AN ABSTRACT OF THE THESIS OF

RICHARD BURTON BARNHART JR. for the DOCTOR OF PHILOSOPHY
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Title: ATTITUDES OF SECONDARY SCHOOL SCIENCE AND NON-SCIENCE TEACHERS TOWARD CERTAIN SCIENCE RELATED SOCIETAL ISSUES

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Stanley E. Williamson

In response to a need expressed by science educators, it was determined that the present status of science teacher attitudes should be assessed regarding science related societal issues.

The purposes of the present study were as follows:

1. To determine the attitudinal dimensions of a universe of science related societal issues.
2. To construct valid and reliable attitude scales for as many of the identified dimensions as is practical.
3. To determine, by application of these scales, whether there exists a statistically significant difference in attitude toward these science related societal issues between science teachers and non-science teachers.

Approximately 250 Likert-type items were developed concerning such topics as pollution, population control, conservation, etc. Responses from pilot groups of university and high school students were used as a basis for selection of 100 items to represent the universe of science related societal issues.

The 100 items of the preliminary inventory were administered to a representative sample of 304 Oregon public high school seniors. The responses were factor analyzed using principal components analysis and Varimax rotation. Twelve factors were extracted, accounting for approximately 40 percent of the variance.

Seven of the factors were interpretable using attitude models based on examination of the relationship of item content within each factor. The following interpretations were obtained:

Factor 1. Regard for human life. Special referents include abortion, euthanasia and drug use.

Factor 2. Apparent fatalistic disillusionment with "progress" as represented by scientific and technological advances.

Factor 3. Need to cooperate with nature rather than subjugate it. Conservation and preservation are stressed.

Factor 4. Concern with control of population and its related problems. Both population and authority are present.

Factor 7. Need to take personal responsibility for societal woes. Specific references are to personal conveniences, luxuries and enjoyments.

Factor 9. Belief in the utility of science and technology and their ability to solve many of society's problems.

Factor 11. Desire to have and allow individual freedom.

High item loadings and logical consistency to attitude models were sought in development of the final inventory. Seven Factor Attitude Scales of from five to 12 items each constituted the 60 item Inventory of Societal Issues (ISI). Factorial stability of the 60 items of the ISI was inspected by factor analysis of the responses of the high school seniors. The factors were judged stable on the basis of their identifiability in the new analysis.

Random samples of science and non-science teachers were requested, by mail, to respond to the ISI in November, 1970. Approximately 65 percent (450) of the teachers responded, and 414 usable inventories were obtained.

The Scale reliabilities ranged from 0.36 to 0.91. Both KR-20 and Spearman-Brown correction to Pearson product-moment correlation coefficients were calculated. Total ISI reliabilities of 0.82 and 0.85, respectively, were obtained using these two techniques.

Temporal stability was investigated using Pearson product-moment correlation coefficients relating responses of 19 teachers

from two occasions separated by two weeks. Values for the separate scales ranged from 0.39 to 0.91 with the total ISI registering 0.93.

Responses of the extreme 27 percent groups were used to determine item discriminability. Each item discriminated significantly beyond the 0.001 level.

Factorial stability was investigated through factor analysis of teacher responses to the ISI. The Scales were judged relatively stable as they were identifiable within or between the resultant T-Factors. The ISI was judged appropriate for the teacher group, though some scales did not display unidimensionality.

A known-group test was made to demonstrate construct validity. A criterion group of concerned environmentalists was identified and administered the ISI. A t-test was used to compare teacher and criterion group responses. Factor Attitude Scales I, VI and VII provided significant differences.

The science and non-science teacher groups were compared by analysis of covariance. Scores on each of the Factor Attitude Scales were used as criterion measures. Control variables were chosen, using a preliminary analysis to determine appropriateness, from the following: 1) Grade level responsibility, 2) size of teaching community, 3) size of community of origin, 4) amount of teaching experience, 5) age, 6) sex, 7) undergraduate degree institution, and 8) amount of educational preparation.

Comparison of responses of science and non-science teachers yielded the following results:

Factor Attitude Scale II

Though the majority of teachers displayed the disillusionment with science represented by this Scale, non-science teachers displayed it to a significantly greater degree than did the science teachers.

Factor Attitude Scale VI

Non-science teachers showed a significantly greater belief in the utility and ability of science and technology than science teachers.

Factor Attitude Scale VII

Science teachers exhibited a significantly greater desire to have and to allow individual freedom, as measured by this Scale.

No significant differences were measured on the remainder of the Scales.

It was concluded that, within the limits outlined for this study, science teachers differ in attitude from non-science teachers concerning some science related societal issues.

Attitudes of Secondary School Science and Non-Science Teachers Toward Certain Science Related Societal Issues

by

Richard Burton Barnhart Jr.

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Professor of Science Education
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Redacted for Privacy

Chairman of Department of Science Education

Redacted for Privacy

Dean of Graduate School

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I. INTRODUCTION

In recent years, certain social issues have become of growing concern to a larger segment of the population of this country. The mass media have put before the American people a montage of concerns including: the ugliness of pollution, the threat of depletion of natural resources, the menace of a population in the state of explosion, the wonders and dangers of an automated, technological age, and the increasing difficulty of experiencing the aesthetic pleasure of seclusion in areas of natural beauty. These and many other related issues are of more than a passing interest to science educators. In a recent publication commemorating the Silver Anniversary Year of the National Science Teachers Association (Butts, 1969), at least four articles refer to these issues either explicitely or implicitely. Herman Branson writes of "An Era of Wider Responsibility":

> In all education, but especially in science education, there must be a heightened sense of urgency, of immediacy, to relate learning to our human and social problems (p. 8).

Stanley Williamson discusses "Changing the Education of Science Teachers":

> Prospective science teachers must be aware of the societal implications of the times -- the social forces and conditions influencing the educational endeavor... They should study

> the characteristics of projected changes in society and be able to identify the societal ingredients that have implications for education. The increase in populations by an estimated 45 to 50 million in the next 15 years, combined with an ever-increasing life span, and the tendency toward urban living, present many problems related to environmental pollution, maintenance of physical and mental health, and the depletion of natural resources. These concerns must be kept in their proper perspectives by science teachers. Scientists and science teachers have a responsibility to understand the problems involved in the development of a more humanistic culture and must be able to assist in developing effective strategies to bring it about...
>
> Science teachers should recognize the serious problem areas of the contemporary society, recognize new ones as they emerge, and should see the implications for science and science teaching... (p. 22).

Fred Fox describes "Forces Influencing Education":

> A crucial factor is the teacher. He must be a perpetual student of the total scientific enterprise and its relation to the human condition. Unless he develops understandings, indeed, convictions of his own which stimulate and sustain his personal life, there is little likelihood that true changes will be effected in the classroom. For the teacher whose conceptions of education mingle in both his tissues and his mind, methods, content, and materials flow easily for classroom experiences. To bring about the kind of change of which we have been speaking, we must start with ourselves (p. 15).

Richard Merrill and David Butts recommend "Vitalizing the Role of the Teachers":

> If science teaching is to affect the attitudes and behaviors of students outside the classroom, then a part of the teacher's role must be to have the desired attitudes and behaviors in all his relationships with students (p. 41).

These distinguished science educators seem to be committing their field to the task of identifying and clarifying the role of science

and technology as it relates to societal issues. They seem to be placing science education in the position of at least partial responsibility for the attitudes and behaviors exhibited by students when confronted with these issues. In addition, they appear to be singling out, as the most important and effective instrument to carry out that responsibility, the science teacher. And they offer as an effective method of bringing about attitude and behavior change possession and exhibition by the teacher of the desired attitudes and behaviors.

A search for differences becomes a relevant quest. If science education is to take on responsibility for some of these attitude changes then science teachers will be able to fulfill that responsibility more effectively if they hold more positive attitudes toward the issues involved. If such differences do not exist then the implication for teacher training, both in-service and pre-service, is that some emphasis should be placed on the development of these positive attitudes.

If, indeed, this is an effective course to follow then it seems almost mandatory, as a first step, to seek an answer to this question: is the science teacher, who has only recently been charged with the role of instructing pupils in the skills of solving problems, equipped affectively to guide pupils toward the ability to resolve issues? In other words, are the attitudes held by science teachers reasonable models for students to emulate? It is in search of the answer to this question that the present study is directed.

Statement of the Problem

The problem may be stated in the form of a question: Do science teachers and non-science teachers differ in their attitudes toward certain science related societal issues?

The purpose of the study is threefold:

1. To identify the attitudinal dimensions of a universe of science related societal issues.
2. To construct valid and reliable attitude scales for as many of the identified dimensions as is practical.
3. To determine, by application of these scales, whether there exists a statistically significant difference in attitude toward these science related societal issues between science teachers and non-science teachers.

The first two purposes are common to this study and to a study carried out by Robert Steiner. Since a common need exists for the measuring instrument it is developed in a common effort by these two researchers.

Importance of the Study

In a study carried out in Britain (Pollock, 1966), teachers were asked to rate what they thought were the important outcomes of an education. The most important objective was listed as "producing a better

understanding of our environment." High on the list of outcomes was "attitudes".

Sufficient hue and cry has been heard from both within and without educational circles, for the installation of environmental studies. A large apostolate also exists that preaches the virtue of attitude development as a worthy endeavor for education. Accepting the learning principle that calls for exhibition, by the teacher, of that which is to be taught, leads one to search out models - teachers whose attitudes towards environmental issues are well developed - to direct new programs that deal with those issues.

Environmental issues can be, for the most part, connected to science and technology by one route or another. The application of science has, on the one hand, brought about the machines, techniques or products and by-products that have dealt us into this lemming-like game (according to some writers) of the Rape of Mother Nature.

On the other hand, her virtues, and ours, can be salvaged by turning to science and using our rational thought processes to invent, discover, medicate, cultivate and automate our way to harmony with all the Universe (according to certain other writers).

Science and applications of science become either the devil's advocate or the saving grace for many of the environmental issues extant today. These science-related societal issues are the ones with which those teachers, referred to earlier, will be dealing when

attempting to develop attitudes in the student enrolled in environmental studies courses.

Is there a group of teachers that, today, is better prepared than any other group, to lead students toward development of attitudes in this realm? One group that comes to mind for this function is that group supposedly best prepared to deal with the science-relatedness aspect of the issues - science teachers. One important aspect of this study is to determine whether or not such a difference exists. Such a determination calls for reassessment of teacher training programs in science education if no difference exists. If a difference does exist, then there are immediate implications for choosing teachers for newly instituted environmental studies programs.

To determine if differences in teacher groups do exist, a measurement must be taken of the attitudes of both groups. Remmers, (1954) in a discussion of the value of attitude measurement to society, offers support to researchers dealing with attitude measurement and points to societal concerns as a most appropriate target area for emphasis on attitudes.

> The realization is rapidly growing that attitudes, the way individuals and groups feel about the various aspects of their world, are probably more determinative of behavior than mere cognitive understanding of this world. When this is granted, the importance and value of attitude measurement becomes at once obvious. On the basis of experimental evidence psychologists agree on the majority of psychological issues of importance in the determination of happy, need-gratifying individual existence. Areas

> about which there is substantial agreement include mental hygiene, intelligence, race differences, nutrition, specific aptitudes, and educational methods. Turning from the individual to society, from which he is inseparable, it is essential that the body of knowledge on which there is professional agreement and for which there is objective substantiation be utilized for the realization of the individual's capacities and happiness and for his integration in terms of the general welfare.
>
> Among the prerequisities for the fulfillment of the promise of psychology and the other social sciences are the cultivation of attitudes favorable to (1) social change and social invention, (2) public responsibility and open discussion of public issues, and (3) the fruitfulness of free inquiry. Nothing less in the areas of social attitudes will permit the extension of knowledge for free men in a democratic society. (p.15)

The measurement of attitudes cannot be undertaken without the appropriate instrument. It is disappointing to search for attitude scales appropriate for the measurements desired in this study. Of equal importance to the actual measurements that result from this study is the production of an attitude inventory directed at societal issues. Of such instrument development Fox (1969) says:

> What we can expect with student research, and what should be encouraged far more than it is, is the recognition that a creative effort in the area of instrument development, in and of itself, may be the most productive project a student can undertake in a particular problem area. Graduate faculties could move research in education forward if they would consistently support this idea. If a student is stymied in working on a particular problem because of instrument limitations, it is far more sensible to encourage the student to devote his time, energies, and abilities to the effort of trying and evaluating some new approach to instrumentation in the problem area than it is to sympathetically accept his use of the instrument with recognized inadequacies.

> This author firmly believes that if the efforts which graduate students have devoted in the past 15 years to studies doomed from their beginnings by inadequate instrumentation had been devoted instead to the instrumentation problem itself, we would be far better able today to conduct studies of educational significance (p. 105).

Teaching for attitude development may be fruitless if, for each specific case of environmental concern, new attitudes must be developed. A more efficient technique would certainly be to determine underlying attitude dimensions that encompass many specific issues. These dimensions could then be dealt with in a more general manner.

Another important aspect of this study, then, is the identification of attitude dimensions that encompass many specific issues. The dimensions themselves, and their example as an application of the factor analytic technique to the definition of a broad area of the attitude domain, stand as a possible contribution of more than passing interest.

The importance of the study can be summarized as follows:

1. The determination of whether differences in attitude, toward science related societal issues, exist between science teachers and non-science teachers, has implications for science education teacher training programs and/or teacher assignment to newly instituted environmental studies programs.
2. The production of an attitude inventory directed toward societal issues is important in itself.
3. The identification of attitude dimensions is an important

aspect of the study since it provides for measurement of those dimensions and offers an example of the use of factor analysis for identification of such dimensions.

Hypotheses to be Tested

The general hypothesis with which this investigation is concerned is that secondary school science teachers have a more positive attitude than other secondary school teachers. A specific hypothesis to support or deny this contention is the following: the scores obtained by secondary school science teachers differ significantly from scores obtained by secondary school non-science teachers on each of the measures represented on the final attitude inventory.[1]

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[1] The results of the study will show that seven such measures, referred to as Factor Attitude Scales, will have been developed. These will be identified as measures of the following attitudes:

1. Regard for human life. Special referents included abortion, euthanasia and drug use.
2. Desire for a return to laissez-faire with respect to nature. Fatalistic disillusionment with "progress" as represented by scientific and technological advances was evidenced.
3. Need to cooperate with nature rather than subjugate it. Conservation and preservation were stressed.
4. Concern with control of population and its related problems. Both population and authority were present as referents.
5. Need to take personal responsibility for societal woes. Specific references were made to personal conveniences, luxuries and enjoyments.
6. Belief in the utility of science and technology and their ability to solve many of society's problems.
7. Desire to have and allow individual freedom.

Overview of the Design of the Study

What follows is a brief outline of the steps leading to solution of each of the stated problems of this study.

Identification of Attitude Dimensions

1. Appropriate referents are identified from multitudinous sources including professional and popular literature, mass media, conversations, lectures, etc.
2. Items are prepared and evaluated using accepted guidelines for item writing and responses of university and high school pilot groups to determine ambiguity, readability and discriminability. A panel of judges is used to assess comprehensiveness as represented by the spectrum of item content.
3. The preliminary inventory is constructed from the chosen items.
4. The senior sample is chosen.
5. The preliminary inventory is administered.
6. The responses are factor analyzed.
7. Attitude models are constructed to account for the various item groupings represented by each factor.

Factor Attitude Scale Development

1. Items most representative of each factor are chosen. High factor loadings and good fit to the attitude model are sought.
2. Reliabilities are calculated from the senior sample responses.
3. Factorial stability is inspected. Factor analysis of the senior responses to the 60 items of the ISI is used for this purpose.

Assessment of Teacher Attitudes

1. The teacher sample is chosen. Random samples of two populations, one a general teacher group, the other predominantly a science teacher group, are selected.
2. The ISI is administered to random samples by mail. Background information is also collected.
3. Analysis of covariance is performed to compare science and non-science teachers on each Scale.
4. ISI reliabilities are calculated using teacher data. Both internal and temporal consistency are tested.
5. Construct validity is tested. A known-group technique is utilized to assess the merit of some of the Scales.

6. Item discriminability is calculated. Chi-square, comparing the extreme groups on each Scale, is calculated.
7. Factorial stability is inspected. Factor analysis of teacher responses to the ISI is carried out.

Definition of Terms

Several terms appear repeatedly throughout the study. Presented here is the definition of each of those terms, as utilized for the present purposes.

Attitude

> Attitude is a relatively enduring system of affective, evaluative reactions based upon and reflecting the evaluative concepts or beliefs which have been learned about the characteristics of a social object or class of social objects (Shaw and Wright, 1967, p. 10).

(The concept Attitude will be discussed further in chapter II.)

Science Related Societal Issue

The issues chosen to serve as referents in the building of attitude statements are identified from popular and professional literature, the mass news media, and solicitations from students and colleagues. They are agreed upon by the researchers involved in the instrument development based upon informal criteria and subjective judgment. In addition, a panel of judges is asked to offer criticism as to the

relevance of those issues selected and their scope with respect to the universe of issues of possible concern. (The names of the panel members appear in Appendix A.) Science is defined broadly and in a popular sense so that a broad interpretation can be made concerning which issues are related to science. The inclusion of technological devices and practices such as computers and medicine exemplifies the latitude allowed in defining science related societal issues.

Secondary School Science Teacher

Public school teachers of grades seven through twelve, teaching and holding certification to teach courses commonly recognized as science courses and not holding certification to teach courses commonly recognized as non-science courses are classified as secondary school science teachers. For some statistical analyses a somewhat less stringent definition is used; whereby teachers are allowed to hold certificates for areas other than science, so long as they are teaching and are certified to teach, science. Teachers fitting the more (less) strict definition are referred to as members of the Pure (All Teachers) group, symbolized as S(s). These definitions do not include any teacher classified as a secondary school non-science teacher.

Secondary School Non-Science Teacher

Public school teachers of grades seven through twelve, not

teaching or holding a certificate to teach courses commonly recognized as science courses are classified as secondary school non-science teachers. For some statistical analyses a somewhat less stringent definition is used; whereby teachers are allowed to hold certificates to teach science so long as they are not actually teaching science. Teachers fitting the more (less) strict definition are referred to as members of the Pure (All Teachers) group, symbolized by NS (ns). These definitions do not include any teacher classified as a secondary school science teacher.

Factor Attitude Scale

Each attitude statement used in the factor analysis loads, or correlates with, each factor extracted in the analysis. Those items that load highest and appear, in the judgment of the researchers, to be related, logically and psychologically, to the other high loading items are retained for that factor and are referred to, collectively, as the attitude scale for that factor. Each factor that is interpretable and is deemed to have sufficient items to be included in the final inventory is represented by its Factor Attitude Scale, i.e., that collection of items judged to best represent that factor. Any allusion to specific Scales used in this study are in reference to Factor Attitude Scales.[2]

[2] The previous footnote (see page 9) is in reference to the results of the study, and the Factor Attitude Scales are listed therein.

Inventory of Societal Issues (ISI)

The collection of attitude statements that makes up the Factor Attitude Scales is called the Inventory of Societal Issues and referred to as the ISI.

Community Size

Four classifications are used as appropriate groupings for teachers from schools serving communities of different sizes. They are as follows:

1. Urban -- Only the area within the city limits of Portland is included in this class.
2. Portland-Suburban -- This classification includes Clackamas and Washington Counties and the area of Multnomah County exclusive of the urban Portland area.
3. Town -- Included in this classification are all communities, excluding the urban and Portland-suburban communities, that have populations between ten thousand and one hundred thousand.
4. Rural -- This classification includes all communities with populations less than ten thousand.

Community Background

Three classes of community are used to classify teacher community background. They are as follows:

1. Less than ten thousand population
2. Between ten thousand and one hundred thousand population
3. Greater than one hundred thousand population

Basic Assumptions

Certain assumptions are made in carrying out this research activity. The most basic of these assumptions are the following:

1. Attitudes cannot be observed directly and so must be inferred from behaviors or responses. It is therefore assumed that responses to self report opinion and belief statements are appropriate manifestations of the attitudes being measured.
2. It is assumed that the technique of factor analysis, combined with careful interpretation by the technique of the construction of consistent, interpretive models, provides meaningful clusters of items to sample attitudes.
3. It is assumed that the attitude dimensions that are identified using public school seniors as respondents are meaningful measures for secondary school teachers.
4. Though a random sample of teachers was chosen to participate in this study, a complete return of responses was not

achieved. It is assumed that the non-respondents are distributed similarly as the respondents on the measures of interest, teaching of science vs. non-science courses and each of the attitude measures.

Limitations of the Study

In this study, certain issues are raised for which compromise procedures are employed as a means of resolution. The compromise procedures may be perceived as limitations of the study. Possible limitations of this study are the following:

1. The study is limited to the extent that teachers do not respond honestly to the Inventory of Societal Issues.
2. The study is limited to the extent that the models used in interpreting factors are not unique and general. It may be that other models serve the interpretive function as well as the one chosen and, in addition, are more useful in explaining additional items that, through further study, might be found to fit the dimension.
3. The study is limited to the extent that a small number of items used as a Factor Attitude Scale is perceived as unrepresentative of an attitude model.

Delimitations of the Study

A study may lead to certain interpretations that the researcher did not intend. The following are statements by this researcher indicating bounds placed upon the study:

1. No value judgements are implied concerning replies to individual statements or scores on particular Factor Attitude Scales.
2. No prediction of behavior is inferred from replies to individual statements or scores on particular factor attitude scales.
3. The sub-universe of issues, represented by the final inventory and identified by factor analysis, is not offered as an exhaustive group of items fully representative of the universe of science related societal issues.

II. REVIEW OF RELATED LITERATURE

The literature relevant to the present study has been divided into four convenient areas: a brief discussion of attitude--its history and present theoretical status, a more specific look at techniques of attitude measurement, with particular emphasis on scale construction, the technique of factor analysis and science teacher attitudes. This chapter deals with each of these topics.

Attitude

Each division of the study of human behavior has developed a concept similar to the concept set. Set may be described as a person's state of aptness or readiness. The concept of attitude has evolved from this original construct. Allport (1935) reviewed the early development of the concept of attitude. He referred to nineteenth century usages including "attitude of mind" and "motor attitude" as precursors to our present use of the term, attitude. These terms referred to cognitive and psychomotor sets respectively. Allport attributed the work of the German experimental psychologists, and particularly that of the Wurzburg school, with making attitude an acceptable concept in psychology.

Acceptance of attitude as existent did not make it immediately popular as an object of study. The limited studies that were done in

those early days tended to relegate attitude to the unconscious. Experimental procedures with the unconscious were not extremely popular with these early scientists. So, it was to wait until Freud unleashed the emotions of man for inspection, before serious pursuit of a theoretical conception of attitude could occur.

Sociologists, in attempting to conceptualize social behavior in terms of psychological theory, evolved eventually to the use of attitude as a central object of study. Allport credited Thomas and Znaniecki (1918) with providing this direction and impetus with their study of Polish peasants. The next fifteen years was a period of rapid development in the study of attitudes.

Presently the concept of attitude is described in a wide variety of ways. The characteristic included in most formulations of the concept, according to Shaw and Wright (1967), is that attitude "entails an existing predisposition to respond to social objects which, in interaction with situational and other dispositional variables, guides and directs the overt behavior of the individual" (p. 2).

To delve more deeply into the concept of attitude requires adoption of a particular perspective. There are available two points of view from which to choose. Since the viewpoints are not mutually exclusive but, rather, complementary, both will be dealt with, allowing each to add to the total conception of the construct, attitude.

The descriptive approach to the understanding of attitude is a more or less static view. Bounds are placed on the concept and an analytical picture is painted of what attitude is and, just as importantly, what it is not.

Also available for inspection is the purpose of attitude. The purpose served by this personality characteristic affords one the opportunity of observing the dynamic operation of attitude.

A Descriptive Look at Attitude

The end result of a description of an object is often parsimony in communication concerning the object or derivation of parameters for measurement of the object. A descriptive look at attitude, however, will be a disappointment if these are one's goals. Allport (1935) included seventeen definitions of attitude in his review.

Definitions of Attitude and Similar Constructs

It is true that there are common aspects of the concept of attitude that are shared by most workers in the realm of attitude study. It is equally true that complete agreement is not forthcoming. Such a state makes a precise, universally acceptable definition of attitude very difficult to construct. Shaw and Wright (1967, p. 4-6) attempted to sort out some common usages of eight often used terms and to contrast them with attitude. A look at these contrasts will allow a better

definition of what attitude is not.

Belief vs. Attitude -- Belief is commonly conceived of as an acceptance or rejection of a characteristic of an object or the existence of that object. Attitude refers to a preference or non-preference for the object.

Concept vs. Attitude -- A concept is thought of as two or more entities in some relationship. No a priori evaluative implications are assumed and no particular content or referent need be inferred. An attitude requires an evaluative component referred to a specific object. Two is greater than one is a concept. Two heads are better than one is more representative of an attitude.

Motive vs. Attitude -- A motive is accompanied by an existent drive; it is labeled by a goal and is therefore goal specific. An attitude is a probability that a motive (and drive) will be elicited; it is labelled by its object and is therefore object specific.

Opinion vs. Attitude -- An opinion is usually conceptualized as a verbalized or verbalizable entity. It is a response and represents a belief that need have no emotional commitment or desire. It is usually open to reevaluation. An attitude may be mediated by nonverbal processes. It is a response predisposition. It is not always conscious and so may be less open to reevaluation.

Set and Habit vs. Attitude -- All of these represent acquired action tendencies. Set is usually reserved to represent motor

readiness. A habit is a stronger action tendency. It has a more enduring structure than set. Attitude is restricted to the affective, evaluative reactions.

Trait vs. Attitude -- A trait may be described as a stable, nonspecific, consistent disposition to respond in certain ways. An attitude has a specific referent. An attitude could be classed as one type of trait.

Value vs. Attitude -- A value is referred to as the degree of worth ascribed to an object. An attitude characterizes the valuing process, giving rise to or accompanied by motive arousal. Attitudes may be inferred by observing a person in the process of valuing.

It should be noted that these differences are not accepted by all workers in the field of attitude study. McGuire (1969), for instance, discussed the concepts of attitude and value. Although he seemed to ascribe to the distinctions outlined above, he was quick to point out that some theorists view value as a broad attitude. "Two different courses have been pursued in the attempt to untangle the concepts of attitude and value. The less interesting involves defining a value as a broader attitude"(p. 151).

Properties of Attitude

To know what attitude is not, is not to know what attitude is.

Several reviews have listed properties of attitudes that are commonly accepted. Scott (1969), for instance, listed eleven such properties. Shaw and Wright (1967) summarized general characteristics of attitudes acceptable to many attitude theorists. The latter will be discussed here since it is the Shaw and Wright definition that has been adopted for the purposes of this study.

> 1. Attitudes are based upon evaluative concepts regarding characteristics of the referent object and give rise to motivated behavior (p. 6).

This particular characteristic is not universally accepted. Note that the cognitive and behavioral aspects have been separated from attitude according to this description. Some workers would hold that these aspects are simply components of attitude (Rosenberg and Hovland, 1960). Anderson and Fishbein (1965) are in agreement with this characteristic. They defined attitude in terms of a summation of beliefs (evaluative concepts), but, upon close inspection, it is found that this was an attempt to operationalize the definition. In the discussion of attitude measurement, it will be viewed as a necessity to infer from opinions, beliefs, behaviors, etc. in order to assess attitudes.

> 2. Attitudes are construed as varying in quality and intensity (or strength) on a continuum from positive through neutral to negative (p. 7).

The postulated continuum is perceived as having a neutral point from which to define positive and negative directions. Strength or intensity of attitude is represented by the distance from the neutral

point with more extreme attitudes residing further from the neutral point. Variation and refinements of this scheme exist (Guttman, 1954), but most measurement has been based on this conception.

> 3. Attitudes are learned, rather than being innate or a result of constitutional development and maturation (p. 8).

This conception of attitude carries with it the possibility of the application of learning theory to development and/or change of attitude. This experiential nature of attitude development, to the exclusion of other influences, is almost universally accepted. Perhaps because this is so McGuire (1969) challenged its validity. (This will be discussed further in the section concerning determinants of attitude.)

