude measurements from the semantic differential are taken to be measures of the success of the model in predicting attitude.

AN APPLICATION TO NUCLEAR POWER

Considerable experimental evidence to support the model can be found throughout the literature on attitude research; virtually all studies designed to test this model have obtained significant results. Applications of the model have been primarily in the areas of attitudes toward minority groups, family planning, politics, and special experiments in laboratory settings. It was proposed to make an application to the formation of attitude toward technologies and nuclear power was selected as a case study.

The particular attributes used in formulating the questionnaire were developed primarily from the research of the Joint IAEA/IIASA Research Project. (Otway, 1975, Otway, et. al., 1975, Maderthaner, et al., 1976; Swaton et al., 1976; Otway and Pahner, 1976; Pahner, 1976; Nowotny, 1975) and from work carried on elsewhere (Golant and Burton, 1969) Starr, 1969; Lowrance, 1976; Agrafiotis, de Larminat and Pages, 1977)*.

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* Earlier attempts to elicit attributes using traditional methods produced superficial, descriptive, attributes; this may be due to the affective content of this topic.

A total of twelve attributes related to nuclear power were included. Some of these attributes were:

- nuclear power provides **benefits which are essential to society;**
- the principles and processes of nuclear power are **difficult for people to conceptualize;**
- nuclear power involves **hazards which could affect large numbers of people at the same time;**
- nuclear power is **in the hands of big government and/or business.**

Eleven attributes related to the risks associated with nuclear power were also considered. Some of these were:

- the risks are **imposed** on people **involuntarily;**
- the risks are **not known to the average person** with a high degree of certainty;
- the risks are **determined by the actions of men and machines;**
- the risks are such that **people are exposed to them in a passive way** (their actions or skills cannot change the outcome).

The complete set of attributes were used as the basis for a 32 page questionnaire with statements designed to elicit evaluation of the attributes as well as measures of belief strength. Direct measures of attitudes toward nuclear power (as an object) and the risks associated with nuclear power were also included, using the semantic differential technique. The questionnaire was administered to a group affiliated with a university research station. Many of the subjects were engaged in energy research. Almost all had university degrees, and about half had experience in the nuclear energy field.

Of the twelve possible object attitude determinants used, ten had a significant influence in determining attitudes toward nuclear power. Eight of the eleven risk items were sufficient to determine attitudes toward the risks associated with nuclear power.

The absolute value of the b times e products obtained from the model may be taken as measures of the particular attributes' importance in determining attitude formation. With regard to nuclear power attitudes, the three most important determinants were found to be negative, or risk items; the highest ranking positive determinant occupied fourth place. This agrees with observations that the risks from nuclear power seem to be more important than the potential benefits in attitude formation.

The correlation between $A_o = \Sigma$ be (from the model) and the direct measurement of attitudes toward nuclear power (semantic differential) was 0.68 ($p < 0.001$). The correlation between $A_r = \Sigma$ be (model) and the direct measurement of attitude toward the risks associated with nuclear power (semantic differential) was found to be 0.76 ($p < 0.001$).

We are well aware that the specific results obtained in this experiment come from only one homogeneous group in one specific cultural environment. However, the application of the Fishbein model to learning more about the public response to nuclear energy has been demonstrated; it is intended to apply the method to larger groups, in several cultures, and to include attitudes toward other types of energy systems. Data analysis

is continuing; detailed results of this experiment are expected to be presented at the 1977 Salzburg Conference on Nuclear Power and its Fuel Cycle.

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