> 4. Attitudes have specific social referents, or specific classes thereof (p. 8).

Referents are general or specific according to the degree of relatedness that exists between them when attitudes are exhibited. The generality of the referent is then simply the degree of relatedness of the attitude objects. Agreement on the level of relatedness that is acceptable to determine generality is difficult to find. Polar positions exist. One position holds that referents are quite specific; i.e., each object must be evaluated separately. Another requires that referents be very general; i.e., evaluation must be made solely in terms of one or two dimensions. As an example, one formulation hypothesized that many objects fit somewhere along two continua, a conservative vs. liberal dimension and a tough vs. tenderminded dimension (Eysenck, 1953).

Neither of these two polar positions is very useful in determining attitudes toward specific areas of human interest. No generalizations can be made if all referents are singular and specific, nor, for that matter, can studies that are obviously similar be compared in the hope of finding consistencies. On the other hand the general outlook requires that we concentrate wholly on the characteristics of the people involved and even then on only a small portion of their personality spectra. Some attitude theorist may be interested in resolving all attitudes into one or two facets of human personality. Such a general outlook, however, is of little use to the educational experimentalist whose objectives will be a great deal more specific than this outlook will allow.

Traditionally, attitude has come to include only predispositions to respond to objects perceived as social in nature. The object must somehow become attached to the wishes, desires, motives or intents of another person, a group of people or even, in some anthropomorphic way, the object itself. It is necessary that this attachment be involved in the response the person makes to the object. If he does not attach these characteristics to the object, but, instead, is stimulated in some non-social way by it, the response set that is obtained would not be called an attitude. Suppose, for instance, that the person discovered at the last moment that a surface he was about to touch was hot. In the moment before contact, his body would attain a state of readiness to respond to the contact that was about to be made. This readiness

would not be classified as an attitude since the object is perceived only as a hot object, not as an instrument of the devil.

Obviously there are fuzzy areas of gray in determining which objects are perceived in a social sense. The possibility always exists that only some of the sample of interest perceives an object in a social way. It is the function of the researcher to attempt as much as possible to ascertain which objects are best suited for use as referents.

5. Attitudes possess varying degrees of interrelatedness to one another (p. 9).

The beliefs upon which different attitudes are based may overlap as may, also, the referents to which each attitude relates. This overlapping need not be logical or consistent. The total attitudinal system of an individual is made up of interrelated subsystems of attitudes. Attitudes occupy positions central or peripheral in the attitudinal system with those more central holding more value to an individual and, thus, showing greater resistance to change.

6. Attitudes are relatively stable and enduring (p. 9).

The source of this stability resides in the interrelatedness of the attitudes, reinforcement experiences during attitude acquisition and active resistance to change by the possessor when his attitudes are threatened.

Determinants of Attitude

There is substantial agreement among attitude theorists that

experience helps develop and change attitudes. There is not total agreement on which experiences are most important to development and/or change nor to what degree any experience contributes to development and/or change of attitude.

McGuire (1969) broke down human experiences into the following areas:

1. Physiological factors. These include aging, illness and certain pharmacological and surgical interventions (p. 163-166).

Hormonal actions at menopause give evidence that the physiological effects of aging and drug intervention, in the case of hormonal treatment, affect attitudinal outlooks of some people experiencing these changes.

2. Direct experiences with the stimulus object (p. 166-167).

Examples of the traumatic incident or of repeated cumulative contacts in such situations as war or natural disaster can be held up as evidence for attitude change through direct experience.

3. Total institutions (p. 167-171).

Programmed existence, such as imprisonment accompanied by brainwashing, prolonged psychoanalysis or, more commonly and less spectacularly, the day to day experience of "being raised" as a child, are situations conducive to development and/or change of attitudes.

4. Social communications (p. 171-180).

Both verbal and nonverbal communication are recognized means of social interaction in current research. Researchers from the fields of social psychology, education and communication place great emphasis on these techniques as means of persuasion and, therefore, possible avenues of attitude change.

In addition to experience as a determinant of attitude, McGuire (1969) stepped out onto a lonely limb and attempted to make a case for genetic factors as possible determinants of attitudes. He offered certain plausibility arguments for this position and extrapolated from research on genetic transmission of agressiveness to speculate on the possibility of ontogenetic and phylogenetic manipulation of genetically determined attitudes through the procedures of genetic engineering. He also scolded other attitude theorists for ignoring a hypothesis from existence simply because the possibilities are distasteful.

> The important topic of possible genetic determination of attitudes has been so neglected by researchers that this (discussion) has been very conjectural. Yet the very neglect and mild distastefulness of the issue militate against our passing over the topic in silence. It has not been definitively shown that genetic factors influence one's general attitude orientations or one's general susceptibilities to various social-influence pressures. However, it appears quite possible that each of these areas is so affected (p. 163).

The Function of Attitude

Attitude theories have been classified by several writers

(Fishbein, 1967; Kiesler, Barry and Miller, 1969). These classifications are somewhat arbitrary, but useful. One class, recognized as a separate theoretical approach by some, is referred to as the functionalists. It can be argued that functionalists present more of a taxonomy for classifications of existent attitude theories than a separate theory. The purpose of this section is not to argue that point. The functionalist viewpoint is general enough to allow its use as a taxonomy. A discussion of this viewpoint will provide a basis for discussion of two other theories that will be presented -- consistency theories and behavior theories.

Representatives of the functionalist approach to attitude description are Katz (1960), Smith, Bruner and White (1956) and Kelman (1958). The Katz formulation will be presented here as it appears to have more widespread recognition.

Katz listed the following four major functions which are performed for the personality by attitudes:

1. The instrumental, adjustive, or utilitarian function.

> ...this function is a recognition of the fact that people strive to maximize the rewards in their external environment and to minimize the penalties... Attitudes acquired in the service of the adjustment function are either the means for reaching the desired goal or avoiding the undesirable one or are affective associations based upon experiences in attaining motive satisfactions...the dynamics of attitude formation with respect to the adjustment function are dependent upon present or past perceptions of the utility of the attitudinal object for the individual (p. 23). A modern expression of this approach can be found in behavioristic learning theory (p. 21).

2. The ego-defensive function.

> ...The person protects himself from acknowledging the basic truths about himself or the harsh realities in his external world. Freudian psychology and neo-Freudian thinking have been preoccupied with this type of motivation and its outcomes (p. 21).

3. The value-expressive function (P. 120).

Another aspect related to, perhaps more current, psychoanalytic theory is that of value expression. Katz holds that expression of attitudes gives satisfaction to the person and allows him to examine and define his self-concept and central values. In addition, he may find such expression helpful for adoption of group values when entering a new organization.

4. The knowledge function (p. 170).

This function of attitudes is motivated, according to Katz, by the individual's need to develop a consistent structure for understanding and accepting his universe; presumably his social universe. This function is manifest under conditions of inconsistency and, as such, could encompass consistency theories of attitude including dissonance theories.

Kiesler et al. (1969), in criticizing functional theories, pointed out a measurement problem that seems extremely difficult to overcome.

> The functional theories...leave us powerless to predict unless we have accurate measures of individual characteristics. Thus its foremost requirement and most striking

> present lack is a technology for assessing the function of attitudes. The functional theorists have made little headway in providing such a technology and, furthermore, have invested relatively little effort into the problem. (p. 326-327)

Consistency Theories

Consistency theories are based on the assumption that there exists a basic need for some kind of consistency within the personality. What is to be consistent and how this consistency is maintained defines the various divisions of consistency theory, but the basic general postulate is the same for all. Kiesler et al. (1969) referred to a statement by Zajonc wherein it was pointed out that the basic presumption of consistency theory is that man is rational. But, Zajonc pointed out, the means by which consistency is attained "unveils his irrationality". Kiesler et al. then related an example of this from Allport.

> Mr. X: The trouble with Jews is that they only take care of their own group.
>
> Mr. Y: But the record of the Community Chest shows that they give more generously than non-Jews.
>
> Mr. X: That shows that they are always trying to buy favor and intrude in Christian affairs. They think of nothing but money; that is why there are so many Jewish bankers.
>
> Mr. Y: But a recent study shows that the percent of Jews in banking is proportionately much smaller than the percent of non-Jews.

Mr. X: That's just it, they don't go in for respectable business. They would rather run night clubs. (p. 156)

Balance Theory

As an example of consistency theory Heider's balance theory (1946) will be described briefly. This theory has been the basis from which other theorists have built their own particular variations. The description here follows that of Cartwright and Harary (1956) and Kiesler et al. (1969). The former have generalized Heider's theory. The latter have reviewed it.

Heider conceived of interactions between P (one person), O (some other person) and X (some impersonal entity). Relationships exist between the separate pairings of P—O, O—X and P—X. These relationships may be represented by triadic diagrams with P, O, and X forming the points of the triangle. The relationships that occur within each pair are of two types. The first is an attitudinal relationship and is represented by L if the relationship is positive (like, love, value, approve) and by -L if the relationship is negative (dislike, hate, etc.). The second type of relationship is a cognitive unit formation represented by U or -U. This relationship deals with such concepts as belonging to, being similar to, causing, being close to or somehow being perceived as having an association with the other member of the pair. For the present purposes it is sufficient to illustrate the

attitudinal component. The unit formation relationships follows the same pattern.

Eight possible triadic combinations exist using P, O and X as the related objects and L or -L as the relationships. They are as follows (Kiesler, 1969, p. 159):

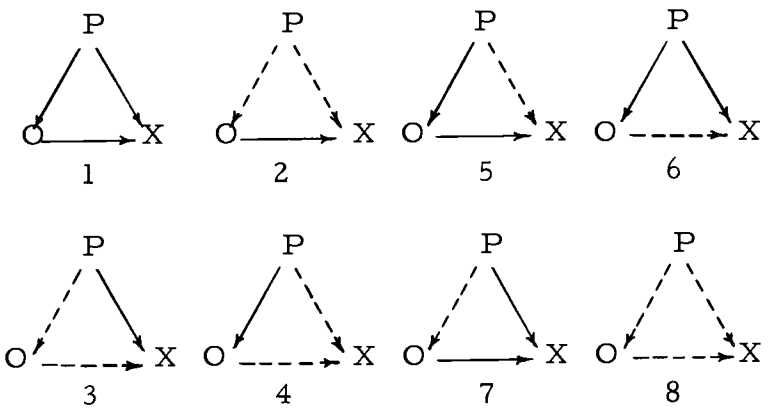

Figure 1. Schematic representation of balanced and unbalanced states. A positive relationship is indicated by an unbroken line; a negative relationship by a broken line. The direction of the relationship is indicated by the arrow.

Each of the first four triads contains an even number (zero or two) of negative relationships. These are referred to as balanced states. A specific example of this interaction might involve a boy (P) who admires (L) another boy (O). This relationship is represented by P L O. Suppose O consistently roots against (-L) a particular baseball team (X). This relationship is then represented by O -L X. A balanced state exists if the first boy also roots against that baseball team,

P - L X. This would be represented by triad number 4 in Figure 1.

Heider hypothesized that if no balanced state exists then forces exert themselves to change one of the relationships so that balance is achieved.

Cognitive Dissonance

Another consistency theory is of sufficient importance to warrant mention here. Festinger's (1957) cognitive dissonance theory has motivated a great deal of research. Its basic postulates are as follows (Kiesler, 1969):

1. The existence of dissonance creates psychological tension or discomfort and will motivate the person to reduce the dissonance and achieve consonance.

2. When dissonance exists, not only will the person attempt to reduce it, but he will actively attempt to avoid situations and information which would increase the dissonance (p. 194).

Dissonance may arise from any of four sources: logical inconsistency; cultural mores; inclusion of a specific opinion in a general one; and past experience.

Dissonance exists, then, if two elements are related to one another in a way opposite to what is expected on the basis of logic, tradition, etc.

Behavioral Theories

The theories just discussed represent one perspective in attitude study. Another general viewpoint is that of the behaviorists. Doob (1947), Lott (1955), Staats (1967, 1968), Scott (1957, 1969), Hovland, Janis and Kelley (1953), Bem (1966) and McGuire (1964) are all classified as behaviorists by Kiesler (1969). It should be noted that such a broad spectrum of researchers may have their doubts about such a classification. The study of the adaptive nature of man with particular emphasis on the stimulus and response nature of man's environment is the common bond that is used for grouping these researchers together.

A representative of this outlook is the theory put forth by Doob (1947). In his view attitudes serve as mediating processes. The mediation occurs between some objective stimulus and the overt behavior that is motivated. The bonds between both the stimulus and the attitude and the attitude and response are developed according to classical learning processes. The same attitude could be bonded to several stimuli; thus, the one response that is also bonded to that attitude serves all of the related stimuli. Doob defined attitude as "an implicit drive producing response considered socially significant in the individual's society" (1947, p. 136).

Other determinants of behavior exist, in Doob's viewpoint, in addition to attitude. These other factors make it impossible to predict,

precisely, what actions will be from knowledge of a single attitude. Thus other stimuli, drives, habits and attitudes can contribute to motivate the resultant response, in addition to the attitude of interest.

These two broad divisions of attitude theory, the behavioral and the consistency theories, each encompass wide variations in theoretical specifics. Both viewpoints have stimulated considerable research, though the consistency theories, especially the Festinger theory, has produced the most activity. Behavior theory, according to Kiesler et al. (1969), in seeking strict control and rigid definition, has relegated much of its research activity to the animal laboratory. Specific application to the human situation becomes difficult; though notable exceptions such as programmed instructional materials and the communications work of Hovland et al. (1953) do exist.

Attitude Measurement

A Brief History

The techniques of attitude measurement trace their beginnings to a content analysis of letters exchanged between Polish peasants and their relatives who had emigrated to America. (Thomas and Znaniecki, 1918). Most researchers are not so fortunate to have available such a spontaneous and personal source of responses for analysis. This study spurred efforts by other social psychologists to measure attitudes.

Attitude questionnaires, developed in a similar fashion to psychological tests, soon came into common use. One of the earliest attempts at this approach was that of Watson (1925). He attempted to measure fairmindedness by means of a six part, three hundred item inventory representing twelve dimensions believed by Watson to represent measures of prejudice. The six parts were each constructed differently. Opinion sampling and analysis of cognitive, logical arguments, for instance, were used as tasks from which to infer attitudes. This early approach served as a model for recommendations made recently, suggesting that multiple measures are necessary to insure high reliability of attitude scores (Cook and Silletz, 1964).

Bogardus (1925) introduced the scaling concept, later to be adopted by Thurstone, with his seven step social distance scale. Various conative actions were suggested to the respondents who then indicated whether they would allow a person (usually some stereotype) to enter the social group represented by the various scale steps. The scale step representing the closest kinship allowed the stereotype to family membership by marriage. Representing the other end of the scale was "exclusion from my country".

The obvious shortcomings of setting up scales that are indeed scaled as to both order and relative distance, led to attempts by some researchers to insure these conditions. The most notable attempt was made by Thurstone and Chave (1929).

Likert (1939) simplified the process of item development, and his approach has been used, with various alterations, in the majority of questionnaire developments ever since.

Types of Attitude Measurement

Historical references, thus far, have been mainly to questionnaire approaches to attitude measurement. Cook and Sellitz (1964) recommended a multiple approach to attitude measurement. This recommendation was based on the recognition that responses to attitude stimuli may result from situational and personality variables as well as the attitude of interest to the researcher. Thus the multiple approach was suggested to minimize the effects of such interfering variables. In making their recommendations they also provided a taxonomy by which to classify different types of measuring instruments in terms of the kinds of evidence used as a basis for inference about attitudes. The five major groupings offered were as follows:

1. measures in which the material from which inferences are drawn consists of self-reports of beliefs, feelings, behavior, etc., toward an object or class of objects.

2. measures in which inferences are drawn from observed overt behavior toward the object.

3. measures in which inferences are drawn from the individual's reactions to or interpretations of partially structured material relevant to the object.

4. measures in which inferences are drawn from performance on objective tasks where functioning may be influenced by disposition toward the object.

5. measures in which inferences are drawn from physiological reactions to the object (p. 39).

Horrocks (1964) listed seven specific approaches to attitude measurement. Although these may be subsumed under the general categories provided by Cook and Sellitz, they are also listed here separately, as follows:

1. Observations (p. 679).

Standardized techniques for recording specifically outlined behaviors have become especially popular (Evans, 1968) since the inception of video recording equipment.

2. Interviews (p. 679).

This approach allows for flexible structuring of the examination as the interview progresses. This interaction also may allow interviewer bias to influence responses.

3. Specific performances (p. 680).

The LaPiere (1934) study of racial prejudice offered a classic example of behavioral observation in assessment of attitudes. It provided evidence to support the existence of differences between conative and behavioral attitude components. Restaurant and hotel owners were approached by LaPiere and a Chinese couple seeking service or accomodations. In all cases but one they were served, often with more than usual enthusiasm. The results of a later written inquiry indicated that many of the same restaurants and hotels connote refusal of Chinese clientele.

5. Sociometric techniques (p. 680).

Assessment here is made of actual or desired social groupings. Respondents are asked to choose people with whom they do (or would like to) associate. The Bogardus Social Distance Scale described earlier was a sociometric questionnaire.

6. Analysis of personal documents (p. 681).

This technique, often employed by historians, is exemplified by the Thomas and Znaniecki (1918) study of Polish peasants.

7. The questionnaire technique (p. 681).

This has served as the most popular approach to measurement almost since the inception of attitude study. The possibility of instrument standardization can be counted as one of the major reasons for the popularity of this technique.

Though attitude definitions have often referred to large numbers of separate properties (Scott, 1968; Shaw and Wright, 1967) possessed by attitudes, measurement of attitude has been almost exclusively limited to magnitude and direction. Further, though the techniques just outlined each offer their distinct advantages to the measurement, process, most attitude measurement is still carried out with the self-report technique of the questionnaire. Questionnaires are typically developed in one of three classical ways. These techniques differ in the manner that items are expected to represent the magnitude of attitudes.

The Method of Equal Appearing Intervals (Thurstone and Chave, 1929)

A large number of items was collected, hopefully representing a broad range of the attitude spectrum. These items were submitted to a large number of judges. The judges were informed as to what the attitude dimension was supposed to be and asked to separate the items into groups, usually eleven, to represent equally spaced segments of the attitude continuum. A mean position was computed for each item for scoring purposes. A variability statistic was also computed. This statistic, the Q value, was used as a measure of ambiguity--large variability in placement of an item representing an ambiguous statement. An irrelevancy measurement was also suggested by Thurstone to allow judgement of those items which did not relate to the dimension of interest. Ambiguous and irrelevant statements were discarded.

Items used in the development of Thurstone-type scales were referred to as non-monotone. Response to a scale of this type was usually accomplished by the respondent choosing one or more of the several items as representing his position. To illustrate, the following is a simple example of a Thurstone scale:

Circle the statement that is correct for you.

1. I am less than 20 years old.

2. I am at least 20 years old but less than 40 years old.

3. I am at least 40 years old but less than 60 years old.

4. I am at least 60 years old but less than 80 years old.

5. I am at least 80 years old.

Attitude scales can seldom offer such well defined categories. Therefore respondents were often allowed to choose more than one statement with which they could agree. Scoring was accomplished by assignment of the scale value of the item (or the median of scale values for more than one item), derived from the judges placements, to the respondent that chooses that item.

Method of Summated Ratings (Likert, 1932)

Monotone items were constructed on some a priori basis to represent the attitude dimension of interest. Again, using the uncomplicated referent, age, the following is an example of a Likert-type, monotone item:

My age is
1. 0 - 19
2. 20 - 39
3. 40 - 59
4. 60 - 79
5. 80 or more

Monotone items have scaled responses (usually scored as 1, 2, 3, 4, 5) so that respondents with favorable attitudes score higher on an item than does a respondent with an unfavorable attitude.

The pool of items was given to a sample of the population and the responses were item analyzed. Those items that correlated highly

with the total score or discriminated between high scoring and low scoring groups were retained.

Scores were determined simply by summing the individual item scores over all items thus, the name, method of summated ratings. Likert indicated that comparable reliabilities to the Thurstone technique were obtainable using far fewer items and the Likert method.

Scalogram Analysis (Guttman, 1950)

Items for this approach were required to be scaled so that responses were cumulative along the scale. By knowing the highest ranked response given by an individual, the tester could also list all other responses given by the respondent. Again, an age example:

Circle all statements which apply to you.

1. I am at least 20 years old.
2. I am at least 40 years old.
3. I am at least 60 years old.
4. I am at least 80 years old.

The classic example of the Guttman-type scale was the Bogardus Social Distance Scale, written before Guttman's technique was developed. This technique is more often used as a theoretical test of unidimensionality than as a practical scoring procedure. Scores were, presumably, scale position scores or a simple statement of the number of items accepted.

Properties of Attitude Scales

Shaw and Wright (1967) listed two properties necessary to insure usefulness of an attitude scale--reliability and validity. In addition, they listed equality of units, unidimensionality, and a zero point as three further desirable characteristics.

Reliability refers to the degree to which a scale gives consistent scores. There are three empirical techniques available to test for reliability. First, the test-retest technique, is a comparison of two scores taken from the same sample at two different times. The assumption must be made that the intervening time period had no effect on the score. Test interaction, including remembering specific items or being influenced by attitude statements or outside variables, may cause coefficients to be a misrepresentation. The former tends to cause spuriously high reliabilities and the latter spuriously low ones. A balance between the memory and outside influence variables is usually attempted by waiting two to six weeks between administrations of the scale. Secondly, the equivalent forms approach is a method of obtaining reliability. Two forms of the scale are developed and administered simultaneously. Comparison is made between the scores of the equivalent forms. This overcomes the intervening variable and memory criticisms of the test-retest technique but invites criticism as to the actual equivalence of the two forms.

Thirdly, the split-half technique is also employed for reliability measurements. Only one scale is required, and it is split in half by odd-even or some other arbitrary technique to provide two scores for comparison. The advantages are the same as for the equivalent forms technique, but it cannot be used to determine consistency over a period of time.

Validity, simply stated, refers to the ability of a test to measure what it is supposed to. Certain standard approaches are available to help determine if a psychological test is valid. Some psychological tests lend themselves more readily to these techniques than others, and their applicability to attitude scales is not always obvious. Following are standard validity concepts and suggested criteria for their assessment (APA Committee, 1954):

Predictive validity--Attitudes toward political candidates might be predicted from a questionnaire. An external criterion, such as the amount of money contributed to a candidate's campaign, could be matched to guesses derived from the results of the questionnaire. The degree of correspondence between the guess and the actual amount is a measure of predictive validity.

Concurrent validity--The same procedures apply here as for predictive validity except that both the scale measurement and the criterion measurement are taken at about the same time. Thus interaction between instrument and external criterion may enter in.

Content validity--The degree to which the items of a scale represent the content of the attitude domain is the focus here. The question is usually put to a panel of judges, and they are asked to judge whether the items are both relevant to the attitude dimension and representative of the continuum.

Construct validity--Theoretical aspects of the attitude-personality interactions may lead the test constructor to expect differential scores according to personality variables. The known-groups technique is an example of this approach to validity. Attitudes toward preservation of wildlife would be expected to be highly favorable for members of certain conservation groups. A scale that purports to measure those attitudes needs to elicit high scores when administered to such groups.

Experimental manipulations aimed directly at an attitude for which a scale, purporting to measure that attitude, exists can offer support for construct validity if the scale shows that the manipulation was successful.

The Thurstone technique of equal appearing intervals was developed for the purpose of attempting to provide for equality of units. This trait, though desirable, may be, for some purposes, unnecessary. Assuming that item scores ought to be weighted according to their relative contributions to the attitude scale, Likert (1932) assigned sigma-deviate weights to item responses. He then compared these weighted scores to scores derived by assigning arbitrary weights of

1, 2, 3, 4, 5 to the responses. He found that the scores correlated 0.99.

The concept of unidimensionality refers to the ability of a scale to measure one attitude with no interference from other attitudes. Such ideal scales probably cannot exist, but attempts can be made to minimize the interference from other attitude variables. In analogy with Scott (1967) an item score X may be broken into three scores:

$$X = T + \Sigma t_i + e$$

where T is the segment of X representing the response to the item based on the attitude of interest. The t_i are segments of X representing the response to the item based on the i other attitudes entering into the response. The e represents random error and involves such things as response bias, situational variables, etc.

What is desired is to make T as large as possible in comparison with $\Sigma t_i + e$ so that in the total scale score

$$X = \Sigma X_j = \Sigma T_j + \Sigma\Sigma t_{ij} + \Sigma e_j$$

ΣT_j will be much much greater than $\Sigma\Sigma t_{ij} + \Sigma e_j$.

Factor analytic techniques are used in an attempt to isolate components represented by items with much higher T scores than Σt_j scores or e scores.

The zero point is a desirable quality to identify when speaking of attitude scales. The problems accompanying the interpretations

of such a point, however, have not been solved satisfactorily. The existence and meaning of "zero attitude" are theoretical considerations that are unresolved (Shaw and Wright, 1967).

Extraneous Determinants of Responses

The importance of determinants other than the attitude of interest in responses to attitude statements cannot be overemphasized. The e and the t_i terms appearing in the equation earlier must be dealt with when measuring attitude. The sources of these effects have been referred to by Scott (1969) in his discussion of extraneous determinants of responses. Three sources of error are listed: subject characteristics; instrument specific determinants; and circumstances of assessment (p. 233-238).

The subject characteristics of importance are the systematic personality characteristics. These contribute in a summative manner to the error of measurement. Social desirability is the subject characteristics that is most frequently discussed. This characteristic may manifest itself through responses that may place the respondent in a favorable light.

The assumptions that are made to project this characteristic on a person are that he is motivated to picture himself favorably and that he recognizes favorable responses.

Instrument specific factors such as carelessness, acquiescence

and extremity have been listed as possible extraneous determinants of responses (Scott, 1969). Carelessness in response is usually evidenced by inconsistent replies and/or randomness of replies. Acquiescence manifests itself most usually when items referring to the same attitude dimension are all either ambiguously phrased or scored in the same direction. Extremity of response can be a confounding determinant of responses on scales that allow for various degrees of agreement and disagreement.

Horst (1966) listed relevant environmental conditions that can affect the respondent such as lighting, atmospheric conditions, noise and working facilities (p. 54). These may all contribute to the final responses if allowed to interfere.

Again, Scott (1969) presented four basic ways of attempting to minimize extraneous determinants:

1. Modify conditions of administration (p. 238).

The objective here is to establish adequate rapport with the respondents. Usually the importance of the respondent's participation is stressed and assurances given that his replies will be kept confidential. It is also stressed that honesty and frankness in his responses are desired.

2. Modify the instrument (p. 238).

Repeated measurements would be helpful, but there is the danger of contaminating the results by boredom or memory variables as well

as outside influences. An alternative is to lengthen the instrument thus increasing the chance of reducing the influence of random error. Acquiescence may be overcome by balancing the number of direct and reverse-worded items if "sensible reversed items can be written". Kerlinger (1967) criticized this practice, in general, offering evidence that most attitude dimensions are not bi-polar, and, therefore, reverse worded statements do not necessarily induce mirrored responses.

Forced choice techniques have been suggested to overcome the social desirability set as choices can be constructed so that neither choice is desirable. Scott (1969) cited conflicting research results as a caution against embracing this technique wholeheartedly. Disguised techniques have been suggested as a way of overcoming social desirability tendencies in responses.

3. Detect and discard subjects whose responses are largely affected by irrelevant factors (p. 238).

4. Correct the scores of all subjects in proportion to the amount of their known contamination (p. 238).

These last two techniques require identification of the contamination and the last also requires quantification. Some measures have been constructed for these purposes (Norman, 1963; Crowne and Marlow, 1960).

Factor Analytic Approach to Attitude Scale Construction

The technique of factor analysis has been alluded to in previous sections. Much of the logic that is applied to arrive at various techniques of scale construction mentioned previously can be used to support the method of factor analysis as a reasonable approach to attitude scale construction. Campbell (1950), in an article supporting the use of indirect methods of attitude assessment, offered the following operational definition of attitude: A social attitude is (or is evidenced by) consistency in response to social objects (p. 31). He felt, on the basis of observation of the kinds of measurements that are actually taken in attitude research, that this definition should be satisfactory to most attitude researchers.

Campbell inspected the Allport definition of attitude and concluded that when measurement is done by those supporting this definition they seek, as evidence of the "state of readiness", consistency or predictability among responses. He also admonished behaviorists who define attitude as a response rather than a set to respond, pointing to their practice of seeking response consistencies, not isolated responses. In the following statement, he called for a marriage of definition and measurement practice:

> ... if attitude measurement be integrated with definition, internal consistency among the sample responses collected by the test must be demonstrated. To the present writer, the demonstration of a single factor

through factor analysis seems ideal, although time consuming (p. 32).

Another supporter, Nunnally (1959), outlined the technique by which attitude scales could be developed using factor analysis. This outline follows:

> One of the most direct approaches to determining the number and kinds of scales involved in a collection of items is to factor analyze responses. All of the conventional methods of factor analysis can be used on attitude items in the same way that they are applied to other sets of psychological measures. Desirably, the items should be rated on a continuum, using, say, five or more points, rather than to obtain only an agree or disagree response. After the collection of items is administered to a group of respondents, preferably with at least several hundred persons included, all intercorrelations among the items are obtained. The intercorrelations are then factor analyzed. Each of the major factors constitutes a separate attitude scale. The items which relate most prominently to a factor can be used to construct the scale.
>
> ...The tests and attitude scales which have been derived in this way work well in practice. Factor analysis would have been used more broadly in the derivation of attitude scales were it not for the statistical labors that are involved. Now that high-speed computational equipment is becoming more available, large-scale factor analysis of attitude items will probably become more common (p. 310-311).

Nunnally continued by pointing to the area of weakness of classical techniques:

> Methods of attitude scaling like Thurstone's and Likert's have been successful without factor analysis largely because they have dealt with collections of statements which are dominated by one large attitudinal factor. Although both methods tend to eliminate items that belong to small extraneous factors, neither method will work well if applied to collections of items in which several prominent factors are present.

Lumsden (1961) compared five methods of constructing unidimensional tests (classical item analysis, Loevinger's procedure (1948), the independence criterion method, Guttman's procedure (1944) and factor analysis). The criteria for comparison were the provisions that each made for: a rational procedure for item selection, a criterion of unidimensionality, and an index of unidimensionality. He concluded that: "only factor analysis provides a rational procedure of item selection (p. 130)." He also stated that no satisfactory criterion or index of unidimensionality exists, though one possibility was suggested for the factor analytic approach.

Alumbaugh, Davis and Sweeney (1969) compared stepwise regression, ranking and factor analysis as techniques for developing predictive instruments. They supported factor analysis for this purpose.

Historically, factor analysis can be traced to the year 1901 and Karl Pearson's statistical statement concerning the method of principal axes. Factor analysis is usually traced to Charles Spearman for its beginnings, however. The major development and influence of factor analysis has taken place in the field of psychology, and it was Spearman's article on general intelligence (1904) that was the stimulus for the attention that factor analysis received thereafter. Work proceded for nearly two decades on the basis of Spearman's two-factor theory of intelligence. Deviations from this concept were few. The first

major step away from the two-factor theory was an attempt by Garnett (1919) to extract several factors from a matrix of test correlations. This was the beginning of multiple-factor analysis, popularized by L. L. Thurstone.

Hotelling (1933) developed, from Pearson's original concept, the principal axes method. The method is straightforward but cumbersome computationally, and it has not been until recently, since the inception of high speed computers, that analysis of more than a few variables by this method has been feasible.

A great deal of time and effort was spent in the three decades since 1930, attempting, usually by rhetoric, to identify the "best" factorial solution. Harman (1967) offered the following excerpt from Cureton (1939) which characterized the feelings that were exhibited by various writers during this period:

> Factor theory may be defined as a mathematical rationalization. A factor-analyst is an individual with a peculiar obsession regarding the nature of mental ability or personality. By the application of higher mathematics to wishful thinking, he always proves that his original fixed idea or compulsion was right or necessary. In the process he usually proves that all other factor-analysts are dangerously insane, and that the only salvation for them is to undergo his own brand of analysis in order that the true essence of their several maladies may be discovered. Since they never submit to this indignity, he classes them all as hopeless cases, and searches about for some branch of mathematics which none of them is likely to have studied in order to prove that their incurability is not only necessary but also sufficient. (Harman, p. 9)

Harman (1967) offers a description of the use of factor analysis:

> The mathematical techniques inherent in factor analysis certainly are not limited to psychological applications. The principal concern of factor analysis is the resolution of a set of variables linearly in terms of (usually) a small number of categories or "factors". This resolution can be accomplished by the analysis of the correlations among the variables. A satisfactory solution will yield factors which convey all the essential information of the original set of variables. Thus, the chief aim is to attain scientific parsimony or economy of description. (p. 4)

The fact that an infinite number of solutions is possible offers opportunity for the controversy described previously. Two general principles are applicable in making a choice of the "best" solution; statistical simplicity and psychological meaningfulness (in psychology). If only statistical considerations are important, Harman favored the principal axes method. Psychologists, in general, have found neither the centroid solution of Thurstone nor the principal axes solution adequate. Various attempts have been made to provide criteria for adequate solutions. The most widely accepted are the simple structure criteria set forth by Thurstone (1954). The following modifications of these criteria were presented by Harman (1967):

1. Each row of the factor matrix should have at least one zero.

2. If there are m common factors, each column of the factor matrix should have at least m zeros.

3. For every pair of columns of the factor matrix there should be several variables whose entries vanish in one column but not in the other.

4. For every pair of columns of the factor matrix, a large proportion of the variables should have vanishing entries in both columns when there are four or more factors.

5. For every pair of columns of the factor matrix there should be only a small number of variables with nonvanishing entries in both columns (p. 98).

Attempts to arrive at simple structure usually involved arduous computational and graphical techniques based on rotation of the axes of original centroid or principal axes solutions. High speed computers have allowed more complex attempts at such manipulations. The most common technique used in factor analytic studies has been the orthogonal rotation of a principal axes (or components) solution by the Varimax criterion of Kaiser (1958). Harman (1967) showed two examples for which the Varimax solution approximates, very closely, simple structure. The concept of "factorial invariance under change in composition of the test battery" (Kaiser, 1958, p. 195-198) was offered as a more fundamental criterion than simple structure by Kaiser. He demonstrated that the Varimax criterion tends to have this property.

Ferguson (1952) offered two other properties of statistically and psychologically significant factors, as follows:

1. It appears in the same form in data based upon different subject populations.

2. It is subject to a logical and rational explanation (p. 112).

It should be noted that the non-statistical aspect of factor analysis--

the psychological meaning criterion for acceptance of a solution--provides another use for this technique. Eysenck (1953) listed the following three purposes for factor analysis:

1. To provide descriptive statistics. These are in the form of condensed statements that can represent the data more economically.

2. To suggest hypotheses. Concerning this, Eysneck states: "In so far as it does that, the factor ceases to be merely descriptive and becomes part of theoretical psychology."

3. To support or disprove an hypothesis (p. 106).

It is this second approach that seems to be of interest to the present research since factor analysis provides the dimensions for interpretation. Interpretation is a process of model building toward explanation of the correlation of each item to the unnamed factor. The model becomes the hypothesis. The following statement by Bliss (1933) can perhaps help keep the problem in perspective:

> The danger is always when a theory has been found to be convenient and effective..., that people begin to think that nature herself behaves precisely in the way which is indicated by the theory. This is never the case, and the belief that it is so may close our minds to other possible theories and be a serious impedence to progress in the development of our interpretations of the world around us (p. 477).

Factor analysis has found its most common use in the isolation of factors common to various mental and psychological tests (Holzinger, 1934-36; Thurstone, 1938; Guilford, 1956; Cattell, 1957). Various fields of the social, biological and applied physical sciences

have made use of factor analysis. Harman (1967) referred to some fifty studies outside the area of psychology.

Factor analytic studies outside the realm of attitude measurement are multitudinous. One study relating directly to science education was the development, by Cooley and Reed (1961), of the Science Activity Inventory consisting of seventy items. Six factors were extracted and interpreted to represent the attitude interest domain. The factor descriptions were: 1) general science interest, 2) "woodsy birdsy", nature study interest, 3) science tinkering interest, 4) thinking about vs. doing interest in science, 5) a verbal activity dimension and 6) home economics interest. The authors concluded that science interest is not unidimensional.

Winkel, Malek, and Thiel (1969) developed a personality questionnaire to assess the structure of judgments of roadside quality. Responses to the questionnaire were factor analyzed and three factors extracted. The factors were described as: 1) negative orientation toward the urban roadside with unregulated private enterprise obtaining much of the responsibility for roadside quality, 2) belief in conservation, preservation and maintenance of order, and 3) orientation toward action represented by acceptance of some roadside chaos on the basis of its necessity.

Hoover and Schutz (1963a) factor analyzed a 32 item inventory of attitude statements related to conservation. They extracted twelve

factors using responses from university students majoring in science. Eleven factors were extracted using responses from a group of non-science majors. They concluded that the usual arbitrary dichotomies such as "human" vs. "natural" resources were inappropriate as dimensions to represent conservation attitudes. They also concluded that conservation attitudes were closely related to broader cultural beliefs and that the emphasis on such concepts as soil, wildlife and forest conservation as content bases for teaching conservation may be misguided. They further reported that the factor patterns differed somewhat between the science and non-science groups with science majors obtaining more clear-cut conceptions more closely related to conservation.

Hoover and Schutz (1963b) used ten of the factors derived in a previous study (1963a) as a base to develop one hundred sixteen items related to those dimensions. Responses of one hundred four university science majors were cluster analyzed. Fifty-four items clustered in three groups, and the groups were interpreted as follows: 1) assistance for the common good, 2) regulation for the common good and 3) private rights vs. conservation. Their conclusions were similar to those of their earlier study.

Hoover (1967) used a problem oriented approach with problems based on attitude dimensions derived earlier (Hoover and Schutz, 1963b), as well as some hypothetical value dimensions, to teach

secondary school students democratic values. Using the Hoover and Schutz attitude inventory and a semantic differential scale relating to the dimensions of interest as criterion measures, they concluded that some changes in the broad value dimensions under study could be brought about. This conclusion was based on the results of the semantic differential measurement.

Other Attitude Instruments in the Area of Science Education

Herein are listed several attitude instruments which have been developed relating to science teaching and learning. Most of these are concerned with attitudes toward some aspect of science or scientists. These are included in recognition of their contribution to science education research.

Mead and Metraux (1957), using an open-ended statement technique, sampled high school students' attitudes towards science and scientists. In general, science and scientists were perceived in a favorable light by a minority of students while a majority perceived scientists in a stereotyped manner similar to projections offered by the mass media.

Allen (1959) selected New Jersey public high school seniors in an attempt to answer the following questions:

1. In general, do high school seniors have positive, constructive attitudes toward science and scientific endeavor?

2. Do high school seniors choosing scientific careers have more positive, constructive attitudes toward science and scientific endeavor than those choosing other careers?

3. Is the intelligence of the high school senior related to his attitudes regarding science and scientific endeavor?

4. Is there a difference in attitudes toward science and scientific careers between high-ability high school seniors who (a) plan careers in science or engineering, and (b) those who plan other careers?

Allen concluded that the image of science, scientific work and scientists which characterized the group as a whole seemed favorable and constructive. However, he was disturbed with the substantial numbers of responses indicating that many of the seniors did not fully understand the nature of science and scientific work and that they had a stereotyped image of the scientist.

Cooley and Klopfer (1961) developed the Test on Understanding of Science as a result of the Mead and Metraux study. Three subscales were included assessing the image held by high school students of: 1) scientists, 2) the scientific enterprise and 3) the methods and aims of science. This has been probably the most widely used scale developed in this area.

Dutton and Stephens (1963) developed a twenty item Thurstone scale to assess attitudes toward science.

Schwirian (1968) constructed the forty item Science Support Scale based upon five cultural values theorized by Bernard Barber (1962). These values were rationality, utilitarianism, universalism,

individualism and commitment to progress and meliorism.

Vitrogen (1967) constructed an eighty item scale for assessment of attitude toward science. Analysis of responses after construction caused a reduction from eight to four hypothetical dimensions.

Welch and Pella's (1967) Inventory of Knowledge on the Process of Science and Korth's (1968, 1969) Test on Social Aspects of Science attempted to deal with a specific aspect of science or its process instead of the total domain of the nature of science.

Science Teacher Attitudes

Perusal of a recent review of research in science and mathematics education (AERA, 1969) shows a definite lack of attitude studies of science teachers. One exception should be noted, and that is Kimball's (1968) attempt to assess teacher and scientist understanding of science. Restricting science teacher groups rather stringently to those with undergraduate science majors, he found no difference in understanding as measured by his Nature of Science Scale.

Studies of the general teacher population are most often restricted to the sociology of teaching or to assessing teacher personality traits. A most ambitious example is Ryan's (1960) six year study of teacher characteristics. Attempts were made to compare teachers on the basis of such demographic variables as community

size, age, sex, marital status and college background. Behavior patterns were derived and various assessment techniques were used to judge teacher effectiveness. Teacher characteristics used for comparison of various teacher subgroups were: understanding classroom behavior, business-like classroom behavior, imaginative classroom behavior, favorable opinions of students, favorable opinions of democratic classroom procedures, favorable opinions toward administration, learning centered traditional viewpoint and verbal understanding.

Secondary women science teachers scored high on businesslike and stimulating classroom behaviors. Physical science teachers had favorable attitudes toward pupils as well as administrators.

Some of the most popular and exicting research being conducted presently has to do with teacher classroom behavior. Balzer (1968), working in the area of nonverbal behavior, concluded that nonverbal behavior may contribute a larger portion of total teacher behavior than previously thought. If this is so, and if it is found that such behavior is significant in its effect on learning, there may be a resurgence in research that attempts to assess the motivation for that behavior. It is not difficult to hypothesize attitude as a motivating influence.

III. DESIGN OF THE STUDY

This study entailed two major purposes-definition of the attitude domain resulting in the development of the Inventory of Societal Issues (ISI) and assessment of teacher attitudes as measured by response to the ISI. The first of these purposes was shared with this researcher by Robert Steiner, another doctoral candidate in the department of science education. The development of the ISI was a cooperative effort of these two investigators. Steiner assessed attitudes of public high school seniors using their responses to the ISI. Each researcher was responsible for his own description of the instrument development. The different viewpoints that were manifest in some circumstances were useful in item construction and selection as they allowed for broader boundaries to be placed on the initial attitude domain.

Development of the Attitude Scales

Attitude scales are developed to assess feelings about social "objects". These objects are referred to as referents. As was stated previously, referents are specific or general according to the degree of relatedness that exists between them when attitudes are exhibited. Thus, the goal of attitude scale development is to provide several specific referents to which responses can be made. This combination of responses to related referents would, hopefully, represent an

attitude toward a more general referent. A measure of the generality of this more inclusive referent or social object would be the degree to which this attitude score failed to correlate with other, similarly developed, scales.

The usual approach to developing attitude scales is deductive in nature. This means that the general referent is chosen a priori by the researcher, and steps are then taken to choose specific referents to represent the general referent.

By contrast, an inductive approach to scale development requires ignoring a priori general referents, no matter how seemingly obvious, and choosing specific referents on a relatively unrestricted basis. General referents are identified from response patterns after respondents have reacted to the specific referents.

The usual deductive approach to attitude instrument development requires the following steps:

1. "identification" of a general referent.
2. construction of attitude statements "designed" to refer to the general referent.
3. pilot studies, panels of experts and item analyses to choose items that are "valid" and reliable.

There is little doubt that instruments developed in this deductive manner, while measuring something very well, may, in fact, measure something quite different from the intent of the instrument builder. Very likely they are multi-dimensional.

An attempt was made in this study to minimize this problem by sidestepping the issue of intent (at least in the specific sense represented by a priori choice of the dimensions for which the instrument would be built). Instead, a very general area of concern, no doubt represented by many general attitude referents and even a larger number of specific referents, was informally defined. From this wide area of interest or "universe" a representative sample of specific referents was chosen.

The general area of interest was that of societal issues, especially those related to science. This generally included environmental concerns with specific reference to topics such as the following: pollution, population increase, conservation of natural resources and preservation of unique natural sanctuaries. Though attitudes can be inferred from descriptions of responses to individual referents, it was decided that a better picture could be gained by analyzing response patterns and identifying related sub-groups of referents. The factor analytic technique outlined by Nunnally (1959) was chosen as a means to identify response patterns and isolate the meaningful sub-groups. This technique appeared ideal for the purpose of isolating general referents (dimensions). The principle components analysis with orthogonal rotation provides for dimensions that are minimally related. Thus, the general nature of the scale referent is guaranteed. The recommendations of Campbell (1950), Lumsden (1959) and Alumbaugh et al.

(1969) provided support for this choice.

Since one purpose of this study was to identify meaningful dimensions of a broad area of concern, then the multi-dimensionality of a large inventory of referents was highly desirable. The inductive approach was chosen to capitalize on the same multi-dimensionality which is a difficulty in the case of the deductive approach.

It is not inferred that patterns and sub-groups identified by factor analysis have a magical quality usually reserved for description of the mystical secrets of occult religious sects. It was recognized that the identified dimension, and models derived from them, provided only hypotheses concerning the structure of the attitude domain. However, the desire was to hypothesize underlying attitudes used in responding to statements concerning societal issues. Thus, it was thought that a better source of such hypotheses would be response patterns of respondents rather than the biased viewpoints of researchers working on an a priori basis.

Development of the Item Pool-Preliminary Inventory

In order to minimize as much as possible the imposition of a priori dimensions upon the attitude domain it was seen desirable to use procedures that would dictate a wide choice of sources. In order to allow for general boundaries, biased as little as possible by researcher predisposition, a wide diversity of referent sources was

sought. Popular and professional journals, books related to specific concerns, television specials, solicitation from individuals recognized as concerned environmentalists, open ended questions and personal conversations were all used to some degree in gathering item referents.

An attempt was made to develop a systematic review procedure with respect to popular and professional journals. An initial informal perusal of several journals provided the following information: journals written by or for the general public often differed in their approach to societal concerns, both editorially and in the strict reporting sense; societal concerns of present relevance could be sampled adequately by inspection of a few years worth of the back issues of journals. It was decided that certain journals should be thoroughly searched through five years of publication, ending with January, 1970, to establish a base level inventory of societal issues. Typical of the popular journals for which this was done are Time and Newsweek. Examples of professional journals inspected by this procedure are Science, Journal of Social Issues and Bulletin of the Atomic Scientists.

Certain broad bounds were devised to aid in identification of acceptable referents:

1. The issue (referent) should be related to science. This might include circumstances in which science was being looked to for solutions as well as situations for which science

could be perceived as a contributor to the existence of a problem.

2. Science should be interpreted in a broad, popular sense. Thus, such technological areas as medicine, engineering and industrial technology would fit this loose definition.
3. Referents should not be used pertaining to direct military involvement, especially the Southeast Asian conflict.

The ground rules were established for purely practical purposes. Preliminary inspection of literature dealing with societal issues indicated that there were vast numbers of interesting and controversial issues. It was obvious, however, that so many issues could not be properly represented unless the final inventory contained many more items than was reasonable.

It was thought possible that the issue of present military involvement might be of sufficiently greater magnitude in the minds of some respondents as to bias responses to other issues. Thus, this issue was excluded.

Another systematic attempt was made to solicit societal concerns from university students involved in courses that were easily accessible to the researchers. Students in the general biology, general physical science and general physics courses were requested to complete such open ended statements as "The social problem that is of the greatest concern to me is _____." The efficiency of this technique was

considerably less than other techniques which were used.

The referents were incorporated into standard Likert-type attitude statements. A five choice response format was utilized. (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree were the choices.) In some cases the original source provided a statement context for the referent. This was judged to be desirable since researcher bias would not be involved in constructing the statement, and it would be a natural statement more likely to elicit a response on the basis of its affective stimulus value, not its particular sentence structure. In cases where statements had to be constructed, an attempt was made to structure them in such a way that they would be perceived as natural statements, i.e. the reader would likely conceive of the statement being made by someone concerned with the issue.

Several sources were available that offered hints for selecting and constructing items. Typical suggestions are those of Likert (1932):

1. It is essential that all statements be expressions of desired behavior and not statements of fact.

2. It is necessary to state each proposition in clear, concise, straight-forward statements. Each statement must avoid ambiguity.

3. It seems desirable to have the different statements so worded that about half represent one end of the attitude continuum and half the other.

4. Statements should involve only a single attitude variable and not several.

Another more recent source used was Edwards (1957). Some useful criteria offered by him are as follows:

1. Avoid statements that are likely to be endorsed by almost everyone or by almost no one.

2. Statements should be short, rarely exceeding 20 words.

3. Statements containing universals such as all, always, none, and never often introduce ambiguity and should be avoided.

4. Words such as only, just, merely, and others of similar nature should be used with care and moderation in writing statements.

5. Avoid the use of words that may not be understood by those who are to be given the completed scale.

6. Avoid the use of double negatives (p. 14).

These suggestions were followed to the extent that it was possible to do so and still represent the attitude domain in question. The complexity of some issues, made it difficult, at times, to adhere strictly to these suggestions. The inductive approach that was used made it impossible to identify the general attitude referent. Therefore, references to attitude continuum, for instance, have little meaning before the items are constructed, administered and analyzed. But, for the most part, the items were written with the hope of providing clear, simple, unambiguous statements to respondents in order to elicit affective reactions.

In all, approximately 250 items were constructed to form the initial item pool. This pool became the source from which items were selected for the preliminary inventory.

Item Selection--Preliminary Inventory

In order to choose from the 250 items 100 items suitable for the preliminary inventory, a means by which to judge the worth of the items was sought. A four step approach was incorporated.

The first stage involved administration of all items to students involved in physical and biological science laboratories in the Department of General Science at Oregon State University. These courses were designed as service courses. Thus, most of the students involved in responding to the items were non-science majors. Each student was asked to respond, on a five point scale, with their degree of agreement or disagreement, to from five to seven items. In addition, they were requested to point out ambiguities, circle words that they did not understand and discuss why they answered as they did. This latter request was made so that some judgement could be made concerning the meaning students might read into statements. Approximately 12 to 20 students responded to each item.

On the basis of these responses an informal check was made on discriminability, ambiguity, clarity, etc. Discriminability was inferred from frequency of response tabulations. Items were judged discriminating if the total number of strongly agree (strongly disagree), agree (disagree) and neutral responses was approximately equal to the total number of strongly disagree (strongly agree) and

disagree (agree) responses. Statements that clearly did not discriminate, were ambiguous, were unacceptably multidimensional or seemed confusing were either discarded or rewritten in an attempt to overcome the apparent weakness. Rewriting was also done on other items if it appeared, from the students' responses, that an improvement, especially in discriminability, could be made.

The second phase of the item selection process involved repeating the first phase, being careful that different students were involved or that students reacted to different items in this administration. Further sorting and rewriting resulted in a reduction of the item pool to approximately 150 items.

The sample that was to be used to develop the ISI was to be high school seniors. Therefore, it was deemed desirable to choose a pilot group of high school students as respondents in order to determine if, indeed, the items were relevant to them. In this third phase, student science teachers, who returned once a week to campus for seminar, were approached concerning the problem. Approximately ten student teachers consented to administer items to students with whom they were involved. The students were asked to respond to no more than ten items each so as not to interfere with normal classroom procedures. Each item was administered to between 15 and 20 high school students. The students were asked to circle unknown or ambiguous words and to comment on and respond to each item. On the basis of these

responses a final revision was made of the items in the item pool.

A scoring system was developed in the final phase to assist in choosing the items for the preliminary inventory. From one to three points was given for several categories. Three points indicated a desirable item as evidenced by the following characteristics: 1) The responses of the university student group divided approximately equally between the agree (disagree) plus neutral end of the response continuum and the disagree (agree) end; 2) Similar discriminability was evident for the high school student pilot group responses; 3) The statement was no longer than 20 words; 4) The researchers judged the statement highly relevant to the overall attitude domain of the study; 5) The researchers expressed a personal preference for the statement. Two and one points were assigned if the item exhibited these characteristics to a lesser degree.

Application of this scoring procedure allowed for ranking of the statements in the item pool. The statements were then scanned to eliminate obvious duplications and the 100 highest ranking items chosen as those items that were to be contained in the preliminary attitude inventory.

The 100 items were given to a panel of judges, representing the areas of science, humanities and social sciences at Oregon State University. They were asked to evaluate whether the referents contained within the items were within the broad bounds that had been set

up for the development of the item pool. They were also asked to judge the relevance of those statements toward the broad attitude domain and to list omissions they felt had been made so that the degree to which the attitude domain of interest to this study had been represented could be gauged. Names of the judges are listed in Appendix A.

The Preliminary Attitude Inventory

By the item selection procedures described, 100 items were chosen as representative of the attitude domain of interest to this study. These 100 items form the preliminary inventory of Appendix B.

The items were ordered randomly, and the order was inspected for proximal items that appeared to be related. If, in the judgement of the researchers, any two items could be easily perceived as similar in content, and they were within a few items of each other upon random assignment, they were placed so that several items separated them.

From discussion with the student teachers who assisted in the item selection procedures, it was suspected that students would find the items interesting and stimulating enough so that boredom and other instrument length-related biases would probably not operate when the preliminary inventory was administered to the high school seniors. In order to minimize such effects, however, if they did indeed operate,

seven pages of items were prepared. Eighteen combinations of the seven pages were arranged. This insured that an item appeared on the first page of the inventory for one seventh of the respondents. It also appeared one seventh of the time in each of the other six positions. The inventories were stacked so that each pile of 18 inventories represented a cycle containing one each of the 18 page arrangements. This was to minimize any school-page arrangement interaction that might exist since each student at any school would have a different page arrangement (unless a school contributed more than 18 students to the study).

Choice of scoring direction, for many of the items, was difficult. Two techniques were used--one before administration of the preliminary inventory and one following the factor analysis of responses.

Prior to administration of the preliminary inventory the doctoral candidates in the Department of Science Education were asked to complete the questionnaire. Where agreement was found in the responses of the candidates their modal tendency was used to assign a direction to responses. Where agreement could not be reached the item scores were arbitrarily assigned a direction by the researchers.

After the factor analysis was performed, the most popular response technique was used to assign a scoring direction to the items for which agreement could not be reached. This was accomplished by assigning the modal response direction as the scoring key direction.

Factor loadings that related an item, which had been assigned an "incorrect" scoring direction, to a factor, were found to obtain an "incorrect" sign. That is, the item would need to be stated in an opposite fashion to be consistent with a factor interpretation model. Thus, if the direction of an item was in question both the modal response and the consistency of interpretation served as a posteriori clues as to the proper direction to assign to responses on the final inventory.

Selection of the Sample-Preliminary Inventory

Initial discussion of an appropriate sample from which to develop an instrument to assess attitudes toward societal concerns, centered around some general samples representative of society in cross-section. It seemed infeasible to obtain such a sample without the network of contacts developed by pollster groups. An alternative was discussed whereby some intact group would be sought whose attitudes would be most like a cross-section of this society's population. Though no claim is being made that the results of this study are representative of society's attitudes or that the ISI represents relevant dimensions for the society, it was hoped that high school seniors would possess as wide a range of attitudes as their parents and that they would be distributed in a similar fashion, both in direction and magnitude.

In an opinion solicited from Dr. Roger Petersen, Statistics Department, Oregon State University, one per cent, or approximately

300 of the public high school seniors in the State of Oregon, would be the smallest sample that could be used to claim representativeness of that population.

A stratified random selection procedure was decided upon, in which the approximately 220 public high schools in Oregon were listed according to attendance. This figure was based on enrollment in grades nine through twelve and was adjusted to that figure in the case of schools operating on a ten through 12 or 11 and 12 basis. The figures used for this procedure were obtained from the 1969-1970 Oregon School Directory, compiled by the Oregon Board of Education. This provided 22 strata of ten schools each. A number was chosen between one and ten and the school of that rank within each stratum was chosen as part of the school sample. This was repeated to provide for a double sample.

The principal from each school chosen was sent a letter explaining the study. His school's participation was requested and, if available, a list of seniors if the decision was made to participate. A request was also made for attendance figures and the number of seniors, as well as the name and phone number of the person that should be contacted for further discussion. A return was requested and a stamped, pre-addressed envelope enclosed for that purpose.

Thirty-nine of the 44 schools responded. Twenty-seven of the responses were favorable. Smaller schools tended to respond more

favorably since fewer students were involved for them than was the case for larger schools. Three schools in the Portland district were included in the original double sample, and all three responded negatively. Arrangements were made to discuss the study with Dr. George Ingabo, Research Director, and Dr. Donald Stotler, Science Supervisor, of the Portland school district. They agreed to a second solicitation and, through the efforts of Dr. Stotler, two Portland schools consented to participate. One of the Portland schools had been in the original double sample of 44 while the other had not.

Twenty of the 22 strata were represented by positive respondents. The other two were filled from adjacent strata which, fortuitously, had been graced with two positive respondents. A personal letter explaining the double sampling procedure and thanking them for their cooperation was forwarded to those schools which had consented to participate and were not needed.

Random numbers were drawn and matched to alphabetical lists of seniors from each of the 22 schools in the final sample. In order to insure a one percent sample of seniors it was necessary to draw a ten percent sample from each of these 22 schools. When lists were not available, the random numbers, with sufficient alternates to guard against absenteeism was forwarded to the schools so that the sample list could be compiled there.

In two cases this procedure could not be adhered to. In one case

the school counselor, who was responsible for obtaining the sample, gave assurances that the sample chosen was a representative cross-section of that high school senior population. In the second case intact groups had to be used. The groups were enrolled in a required senior course and heterogeneous grouping prevailed. If a bias was introduced, it was the result of scheduling peculiarities. It is possible, for instance, that only high achievers were in the group because some elective, popular with low achievers, may have been offered only at that time. The school was large, however, minimizing the possibility of such a situation as most courses were offered several times during the day.

In all, 304 seniors were chosen to participate in responding to the preliminary inventory.

Administration--Preliminary Inventory

Twenty-two schools consented to allow about 300 seniors to respond to the preliminary inventory in May of 1970. Inquiry was made as to the feasibility of sending the questionnaires to each school and having them administered by school personnel. This request was fulfilled by 15 of the 22 schools. In those cases the questionnaires, specific instructions (including instructions, designed to establish rapport, to be read to the students), a list of seniors (or random numbers) and stamped, pre-addressed manila envelopes were sent to

the schools. All of these were returned.

The seven other schools requested that administration of the questionnaire be carried out by the researchers. An appointment was made with each of the schools, and a list of seniors (or random numbers) was forwarded to each school.

The written instructions, to be read aloud, forwarded to the 15 schools which provided administration were similar to those used in the seven schools where the questionnaires were personally administered by the researchers. A statement was made to the students concerning the questionnaire content, especially pointing out that the issues discussed were controversial, and that differences of opinion existed so that there were no right or wrong responses. The students were assured anonymity and asked for frank, honest responses ignoring what they might think others would like them to respond. A copy of the cover sheet, with instructions, sent to these schools is displayed in Appendix C.

Personal administration allowed for feedback. As students finished some were asked to react to the experience and to give impressions about the tenor of the items as well as their structure and clarity. Responses were almost totally encouraging. The most common comment was that the items were interesting. Reading level appeared to be appropriate, and most students felt that the intent of each statement was clear. The fact that response time averaged under 30

minutes was thought to be indicative that the statements were eliciting responses on the basis of attitudes as opposed to cognitive considerations. The maximum time taken by any student was 55 minutes, and he was identified as a very slow reader. His high interest throughout the 55 minutes was pleasing. This researcher was especially interested in the teacher and counselor reactions for there seemed to be a genuine interest exhibited by most of them who were able to peruse the questionnaire during its administration.

The ISI

The responses of 304 public high school seniors from the State of Oregon to the 100 item preliminary inventory were factor analyzed using the facilities of the University of Oregon Computer Center and the program FACTOL. This program carries out a principle component extraction of primary factors and an orthogonal rotation using the Varimax criterion. Seven factor attitude scales, each containing from five to twelve of the highest loading items, were used to form the final instrument, the 60 item Inventory of Societal Issues (ISI).

Item discriminability calculations and reliability coefficient determinations were carried out by Steiner as part of his study concerning student attitudes. His reliability statistics, identified as such, are included in this study to insure completeness in the description of the ISI.

They include, for each scale of the ISI and the total, the following:

1. odd-even, split half reliability using Pearson-product-moment correlation coefficient and its Spearman-Brown correction.

2. The Kuder-Richardson formula 20 reliability.

This concludes the portion of the design for which dual responsibility applies.

Selection of the Sample-ISI

There are somewhat over 10,000 secondary school teachers within the state of Oregon. Of these, less than ten percent are science teachers. If the stringent requirements that a teacher teach only science and be certified to teach only science are imposed, then the percentage of science teachers drops considerably lower. A science teacher list was obtained from Gene Doty, editor of The Oregon Science Teacher. It was decided that half of the population of science teachers and an equal number of non-science teachers would be requested to participate. Such a sample represented slightly over 3.5 percent of non-science teachers if all responded. If only half responded a sample of well over one percent would still be obtained. The science teacher list was sampled with the aid of a random number table.

In order to insure a representative cross-section of non-science teachers two days were spent at the offices of the Oregon Education

Association (OEA) in Tigard choosing a systematic random preliminary sample of teacher names from the records of OEA. These lists were matched, and teachers who appeared on the OEA lists who were also included in the OSTA list were eliminated from the OEA listing.

In all, some 360 science teachers and an equal number of non-science teachers were chosen as the preliminary sample. These 720 teachers were contacted, by mail, in an effort to secure their participation. A letter, explaining the general purpose of the study and outlining what was required of each teacher was sent, along with the ISI, a personal and professional background data sheet and a stamped, pre-addressed envelope for the return of materials.

The Sample--ISI

Seven hundred twenty teachers made up the preliminary sample. Each was requested, by mail, to participate in the study by filling out the ISI and a teacher background information sheet. The background sheet was designed to sample the teacher's personal and professional background. A copy is displayed in Appendix D. In addition, elaboration of certain of the classifications follows:

1. For what grade level is the teacher primarily responsible? The sample was broken into junior high school and senior high school. Due to an error on the information sheet this information had to be derived later from OEA files.

2. What is the nature of the community in which the teacher works? This was originally sampled in terms of school size, but it was found to be much more convenient to use population figures from the 1966 census for this determination. Also used as a model was the sampling strata used by the Louis Harris and Associates, Inc. when compiling The Public's View of Environmental Problems in the State of Oregon in March of 1970. The four strata were: a) Urban, which included everything within the Portland city limits; b) Portland Suburbs, which included Washington, Clackamas and Multnomah Counties, excluding Portland; c) Town, which included all population centers with populations 10,000 or greater, excluding the Urban and Portland Suburbs classes; d) Rural, which included all population centers with fewer than 10,000 people.

3. For what subject areas does the teacher have responsibility, and for which is he certified? Three questions were involved in eliciting the necessary information. Though more specific assignments were sampled the four categories into which the sample was divided were: a) Science, Pure (S)--the teacher is certified to teach only science and is assigned to teach science; b) Science, All Teacher(s)--the teacher is certified to teach science and some other subject but is

assigned to teach science; c) Non-science, All Teacher(s)--the teacher is certified to teach non-science courses as well as science but does not teach science or the teacher is not certified to teach science but is certified to teach non-science courses but is teaching science; d) Non-science, Pure (NS)--the teacher is certified to teach non-science courses, is not certified to teach science and is not teaching science.

4. How much education beyond the bachelor's degree has the teacher obtained? This information was obtained in detail, after administration of the ISI, from the OEA files. Four categories were provided: a) Bachelors or less, b) Fifth Year, c) Master's Degree, and d) Masters plus 45 quarter hours or more.

Of the 720 requests 483 letters were returned, or 67 percent. Of those that were returned, 20 were identified as unknown or retired. Many of the unknown no doubt had moved since the time of compilation of the addresses used to draw the preliminary sample.

The question of respondent vs. non-respondent bias must be faced in light of the fact that, of the 700 viable members of the preliminary sample (this figure is the remainder of the 720 initial attempted contacts after excluding the 20 unknowns and retireds), 450 returned completed forms. This leaves 250 as non-respondents with unknown scores.

Table 1 represents the distributions of the preliminary sample, the respondents and the non-respondents on each of the parameters for which information could be gathered. Chi-square has been calculated for comparison of respondents and non-respondents.

The non-respondents did not differ significantly from the sample of respondents on four of the five parameters available for inspection. Those teachers with less than a fifth year preparation show a significant tendency to fail to respond, however.

Of the 450 respondents 36 were unusable due to incomplete or invalid responses. The final sample numbered 414.

Administration-ISI

As with the student sample, care was taken to point out the importance of frank, honest answers, free from the influence of "correct" answers as a model. It was pointed out that the ISI was being administered statewide. Cognizance of the usual busy teachers' schedules was taken and an assurance given that the ISI was designed to take a minimum amount of their time. An opinion was expressed to the effect that the items would be found to be interesting to the teacher. A pledge was made that no specific teacher or school would be identified with any response in any report of the study. The teachers were requested to return the unfinished questionnaire if they could not spare time to complete it.

Table 1. Distribution and Chi-Square Values of Respondents and Non-Respondents with Respect to Science, Non-Science Sample Source List, Grade Level, Community Size, Sex and Educational Background.

	Respondents	Non-Respondents	Total	Degrees of Freedom	Chi-Square
Source List					
Science	198	108	306	1	0.11
Non-Science	216	124	340		
Grade Level					
Junior High	125	67	192	1	0.12
Senior High	289	165	454		
Community Size					
Rural	186	96	282		
Town	108	57	165		
Portland Suburbs	77	49	126	3	2.62
Urban	43	30	73		
Sex					
Male	297	177	474	1	1.51
Female	117	55	172		
Educational Background					
Bachelors	119	98	217		
Fifth Year	127	57	184		
Masters	143	62	205	3	12.70**
Masters + 45	25	15	40		

** Significant at 0.01 level

Statistical Analysis-ISI

In addition to the statistics pertinent to the ISI calculated by Steiner, several statistical analyses were performed on the teacher sample responses to the ISI for the purpose of adding to the knowledge concerning the reliability and validity of the ISI.

Odd-even, split-part reliabilities, for each factor scale using the Horst adaptation of the Spearman-Brown prophecy formula to estimate from Pearson product-moment correlation coefficients, were calculated. This was accomplished with the aid of the Oregon State University CDC-3300 computer system. A program to extract split-part scores, using odd items for one part score and even items for the other, was written by James Sasser of the Oregon State University Computer Center. These scores were used as input with the BMDO3D program from the O.S.U. Statistical Program Library. This program produces a correlation matrix of all scores with Pearson product-moment correlation coefficients. Those coefficients r_{pp} relevant to the Horst Formula,

$$R = \frac{r_{pp}\left[\sqrt{r_{pp}^{2} + 4pq(1-r_{pp}^{2})} - r_{pp}\right]}{2pq(1-r_{pp}^{2})}$$

where:

R = corrected reliability
p = proportion of scale items included in even item scores
q = (1-p)

were selected from the matrix and inserted for the calculations. The Horst version of the Spearman-Brown formula corrects for the fact that the split-part scores used in the calculation generally have greater variance than would scores from a test of twice the length, such as the one for which the calculations are being carried out. Thus Spearman-Brown reliabilities are generally higher than the Pearson product-moment correlation coefficients for which the prophecy formula corrects.

The Ferguson adaptation of the Kuder Richardson formula-20 was also used to calculate reliabilities for each factor scale using teacher response data. This formula allows for responses to have weighted scores. The Kuder Richardson formula-20 is essentially a mean of split-half scores and is generally lower than the Spearman-Brown reliability. Test-retest reliabilities were calculated using responses solicited from 19 junior high school teachers in the Corvallis, Oregon school district. The Pearson product-moment correlation coefficient was the statistic calculated.

Within each factor scale the teacher responses were utilized to determine the discriminability of each item. Each 27 percent of the respondents that scored highest and lowest on a factor scale was compared by χ^2 to determine if any or all items discriminated these extreme groups. This was deemed useful for the purpose of instrument evaluation.

χ^2 was also used to determine if individual items discriminated between science teachers and non-science teachers. This was seen as useful in describing differences that might exist between the groups on factor scales. Both the Kuder Richardson-20 and the χ^2 programs were written by James Sasser and the calculations carried out at the Oregon State University computer center.

In order to determine whether the ISI was indeed a useful instrument for use with secondary school teachers, it was decided to carry out factor analyses of the ISI responses of teachers and of students. Ideally, teacher responses would have been available from the 100 item preliminary inventory for this purpose so that initial definition of the attitude domain could have been compared. However, comparison of a factor analysis of the same sixty items over teacher and student samples seemed the next best thing. The program *FAST, available through the O.S.U. computer center, was used for this purpose. It carries out a similar analysis to the FACTOL program referred to previously.

As a contribution to knowledge of the construct validity of the ISI, a known groups validation was attempted. It was hypothesized that the known group would score significantly higher on, possibly, six of the factor scales. Four individuals recognized as knowledgeable concerning environmental problems and admitting to strong opinion thereof, were solicited to respond to the ISI. The names of

these individuals are displayed in Appendix E. The results were compared to the teacher group and means compared by a standard t-test using the O. S. U. - 20 program in the O. S. U. Statistical Analysis Program Library.

The comparison of science and non-science teachers attitude as measured on the seven factor Scales of the ISI was carried out with an analysis of covariance design using the BMDO5V-General Linear Hypothesis program available as O. S. U. - 14 from the O. S. U. Statistical Analysis Program Library. Criterion variables were each of the seven factor Scale scores while the predictor variable of interest was the science, non-science classification. Control variables were used in various combinations for fourteen different analyses, two each for each criterion variable.

IV. THE STUDY

A preliminary inventory of 100 attitude statements was designed to represent issues of concern to society which were related to science. This was administered to a representative sample of Oregon public high school seniors, 304 in number and the responses were factor analyzed. Seven factors were interpreted, as follows: 1) Regard for human life; 2) Fatalistic disillusionment with "progress" as represented by scientific and technological advances; 3) Need to cooperate with nature rather than subjugate it; 4) Concern with control of population and its related problems; 5) Need to take personal responsibility for societal woes; 6) Belief in the utility of science and technology and their ability to solve many of society's problems; 7) Desire to have and allow individual freedom.

Seven Factor Attitude Scales were developed using representative items of the seven interpretable factors. The resulting 60 items constituted the final Inventory of Societal Issues (ISI). This was administered to a sample of Oregon secondary school teachers, 414 in number, representing professionals responsible for science instruction and non-science instruction. These two groups were compared concerning their attitudes toward societal issues.

Factor Analysis of the Preliminary Inventory

The first purpose stated for this study was that of determining the attitudinal dimensions of a universe of science related societal issues. The procedures of this section were directed toward that purpose.

Responses to the 100 item preliminary inventory, made by 304 Oregon public school seniors, were factor analyzed utilizing the facilities of the computer center at the University of Oregon and the program FACTOL, available through that facility. FACTOL performs a principal component analysis of the correlation matrix and carries out an orthogonal rotation using the Varimax criterion.

An initial abortive attempt to analyze the data provided sufficient information to indicate that approximately 40 percent of the common variance would be accounted for with the extraction of twelve factors. It is desirable, of course, to explain as much of the common variance as possible. Ideally 100 percent would be explained. The preliminary analysis indicated, however, that 79 factors would be required to explain the total variance. More importantly, it appeared that the amount of common variance that would be removed by each additional factor beyond 12 was sufficiently small as to indicate that these additional factors probably contained no more than one or two variables of significance. This indicated that the additional 67 factors were most commonly very specific or simply factors resulting from accidental

correlation, i.e., random statistical factors. Thus, 12 factors were extracted.

It was necessary to decide upon a useful criterion for initial inclusion of an item within a factor. A factor loading can be perceived as the correlation of the item to the factor. As such, factor loadings for 304 seniors should be statistically significant at the 0.01 level if their value equals or exceeds 0.148. However, most multiply loading items (a tendency of low loading items) help little in identifying dimensions better represented by more meaningful, higher loading item clusters. On the other hand, setting a very high criterion level would have resulted in elimination of many items that may have loaded significantly on only one factor indicating that these items were relatively pure representatives of that factor. A level of 0.30 was set as a compromise criterion level based upon these two considerations.

Another meaningful guide concerning the contribution that an item made to a factor was how the magnitude of a loading compared to the magnitude of loadings of other items included under the factor. Several high loading items might represent a factor sufficiently well without the addition of items whose loadings were low. Ultimately, this guide was useful only if a factor contained a wealth of items.

In addition, individual item factor loadings were compared across factors. An item that loaded on more than one factor was examined carefully, as the purpose was not to obtain as many items as possible

but to represent the factor as well as possible with items that were most representative of the factor. Initially, stringent, though informal, requirements were applied to items concerning multiple loading. The ultimate criteria, however, were related to the logical and psychological model used to identify the factor and subjective judgements concerning the desirability of retaining the item. If an item seemed to fit one model very well, though it also loaded on another factor, it was retained provided that both researchers judged it as very representative.

Each factor loading was either positive or negative. The sign of the loading, in combination with the scoring direction assigned, indicated whether the item related directly or conversely to the factor as it was stated. The assignment of a direction, for scoring purposes, was often difficult, since opinions concerning controversial topics, by definition, differ. The direct or converse relationship was unaffected, however, by the scoring procedure. A change in sign in the scoring key would simply reverse the sign of the factor loading, and their relationship would remain the same. This characteristic was used to arrive at a meaningful assignment of directions to each item after the factor analysis was performed. Scoring directions were assigned in such a way as to cause the sign of the factor loadings to be the same for all items within a factor. This allowed items, which related conversely to the factor, to contribute to the factor score in a manner consistent with the item-factor relationship.

A second consideration concerned the model used for factor interpretation. The model building procedure included the following steps: 1) The items were perused for the purpose of identifying common content, either manifest or underlying; 2) An attitude was hypothesized to represent the common content of the items and, therefore, the factor itself. This hypothesis became the preliminary attitude model, subject to logical verification; 3) Logical verification was attempted to determine the usefulness of the attitude model. For this purpose a criterion individual was devised. This was a fictitious person holding an extreme position with respect to the model attitude. Each item was then inspected, and a response was projected on the basis of this fictitious extreme individual; 4) The pattern of projected responses was inspected, and, if it was found that consistency was obtained, the attitude model was accepted. The consistency criteria was a simple requirement that each projected response contribute maximally to the total score of the fictitious criterion individual. This extreme individual should receive an extreme (either high or low) score, and each item should contribute in a logically consistent fashion, based on the model attitude. Rejection of the model required beginning the process again.

If all but one or two, from a large group of items, could be explained by a particular model, and no other model could be designed to include that (those) item(s), the item(s) would be considered suspect,

possibly falling within the group due to a statistical accident.

Using the two criteria in conjunction provided a reasonable tool by which the major portion of the final item inventory was chosen. Subjective judgements, based on apparent relationships, even though factor loadings were low or dispersed, were incorporated as criteria for the choice of a few of the final items. In no case was an item included in the final inventory whose factor loading was less than 0.30 for the factor which it was to represent.

Twelve factors were extracted, and seven contained a sufficient number of items to be retained as part of the final inventory. The items, their factor loadings 0.300 and above (excluding decimals) and secondary loadings, for those items which loaded multiply, are displayed in Tables 2 through 13. The initial scoring key and factor loading sign are included, along with the revised scoring key. The model attitude used in interpretation and a description of opinions and beliefs of a hypothetical high scoring individual accompanies each Table.

Scoring of the final factor scales was accomplished by assigning values from one to five for each of the response choices available for an item. Strongly agree received five points (one point) if the scoring key indicated that the item should be scored as + (-). Factor attitude scale scores were compiled by summation of individual item scores within the factor.

Factor 1

Factor 1 items, and their respective loadings, are included in Table 2.

Eight items loaded under Factor 1. None of these loaded elsewhere. The attitude model developed for this factor was a general regard for human life and a concern for its maintenance. A hypothetical high scoring individual on this collection of items would believe that abortion was the taking of a life, and as such, he would not support the practice personally nor allow others that option. Euthanasia would be an unthinkable alternative to this individual as would personal use of drugs or tolerance for their use by others.

All eight of the items loading under Factor 1 were retained for inclusion as Factor Attitude Scale I of the Inventory of Societal Issues (ISI).

Factor 2

Factor 2 items, and their respective loadings, are included in Table 3.

Nine items loaded under Factor 2. The attitude model developed to represent this factor was an apparent fatalistic disillusionment with "progress" as represented by scientific and technological advances. A desire for a return to laissez-faire with respect to nature was

Table 2. Factor I Items and Their Respective Loadings

Scoring [a] Initial	Scoring [a] Final	Item Number [b] Preliminary Inventory	Item Number [b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	+	30	57	Abortion is the taking of a life.	-786											
-	+	15	53	Personally, I would probably never have (or recommend that my wife have) an abortion.	-749											
+	-	12	45	A woman should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would live if born naturally.	-738											
-	+	91	43	A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	-684											
+	-	68	27	Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	-547											
-	-	78	21	I would probably try some type of drug if their use were legalized.	506											
-	-	42	10	The law should allow a person to choose freely whether or not he wishes to experience drugs.	485											
-	-	24	5	Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	436											

[a] A + (-) indicates that a strongly agree response receives five (one) points.
[b] If no number appears in the ISI column, the item was not included in the final inventory.

Table 3. Factor 2 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
+	+	90	55	It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.		496										
-	+	54	49	America, in the near future, will be filthy and foul, and our air will be unfit to breathe.		-465										
-	+	47	41	Science can never solve the problems which are really important to man.		-417										
+	+	26	32	Man should not tamper with the grandeur of nature.		417	-323									
-	+	53	25	Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.		-411										
-	+	87	22	Technological devices which make it easier for man to exploit nature should be banned.		-401										
+	+	96	9	Science and technology often create products and services that man does not really need.		341										
+	+	21		The vast majority of people in the world probably don't care about wilderness areas.		334										
+	+	93		People should be free to do whatever they wish about birth control.		326		317					-324			

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

detected. A high scoring individual would lament the loss of virgin wilderness and would exhort mankind to leave nature as is. He would foresee America of the future as a polluted wasteland. He would look upon science and technology as oftime creators of irrelevant products and services, and he would recognize problems of mankind with which science could not appropriately deal. Computers would be perceived as a threat to privacy, and those technological devices which could be used to exploit nature would be outlawed by this individual.

Item 21 was too ambiguous to be useful, in the judgement of the researchers. Reinspection of the comments made by the priliminary pilot groups, used in development of the items, indicated that this item had been a borderline choice for the preliminary inventory. Item 93 had a low factor loading on Factor 2 as well as being multiply loaded. In addition, it was difficult to reconcile this item to the attitude model, which seemed adequate to explain the other items. Since no attitude model could be devised to include this item comfortably, and the factor loading was low, it was concluded that item 93 was included in Factor 2 by chance.

Items 21 and 93 were not included in the final inventory. The other seven items were used to make up Factor Attitude Scale II of the ISI.

Factor 3

Table 4 contains the items, and their respective loadings, for Factor 3.

Eight items loaded under Factor 3. The attitude model developed for this factor was a need to cooperate with nature rather than subjugate it. A high scoring individual would be concerned with preservation and conservation of natural resources and wildlife. He would support groups asking for total protection of certain areas and would tend to blame the unaware public citizen for deterioration of the environment.

All eight items from Factor 3 were included in the ISI and form Factor Attitude Scale III of that instrument.

Factor 4

The items, and their respective loadings, for Factor 4 are included in Table 5.

Factor 4 items were thirteen in number. The attitude model developed for this factor was concern with control of population. Equal emphasis was placed on control and population in this model. A high score on this factor indicates a great concern for the numbers of people that are presently, or will soon be, populating the planet. Control would be looked upon as necessary and/or right, by this

Table 4. Factor 3 Items and Their Respective Loadings

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	-	50	60	Extinction of some species of wildlife is a necessary result of man's involvement with nature.			-545									
-	-	1	47	Land should be utilized in such a manner that the most people benefit from its ultimate use, even if it means giving up already preserved areas.			-537									
-	-	63	40	There is no point in attempting to take nature back to pristine purity.			-529									
-	-	62	35	After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.			-487									
-	-	51	30	It is unjustifiable to set aside large expanses of marketable timber for recreation.			-475									
+	+	36	16	Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.			-443									
+	+	58	11	Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.			-385									
-	-	48	4	Conservationists' pleas for total protection of an area rich in natural resources (e. g., Alaska) are unrealistic.			-432								-340	

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

Table 5. Factor 4 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		1	2	3	4	5	6	7	8	9	10	11	12
-	+	46	54	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.				577								
-	+	99	50	In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control. I approve.				550								
+	+	45	42	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies toward the population and environment of the United States.				-499								
+	+	49	36	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.				-495								
-	+	85	29	It has been suggested that this country determine which countries are beyond help populationwise. Massive surplus food efforts would then be directed toward areas with a greater hope of success.				377								
+	+	22	24	The tax system should be redesigned to encourage small families rather than large ones.				-364								
-	+	75	18	In order to encourage a lower birth rate single people should be assessed much lower taxes.				362								
-	+	17		It is inevitable that world wide famine will occur in the next decade.				332								
-	+	6	13	Sterilization should be mandatory after the birth of a couple's second child.				434			352					
+	-	71	7	No one but the family should make decisions regarding its size.	327	354		402			357		-317			
-	+	23		Environmental pollution is a direct consequence of increased population.			312	401								
-	+	52		Science and technology are removing the last remaining barriers that have kept man from controlling his life.				354					306			
+	+	59	3	The population growth of the United States should be halted.				-326			-304					

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

individual, no matter what the means, including mass, involuntary contraception, withdrawal of surplus food aid to those countries judged beyond help, tax incentives and mandatory sterilization. Lack of control, as evidenced by the Roman Catholic Church's position, densely populated underdeveloped countries, and families wishing to make their own decisions, would be looked upon with disfavor by this individual.

Item 17 obtained a low loading and was only peripherally consistent, logically, to the factor model. Since sufficient other items remained, this item was not retained in the ISI. Items 23 and 52 loaded doubly and were also only peripherally pertinent to the attitude model. These three items were not included in the ISI.

Item 71 loaded on several factors but was viewed as directly pertinent to the factor model and so was included, along with the other nine items that represented the attitude model, in the final inventory. These ten items represent Factor Attitude Scale IV of the ISI.

Factor 5

The items, and their respective loadings, for Factor 5 are included in Table 6.

Since only a limited number of items loaded under this factor, no concerted effort was made to develop an attitude model to describe the factor. The factor, and its items, was not used on the ISI. Some tendency toward a concern for the "rest of the world", or an

Table 6. Factor 5 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
+	+	43		All regions of the United States should have equal right to the resources of the country.					571							
+	+	66		The world's supply of resources belongs to all people, not strictly to the countries in which they are found.					481							
+	-	81		The World War II atomic bombings are justifiable because they ended the war quickly and in the long run saved more lives than they took.					-390							
+	-	69		Advanced nations should discourage emigration of scientists and technologists from developing nations.					-365							
-	-	61		The only way to meet further power supply needs is with nuclear sources regardless of their possible hazards.					316							

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

international viewpoint, can be detected as a possible theme of these items, but the relationship is not clear cut.

Factor 6

Factor 6 items, and their respective loadings, are included in Table 7.

Only two items loaded under Factor 6 , both specifically related to sonic boom. These items were not included in the ISI.

Factor 7

Factor 7 items, and their respective loadings, are included in Table 8.

Fifteen items loaded under Factor 7. The attitude model developed for this factor was a need to take personal responsibility for societal woes. An individual achieving a high score on this factor would support a move toward fewer, more efficient automobiles used less often and disposed of by the owner. Fireplaces and incinerators, pesticides and large families, representing conveniences and luxuries, would be perceived as considerations that should be secondary to society's needs. In all of this, he would lament the lack of personal responsibility shown by those who desire the conveniences and would recommend encouragement and/or requirement that those, who directly benefit, take action to alleviate problems caused by their actions.

Table 7. Factor 6 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	-	2		People will come to accept the sonic boom of proposed supersonic commercial flights as they have the rather unpleasant side effects which have accompanied other advances in transportation.						-632						
-	-	19		Sonic boom is only a temporary annoyance to which people can soon adjust.						-545						

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

Table 8. Factor 7 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
+	+	74	59-	Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.							-706					
-	+	41	52	To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity.							625					
+	+	18	44-	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.							-616					
+	+	8	38-	Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.							-575					
-	+	76	34	Citizens should not be allowed to use fireplaces in pollution-prone areas.							543					
+	+	57	28	The cost of automobile disposal should be paid by the auto owner, not by society as a whole.							-408					
-	+	95	23-	The automobile is incompatible with our health and well being.							391					
-	+	65	19	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contributions to air pollution.							385					
-	+	13	17-	We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.							354					
-	+	73	14-	Our current cities are a lost cause; we need entirely new experimental cities.							344					
-	-	29		The internal combustion engine, a major source of air pollution, is the backbone of our industrial society, and, therefore, its elimination is not feasible.							-335					
+	+	25		Until fool-proof means of obtaining undersea oil deposits are developed, offshore oil drilling should be halted.							-330					
-	+	86		Most of the man-made objects along the highway are degrading.							303					
-	+	80	6	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.				374			509					
+	+	44	1	Environmental quality is generally neglected when economic considerations are involved.			304				-350					

[a] A + (-) indicates that a strongly agree response receives five (one) points.
[b] If no number appears in the ISI column, the item was not included in the final inventory.

Items 25, 79 and 86 were judged on the basis of relatively low-factor loadings, to contribute less than the other items to the attitude model. Since there was an abundance of items, these were not included in the ISI. The other 12 items were included in the ISI and represent Factor Attitude Scale V of the ISI.

Factor 8

Factor 8 items, and their respective loadings, are included in Table 9.

Four items loaded under this factor, and no attitude model was developed to explain the item relationships. A tendency toward a realistic viewpoint, as opposed to an idealistic outlook, can be perceived within this factor, but too few items load here to apply the interpretation. None of these items were retained for the ISI.

Factor 9

Factor 9 items, and their respective loadings, are included in Table 10.

Eleven items loaded under Factor 9. The attitude model developed for this factor was a belief in the utility of science and technology and in their ability to solve many of society's problems. This is accompanied by an optimism concerning those problems. An individual achieving a high score on this factor would consider science

Table 9. Factor 8 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	+	31		It should be illegal to possess products made from the skin or fur of wild animals.								449				
+	+	98		Considering population projections for the next 50 years, it is not realistic to expect all of our water resources to be pollution free.								462				
+	-	100		The consumer who buys a finished alligator product is at least as guilty of causing extinction of the alligator as the poacher who obtains the skins.						-347		-473				
-	+	92		The advertising along the highway is an invasion of privacy.						327		417				

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

Table 10. Factor 9 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	+	72	56	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.									579			
-	+	32	51	Man's vast technological abilities should be used to put water where people want to be.									541			
-	+	64	46	The oceans represent an almost limitless source of food and resources for the future.									534			
+	+	60	37	Technology's positive contribution to our lives far outweight the negative.									-439			
-	+	34	33	The primary objective of the working scientist is to improve human welfare.									352			
-	+	94	26	When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.									335			
+	+	14	20	We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.									-320			
-	+	35	15	Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.									312			
-	+	77		Man is part of nature, subject to nature's relationships, but since he is the most gifted of nature's children, he should mainipulate those relationships to his advantage.									310			
-	+	37	8	There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.				367					372			
+	+	67	2	Science and technology should attempt to control the weather.		-313							-333			

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

and technology as able to solve social problems, develop new foods and provide leisure and freedom through automation. Science and technology would be perceived as existent to improve human welfare and controlling nature to that purpose. Providing water for man's convenience to areas lacking it and controlling weather would be manifestations of the good that technology should do that would overshadow its negative contributions.

Only item 77 was eliminated from the final inventory, and it more on the basis of its awkward wording than its content. The other ten items were included in the ISI and represent Factor Attitude Scale VI of that final inventory.

Factor 10

Factor 10 items are included in Table 11, along with their respective loadings.

Only three items loaded under Factor 10. No attitude model was developed for this factor, and none of the items were included in the ISI. No clear relationship among these items could be ascertained.

Factor 11

The items, and their respective loadings, for Factor 11 are included in Table 12.

The attitude model developed for this factor was a desire to have,

Table 11. Factor 10 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
-	-			Surplus food aid programs to underdeveloped countries should be halted because continued aid does not force these countries to face up to the reality of a limited food supply and to take positive action on their population problem.										-552		
+	+			Automation will degrade the industrial machine operator even more as he assumes the role of button pusher.										-513		
+	-			Emotional and exaggerated views of water pollution are common. In such a mental environment it is often difficult to establish realistic needs and priorities.										394		

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

Table 12. Factor 11 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 1	2	3	4	5	6	7	8	9	10	11	12
+	+	84	58	If a farmer finds it unprofitable to harvest his crops he should have the right to let them rot in the field.											454	
-	-	39	48	Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.											396	
-	-	16	39	Personal information useful for combating tax evasion should be collected and stored in computers.											328	
-	-	38		Computers represent a reliable means of unbiased decision making.											325	
-	-	83	31	The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.						-309					467	
-	-	89	12	Scientists should not meddle in matters which are inappropriate for scientific methods.										-316	393	

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

and allow others to have, personal freedom. An individual achieving a high score on this factor would not infringe upon the freedom of others and, presumably, would, in turn, desire full use of his freedom. This attitude would be manifest in such activities as: allowing hikers to enter areas known to be inhabited by grizzly bears, if the hikers so chose; keeping computers from compiling information for use against an individual; protesting suggestions that individuals wear noise filters to combat noise pollution; supporting a scientist's freedom to investigate any area he deems appropriate.

Item 38 obtained a low loading, and its content was connected to the attitude model in a peripheral manner; thus, this item was not included in the final inventory. The other five items were included in the ISI and form Factor Attitude Scale VII of that instrument.

Factor 12

The items, and their respective loadings, for Factor 12 are included in Table 13.

No attitude model was developed for this factor since only four items loaded on it. None of the items were included in the ISI.

Other Items

Eleven items did not have loadings of 0.30 or greater on any factor. These items, and their respective loadings 0.20 or greater,

Table 13. Factor 12 Items and Their Respective Loadings.

Scoring[a] Initial	Scoring[a] Final	Item Number[b] Preliminary Inventory	Item Number[b] ISI		Factor 12
-	+	97		Individual tax payers should help industry pay the cost of elimination of industrial pollution.	-498
+	+	29		Typically a community will allow pollution from its industries if increased revenues are likely to result.	407
+	+	55		People who believe that pollution-producing industries should be immediately stopped are short sighted concerning the consequences of that action.	397
+	-	56		We are mistaken to think that we can control man's breeding habits by appealing to his conscience.	-342

[a] A + (-) indicates that a strongly agree response receives five (one) points.

[b] If no number appears in the ISI column, the item was not included in the final inventory.

are included in Appendix F.

Summary of the Factor Analysis of the Preliminary Inventory

This aspect of the study was directed toward accomplishing the study's first purpose--to determine attitudinal dimensions of a universe of science related societal issues. Factor analysis of Oregon public school seniors' responses to the preliminary inventory was carried out. Criteria were established and applied that allowed items to be listed under a factor depending on their factor loading and consistency of the items with the attitude models developed for the factors. Twelve factors were extracted and seven were retained for the final inventory, on the basis of number of items and interpretability. The 12 factors are displayed in Tables 2 through 13.

The identification of 12 factors, and interpretation of seven of these, accomplishes the first purpose of the study as each of the interpretable factors represents an attitudinal dimension of the original universe of science related societal issues.

The ISI

The second purpose of this study was to construct valid and reliable attitude scales for as many of the identified dimensions as was practical. This section is devoted to a description of the procedures and results of that endeavor.

Responses from 304 Oregon high school seniors were factor analyzed and 12 factors extracted. Attitude models were developed for seven of these factors and items chosen to represent those factors as Factor Attitude Scales on a final inventory, the Inventory of Societal Issues (ISI). The Factor Attitude Scales were represented by, from five to 12, items each, with 60 total items constituting the ISI. The seven Factor Attitude Scales were identified by the attitude models displayed in Table 14.

The ISI is displayed, in its final form, in Appendix G. The items within the seven Factor Attitude Scales are distributed throughout the inventory.

Appendix H contains statistics pertinent to the ISI, as derived from the senior responses, by Steiner. Included are the following:

1. Odd-even, split-half reliabilities, as estimated by the Spearman-Brown Prophecy Formula, using Pearson product-moment correlation coefficients.
2. Kuder-Richardson Formula 20 reliability statistics.

Stability of the ISI Factors as Observed from the Senior Responses

Though factor stability was not an explicitely stated hypothesis or purpose of the study, it is closely related to the validity, reliability concepts so important in the instrument development. Thus, the inspection of factor stability is included as part of the main study as

Table 14. Summary of the ISI Factor Attitude Scales and Attitude Models.

Preliminary Inventory					
Factor	Number of Items	Factor Attitude Scale	Number of Items	Attitude Model	Representative Specific Referents
1	8	I	8	Regard for human life and concern for its maintenance	Abortion, drugs, euthanasia
2	9	II	7	Fatalistic disillusionment with technical "progress"; desire to return to laissez-faire with respect to nature	Nature; devices for exploiting nature; science and technology, computers and man as threat
3	8	III	8	Need to cooperate with nature rather than subjugate it	Preservation and conservation of natural resources and wildlife
4	13	IV	10	Concern with control of population	Voluntary and mandatory control methods for limiting population
5	5				
6	2				
7	15	V	12	Need to take personal responsibility for societal woes	Autos, their use and development; other luxuries and conveniences
8	4				
9	11	VI	10	Belief in the utility of science and technology and their ability to solve society's problems	Science and technology as provider of food, water, general welfare
10	3				
11	6	VII	5	Desire to have, and allow others to have, personal freedom	Crop harvest, hiking limitations, computer information compilation, noise filter use
12	4				

a contribution to the knowledge of the attitude instrument.

After reduction to the 60 item ISI had taken place, it was decided to test the stability of the factor solutions obtained from the factor analysis of the senior responses to the preliminary inventory. This was accomplished by factor analyzing the senior responses to the 60 items that were chosen for the ISI. Twelve factors were extracted using the *FAST program and the O.S.U. computer facilities. It was expected that a stable factor would be identifiable, from this analysis, as essentially the same as from the first analysis. Some variation, combination or separation was expected, along with a higher number of multiple loadings, due to the decreased number of items. But it was thought that some insight into the appropriateness of inclusion of some items would be gained.

The results of this stability investigation are displayed in Tables 15 through 22. Identification and description of the factors accompany each table. The factors from this analysis are labeled as S-Factors to indicate that they differ from factors obtained from the preliminary inventory and also from T-Factors that are reported later. Roman numerals are used to label the S-Factors, but they should not be confused with the Factor Attitude Scales which are also labeled with Roman numerals. The Factor Attitude Scales are the groups of items chosen to represent the interpretable factors of the factor analysis of the preliminary inventory.

S-Factor I

The items, and their respective loadings, of S-Factor I are displayed in Table 15.

Factor Attitude Scale I is essentially recaptured by S-Factor I. A shift toward a more strict concern for population is evidenced by the inclusion of items 24, 7 and 3 from Factor Attitude Scale IV and item 6 from Factor Attitude Scale V. Most of these had exhibited low and/or multiple loadings in the initial analysis. Factor Attitude Scale I was judged to be stable on the basis of this analysis.

S-Factor II

The items, and their respective loadings, of S-Factor II are displayed in Table 16.

S-Factor II displays nine of the 12 items from Factor Attitude Scale V. Two of the three items not appearing here were the lowest loading items of Scale V. The additional items loading under S-Factor II can be reconciled to the Scale V interpretation of a need to take personal responsibility. Four of the five additional items come from Factor Attitude Scale IV. If personal responsibility is considered as a form of population control this grouping offers support for the inclusion of control as a major consideration in the interpretation of Factor Attitude Scale IV.

Table 15. S-Factor I Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
57. Abortion is the taking of a life.	-80								I
45. A woman should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would live if born naturally.	-74								I
43. A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	-73								I
53. Personally, I would probably never have (or recommend that my wife have) an abortion.	-71								I
27. Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	-51								I
7. No one but the family should make decisions regarding its size.	49	-48							IV
24. The tax system should be redesigned to encourage small families rather than large ones.	-40								IV
5. Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	39								I
6. Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	38	-54							V
21. I would probably try some type of drug if their use were legalized.	34								I
3. The population growth of the United States should be halted.	-31	37			-30				IV

Table 16. S-Factor II Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

	Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
59.	Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.		73							V
44.	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.		61							V
52.	To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity.		-56							V
38.	Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.		55					-38		V
6.	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	38	-54							V
34.	Citizens should not be allowed to use fireplaces in pollution prone areas.		-53							V
7.	No one but the family should make decisions regarding its size.	49	-48							IV
13.	Sterilization should be mandatory after the birth of a couple's second child.		-43			45				IV
19.	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.		-42				-43			V
58.	If a farmer finds it unprofitable to harvest his crops, he should have the right to let them rot in the field.		-38						-43	VII
3.	The population growth of the United States should be halted.	-31	37			-30				IV
42.	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the U.S.		33			-34				IV
17.	We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.		-32	34						V
28.	The cost of automobile disposal should be paid by the auto owner, not by society as a whole.		30							V

S-Factor II offers evidence for the stability of Factor Attitude Scale V.

S-Factor III

The items, and their respective loadings, of S-Factor III are displayed in Table 17.

Five of seven Scale II items and six of ten Scale VI items loaded under S-Factor III. In each case, the highest loading item or items from those Scales did not load under S-Factor III. This analysis apparently provided a dimension representing a gross attitude toward science and technology. The differences that placed the high loading items of Scales II and VI in those definitive positions in the first analysis no doubt precluded their appearance together under S-Factor III.

Stability was not demonstrated for each of the Factor Attitude Scales, II and VI, from inspection of S-Factor III. However, it was proposed that Scales II and VI represent more basic dimensions than S-Factor III, since the latter was derived from fewer items and represented a combination of the others.

S-Factor IV

Items, and their respective loadings, of S-Factor IV are included in Table 18.

Table 17. S-Factor III Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
41. Science can never solve the problems which are really important to man.			51						II
26. When nature is deficient in doing what is should for human welfare, science and technology must make up for that deficiency.			-50						VI
37. Technology's positive contribution to our lives far outweighs the negative.			49						VI
25. Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.			49						II
15. Automation holds the promise of the future with new abundance for all, new leisure and new freedoms			-43	32					VI
22. Technological devices which make it easier for man to exploit nature should be banned.			42						II
2. Science and technology should attempt to control the weather.			37					-36	VI
17. We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.		-32	34						V
49. America, in the near future, will be filthy and foul, and our air will be unfit to breathe.			33						II
9. Science and technology often create products and services that man does not really need.			-32	30					II
20. We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.			30				38		VI
8. There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.			-30			-44			VI

Table 18. S-Factor IV Resulting From Factor Analysis of Senior Responses to the 60 Items of the ISI.

Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
47. Land should be utilized in such a manner that the most people benefit from its ultimate use, even if it means giving up already preserved areas.				67					III
60. Extinction of some species of wildlife is a necessary result of man's involvement with nature.				56					III
16. Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.				50					III
30. It is not justifiable to set aside large expanses of marketable timber area for recreation.				45					III
32. Man should not tamper with the grandeur of nature.				44				35	II
35. After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.				42			-33		III
40. There is no point in attempting to take nature back to pristine purity.				41			-45		III
11. Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.				32					III
15. Automation holds the promise of the future with new abundance for all, new leisure and new freedom.			-43	32					VI
9. Science and technology often create products and services that man does not really need.			-32	30					II

Seven of eight items from Factor Attitude Scale III are found under S-Factor IV. It appears that this is simply Scale III recaptured, so that stability is demonstrated.

S-Factor V

Items, and their respective loadings, for S-Factor V are displayed in Table 19.

Eight of the ten items representing Factor Attitude Scale IV were found under S-Factor V. Scale IV was judged to be stable.

S-Factor VI

The items, and their respective loadings, of S-Factor VI are displayed in Table 20.

Four of ten items from Scale VI appeared under S-Factor VI. Three of these were the three highest loading items of Scale VI. Since S-Factor VI included most of the other Scale VI items under a broad attitude toward science dimension, it was proposed that this nucleus remained representative of the optimism displayed under Scale VI. The items that grouped themselves with this nucleus under S-Factor VI came from various other factors and, in general, could be incorporated into an optimism dimension, though a shift in emphasis from the specific content of Scale VI was noticed.

Some support for considering Factor Attitude Scale VI as stable

Table 19. S-Factor V Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

	Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
29.	It has been suggested that this country determine which countries are beyond help populationwise. Massive surplus food efforts would then be directed toward other areas with a greater hope of success.					51				IV
54.	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.					49				IV
13.	Sterilization should be mandatory after the birth of a couple's second child.			-43		45				IV
50.	In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control. I approve.					42				IV
18.	In order to encourage a lower birth rate single people should be assessed much lower taxes.					36				IV
56.	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.					-36				VI
36.	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.					-35	-40			IV
42.	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the U.S.		33			-34				IV
3.	The population growth of the United States should be halted.	-31	37			-30				IV

Table 20. S-Factor VI Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

	Item	S-Factor								ISI
		I	II	III	IV	V	VI	VII	VIII	Factor
46.	The oceans represent an almost limitless source of food and resources for the future.						-56			VI
8.	There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.			-30			-44			VI
19.	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.		-42				-43			V
56.	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.						-40			VI
36.	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.					-35	-40			IV
51.	Man's vast technological abilities should be used to put water where people want to be.						-37		44	VI
60.	Extinction of some species of wildlife is a necessary result of man's involvement with nature.						-30			III
23.	The automobile is incompatible with our health and well being.						-30	38		V

was inferred from inspection of S-Factor VI, relative to the considerations mentioned.

S-Factor VII

Items, and their respective loadings, for S-Factor VII are displayed in Table 21.

No clear-cut relationship between S-Factor VII and any Factor Attitude Scale was observed.

S-Factor VIII

Items, and their respective loadings, of S-Factor VIII are displayed in Table 22.

Factor Attitude Scale VII evidences itself in S-Factor VIII. The added items can be explained sufficiently well with the Scale VII Attitude model to suggest that Scale VII is stable.

Other S-Factors

S-Factors IX, X, XI and XII each included only a few items, and no clear relationships with the Factor Attitude Scales were found.

Summary of the Stability Observations Based on Senior Responses

The senior responses to the 60 items chosen for the Inventory of Societal Issues were factor analyzed to test whether the Factor

Table 21. S-Factor VII Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
4. Conservationists' pleas for total protection of an area rich in natural resources (e.g. Alaska) are unrealistic.							-48	33	III
40. There is no point in attempting to take nature back to pristine purity.				41			-45		III
38. Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.		55					-38		V
23. The automobile is incompatible with our health and well being.						-30	38		V
20. We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.			30				38		VI
35. After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.				42			-33		III
55. It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.							-31		II

Table 22. S-Factor VIII Resulting from Factor Analysis of Senior Responses to the 60 Items of the ISI.

Item	S-Factor I	II	III	IV	V	VI	VII	VIII	ISI Factor
51. Man's vast technological abilities should be used to put water where people want to be.						-37		44	VI
58. If a farmer finds it unprofitable to harvest his crops, he should have the right to let them rot in the field.		-38						-43	VII
31. The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.								-40	VII
39. Personal information useful for combating tax evasion should be collected and stored in computers.								-39	VII
48. Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.								-36	VII
12. Scientists should not meddle in matters which are inappropriate for scientific methods.								-36	VII
2. Science and technology should attempt to control the weather.			37					-36	VII
32. Man should not tamper with the grandeur of nature.				44				35	II
4. Conservationists' pleas for total protection of an area rich in natural resources (e. g. Alaska) are unrealistic.							-48	33	III

Attitude Scales could be identified as a factor in this analysis. If so, it would support the validity and reliability of the initial analysis. Twelve factors, labeled S-Factors, were extracted. Stability of Factor Attitude Scales I, III, IV and VII and, to some extent, VI, were directly identifiable as S-Factors I, IV, V, VIII and VI respectively. Factor Attitude Scale V appeared in combination with a few Scale IV items. These could be reconciled to the Scale V attitude model, however. Factor Attitude Scales II and VI appeared in combination as S-Factor III. These two Scales were proposed to be more basic than S-Factor III because they combined under analysis of fewer items.

The factor analysis and interpretation process which resulted in the ISI have been supported by subsequent factor analysis of the 60 item ISI, using the same senior responses and comparison of the resulting S-Factors with the Factor Attitude Scales. The Scales were shown to be substantially stable, indicating a reasonable analysis was performed initially.

Secondary School Teacher Response to the ISI

The third purpose of this study was to determine, by application of the scales of the ISI, whether there exists a statistically significant difference in attitude toward science related societal issues between science and non-science teachers. The procedures and results described in the following sections are directed toward that purpose.

Four hundred fourteen complete responses were made to the ISI by Oregon secondary school science and non-science teachers. The teachers were classified according to the following parameters:

Science, Non-Science -- Two classifications were used:

1. S -- Teachers certified to teach, and engaged in teaching, only science courses. (Science, Pure)

2. s -- Teachers certified to teach only science who may teach some non-science courses, or teachers certified to teach science and engaged in teaching only science who may also hold certification in some non-science field. (Science, All Teachers)

3. ns -- Teachers not engaged in teaching science who may be certified to teach some science courses. (Non-science, All Teachers)

4. NS-- Teachers never having been certified to teach, and who were not actively engaged in teaching, science courses. (Non-science, Pure)

Grade Level Responsibility -- Two classifications were made, as follows:

1. Junior High School

2. Senior High School

Community Size -- Four classifications were used, as follows:

1. Rural -- All population centers with fewer than 10,000 people.

2. Town -- All population centers with populations 10,000 or greater, excluding the Urban and Portland Suburbs class.

3. Portland Suburbs -- Washington, Clackamas and Multnomah counties, excluding Portland.

4. Urban -- The area within the Portland City limits.

Community Background -- Three classifications were used, as follows:

1. Less than 10,000 population
2. 10,000 - 100,000 population
3. Greater than 100,000 population

Experience -- Four classifications were used, as follows:

1. 1 - 3 years
2. 4 - 6 years
3. 7 - 10 years
4. More than 10 years

Age -- Four classifications were used, as follows:

1. 20 - 29
2. 30 - 39
3. 40 - 49
4. 50 or over

Sex --

1. Male
2. Female

Undergraduate Degree Institution -- Four classifications were used, as follows:

1. Teacher training institution
2. University

3. Liberal Arts college

4. Other

Educational Background -- Four classifications were used, as follows:

1. Bachelor's degree

2. Fifth year

3. Master's degree

4. Master's degree plus 45 hours or more

Table 23 shows tabulations of the number of teachers included in each of the sub-categories of the nine parameters identified above.

The Science, Non-Science classification was obtained by two separate criteria. The first, more strict classification included 271 of the total sample of 414. Slightly more (151) Pure non-science teachers were obtained than Pure science teachers (120). The second criterion provided for all of the teachers of the sample, and slightly more (222) science teachers were obtained than non-science teachers (192).

Slightly less than one-third of the teachers sampled were junior high school teachers; the rest teaching in senior high school.

The number of teachers from small communities was greater than from suburban or urban areas.

More than half of the teachers had been raised in communities with populations less that 10,000. A few more came from communities

Table 23. Distribution of Teacher Sample on Each of the Nine Parameters Used for Identification.

Science	S	s	ns	NS
Non-Science	120	222	192	151
Grade Level	Junior High	Senior High		
	125	289		
Community Size	Rural	Town	Portland Suburb	Urban
	125	108	77	43
Community Background	10,000	10,000 to 100,000	100,000	
	244	98	72	
Experience	1 - 3	4 - 6	7 - 10	more than 10
	71	86	83	174
Age	20 - 29	30 - 39	40 - 49	50 or over
	121	132	95	66
Sex	Male	Female		
	297	117		
Degree Institution	Teacher Training Institution	University	Liberal Arts	Other
	98	198	111	7
Educational Background	Bachelors	5th year	Masters	Masters + 45
	119	127	143	25

of 10,000 to 100,000 than came from communities with populations greater than 100,000 (98 vs. 72).

Approximately 40 percent of the teachers had more than ten years experience while the rest were roughly evenly divided among the other three categories.

Roughly equal numbers of teachers were in the 20-29 and 30-39 age classifications. Fewer (95) were 40-49, and still fewer (66) were 50 or over.

Nearly 30 percent of the teachers were female.

More teachers (198) graduated from a university. The others were approximately equally divided between teacher training institutions and liberal arts colleges.

Teachers with bachelors, fifth year and masters level educational background were represented well (119, 127 and 143 respectively). Only 25 teachers in the sample had obtained at least 45 hours beyond the masters level.

Comparisons were made between science and non-science teachers (both S vs. NS and s vs. ns), using each of the seven Factor Attitude Scales of the ISI as criterion variables. The other eight teacher classifications were used as control variables for a single classification analysis of covariance. A preliminary analysis was made, in each case, to identify those control variables that contributed substantially to the criterion score. The analysis of covariance was

carried out using these contributing variables as control variables. The effects of the dependent variable on the criterion variable were then inspected with more confidence that contributions from those confounding influences had been minimized. The results of the analyses of covariance are summarized in Tables 24 and 25 and descriptions are included in the textual material accompanying Tables 26 through 32.

Tables 26 through 32 summarize the responses of the teachers to items in each of the Factor Attitude Scales. Chi-square values, comparing responses of science and non-science teachers, are included for each item. A textual description of the results accompanies each table.

The Analysis of Covariance

Distribution of teacher responses and chi-square values comparing science and non-science, both Pure (S vs. NS) and All Teachers (s vs. ns) classifications, for each Factor Attitude Scale are displayed in Tables 26 through 32, each placed proximately with the description of the results of the analysis of covariance. In addition, covariate contributions are described referenced to Tables 24 and 25.

Factor Attitude Scale I

Results of the analysis of covariance for Factor Attitude Scale I,

Table 24. Analysis of Covariance of Scores of 271 Science (S) and Non-Science (NS) Teachers on the Seven Factor Attitude Scales of the ISI, Including Control Variables.#

Variables		Factor Attitude Scale I	II	III	IV	V	VI	VII
F Values (S vs NS)	1 df	0.28	5.68*	0.50	0.06	1.03	12.27**	4.02*
Degrees of Freedom		267	266	263	266	264	267	264
Grade Level		[+]	[-]	[-]	[-]	[-]		[-]
Community Size				[+]		[+]		[-]
Community Background				[+]	[-]			
Experience		[+]	[-]	[-]	[-]	[-]	[+]	[-]
Age				[-]			[+]	
Sex						[+]		[-]
Undergraduate Institution			[+]			[+]		
Educational Background				[+]				[+]

#Control variables are indicated by [+] or [-] according to whether increasing value of variable tended to increase or decrease, respectively, the scale score. (Direction of increase is according to the number system of pages 137 to 139.)

*Significant at the 0.05 level.

**Significant at the 0.01 level.

Table 25. Analysis of Covariance of Scores of 414 Science (s) and Non-Science (ns) Teachers on the Seven Factor Attitude Scales of the ISI, Including Control Variables.[#]

Variables		Factor Attitude Scale I	II	III	IV	V	VI	VII
F Values (s vs ns)	1 df	1.75	3.58	0.24	0.41	0.79	10.60**	6.36*
Degrees of Freedom		410	409	407	410	407	408	407
Grade Level			[-]	[-]	[-]	[-]		[-]
Community Size				[+]		[+]		[-]
Community Background		[-]		[+]			[+]	
Experience		[+]	[-]		[-]	[-]	[+]	[-]
Age				[-]			[+]	
Sex						[+]		[-]
Undergraduate Institution			[+]			[+]		
Educational Background				[+]			[-]	[+]

[#]Control variables are indicated by [+] or [-] according to whether increasing value of variable tended to increase or decrease, respectively, the scale score. (Direction of increase is according to the numbering system of pages to .)

*Significant at the 0.05 level.

**Significant at the 0.01 level.

Table 26. Distribution of Teacher Responses to Items of Factor Attitude Scale I, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns). #

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	15	22	25	39	21			8.07
		NS	12	40	16	47	36			
+ 57 (30)	Abortion is the taking of a life.	All	44	98	64	134	74	2.77	1.28	
		ns	16	51	23	60	42			
		s	28	47	41	74	32			9.19
		S	21	25	11	50	13			6.36
		NS	24	36	17	45	29			
+ 53 (15)	Personally, I would probably never have (or recommend that my wife have) an abortion.	All	73	96	41	139	65	2.93	1.38	
		ns	30	48	19	61	34			
		s	43	48	22	78	31			2.59
		S	32	52	10	12	13			4.31
		NS	55	51	14	19	12			
- 45 (12)	A woman should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would live if born naturally.	All	120	163	39	53	39	2.34	1.28	
		ns	64	71	20	22	15			
		s	36	92	19	31	24			4.72
		S	9	11	18	55	27			4.26
		NS	12	16	19	55	49			
+ 13 (91)	A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	All	34	59	55	161	105	2.41	1.24	
		ns	15	23	24	72	58			
		s	19	36	31	89	47			5.03
		S	15	65	16	14	10			6.76
		NS	26	58	26	25	16			
- 27 (68)	Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	All	53	188	61	65	47	2.67	1.21	
		ns	29	78	32	32	21			
		s	24	110	29	33	26			4.46

Table 26. Continued.

Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
	S	10	2	10	22	76			3.36
	NS	12	9	13	29	88			
- 21 (78) I would probably try some type of drug if their use were legalized.	All	28	11	31	88	263	4.35	1.05	
	ns	15	9	15	36	117			
	s	13	2	16	45	146			6.69
	S	8	2	4	42	64			4.16
	NS	12	5	11	57	66			
- 10 (42) The law should allow a person to choose freely whether or not he wishes to experience drugs.	All	27	7	22	149	209	4.27	0.95	
	ns	14	5	13	73	87			
	s	13	2	9	76	122			5.83
	S	22	43	24	23	8			7.23
	NS	29	51	18	30	23			
- 5 (24) Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	All	74	144	70	79	47	2.71	1.28	
	ns	39	66	27	33	27			
	s	35	78	43	46	20			5.91
	S						24.09	6.40	
	NS						23.68	6.79	
Total	All						24.46	6.46	
	ns						23.88	6.44	
	s						24.96	6.45	

#The three columns at the left indicate scoring direction, ISI item number and preliminary inventory number, respectively.

representing a regard for human life, showed no significant difference for either the Pure groups or All Teachers groups.

A majority of the teachers considered that abortion was not the taking of a life, would personally choose abortion, given the occasion, and felt that others should have that right. Euthanasia was considered justifiable. Drugs and the right to use them were overwhelmingly rejected by this group.

Contributing influences to the responses were the grade level taught and the amount of experience of the pure group teachers. Senior high school and more experienced teachers tended to obtain higher scores on this Scale than junior high school and less experienced teachers, for the pure group. Teachers raised in small towns and, again, those with more experience tended to obtain higher scores on this scale, for all teachers.

Factor Attitude Scale II

Results of the analysis of covariance for Factor Attitude Scale II showed a significant difference between the pure groups and a similar tendency, though not statistically significant, between the all teachers groups.

In general, non-science teachers showed greater agreement with the factor's implication of disillusionment with "progress" as represented by scientific and technological advances and a desire to

Table 27. Distribution of Teacher Responses to Items of Factor Attitude Scale II, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Items		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	35	44	13	27	1			6.22
		NS	46	53	24	26	6			
+ 55 (90)	It is unfortunate that there are fewer and fewer areas in this	All	104	161	56	80	13	3.64	1.15	
	country where man has never set foot.	ns	54	67	33	31	7			
		s	50	94	23	49	6			8.47
		S	8	41	17	44	10			4.83
		NS	13	35	26	67	10			
+ 49 (54)	America, in the near future, will be filthy and foul, and our air will	All	31	114	73	168	28	2.88	1.11	
	be unfit to breathe.	ns	15	46	36	83	12			
		s	16	68	37	85	16			2.73
		S	3	18	14	60	25			10.37*
		NS	16	25	19	74	17			
+ 41 (47)	Science can never solve the problems which are really important	All	25	62	32	211	64	2.45	1.11	
	to man.	ns	18	32	24	94	24			
		s	7	30	28	117	40			9.60*
		S	20	37	21	37	5			2.28
		NS	35	47	24	41	4			
+ 32 (26)	Man should not tamper with the grandeur of nature.	All	72	138	73	122	9	3.34	1.14	
		ns	39	60	33	56	4			
		s	33	78	40	66	5			11.73*
		S	21	40	15	35	9			5.86
		NS	26	39	32	48	6			
+ 25 (53)	Computers with their storage and retrieval capacities represent	All	63	137	75	119	20	3.25	1.17	
	a serious threat to the privacy of the individual.	ns	33	56	41	55	7			
		s	30	81	34	64	13			5.69

Table 27. Continued.

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	7	20	30	47	16			19.77***
		NS	20	47	33	46	5			
+ 22 (87)	Technological devices which make it easier for man to exploit nature	All	49	98	87	153	27	2.97	1.16	
	should be banned.	ns	55	56	41	59	9			
		s	22	42	46	94	18			11.69*
		S	28	67	14	11	0			0.87
		NS	42	77	17	15	0			
+ 9 (96)	Science and technology often create products and services that man	All	103	231	39	41	0	3.96	.0.86	
	does not really need.	ns	49	106	18	19	0			
		s	54	125	21	22	0			0,08
	Total	S						21.98	3.94	
		NS						23.05	4.09	
		All						22.50	3.95	
		ns						22.93	4.04	
		s						22.16	3.83	

***Significant at the 0.001 level.

assume a hands off posture with respect to nature. Science teachers exhibit this disillusionment to a lesser degree. Responses to specific items show that this is not necessarily an overwhelming disillusionment.

The majority of teachers agreed: that it was unfortunate that less virgin wilderness exists; that man should not tamper with the grandeur of nature; that computers represent a threat to privacy; that science and technology create irrelevant products and services. The majority disagreed with the contentions that: America's air will be unfit to breathe in the future; science cannot solve man's important problems; technological devices useful for exploiting nature should be banned.

Both Pure and All Teachers groups of science and non-science teachers differed significantly in responding to the issue that science can never solve man's really important problems and whether technological devices useful for exploiting nature should be banned. In addition, the All Teachers science, non-science groups differed significantly as to whether man should not tamper with the grandeur of nature. In each case the science groups tended to disagree with the contention, preferring, more often than non-science teachers, to: look upon science as able to solve the important problems of man; refrain from banning technological devices useful for exploiting nature; allow man to tamper with the grandeur of nature.

Contributing influences to the responses were, for both the All Teachers and Pure groups, grade level taught, experience and undergraduate institution attended. A tendency toward more agreement with the implication of the factor, the disillusionment, hands off outlook, was exhibited by junior high school teachers, teachers with less experience and teachers from liberal arts colleges (or universities as opposed to teacher training institutions).

In the extreme, a model confrontation can be built for this analysis in which the inexperienced, liberal arts college alumnus, junior high school, non-science teacher points out the evils wrought by science and technology and extols the virtues of a humanistic outlook while preaching about leaving nature as it is for the aesthetic pleasure it affords. Threatened by this attitude, the experienced, senior high school science teacher, a teacher training institution alumnus, becomes protective of science and technology's role and holds forth the advancements brought about by them as evidence that "tampering" with nature can be used to man's advantage.

Factor Attitude Scale III

Results of the analysis of covariance for Factor Attitude Scale III, representing a need to cooperate with nature rather than subjegate it, indicate no significant difference exists between the responses

Table 28. Distribution of Teacher Responses to Items of Factor Attitude Scale III, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Items		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	7	20	6	53	34			1.34
		NS	11	19	10	66	45			
- 60 (50)	Extinction of some species of wildlife is a necessary result of man's involvement with nature.	All	28	79	23	175	109	3.62	1.25	
		ns	13	32	13	82	52			
		s	15	47	10	93	57			2.14
		S	0	21	7	64	28			12.95*
		NS	4	26	27	66	28			
- 47 (1)	Land should be utilized in such a manner that the most people benefit from its ultimate use, even if it means giving up already preserved areas.	All	8	65	48	208	85	3.72	1.02	
		ns	4	32	33	88	35			
		s	4	33	15	120	50			12.23*
		S	3	50	8	43	16			7.19
		NS	3	51	25	48	24			
- 40 (63)	There is no point in attempting to take nature back to pristine purity.	All	12	157	57	138	56	3.18	1.15	
		ns	5	67	31	61	28			
		s	7	84	26	77	28			2.38
		S	3	19	27	36	35			7.97
		NS	7	27	34	59	24			
- 25 (62)	After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.	All	17	79	93	147	78	3.46	1.12	
		ns	10	37	43	71	28			
		s	7	42	50	73	50			5.44
		S	2	9	4	41	54			1.91
		NS	5	7	7	51	81			
- 30 (31)	It is not justifiable to set aside large expanses of marketable timber area for recreation.	All	10	25	20	159	200	4.24	0.97	
		ns	5	11	8	75	93			
		s	5	14	12	84	107			0.48

Table 28. Continued.

	Items		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	68	36	7	6	3			6.30
		NS	67	56	7	17	4			
+ 16 (26)	Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.	All	189	148	25	40	12	4.12	1.07	
		ns	80	74	11	21	6			
		s	109	74	14	19	6			2.75
		S	30	57	5	27	1			5.75
		NS	35	72	8	27	9			
+ 11 (58)	Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.	All	103	192	18	86	15	3.68	1.16	
		ns	47	89	8	38	10			
		s	56	93	10	48	5			2.70
		S	4	37	6	41	32			1.30
		NS	9	41	8	52	41			
- 4 (48)	Conservationists' pleas for total protection of an area rich in natural resources (e. g. Alaska) are unrealistic.	All	17	125	26	137	109	3.47	1.28	
		ns	9	55	12	63	53			
		s	8	70	14	74	56			0.81
	Total	S						30.25	4.57	
		NS						29.57	4.61	
		All						29.49	4.55	
		ns						29.32	4.58	
		s						29.64	4.53	

of science and non-science teachers, within either the Pure or All Teachers classifications.

The majority of teachers agrees with the viewpoint represented by this factor. Their responses demonstrate disagreement on the following points: extinction of wildlife species is a necessary result of man's involvement with nature; preserved areas should be given up for a maximum benefit program; there is no point in attempting to take nature back to pristine purity; high yield trees should replace redwoods; conservationists' protectionist pleas are unrealistic. Agreement is demonstrated for the following: wilderness areas should be preserved regardless of cost; pollution can be blamed on an uncommitted public.

A significant difference exists between science and non-science teachers (both classifications) concerning item 47, policies toward preserved areas relative to maximum benefit. Non-science teachers more often respond in agreement with the maximum benefit concept than do science teachers.

Contributing influences to the responses were, for both Pure and AllTeachers classifications, grade level taught, community size, community background, age and educational background. In addition, Pure group responses were influenced by teacher experience. A tendency to exhibit greater cooperation with nature was demonstrated by junior high school teachers, teachers employed and reared in

larger communities, younger teachers and teachers having a greater amount of academic preparation. For the Pure group teachers of less experience, this tendency was also exhibited.

Factor Attitude Scale IV

Results of the analysis of covariance for Factor Attitude Scale IV, representing a concern with control of population and its related problems, indicate no significant difference exists between science and non-science teachers for either the Pure or All Teachers groups.

No clear-cut trend can be established concerning this Scale. The majority of teachers agrees with the following contentions: a federal policy making department of population and environment ought to be established; the world's raw materials should be rationed by an international authority; the tax system should be encouraging of small, rather than large, families; the population growth of the United States should be halted. A majority disagrees with the position that: the Catholic Church's birth control position is responsible for population crisis; contraception through the water supply be used in backward nations; the United States place higher priorities on surplus food aid to countries more likely to deal with their population problems; single people be assessed lower taxes to encourage lower birth rates; sterilization be compulsory after two children; no one but the family make decisions regarding its size. It appears that teachers

Table 29. Distribution of Teacher Responses to Items of Factor Attitude Scale IV, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	9	41	24	37	9			11.17*
		NS	10	41	15	62	23			
+ 64 (46)	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.	All	27	120	59	53	55	2.79	1.19	
		ns	12	51	21	79	29			
		s	15	69	38	74	26			6.12
		S	9	26	11	45	29			5.86
		NS	13	22	20	64	67			
+ 50 (99)	In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control. I approve.	All	42	82	49	160	81	2.62	1.28	
		ns	22	29	25	81	35			
		s	20	53	24	79	46			6.52
		S	24	40	22	23	11			4.25
+ 42 (45)	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the United States.	NS	19	59	31	33	9			
		All	62	145	82	88	37	3.26	1.21	
		ns	26	71	38	43	14			
		s	36	74	44	45	23			2.19
		S	7	44	39	24	6			2.46
		NS	15	46	53	31	6			
+ 36 (49)	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.	All	37	139	139	81	18	3.23	1.01	
		ns	19	59	66	40	8			
		s	18	80	73	41	10			1.62
		S	7	27	23	49	14			4.32
		NS	11	26	37	51	26			
+ 29 (85)	It has been suggested that this country determine which countries are beyond help populationwise. Massive surplus food efforts would then be directed toward other areas with a greater hope of success.	All	26	84	90	155	59	2.67	1.14	
		ns	12	35	47	67	31			
		s	14	49	43	88	28			3.51

Table 29. Continued.

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	39	48	12	17	4			0.46
		NS	49	64	14	18	6			
+ 24 (22)	The tax system should be redesigned to encourage small families rather than large ones.	All	131	167	42	55	19	3.81	1.15	
		ns	59	82	20	22	9			
		s	72	85	22	33	10			1.53
		S	12	28	19	42	19			13.44**
		NS	27	22	37	55	10			
+ 18 (75)	In order to encourage a lower birth rate single people should be assessed much lower taxes.	All	52	82	81	140	59	2.83	1.26	
		ns	30	29	43	69	21			
		s	22	53	38	71	38			11.38*
		S	4	14	12	41	49			0.39
		NS	5	15	14	56	61			
+ 13 (6)	Sterilization should be mandatory after the birth of a couple's second child.	All	12	38	39	154	171	1.95	1.07	
		ns	6	17	18	70	81			
		s	6	21	21	84	90			0.23
		S	22	51	16	18	13			3.76
		NS	21	61	13	43	13			
- 7 (71)	No one but the family should make decisions regarding its size.	All	61	168	44	98	43	3.26	1.26	
		ns	25	79	18	54	16			
		s	36	89	26	44	27			3.05
		S	49	37	11	19	4			5.67
		NS	41	57	18	29	6			
+ 3 (59)	The population growth of the United States should be halted.	All	135	135	49	78	17	3.71	1.22	
		ns	49	71	26	38	8			
		s	86	64	23	40	9			8.67
	Total	S						30.74	7.25	
		NS						30.19	6.99	
		All						30.12	7.17	
		ns						29.88	6.81	
		s						30.33	7.48	

agree in principle to population control but are much more cautious concerning the means to be used.

Significant differences exist between science and non-science teachers on item 54, for Pure groups, and on item 18, for both classifications. Pure groups science teachers exhibit greater agreement with fixing much blame for the population crisis on the Catholic Church's position on birth control. Pure groups science teachers tend to disagree more than do non-science teachers, with the contention that single people should be assessed lower taxes to encourage a lower birth rate.

The differences on item 18 for the All Teachers classification, are more distribution differences than an indication of basic attitude distinctions. Non-science teachers show a greater tendency to strongly agree or to be neutral while science teachers more often choose strongly disagree or agree.

Contributing influences to the responses were, for both Pure and All Teachers classifications, grade level taught and experience. In addition, community background was an influence for the pure group. Junior high school teachers and teachers with less experience, as well as teachers reared in smaller communities, for the Pure group classification, tended to demonstrate a greater concern through their responses than did senior high school and experienced teachers and teachers from larger communities.

Factor Attitude Scale V

Results of the analysis of covariance for Factor Attitude Scale V, representing a need to take personal responsibility for societal woes, indicate no significant difference exists between science and non-science teachers, for either the AllTeachers or thePure groups classifications.

The majority of teachers generally agree with the attitude represented by this Scale. A majority of teachers agrees that one auto per family, car pool policies for commuters, small cars, less use of autos and owner responsibility for disposal of automobiles are worthwhile objectives. A majority disagrees that the auto is incompatible with health and well being and also that our cities are a lost cause. In addition, a majority agrees that: incinerator burning should not be allowed; it is irresponsible to have more than two children; environmental quality is generally neglected when economic considerations are involved. Teachers are about evenly split concerning elimination of the use of pesticides and fireplace use.

Item 17 discriminates between Pure group science and non-science teachers with science teachers exhibiting significantly more disagreement with the proposal to eliminate the use of pesticides.

Contributing influences to the responses are, for both Pure and AllTeachers classifications, grade level taught, size of school's

Table 30. Distribution of Teacher Responses to Items of Factor Attitude Scale V, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Items		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	11	57	20	27	5			3.44
		NS	19	59	34	35	4			
+ 59 (74)	Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.	All	42	170	82	108	12	3.29	1.05	
		ns	23	73	41	51	4			
		s	19	97	41	57	8			3.28
		S	6	57	24	29	4			7.73
		NS	19	52	36	37	7			
+ 52 (41)	To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity	All	43	157	90	108	16	3.25	1.07	
		ns	27	67	43	47	8			
		s	16	90	47	61	8			6.02
		S	14	46	21	36	3			0.44
		NS	20	55	28	43	5			
+ 44 (18)	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.	All	53	140	85	125	11	3.24	1.10	
		ns	26	65	37	59	5			
		s	27	75	48	66	6			0.47
		S	39	70	5	5	1			8.32
		NS	43	75	13	14	6			
+ 38 (8)	Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.	All	115	218	35	38	8	3.95	0.95	
		ns	54	97	16	19	6			
		s	61	121	19	19	2			3.17
		S	10	44	20	38	8			3.41
		NS	8	44	32	56	11			
+ 34 (76)	Citizens should not be allowed to use fireplaces in pollution prone areas.	All	24	145	76	135	34	2.98	1.11	
		ns	11	61	38	67	15			
		s	13	84	38	68	19			2.13

Table 30. Continued.

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	33	65	10	11	1			5.38
		NS	32	74	23	19	3			
+ 28 (57)	The cost of automobile disposal should be paid by the auto owner, not by society as a whole.	All	99	208	55	46	6	3.84	0.96	
		ns	40	95	28	25	4			
		s	59	113	27	21	2			4.08
		S	3	24	18	63	12			7.13
		NS	14	28	29	64	16			
+ 23 (95)	The automobile is incompatible with our health and well being.	All	23	84	70	203	34	2.66	1.06	
		ns	15	39	37	82	19			
		s	8	45	33	121	15			8.62
		S	17	56	15	27	5			2.43
		NS	23	59	19	45	5			
+ 19 (65)	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.	All	60	171	57	108	18	3.36	1.14	
		ns	31	73	27	54	7			
		s	29	98	30	54	11			2.61
		S	18	34	16	45	7			6.23
		NS	24	45	30	50	2			
+ 17 (13)	We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.	All	49	128	62	161	14	3.09	1.14	
		ns	25	62	38	65	2			
		s	24	66	24	96	12			14.32**
		S	3	11	15	63	28			6.11
		NS	3	22	17	89	20			
+ 14 (75)	Our current cities are a lost cause; we need entirely new experimental cities.	All	11	47	52	227	77	2.25	0.97	
		ns	4	27	24	107	30			
		s	7	20	28	120	47			4.52

Table 30. Continued.

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	33	34	18	26	9			3.76
		NS	35	41	18	48	9			
+ 6 (80)	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	All	94	115	56	113	36	3.29	1.32	
		ns	41	50	26	60	15			
		s	53	65	30	53	21			3.05
		S	46	63	5	6	0			6.08
		NS	42	84	16	9	0			
+ 1 (44)	Environmental quality is generally neglected when economic considerations are involved.	All	137	215	31	30	1	4.10	0.84	
		ns	55	101	20	16	0			
		s	82	114	11	14	1			7.72
	Total	S						40.04	6.54	
		NS						39.42	7.18	
		All						39.29	6.81	
		ns						39.29	7.08	
		s						39.29	6.57	

community, experience, sex and undergraduate institution. The tendencies are the following: junior high school teachers demonstrate a greater degree of agreement with the need for personal responsibility; teachers from larger communities tend to demonstrate greater agreement; teachers with less experience tend to show greater agreement; females exhibit greater agreement than males; liberal arts college graduates (or university graduates compared to teacher training institution alumni) show greater agreement.

Factor Attitude Scale VI

Results of the analysis of covariance for Factor Attitude Scale VI, representing a belief in the utility of science and technology and their ability to solve many of society's problems, indicate a significant difference between responses given by science teachers and those given by non-science teachers, for both classifications. Non-science teachers more generally concur with the belief represented by this factor while science teachers show greater skepticism concerning science's abilities.

Four items discriminate between science and non-science teachers for both classifications. Non-science teachers agree, to a significantly greater extent than science teachers that: science and technology will probably develop new foods to feed the world's hungry; technology should be used to put water where people want to be; the

Table 31. Distribution of Teacher Responses to Items of Factor Attitude Scale VI, Including Means, Standard Deviations and Chi-Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	4	53	22	35	6			18.31***
		NS	18	85	25	20	3			
+ 56 (72)	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.	All	39	210	69	83	13	3.43	1.01	
		ns	25	109	30	25	3			
		s	14	101	39	58	10			19.40***
		S	23	60	11	22	4			4.21
		NS	23	64	24	32	7			
+ 15 (35)	Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.	All	70	197	55	76	16	3.55	1.09	
		ns	29	85	31	39	8			
		s	41	112	24	37	8			4.55
		S	28	56	17	12	7			2.27
		NS	29	69	26	21	6			
+ 20 (14)	We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.	All	87	189	66	53	19	3.66	1.09	
		ns	38	89	32	25	8			
		s	49	100	34	28	11			0.56
		S	9	59	22	25	5			3.87
		NS	13	75	38	21	4			
+ 26 (94)	When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.	All	35	218	85	64	12	3.48	0.95	
		ns	17	102	44	24	5			
		s	18	116	41	40	7			3.21
		S	18	54	15	25	8			13.32**
		NS	23	80	29	18	1			
+ 33 (34)	The primary objective of the working scientist is to improve human welfare.	All	65	212	65	60	12	3.62	1.01	
		ns	31	104	33	23	1			
		s	34	108	32	37	11			9.71*

Table 31. Continued.

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	15	63	25	17	0			2.46
		NS	18	72	32	22	7			
+ 37 (60)	Technology's positive contribution to our lives far outweighs the negative.	All	54	207	85	58	10	3.57	0.97	
		ns	26	93	42	24	7			
		s	28	114	43	34	3			1.62
		S	4	30	7	47	32			34.32***
		NS	14	54	32	18	13			
+ 46 (64)	The oceans represent an almost limitless source of food and resources for the future.	All	33	133	48	135	65	2.84	1.25	
		ns	16	72	37	49	18			
		s	17	61	11	86	47			36.12***
		S	3	31	24	48	14			15.86**
		NS	13	59	33	35	13			
+ 51 (32)	Man's vast technological abilities should be used to put water where people want to be.	All	28	146	83	119	38	3.02	1.13	
		ns	18	77	43	40	14			
		s	10	69	40	79	24			16.16**
		S	9	14	18	56	23			5.06
		NS	12	33	22	62	22			
+ 8 (37)	There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.	All	32	79	54	177	72	2.57	1.20	
		ns	15	44	28	74	31			
		s	17	35	26	103	41			5.22
		S	0	6	5	63	46			6.08
		NS	0	9	16	84	42			
+ 2 (67)	Science and technology should attempt to control the weather.	All	1	30	31	215	137	2.55	1.11	
		ns	0	16	20	101	55			
		s	1	14	11	114	82			7.72
	Total	S						29.66	5.64	
		NS						31.95	5.34	
		All						31.20	5.70	
		ns						32.19	5.22	
		s						30.34	6.00	

oceans represent an almost limitless source of food and resources for the future; the primary objective of the working scientist is to improve human welfare.

The majority of teachers is in agreement with the contentions that: new foods will be developed; technology's positive contribution outweighs the negative; scientists work to improve human welfare; science and technology needs to be used to make up for nature's deficiencies; genetic advances to help rid man of hereditary defects should be pursued; automation offers the good life. The majority disagrees that: science and technology could contend with all social problems; science and technology should attempt to control the weather.

Though the majority of teachers feel that the oceans do not represent a virtually limitless reservior of food and resources, this is due to the heavy disagreement of the science teachers. A majority of non-science teachers agree with the statement. The same holds true for the apparent even division concerning using technology to put water where people want to be. Though the majority of non-science teachers agree with this concept, science teachers disagree with the idea.

Contributing influences to the responses are for both classifications, experience and age. In addition, the All Teachers group is influenced by community background and educational background.

Teachers with more experience and older teachers tend to exhibit a greater belief in science's ability. For the All Teachers group, those teachers reared in larger communities and those whose training was from a teacher training institution (or a university rather than a liberal arts college) tend to demonstrate a greater belief in science's ability.

An extreme confrontation model can be imagined here. On the one hand, the older, more experienced, non-science teacher, a city reared graduate of a teacher training institution, would contend that scientists, pursuing their primary objective of human welfare, will be able to provide new foods, perhaps harvesting the limitless resources of the oceans, and will also provide water to people wherever they wish to live.

On the other hand, the younger, less experienced, science teacher, a rural reared graduate of a liberal arts college, would hold that scientists have objectives other than human welfare in mind in their work and that food supplies may be limited to present sources. In addition, the oceans have limited resources, and water should remain where it is.

Factor Attitude Scale VII

Results of the analysis of covariance for Factor Attitude Scale VII, representing a desire to have and allow individual freedom,

Table 32. Distribution of Teacher Responses to Items of Factor Attitude Scale VII, Including Means, Standard Deviations and Chi- Square Values for Science vs. Non-Science (Both S, NS and s, ns).

	Item		SA	A	N	D	SD	Mean	Standard Deviation	Chi-Square
		S	20	59	10	26	5			4.06
		NS	22	68	22	28	11			
+ 58 (84)	If a farmer finds it unprofitable to harvest his crops he should have the right to let them rot in the field.	All	62	196	54	80	22	3.47	1.12	
		ns	27	89	31	34	11			
		s	35	107	23	46	11			3.52
		S	2	14	17	63	24			3.83
		NS	6	25	25	65	30			
- 40 (39)	Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.	All	11	53	56	219	75	3.71	0.99	
		ns	8	29	21	89	35			
		s	11	53	56	219	75			9.27
		S	4	44	26	39	7			10.42*
		NS	16	43	45	35	12			
- 39 (16)	Personal information useful for combating tax evasion should be collected and stored in computers.	All	32	139	104	108	31	2.92	1.10	
		ns	22	54	55	46	15			
		s	10	85	49	62	16			12.05*
		S	1	2	7	59	51			12.84*
		NS	2	11	24	65	49			
- 31 (83)	The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution .	All	3	22	50	186	153	4.10	0.87	
		ns	2	15	31	80	64			
		s	1	7	19	106	89			11.73*
		S	1	17	26	58	18			21.34***
		NS	10	33	47	55	6			
- 12 (89)	Scientists should not meddle in matters which are inappropriate for scientific methods.	All	15	66	113	181	39	3.39	0.98	
		ns	12	41	61	71	7			
		s	3	25	52	110	32			32.42***
	Total	S						18.24	2.57	
		NS						16.96	2.88	
		All						17.62	2.69	
		ns						17.02	2.79	
		s						18.14	2.48	

indicate that a significant difference exists between responses given by science teachers and those given by non-science teachers, for both classifications. Though there is general agreement by a majority of the teachers that individual freedom is desirable, science teachers show this attitude to a greater degree than do non-science teachers.

The majority of teachers agree that the farmer should be able to choose not to harvest his crops. The preponderance of teachers are in disagreement with the contentions that: hikers be barred from grizzly bear habitats; noise filters are a satisfactory method for combating noise pollution; scientists not be free to investigate all matters of their choice. Slight agreement is displayed with the concept of storage of personal information, in computers, to aid in combating tax evasion.

Science teachers and non-science teachers differ significantly in their responses to the noise filter issue, the freedom for scientists controversy and the computer storage of personal information concept. In all cases, the science teachers show a greater inclination to oppose limitations on personal freedom. They are more adamant in their disagreement with the use of noise filters. They show less of a tendency to support computer storage of personal information. And they are much more insistent that scientists not be restricted concerning their choices of areas of investigation.

Contributing influences to the responses are, for both

classifications, grade level, size of school's community, experience, sex and educational background. Junior high school teacher responses tend to display a greater desire for freedom as do responses from teachers employed in smaller communities. Similarly, teachers with less experience exhibit this tendency as do males. Those teachers with a greater amount of academic preparation tend to exhibit the desire for freedom to a greater degree.

An extreme confrontation model can be constructed to describe the differences exhibited for this Factor Attitude Scale. A well educated, male, junior high school, science teacher with limited experience, teaching in a small community would abhor noise filters, computer storage of personal information or any other infringement on individual freedom. In addition, he would be vehement concerning the rights of a scientist to choose any area of interest for his research.

The female, bachelor's degree holder who had taught for a number of years in a large community would feel more reserved concerning the rights a person should enjoy. Scientists should perhaps be limited to generally recognized scientific fields in their professional endeavors. Computers might be useful for combating income tax evasion, and noise filters may be satisfactory to reduce ear damage. In general, she would consider that pure freedom may not be completely practical.

Discussion of the Results of the Analyses of Covariance

On today's college campuses, science and technology are often being linked with military grants for university research and napalm producing components of the chemical industry. An atmosphere of negativistic rhetoric provides students involved in higher education with the opportunity to place blame for perceived injustices. The greater degree of student involvement in such activities at universities or even more so at liberal arts colleges, may provide the background which produces a person disillusioned with many aspects of society, among them science and technology. Such a person, only recently graduated and beginning a teaching career at a junior high school, would have a greater likelihood of distrusting science and projecting awesome qualities to it, especially if that person had been involved in the pursuit of an understanding of the humanities and social sciences instead of the sciences.

The traditionally freer atmosphere of the university or, the even more open liberal arts college campus, may produce a more disillusioned individual, especially if his knowledge of science and its functions and abilities is limited.

The science teacher is much more likely to have an understanding of science that allows him a more realistic, objective view of the capabilities and functions of science. Not that he would necessarily

be any less opposed to atrocities, injustices, excesses or public apathy than his humanities or social science counterpart. Instead, he would have less tendency to choose science as a scapegoat, having a greater understanding of its nature.

This contention is borne out in the results of Scale VI. The majority of teachers maintains a belief in the usefulness and ability of science, but non-science teachers hold a more extreme view. This awe in which science is held supports the distrustful stance exhibited by non-science teachers under Scale II. A greater understanding of the nature of science allows science teachers to maintain a more neutral posture concerning the utility of science.

The results of Scale VII are intriguing. It is difficult to produce a model relative to science teachers' apparent greater desire for freedom. Perhaps this is a selection factor rather than a result of training in science. At any rate, the results of this particular analysis, though very interesting, should be viewed cautiously since so few items are included in this Scale.

Factor Attitude Scale Reliabilities, Teacher Responses

Reliabilities were calculated to determine both internal consistency and temporal stability. The Horst adaptation of the Spearman-Brown prophecy formula, correcting odd-even, split-part correlation coefficients, was used, as well as the Ferguson version of the

Kuder-Richardson formula 20, in order to determine internal consistency . The responses of the 414 secondary school teachers were used to derive the scores for these calculations.

Temporal stability was estimated using Pearson product-moment correlation coefficients. Nineteen teachers from two junior high schools of the Corvallis school system responded to the ISI twice, each administration separated by a period of two weeks. The results of these calculations are displayed in Table 33, along with the statistics described above.

The internal consistency reliabilities are consistent with values reported for similar scales elsewhere. The low value for Scale VII is a function of the small number of items included in the Scale, as well as a lack of homogeneity of the items. The factorial stability demonstrated by this Scale, under S-Factor VIII and T-Factor VIII, (reported later) is indicative of unidimensionality, a desirable trait that supports the use of this scale.

Validity of the Factor Attitude Scales

Validity of the Factor Attitude Scales was tested, to some extent, by inspection of factorial stability. This somewhat subjective approach to validity provides insight into the stability of a factor model across factor analyses of different groups of items and responses from different samples. For the most part, the Factor Attitude Scales

Table 33. Reliabilities of Total ISI and Individual Factor Attitude Scales, Teacher Responses.

Factor Attitude Scale	Total Number of Items	Internal Consistency			Temporal Stability[b]
		Pearson Product-Moment Correlation Coefficients	Spearman-Brown Prophesy Formula Reliabilities	KR-20 Reliabilities	Pearson Product-Moment Correlation Coefficients
I	8	0.81	0.91	0.82	0.70
II	7	0.31	0.48	0.53	0.62
III	8	0.42	0.59	0.58	0.84
IV	10	0.73	0.84	0.81	0.91
V	12	0.61	0.76	0.77	0.91
VI	10	0.53	0.70	0.71	0.91
VII	5	0.25	0.41	0.36	0.39
Total ISI[a]	60	0.70	0.82	0.85	0.93

[a] Scale I scoring was reversed for these analyses to provide between Scale consistency.

[b] Number in sample = 19
Time between administrations = two weeks

of the ISI could be identified within both the S-Factors and the T-Factors. It was concluded that most of the Scales of the ISI were appropriate measures of attitude toward societal issues for secondary school teachers. A tendency to be bi-dimensional was detected relative to Factor Attitude Scales V and VI when used with teachers. Though not ideal, this characteristic is seen as less than disasterous. When note is taken of the differences exhibited by science and non-science teachers on Scale VI, the construct validity of the Scale is supported. Construct validity is demonstrated when the measures involved are shown to relate consistently to the theory on which the test is based.

Factor analysis, in itself, relates to construct validity. Scales derived by this technique provide the bases for hypotheses concerning the nature of the attitude dimensions. Predictions based on these hypotheses tend to support the content validity of the scale if the prediction becomes manifest.

A validity study was undertaken whereby four individuals, identified as concerned environmentalists, were administered the ISI. It was predicted that, compared to the scores of the 414 teachers, this group would produce significantly different scores on Scales I, II, III, IV, V and VI. Factor Attitude Scale VII was not predicted as a measure on which the criterion group would produce extreme scores. This was so because of the references often made by environmentalists

concerning the necessity for setting priorities. The priorities referred to often infringe upon the open freedom implied by the attitude model of Factor Attitude Scale VII. Table 34 displays the results of the t-test comparison of mean scores of these two groups on each of the seven Factor Attitude Scales.

Factor Attitude Scales I, V and VI each provided extreme scores when administered to the criterion groups, significant at least at the 0.05 level.

Scales II, III and IV did not obtain significant t-scores by the comparison. The small number in the criterion group may have affected these results. On the other hand it may not be reasonable to expect concerned environmentalists to be extreme in their concern for "progress" or cooperation with nature or control of population, though it is not obvious why not. Another explanation may be in the wealth of knowledge that such individuals bring to responding to such attitude statements. Their insight into all of the affecting dimensions may lead them to respond, not extremely, but conservatively, for a criterion group. In this case their answers may be quite similar to teachers answers for the different reason of greater knowledge.

Lastly, it is possible that the teachers themselves are a well informed group, with respect to these particular dimensions. In that case, they might be a criterion group themselves and answer similarly to the concerned environmentalists.

Table 34. T-Value Comparisons of a Known Group with Secondary School Teachers on Each Factor Attitude Scale of the ISI.

Factor Attitude Scale		I	II	III	IV	V	VI	VII
Mean	Known Group	13.8	25.0	27.0	34.8	46.8	25.3	16.5
	Teacher	24.5	22.5	29.5	30.12	39.3	31.2	17.6
Variance	Known Group	6.9	8.7	2.0	26.3	35.6	60.9	11.0
	Teacher	41.8	15.6	20.7	51.5	46.3	32.7	7.2
	Pooled	41.5	15.5	20.6	51.3	46.2	32.9	7.2
T-Value		3.31**	-1.27	1.09	-1.29	-2.18*	2.06*	0.83

Sample Size Known Group = 4
Teachers = 414

Degrees of Freedom = 416

* Significant beyond the 0.05 level

** Significant beyond the 0.01 level

At any rate, three of the seven scales, half of those predicted, exhibit known group validity.

Item Discriminability, Teacher Responses

Responses of the upper and lower 27 percent, by rank order, of the respondents were compared on each of the 60 items of the ISI. Chi-square values ranged from 31 to 183 with four degrees of freedom. Thus, each of the 60 items exhibit discriminability, for the extreme 27 percent groups, beyond the 0.001 level.

Stability of the ISI Factor Scales -- Teacher Responses

An assessment of the stability of the factor solutions, represented by the ISI Factor Attitude Scales, was undertaken by subjecting the teacher responses to a factor analysis. The *FAST program was again used and 12 factors extracted and rotated by the Varimax criterion. Again, an exact duplication was not expected, but stability would be implied if similar groupings of items could be identified.

Any demonstration of stability by this analysis would offer support for using the ISI as an appropriate series of measures of secondary school teacher attitude toward the attitude dimensions represented by the Factor Attitude Scales.

The results of this stability investigation are displayed in Tables 34 through 41. Identification and description of the factors accompanies

each table. The factors from this analysis are identified as T-Factors and are labeled with Roman numerals.

T-Factor I

The items, and their respective loadings, of T-Factor I are displayed in Table 34.

Six of eight Scale I items and eight of ten Scale IV items load under T-Factor I. This factor can be represented by a general concern regarding population. Many aspects of the population controversy are included. T-Factor I approximates S-Factor I.

This analysis does not demonstrate complete stability of either Scale I or IV, but, considering the resemblance of T-Factor I and S-Factor I and the apparent more general nature of the attitude represented by T-Factor I, both Scale I and IV would appear to be appropriate for assessment of secondary school teacher attitudes. Scales I and IV are proposed as more basic sub-dimensions of T-Factor I, due to their combination.

T-Factor II

The items, and their respective loadings, of T-Factor II are displayed in Table 35.

Six of eight items of Scale III load under T-Factor II. The other items from Scales II, IV and V tend to shift the emphasis of

Table 35. T-Factor I Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	T-Factor I	II	III	IV	V	VI	VII	VIII	Factor Attitude Scale
- 45	A woman should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would live if born naturally.	-77								I
+ 51	Abortion is the taking of a life.	-74								I
+ 43	A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	-74								I
+ 53	Personally, I would probably never have (or recommend that my wife have) an abortion.	-71								I
+ 6	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	65				30				V
+ 3	The population growth of the United States should be halted.	60				37				IV
+ 54	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.	59								IV
+ 13	Sterilization should be mandatory after the birth of a couple's second child.	57								IV
+ 50	In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control. I approve.	57								IV
+ 24	The tax system should be redesigned to encourage small families rather than large ones.	50								IV
- 7	No one but the family should make decisions regarding its size.	49				31				I
- 27	Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	-48					39			IV
+ 18	In order to encourage a lower birth rate single people should be assessed much lower taxes.	39			33					IV

Table 35. Continued.

	Item	T-Factor I	II	III	IV	V	VI	VII	VIII	Factor Attitude Scale
+ 42	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the United States.	38	31							IV
+ 20	We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.	31		46						VI
- 5	Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	-30					40			I

this factor toward a more general concern for the maintenance of nature. But, T-Factor II tends to demonstrate factorial stability of Factor Attitude Scale III for the teacher sample.

T-Factor III

The items, and their respective loadings, of T-Factor III are displayed in Table 36.

Six of ten items from Scale VI load on T-Factor III. The higher loading items of this factor seem to relate science and technology to its uses for man's benefit and convenience.

T-Factor III, by itself, does not demonstrate the stability of Factor Attitude Scale VI. However, in combination with T-Factor V, the tendency is more evident. More is said of this in the discussion of T-Factor V.

T-Factor IV

The items, and their respective loadings of T-Factor IV are displayed in Table 37.

Six of 12 Scale V items load under T-Factor IV. These, and the additional items, represent a series of positive action statements regarding possible steps toward elimination or reduction of certain environmental concerns. The negative statements of Scale V do not

Table 36. T-Factor II Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	T-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
- 30	It is not justifiable to set aside large expanses of marketable timber area for recreation.		-57							III
- 4	Conservationists' pleas for total protection of an area rich in natural resources (e.g. Alaska) are unrealistic.		-57							III
- 40	There is no point in attempting to take nature back to pristine purity.		-49							III
+ 55	It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.		-49							II
+ 32	Man should not tamper with the grandeur of nature.		-45							II
+ 22	Technological devices which make it easier for man to exploit nature should be banned.		-42		30					II
- 47	Land should be utilized in such a manner that the most people benefit from its ultimate use, even if it means giving up already preserved areas.		-41							III
+ 16	Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.		-40							III
+ 17	We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.		-39		32					V
- 60	Extinction of some species of wildlife is a necessary result of man's involvement with nature.		-34							III
+ 12	A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the United States.	38	-31							IV

Table 37. T-Factor III Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	T-Factor								Factor Attitude Scale
		I	II	III	IV	V	VI	VII	VIII	
+ 20	When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.			-53						VI
+ 51	Man's vast technological abilities should be used to put water where people want to be.			-48						VI
+ 2	Science and technology should attempt to control the weather.			-47						VI
+ 20	We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.			-46						VI
+ 37	Technology's positive contribution to our lives far outweighs the negative.			-45		32				VI
+ 56	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.			-38		53				VI
- 39	Personal information useful for combating tax evasion should be collected and stored in computers.			35					32	VII
+ 36	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.			-32						IV
- 35	After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.			30						III
+ 11	Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.			-30						III

load under T-Factor IV. Further note of this will be taken in discussion of T-Factor VII.

Stability of Factor Attitude Scale V is not completely demonstrated by inspection of T-Factor IV. In combination with T-Factor VII, a tendency toward factorial stability is perceived.

T-Factor V

The items, and their respective loadings, of T-Factor V are displayed in Table 38.

Six of ten Scale VI items load under T-Factor V. These items convey an attitude of optimism and faith in science and technology. The other items have low loadings under this factor and higher loadings elsewhere.

This factor, in combination with T-Factor III, represents, very well, Factor Attitude Scale VI. It is proposed that Scale VI is perceived as a general attitude made up of two sub-dimensions: 1) a belief in science and technology as benefactor and provider of convenience for mankind; 2) an optimism and faith of science and technology. One dimension seems to require what science should do while the other projects what it can do.

Factor Attitude Scale VI is judged an appropriate measure of secondary school teacher attitude. The attitude appears to be made up of two sub-dimensions.

Table 38. T-Factor IV Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	F-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
+ 14	Our current cities are a lost cause; we need entirely new experimental cities.				-55					V
+ 49	America, in the near future, will be filthy and foul, and our air will be unfit to breathe.				-52					II
+ 23	The automobile is incompatible with our health and well being.				-52			30		V
+ 25	Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.				-51					II
+ 38	Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.				-40					V
+ 44	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.				-34					V
+ 18	In order to encourage a lower birth rate single people should be assessed much lower taxes.	39			-33					IV
+ 17	We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.		39		-32					V
+ 59	Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.				-31					V
+ 22	Technological devices which make it easier for man to exploit nature should be banned.		42		-30					II

T-Factor VI

The items, and their respective loadings, of T-Factor VI are displayed in Table 39.

Four items from Scale I load under T-Factor VI. All Scale I items not related to the status of the fetus or abortion load under this factor. This indicates that, for the teacher group, at least some aspects of regard for human life are perceived as separate from consideration of pre-natal life.

For teachers, then, Factor Attitude Scale I is perhaps made up of two sub-dimensions: 1) pre-natal life; 2) life beyond birth.

T-Factor VII

The items, and their respective loadings, of T-Factor VII are displayed in Table 40.

Four Scale V items make up T-Factor VII. Relating these items to previous observations, it is obvious that this factor represents the negative statements of Scale V that were so conspicuously absent under T-Factor IV.

Kerlinger's (1967) contention that many attitudes may not be bipolar but need to be considered as separate factors, positive and negative, seems to be demonstrated by T-Factors IV and VII. Stability of Scale V is implied by T-Factors IV and VII, but their

Table 39. T-Factor V Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	F-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
+ 46	The oceans represent an almost limitless source of food and resources for the future.					55				VI
+ 56	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.			-38		53				VI
+ 8	There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.					48				VI
+ 33	The primary objective of the working scientist is to improve human welfare.					39				VI
+ 37	Technology's positive contribution to our lives far outweighs the negative.					32				VI
- 7	No one but the family should make decisions regarding its size.	49				-31				VI
+ 15	Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.					+30				VI
+ 6	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	65				-30				V

Table 40. T-Factor VI, Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	F-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
-21	I would probably try some type of drug if their use were legalized.						63			I
-10	The law should allow a person to choose freely whether or not he wishes to experience drugs.						61		30	I
+41	Science can never solve the problems which are really important to man.						42			II
- 5	Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	30					40			I
-27	Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	48					39			I

non-bi-polar nature needs to be kept in mind when using Scale V with teachers.

T-Factor VIII

The items, and their respective loadings, of T-Factor VIII are displayed in Table 41.

Four of the five Scale VII items are included under T-Factor VIII. The fifth item of T-Factor VIII can be readily incorporated into the attitude model represented by Scale VII.

T-Factor VIII demonstrates the factorial stability of Factor Attitude Scale VII, and, therefore, its appropriateness as a measure of secondary school teacher attitude.

Other T-Factors

The four other T-Factors extracted in this analysis consisted mostly of items with low loadings. No further resemblances with Factor Attitude Scales were noticed.

Summary of the Evaluation of the ISI Using Teacher Responses

Both internal consistency and temporal stability were inspected for the seven Factor Attitude Scales of the Inventory of Societal Issues. Values ranged from 0.36 to 0.91. Overall the reliabilities were quite

Table 41. T-Factor VII, Resulting from Factor Analysis of Secondary School Teacher Response to the ISI.

	Item	T-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
+34	Citizens should not be allowed to use fireplaces in pollution prone areas.							73		V
+19	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.							66		V
+23	The automobile is incompatible with our health and well being.				52			30		V
+52	To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity.							30		V

Table 42. T-Factor VIII, Resulting from Factor Analysis of Secondary School Teacher Responses to the ISI.

	Item	T-Factor								Factor
		I	II	III	IV	V	VI	VII	VIII	Attitude Scale
-31	The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.								52	VII
-12	Scientists should not meddle in matters which are inappropriate for scientific methods.								48	VII
-48	Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.								39	VII
-39	Personal information useful for combating tax evasion should be collected and stored in computers.			35					32	VII
-10	The law should allow a person to choose freely whether or not he wishes to experience drugs.						61		30	I

acceptable. Scale VII showed consistently low values, but its small number of items may have accounted for this result.

Validity was claimed on the basis of factor analysis. In addition, a known groups validity study was done. Six of the scales were predicted to be measures upon which a group of concerned environmentalists would obtain extreme scores. The prediction was supported for three of the scales.

All items discriminated between the extreme 27 percent teacher respondents.

Factor stability was tested with the teacher responses to the ISI. In general, each Factor Attitude Scale was identified within the resultant T-Factors. Factor Attitude Scales III and VII were directly recognizable as T-Factors II and VIII. Scales I and IV combined to form T-Factor I thus implying the Scales to be more basic, since they were originally identified from a larger number of items. The other Scales showed various divisions but were identifiable within no more than two T-Factors each.

On the basis of easy recognition of the Factor Attitude Scales within the T-Factors it was concluded that the Scales were appropriate measures of teacher attitude.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Through this study an answer was sought to the following basic question: Is there a group of teachers that is better prepared than any other to guide students toward the development of certain attitudes? Specifically, are science teachers better prepared, affectively, than non-science teachers, to guide attitude development relative to science related societal issues?

Three purposes were listed for this study, as follows:

1. To identify the attitudinal dimensions of a universe of science related societal issues.
2. To construct valid and reliable attitude scales for as many of the identified dimensions as was practical, considering availability of sufficient numbers of items and factor interpretability.
3. To determine, by application of these scales, whether there existed a statistically significant difference in attitude toward these science related societal issues between science teachers and non-science teachers.

To accomplish the first purpose, a broad definition of a universe of attitude referents was stated. A multitude of sources was used to identify referents. Likert type attitude statements were constructed

from these referents, and a five point response format was employed. Responses and comments were solicited from university students and the results used to identify ambiguous or non-appealing, non-discriminating items for elimination or revision. A pilot group of high school students was used as the final test of the resulting items.

In all, approximately 250 items were considered, from which 100 were chosen for use in a preliminary inventory. In the Spring of 1970, 100 items were administered to 303 high school seniors. This was approximately a one percent sample of public school seniors in the State of Oregon. With minor deviations, the sample was chosen using random sampling procedures.

The responses of these seniors were treated using a factor analytic technique to determine the attitudinal structure of the universe of referents represented by the inventory. The FACTOL program and the University of Oregon computer facilities were used to perform a principal components analysis. Twelve factors were identified accounting for approximately 40 percent of the common variance, and rotated using the Varimax criterion.

Seven attitudinal models were developed, one for each of the seven factors judged interpretable. These follow: Regard for human life, Fatalistic disillusionment with "progress" as represented by scientific and technological advances, Need to cooperate with nature rather than subjugate it, Concern with control of population and its

related problems, Need to take personal responsibility for societal woes, Belief in the Utility of science and technology and their ability to solve many of society's problems, Desire to have and allow individual freedom.

The second purpose of the study, that of constructing valid and reliable attitude scales for these dimensions, was intimately linked to the first. The preliminary item pool development provided sufficient opportunity to construct and choose unambiguous, discriminating items. Inspection of factor loadings and relationships of items to attitude models provided the final test of an item's worth.

A sub-universe of referents, represented by 60 items and seven Factor Attitude Scales, was identified. The seven Factor Attitude Scales were made up of, what were judged to be, the most representative items of each of the seven factors identified by factor analysis. The 60 items of the seven Factor Attitude Scales were referred to collectively as the Inventory of Societal Issues (ISI). The ISI is displayed in Appendix G.

Statistics relating teacher responses to each of the Factor Attitude Scales were calculated. They were analyzed to determine internal consistency and temporal stability. In addition, individual item discriminability was tested by a chi-square comparison of extreme groups of teachers. The extremes were represented by those ranking in the upper and lower 27 percent by Factor Attitude Scale score.

Factorial stability was investigated by factor analyzing the responses of the public school seniors to the 60 items used in the ISI. This was done in order to determine if the factors defining the universe represented by the 100 item inventory were appropriate for the sub-universe of ISI items. In addition, teacher responses to the ISI were subjected to factor analysis to determine if the factors appropriate to high school seniors could be recognized in the teacher response patterns.

Construct validity was claimed on the basis of factor analysis. In addition, a known group test was made in an attempt to demonstrate extreme responses of concerned environmentalists on six of the seven Scales. A two sample t-test was used to compare the mean of the teacher sample with the mean of scores of the members of the extreme group.

To accomplish the third purpose of the study, that of seeking attitude differences between science and non-science teachers relative to science related societal issues, the ISI was administered to teachers.

Two random samples were drawn. First, a sample of predominantly science teachers was drawn from the mailing list of The Oregon Science Teacher, a publication of the Oregon Science Teacher's Organization. Second, a sample of predominantly non-science teachers was drawn from the Oregon Education Association listing of

Oregon teachers. Seven hundred twenty secondary school teachers were asked, by mail, to respond to the ISI and a background information sheet. Twenty of these were identified as retired or unknown. Of the possible 700 viable members of the sample, 450 returned completed inventories. Four hundred fourteen were usable, and these constituted the final sample.

The following background information was solicited and/or gathered for each teacher:

1. Grade level responsibility
2. Size of teaching community
3. Size of community of origin
4. Amount of teaching experience
5. Age
6. Sex
7. Undergraduate degree institution
8. Amount of educational preparation

The inventory responses and background information were solicited by mail in early November, 1970.

A comparison of attitudes, contrasting science and non-science teachers, was made using an analysis of covariance. Scores on each of the Factor Attitude Scales served as criterion variables. Control variables were chosen from preliminary analyses from among the eight background parameters available for each teacher.

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5. Age.
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Conclusions

Attitudinal Dimensions of a Universe of Science Related Societal Issues

A factor analysis of responses to 100 items, representing a universe of science related societal issues, resulted in twelve factors which accounted for approximately 40 percent of the common variance. Attitude models were developed for seven of the resultant factors as follows:

1. Regard for human life.
2. Fatalistic disillusionment with "progress" as represented by scientific and technological advances and a desire for a return to laissez-faire with respect to nature.
3. Need to cooperate with nature rather than subjugate it.
4. Concern with control of population and its related problems.
5. Need to take personal responsibility for societal woes.
6. Belief in the utility of science and technology and their ability to solve many of society's problems.
7. Desire to have and allow individual freedom.

Factor Attitude Scales

Factor Attitude Scales I through VII were constructed using the most representative items of each identifiable factor from the factor

analysis. From five to 12 items were used to represent each factor. The seven Factor Attitude Scales of the Inventory of Societal Issues (ISI) consisted of 60 items.

The KR-20 formula was used as a measure of internal consistency. Reliabilities calculated in this manner ranged from 0.36 to 0.82. The Spearman-Brown corrections of the Pearson product-moment correlation coefficients of odd-even, split-part scores, ranged from 0.41 to 0.91 for the seven Factor Attitude Scales. Total ISI reliabilities were 0.82 for the S-B correction and 0.85 for the KR-20 formula.

Temporal stability measurements were carried out using Pearson product-moment correlation coefficients comparing individual teacher scores on two separate administrations of the ISI. Approximately two weeks separated the administrations. The coefficients ranged in value from 0.39 to 0.91 for the separate scales, and 0.93 was the value for the total ISI.

Item discriminability calculations comparing the extreme 27 percent groups, as ranked by each respondents score on each Factor Attitude Scale, showed each item to discriminate significantly beyond the 0.001 level.

S-Factors, resulting from a separate factor analysis of responses of public school seniors to the 60 items of the ISI, were inspected. A similar analysis was carried out for teacher responses, resulting

in T-Factors. For the most part, the Factor Attitude Scales were identifiable within or between both the S and the T-Factors. S-Factors showed excellent stability, though S-Factor III seemed to subsume Factor Attitude Scales II and VI. It was proposed that Scales II and VI were more basic dimensions. Their combination in this analysis may have been due to the smaller total number of items used in the factor analysis. A more gross description of the sub-universe sufficed in this case; whereas the complete inventory of 100 items may have necessitated more dimensions for proper definition. A breakdown of the gross dimensions represented by S-Factor III was perhaps a natural statistical response to the broader boundaries of definition invited by the larger number of items.

T-Factors showed more division and combination of the Scales than did the S-Factors. T-Factor I appeared to combine Scales I and IV. These Scales were considered more basic than the T-Factor due to their combination in the factor analysis of fewer items. Scale I seemed to be separated into pre-natal, post-natal dimensions of concern for life, in the perceptions of the teacher group.

Scale VI was identifiable as the separate T-Factors, III and V. These T-Factors implied that teachers break their preception of the utility of science and technology and their ability to solve society's problems into two sub-dimensions, as follows:

1. Belief in science and technology as benefactor and provider of convenience for mankind, or what science should do.
2. Optimism and faith in science and technology, or a projection of what science can do.

Scale V was recognizable as a combination of T-Factors IV and VII. There was a tendency for positive action statements from Scale V to group under T-Factor IV. The negative statements made their appearance under T-Factor VII. Apparently, teachers perceived these two aspects of Scale V, not as obviously opposite extremes of a bi-polar dimension, but as separate dimensions.

Straightforward correspondence existed between T-Factor II and Scale III as well as for T-Factor VIII and Scale VII.

Scale II was divided between T-Factors II and IV. These factors separated the Scale II items related to nature from those relating technology to man's freedom and/or responsibility. Interestingly, the Scale II item loading in both T-Factor II and IV combined both considerations.

Stability was claimed when Scales were identifiable within the T-Factors. When a Scale combined with another to form a more gross T-Factor, or when a Scale corresponded quite closely to a single T-Factor, the Scale was judged basic or uni-dimensional. Thus, Scales III, IV and VII were both stable and basic and quite appropriate for teacher attitude assessment. Scales I, II, V and VI displayed

tendencies toward bi-dimensionality for the teacher group. Since they were easily identifiable, they were judged stable.

Teacher Attitudes -- Analyses of Covariance

The science and non-science groups were compared with respect to each of the seven Factor Attitude Scale Scores - the criterion measures. Control variables were applied as found appropriate from an initial analysis which included all covariates. Those covariates with coefficients indicative of more than random contribution were retained as control variables. In each case, the hypothesis was put forth that a significant difference in attitude existed between the science and non-science groups, as measured by the Factor Attitude Scale under consideration.

Factor Attitude Scale I

Hypothesis 1, that science teachers differ significantly from non-science teachers in their regard for human life, as measured by Factor Attitude Scale I, was rejected.

No trend could be established with respect to teacher agreement with the viewpoint represented by this factor.

A majority looked favorably upon abortion and euthanasia while overwhelmingly rejecting drugs. The grade level taught, amount of experience and the size of the teacher's home town were used as

control variables.

Factor Attitude Scale II

Hypothesis 2, that a significant difference existed between science and non-science teachers' fatalistic disillusionment with "progress" as represented by scientific and technological advances and their desire for a return to laissez-faire with respect to nature, as measured by Factor Attitude Scale II, was accepted (Pure groups only).

Though disillusionment was exhibited by the majority of leaders, non-science teachers displayed it to a greater degree than did science teachers.

Control variables used included grade level taught, experience and the degree institution attended. More disillusionment tended to be exhibited by junior high school teachers, teachers with less experience and teachers trained at a university or, even more so, a liberal arts college.

Factor Attitude Scale III

Hypothesis 3, that science teachers differ significantly from non-science teachers in their need to cooperate with nature rather than subjugate it, as measured by Factor Attitude Scale III, was rejected.

A majority of the teachers showed agreement with the implication of this Scale.

Grade level, community size and background, age, experience and educational background were all used as control variables for Scale III.

Factor Attitude Scale IV

Hypothesis 4, that science and non-science teachers differed significantly in their concern with control of population and its related problems, as measured by Factor Attitude Scale IV, was rejected.

No trend could be established concerning teacher attitude relative to Scale IV. A majority favored broad, general policies of population control. Specific suggestions, however, such as mandatory sterilization after two children and lower taxes for single people, as well as more extreme suggestions, were rejected by a majority of teachers.

Grade level, experience and community background were used as control variables for this analysis.

Factor Attitude Scale V

Hypothesis 5, that science teachers differ significantly from non-science teachers in their need to take personal responsibility for societal woes, as measured by Factor Attitude Scale V, was rejected.

A majority of teachers agreed with the factor contention.

Control variables for Scale V were grade level, school community size, experience, sex and degree institution.

Factor Attitude Scale VI

Hypothesis 6, that significant differences exist between science and non-science teachers' belief in the utility of science and technology and their ability to solve many of society's problems, as measured by Factor Attitude Scale VI, was accepted.

Non-science teachers showed a greater belief in science's utility and ability.

Experience, age and community size and background were used as control variables.

Factor Attitude Scale VII

Hypothesis 7, that science teachers differ significantly from non-science teachers in their desire to have and allow personal freedom, as measured by Factor Attitude Scale VII, was accepted.

Science teachers exhibit a greater desire to have and allow individual freedom, as measured by this Scale.

Control variables for this analysis were grade level, size of school community, experience, sex and educational background.

Discussion of Teacher Attitudes

A majority of teachers holds that "progress", as represented by scientific and technological advances, may not necessarily be desirable. A need to cooperate with nature, rather than subjugate it, is felt by the majority. Personal responsibility ought to be manifest toward the solution of many of our problems, and individual freedom should obtain for as many situations as possible.

The teachers generally feel that something should be done about population increase but disagree with some of the techniques offered, especially those requiring mass application and lack of self determination. A majority of teachers favors viewing prenatal and permanently dependent humans as less estimable than others. But, they reject the notion that drugs be allowed to affect healthy humans. As a group, secondary school teachers are neither awed nor unimpressed with science's ability and utility.

More extreme views toward science are presented by non-science teachers who are even more disillusioned with "progress" than are science teachers. In addition, they show a bent toward perceiving science as an awesome, mysterious entity with great capabilities. These viewpoints are probably not unrelated. The greater likelihood that a science teacher would understand more clearly both the nature and purpose of science lends credence to the contention that he would

view it as less mysterious than would a non-science teacher. The non-science teacher would more likely project science and its products as a scapegoat in viewing the societal difficulties about him. This might be attributed to his lesser degree of familiarity with the role of science.

The absence of significant differences in attitude regarding such dimensions as regard for human life, man's role with respect to nature, concern for population control and need for personal responsibility, indicates that both science and non-science teachers have similar degrees of concern for specific societal issues. The difference seems to lie in how the two groups perceive science's role as either cause or cure for the ills plaguing modern man.

Interestingly, the science teachers exhibit a greater degree of desire for freedom. Some caution should be exercised in interpreting the attitudes of teachers from so few items, as represented by Scale VII, however.

Thus, if one is willing to accept a lesser degree of disillusionment with scientific advancement, along with a more realistic view of science's ability to solve problems, as desirable attitudes for teachers to hold and convey, then it can be concluded that science teachers, as a group, hold more favorable attitudes than do non-science teachers.

In addition, if having and allowing individual freedom is an attitude that can be accepted as favorable, then science teachers, are

better prepared to serve as exemplars than are non-science teachers. This conclusion is based on measures from a Scale with very few items and so must be considered cautiously.

At the same time, on the four other measures involved in the assessment, science teachers and non-science teachers show no significant differences. It must be concluded, on the basis of the measures developed within this study and subject to the acceptance of the stated attitudes as desirable, that science teachers are better prepared, affectively, to guide attitude development relative to science related societal issues than are non-science teachers.

The implications of such findings are obvious. The responsibility, with which the noted science educators writing in the Silver Anniversary commemorative publication (Butts, 1969) have charged the science teacher, seems warranted. This at least for Oregon secondary school science teachers. Within the limits of the three measures for which differences were observed, those who have responsibility for choosing teachers for courses relating to societal concerns involved with science would do well to seek teachers from the ranks of the science teachers.

Recommendations

On the basis of the results of this study, the following research is recommended:

1. The preliminary inventory should be administered to samples from other populations. The responses should be factor analyzed to further test for factorial stability.
2. The Inventory of Societal Issues should be administered to samples from other populations to determine Scale reliabilities and item discriminability relative to those populations.
3. Further validation should be attempted. Larger groups, serving as external criterion groups, should be identified, preferably a different group for each Scale.
4. The ISI should be used in conjunction with other attitudinal measures, different from self reports, to determine the extent to which this instrument is appropriate as a complete measure of attitude.
5. The Factor Attitude Scales, especially the shorter ones, should be expanded. All of the Scales should be refined using more conventional attitude scale techniques.
6. The ISI should be used as a criterion measure for experimental treatments involving the alteration of attitudes toward societal issues. Especially relevant, for this purpose, would be inservice courses designed to prepare teachers to teach the concepts and attitudes appropriate to bring about change in student attitudes.

7. The ISI should be used to identify teachers with attitudes deemed desirable relative to societal issues. Students influenced by those teachers should be administered the ISI to determine if these attitudes are communicable.

8. A more detailed correlation between teacher personality characteristics and behavior and the ISI measure should be carried out in order to determine what influences operate in the selection and/or training of teachers with desired attitudes.

9. The effectiveness of various teacher preparation programs in bringing about change in attitude should be assessed using the ISI.

10. The ISI should be used to assess teacher and student attitude, these measures to be compared to student achievement measures.

11. The ISI should be part of a test battery to include such existent measures as the instruments of Allen, Cooley and Klopfer, and Korth, among others. The purpose of such a study would be to correlate these various instruments to determine the extent to which each is unique.

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APPENDICES

Appendix A

Judges Participating in the Critique of the Preliminary Inventory

David H. Milne	Assistant Professor of Biology Department of General Science Oregon State University
Daniel L. Hodges	Visiting Assistant Professor of Sociology Department of Sociology Oregon State University
Richard F. Rankin	Professor of Education University of Oregon

Appendix B

Preliminary Inventory

Please circle the appropriate personal information:

Sex: Male Female

Number of years of science, grade 10 through completion of grade 12.

1 1 1/2 2 2 1/2 3

Instructions:

There is a wide range of opinion concerning the items on the following pages. Please read each item carefully to be sure that you understand its meaning; then give your reaction to the statement. Record your first impression--the feeling that comes to mind as you read the item. Do not be concerned with how other people might respond. Please respond to all items.

Response choices:

Draw a circle around SA if you strongly agree with the statement.

Draw a circle around A if you are in partial agreement with the statement.

Draw a circle around N if you are neutral toward the statement.

Draw a circle around D if you partially disagree with the statement.

Draw a circle around SD if you strongly disagree with the statement.

Example:

SA (A) N D SD Oregon's weather is better than California's.

Since A is circled this indicates that the responder is in partial agreement with the statement.

SA A N D SD Land should be utilized in such a manner that the most people benefit from its ultimate use, even if if means giving up already preserved areas.

SA A N D SD People will come to accept the sonic boom of proposed supersonic commercial flights as they have the rather unpleasant side effects which have accompanied other advances in transportation.

SA A N D SD A danger of the current birth control movement is that the more intelligent will significantly reduce their reproduction rate whereas the less intelligent will not, resulting in a general lowering of the intelligence of our society.

SA A N D SD Surplus food aid programs to underdeveloped countries should be halted because continued aid does not force these countries to face up to the reality of a limited world food supply and to take positive action on their population problem.

SA A N D SD I am a fan of the sciences.

SA A N D SD Sterilization should be mandatory after the birth of a couple's second child.

SA A N D SD There is no reason why one 50 horsepower motorcycle should be allowed to make as much noise as four 300 horsepower Cadillacs.

SA A N D SD Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.

SA A N D SD Sonic boom is only a temporary annoyance to which people can soon adjust.

SA A N D SD Technology can rid us of pollution.

SA A N D SD The vast majority of people in the world probably don't care about wilderness areas.

SA A N D SD The tax system should be redesigned to encourage small families rather than large ones.

SA A N D SD Environmental pollution is a direct consequence of increased population.

SA A N D SD Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.

SA A N D SD Until foolproof means of obtaining undersea oil deposits are developed, offshore oil drilling should be halted.

SA A N D SD Man should not tamper with the grandeur of nature.

SA A N D SD Military preparedness is one of the best ways to prevent war.

SA A N D SD Vivisection (surgical procedures on live animals) should not be allowed.

SA A N D SD Typically a community will allow pollution from its industries if increased revenues are likely to result.

SA A N D SD Abortion is the taking of a life.

SA A N D SD It should be illegal to possess products made from the skin or fur of wild animals.

SA A N D SD Man's vast technological abilities should be used to put water where people want to be.

SA A N D SD We should not have to tolerate even a little bit of filth.

SA A N D SD The primary objective of the working scientist is to improve human welfare.

SA A N D SD Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.

SA A N D SD Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.

SA A N D SD There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.

SA A N D SD Computers represent a reliable means of unbiased decision making.

SA A N D SD Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.

SA A N D SD The cost of introducing new technological advances should be borne by the people who immediately benefit from their uses.

SA A N D SD To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity.

SA A N D SD The law should allow a person to choose freely whether or not he wishes to experience drugs.

SA A N D SD All regions of the United States should have equal rights to the resources of the country.

SA A N D SD Environmental quality is generally neglected when economic considerations are involved.

SA A N D SD A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies toward the population and environment of the United States.

SA A N D SD The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.

SA A N D SD Science can never solve the problems which are really important to man.

SA A N D SD Conservationists' pleas for total protection of an area rich in natural resources (e.g. Alaska) are unrealistic.

SA A N D SD In order to keep raw materials from being used up too fast, an international authority must be established to ration them.

SA A N D SD Extinction of some species of wildlife is a necessary result of man's involvement with nature.

SA A N D SD It is unjustifiable to set aside large expanses of marketable timber for recreation.

SA A N D SD Science and technology are removing the last remaining barriers that have kept man from controlling his life.

SA A N D SD Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.

SA A N D SD America, in the near future, will be filthy and foul, and our air will be unfit to breathe.

SA A N D SD People who believe that pollution producing industries should be immediately stopped are short sighted concerning the consequences of that action.

SA A N D SD We are mistaken to think that we can control man's breeding habits by appealing to his conscience.

SA A N D SD The cost of automobile disposal should be paid by the auto owner, not by society as a whole.

SA A N D SD Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.

SA A N D SD The population growth of the United States should be halted.

SA A N D SD Technology's positive contribution to our lives far outweighs the negative.

SA A N D SD The only way to meet future power supply needs is with nuclear sources regardless of their possible hazards.

SA A N D SD After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.

SA A N D SD There is no point in attempting to take nature back to pristine purity.

SA A N D SD The oceans represent an almost limitless source of food and resources for the future.

SA A N D SD Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.

SA A N D SD The world's supply of resources belongs to all people, not strictly to the countries in which they are found.

SA A N D SD Science and technology should attempt to control the weather.

SA A N D SD Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.

SA A N D SD Advanced nations should discourage emigration of scientists and technologists from developing nations.

SA A N D SD Industry is not truly concerned with pollution cleanup.

SA A N D SD No one but the family should make decisions regarding its size.

SA A N D SD Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.

SA A N D SD Our current cities are a lost cause; we need entirely new experimental cities.

SA A N D SD Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.

SA A N D SD In order to encourage a lower birth rate single people should be assessed much lower taxes.

SA A N D SD Citizens should not be allowed to use fireplaces in pollution prone areas.

SA A N D SD Man is part of nature, subject to nature's relationships but, since he is the most gifted of nature's children, he should manipulate those relationships to his advantage.

SA A N D SD I would probably try some type of drug if their use were legalized.

SA A N D SD The internal combustion engine, a major source of air pollution, is the backbone of our industrial society, and, therefore, its elimination is not feasible.

SA A N D SD Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.

SA A N D SD The World War II atomic bombings are justifiable because they ended the war quickly and in the long run saved more lives than they took.

SA A N D SD Automation will degrade the industrial machine operator even more as he assumes the role of button pusher.

SA A N D SD The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.

SA A N D SD If a farmer finds it unprofitable to harvest his crops he should have the right to let them rot in the field.

SA A N D SD It has been suggested that this country determine which countries are beyond help populationwise. Massive surplus food efforts would then be directed toward other areas with a greater hope of success.

SA A N D SD Most of the man-made objects along the highway are degrading.

SA A N D SD Technological devices which make it easier for man to exploit nature should be banned.

SA A N D SD The facilities, personnel and money necessary to extend life by artificial stimulation or with organ transplants could better be used in other endeavors.

SA A N D SD Scientists should not meddle in matters which are inappropriate for scientific methods.

SA A N D SD It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.

SA A N D SD A fetus should be certified as an individual as soon as the mother has knowledge of its existence.

SA A N D SD The advertising along the highway is an invasion of privacy.

SA A N D SD People should be free to do whatever they wish about birth control.

SA A N D SD When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.

SA A N D SD The automobile is incompatable with our health and well being.

SA A N D SD Science and technology often create products and services that man does not really need.

SA A N D SD Individual tax payers should help industry pay the cost of elimination of industrial pollution.

SA A N D SD Considering population projections for the next fifty years, it is not realistic to expect all of our water resources to be pollution free.

SA A N D SD In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control.

SA A N D SD The consumer who buys a finished alligator product is at least as guilty of causing extinction of the alligator as the poacher who obtains the skins.

APPENDIX C

Directions for Administration of the Preliminary Inventory

To the Administrator of the Attitude Inventory

Questions concerning the purpose of this inventory may be raised by students. If so, please indicate to them that it is not to test them. The purpose of this inventory is to develop scales that can be used for measuring attitudes. This inventory is not that scale.

It is important that the students feel at ease but that they are honest and sincere in their responses. We ask you to do whatever you can to promote that atmosphere.

We have suggested that 2 hours be set aside for the inventory. That may not be necessary, but it is important that the students not feel rushed to finish.

INSTRUCTIONS (To be read to the students after they receive the papers.)

You have been given 100 statements. These statements refer to issues you may have heard about on television or you may have read about in the newspaper. Some of the statements are quotes taken from people involved with these issues. Some are statements of opinion that you might hear anywhere that these issues are discussed. You are being asked to indicate how much you agree or disagree with each statement.

It is important that you keep in mind:

first, that there are no right or wrong answers. There is difference of opinion on all of the statements.

second, you should indicate your feelings toward what the statement says--what is your reaction as you read the statement.

third, it is necessary that you respond to all the statements.

fourth, you should use only those responses that are available.

fifth, you should respond to the statements as they are written.

(Although it is not desirable, if it is necessary for students to use more than one block of time (e.g. two study halls separated by a math class) to complete the inventory, please ask them not to discuss the inventory with anyone and not to change the early responses.)

.....

Be sure the students remove the dittoed cover sheet to protect their identity.

Stamps and an addressed label have been included for the return of the completed inventories. Please return them as soon as possible.

Thank you very much for your generous cooperation.

APPENDIX D

TEACHER BACKGROUND INFORMATION

Make responses in the appropriate box at the right of each item. It is important that you:

a) respond to all items, without exception.
b) make only one response to each item.
c) fill in the answer space completely.
(Soft pencil is best, if available.)

1. What grade level is your primary responsibility? ☐ ☐
   a) (7-9) b) (9-12) a b

2. How large is your secondary (7-12) school system? ☐ ☐ ☐
   a) Less than 1000 students a b c
   b) 1000 to 3000 students
   c) More than 3000 students

3. What was the population of the community in which you spent the major portion of your pre-college life? ☐ ☐ ☐
   a) Less than 10,000 a b c
   b) 10,000 to 100,000
   c) Greater than 100,000

4. Including this year, how many years have you taught? ☐ ☐ ☐ ☐
   a) 1-3 c) 7-10 a b c d
   b) 4-6 d) More than 10

5. Does your present assignment include teaching any of the subjects listed in question 6? ☐ ☐
   a) yes b) no a b

6. Which, if any, of the subject areas below are you certified to teach? (Circle if appropriate.)

Biological Science / Physical Science / Earth Science / Mathematics

Other Science _____ (describe)

7. Which, if any, of the subject areas below are you certified to teach? (Circle if appropriate.)

Agriculture / Art / Business / Foreign Languages / Physical Education / Home Economics / Language Arts / Music / Social Studies

Other _____ (describe)

8. What is your age?
   a) 20-29 c) 40-49 ☐ a ☐ b ☐ c ☐ d
   b) 30-39 d) 50 or over

9. What is your sex? a) Male b) Female ☐ a ☐ b

10. Which description best fits the institution from which you obtained your indergraduate degree? ☐ a ☐ b ☐ c ☐ d
    a) Teacher training institution
    b) University
    c) Liberal arts college
    d) Other _____ (describe)

11. How much education beyond the bachelor's degree have you obtained? ☐ a ☐ b
    a) Less than a master's degree
    b) A master's degree or more

APPENDIX E

Criterion Group of Concerned Environmentalists for Known Group Validity Test*

David Martinsen	Radiation Biology Department of General Science Oregon State University
David H. Milne	Assistant Professor of Biology Department of General Science Oregon State University
John H. Lyford, Jr.	Assistant Professor of Biology Department of General Science Oregon State University

* Two other members of this group were identified by Mr. Martinsen. One of these responded. Neither name is known to this researcher.

APPENDIX F

Items not Loading on the 12 Factors Resulting from Factor Analysis of Responses to the Preliminary Inventory and Respective Factor Loadings Greater than 0.200.

	Factor											
	1	2	3	4	5	6	7	8	9	10	11	12
3. A danger of the current birth control movement is that the more intelligent will significantly reduce their reproduction rate whereas the less intelligent will not, resulting in a general lowering of the intelligence of our society.					242					-287		
7. There is no reason why one 50 horsepower motorcycle should be allowed to make as much noise as four 300 horsepower Cadillacs.					233			204				
10. A license should be required for the conception and eventual birth of every child.		276		227			252					
11. The standards for pollution, land use, etc. should not be so rigid as to discourage industrial growth and development.		-236	240			204						
20. Technology can rid us of pollution.				287	251	-296			233			
27. Military preparedness is one of the best ways to prevent war.					267	-242			229			
28. Vivisection (surgical procedures on live animals) should not be allowed.		-299						277			221	
33. We should not have to tolerate even a little bit of filth.	-285		-283			279			300			
40. The cost of introducing new technological advances should be borne by the people who immediately benefit from their use.												
70. Industry is not truly concerned with pollution cleanup.		231		-254			-223		215			
88. The facilities, personnel and money necessary to extend life by artificial stimulation or with organ transplants could better be used in other endeavors.									-298			

APPENDIX G

Inventory of Societal Issues

Key: SA ☐ - Strongly Agree; A ☐ - Agree; N ☐ - Neutral; D ☐ - Disagree

SD ☐ - Strongly Disagree

	SA	A	N	D	SD
1. Environmental quality is generally neglected when economic considerations are involved.	☐	☐	☐	☐	☐
2. Science and technology should attempt to control the weather.	☐	☐	☐	☐	☐
3. The population growth of the United States should be halted.	☐	☐	☐	☐	☐
4. Conservationists' pleas for total protection of an area rich in natural resources (e.g. Alaska) are unrealistic.	☐	☐	☐	☐	☐
5. Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	☐	☐	☐	☐	☐
6. Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	☐	☐	☐	☐	☐
7. No one but the family should make decisions regarding its size.	☐	☐	☐	☐	☐
8. There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.	☐	☐	☐	☐	☐
9. Science and technology often create products and services that man does not really need.	☐	☐	☐	☐	☐

	SA	A	N	D	SD
10. The law should allow a person to choose freely whether or not he wishes to experience drugs.	☐	☐	☐	☐	☐
11. Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.	☐	☐	☐	☐	☐
12. Scientists should not meddle in matters which are inappropriate for scientific methods.	☐	☐	☐	☐	☐
13. Sterilization should be mandatory after the birth of a couple's second child.	☐	☐	☐	☐	☐
14. Our current cities are a lost cause; we need entirely new experimental cities.	☐	☐	☐	☐	☐
15. Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.	☐	☐	☐	☐	☐
16. Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.	☐	☐	☐	☐	☐
17. We must eliminate the use of pesticides to ensure the health and safety of man, domestic animals and wildlife, even though this will result in poorer crops.	☐	☐	☐	☐	☐
18. In order to encourage a lower birth rate single people should be assessed much lower taxes.	☐	☐	☐	☐	☐
19. Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contribution to air pollution.	☐	☐	☐	☐	☐
20. We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.	☐	☐	☐	☐	☐

	SA	A	N	D	SD
21. I would probably try some type of drug if their use were legalized.	☐	☐	☐	☐	☐
22. Technological devices which make it easier for man to exploit nature should be banned.	☐	☐	☐	☐	☐
23. The automobile is incompatible with our health and well being.	☐	☐	☐	☐	☐
24. The tax system should be redesigned to encourage small families rather than large ones.	☐	☐	☐	☐	☐
25. Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.	☐	☐	☐	☐	☐
26. When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.	☐	☐	☐	☐	☐
27. Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	☐	☐	☐	☐	☐
28. The cost of automobile disposal should be paid by the auto owner, not by society as a whole.	☐	☐	☐	☐	☐
29. It has been suggested that this country determine which countries are beyond help populationwise. Massive surplus food efforts would then be directed toward other areas with a greater hope of success.	☐	☐	☐	☐	☐
30. It is not justifiable to set aside large expanses of marketable timber area for recreation.	☐	☐	☐	☐	☐
31. The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.	☐	☐	☐	☐	☐

	SA	A	N	D	SD
32. Man should not tamper with the grandeur of nature.	☐	☐	☐	☐	☐
33. The primary objective of the working scientist is to improve human welfare.	☐	☐	☐	☐	☐
34. Citizens should not be allowed to use fireplaces in pollution prone areas.	☐	☐	☐	☐	☐
35. After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.	☐	☐	☐	☐	☐
36. In order to keep raw materials from being used up too fast, an international authority must be established to ration them.	☐	☐	☐	☐	☐
37. Technology's positive contribution to our lives far outweighs the negative.	☐	☐	☐	☐	☐
38. Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.	☐	☐	☐	☐	☐
39. Personal information useful for combating tax evasion should be collected and stored in computers.	☐	☐	☐	☐	☐
40. There is no point in attempting to take nature back to pristine purity.	☐	☐	☐	☐	☐
41. Science can never solve the problems which are really important to man.	☐	☐	☐	☐	☐
42. A federal department of population and environment should be set up with the power to take whatever action is necessary to establish reasonable policies towards the population and environment of the U.S.	☐	☐	☐	☐	☐

	SA	A	N	D	SD
43. A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	☐	☐	☐	☐	☐
44. To reduce petroleum consumption, only small, efficient automobiles should be manufactured.	☐	☐	☐	☐	☐
45. A woman should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would life if born naturally.	☐	☐	☐	☐	☐
46. The oceans represent an almost limitless source of food and resources for the nature.					
47. Land should be utilized in such a manner that the most people benefit from its ultimate use, even if it means giving up already preserved areas.	☐	☐	☐	☐	☐
48. Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.	☐	☐	☐	☐	☐
49. America, in the near future, will be filthy and foul, and our air will be unfit to breathe.					
50. In some countries where birth control is not practiced or understood, the addition of a contraceptive to the water supply has been suggested as a satisfactory means of population control. I approve.	☐	☐	☐	☐	☐
51. Man's vast technological abilities should be used to put water where people want to be.	☐	☐	☐	☐	☐
52. To reduce the number of cars on the road, commuters should not be allowed to drive to work alone unless it is a real necessity.	☐	☐	☐	☐	☐

	SA	A	N	D	SD
53. Personally, I would probably never have (or recommend that my wife have) an abortion.	☐	☐	☐	☐	☐
54. The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.	☐	☐	☐	☐	☐
55. It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.	☐	☐	☐	☐	☐
56. Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.	☐	☐	☐	☐	☐
57. Abortion is the taking of a life.	☐	☐	☐	☐	☐
58. If a farmer finds it unprofitable to harvest his crops, he should have the right to let them rot in the field.	☐	☐	☐	☐	☐
59. Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.	☐	☐	☐	☐	☐
60. Extinction of some species of wildlife is a necessary result of man's involvement with nature.	☐	☐	☐	☐	☐

APPENDIX H*

Reliabilities of Factor Attitude Scales, Senior Sample.

Factor Scale	Total Number of Items	Pearson Product-Moment Correlation Coefficients	Spearman-Brown Prophesy Formula Reliabilities	KR-20 Reliabilities
I	8	0.741	0.850	0.804
II	7	0.377	0.548	0.547
III	8	0.477	0.648	0.647
IV	10	0.671	0.805	0.747
VII	12	0.688	0.813	0.780
IX	10	0.469	0.638	0.615
XI	5	0.321	0.483	0.382

*Calculated by Steiner