AN ABSTRACT OF THE THESIS OF

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Title: A FACTOR ANALYTIC STUDY OF THE ATTITUDES OF OREGON HIGH SCHOOL SENIORS TOWARD SOCIALLY SIGNIFICANT SCIENCE-RELATED ISSUES

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Abstract approved: Fred W. Fox

The purposes of the present study were:

First, to use factor analysis to determine the organization of attitudes toward specific issues through examination of specific attitude items under each factor,

Second, to develop valid and reliable factor attitude scales from the factored items, to measure the identified factors, and

Third, to determine the attitudes, as measured by the developed factor scales, of a representative sample of Oregon high school seniors, specifically comparing the sample in regard to amount of science, school environment, and sex.

A large pool of Likert-type attitude items was constructed representing a myriad of specific societal issues often linked to science and technology, such as pollution, population, conservation.

The items were evaluated and revised utilizing university and high school students. After eliminating ambiguities, unfamiliar terms, and consensus items, 100 items were selected for a preliminary inventory. This inventory was administered in May 1970 to a representative sample of Oregon high school seniors. The sample was drawn based on random selection procedures. The responses of the seniors were submitted to factor analysis utilizing principal components factor extraction and orthogonal rotation by the Varimax criterion. Twelve factors, accounting for approximately 40% of the item response variance, were extracted. Eighty-eight of the items loaded over 0.300 on the extracted factors, with 72 of the items singly loaded.

Seven of the 12 factors were identified by an examination of the item content and implications. The identified factors were:

Factor I. A general regard for human life and those things which may be detrimental to it.

Factor II. Disillusionment and pessimism regarding the implications and outcomes of the involvement of man with nature.

Factor III. Desire for the conservation and preservation of the environment and natural resources.

Factor IV. Concern for the problem of increased population and implications or consequences of this increase.

Factor VII. Concern for the responsibilities and sacrifices demanded of the individual in order to effectively deal with current social problems.

Factor IX. Optimistic belief in the ability and desirability of science and technology to solve societal problems and deal with deficiencies in our environment.

Factor XI. Concern for individual freedom and rights.

A part or all of the items under each identified factor were selected as comprising Likert-type factor attitude scales. In cases, items were rekeyed so that the sum of the responses to all items gave a consistent measure of the responder's attitude toward each identified factor. The seven factor scales consisting of 5 to 14 items each comprised the 60 item Inventory of Societal Issues (ISI). Total scale reliabilities for each scale and the ISI were estimated by the Spearman-Brown prophesy formula and ranged from .48 for the five item scale to .77 for the ISI. These reliabilities may be somewhat inflated due to the factor analytic procedures utilized in obtaining the scales. The scales had factor validity due to their method of construction.

The senior sample was classified as to amount of science, school environment, and sex. The seniors' scores on each of the factor attitude scales were used as dependent variables, and the seniors' classification as the independent variables in an analysis of variance. In addition, science and non-science oriented senior subgroups were compared by a chi-square on all items of the ISI.

The amount of science, school environment, and sex were each found to be significant on one factor, Factors VII, IX, and XI

respectively. No other main or interaction effects were significant on the individual factor scales or the ISI.

The science and non-science oriented seniors were found to respond significantly different on 24 of the 60 items of the ISI.

A Factor Analytic Study of the Attitudes of Oregon High School Seniors Toward Socially Significant Science-Related Issues

by

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A FACTOR ANALYTIC STUDY OF THE ATTITUDES OF OREGON HIGH SCHOOL SENIORS TOWARD SOCIALLY SIGNIFICANT SCIENCE-RELATED ISSUES

I. INTRODUCTION

The decade of the 1960's has been one of great unrest and ferment concerning various aspects of our American society. This phenomenon has been especially manifested within the younger student population. Issues such as civil rights, an unpopular war in Southeast Asia, the degradation of the earth's environment, and the relevancy of traditional educational institutions have been exposed to a great deal of critical rhetoric. An examination of these societal issues and problems and many other related or separate issues and problems shows that many of them are linked to science and its related application, technology. Medical and health technology have reduced infant mortality and raised the average death age of man, but these advances now are helping to contribute to the population problem which many consider to be the ultimate cause of most of our societal problems. Industrial technology has developed and manufactured new products and processes, but now these same products and processes are contributing to the pollution of our planet. At the same time, other technology offers new ways for cleaning up existing pollution and pollution producing processes. Computer technology allows the handling and treatment of vast quantities of data, but concurrently, it

offers a real threat to the privacy of the individual as an invasion of human rights. It also offers new advances in automation and hence, less expensive consumer products; at the same time, it presents possible unemployment for the unskilled worker.

Science as a method and technology as an application have been extremely successful in improving the living conditions of western civilization. Problems confronted by man have been solved with unequaled success through the application of science and technology. Perhaps this success has given the general citizenry faith that any problem facing them can be solved with the application of science and technology. It may be that this success also has fostered the belief that man's environment is something that must be subjugated.

Science and technology are affecting an accelerating rate of cultural and environmental change. In order to deal with this, man must more effectively learn to cope with the increasingly complex societal problems and issues facing him. Since one's behavior toward any situation is in part dependent upon the constellation of attitudes and values which bear upon that situation, it is necessary to gain a measure and understanding of the attitudes and values and their organization held by the citizenry toward the many problems and issues facing it.

Current media have expressed many facts and opinions about many of these societal issues and problems, but very little is known of

the attitudes of various population subgroups toward these and other current issues. Maybe attitudes are organized around only specific issues such as birth control methods, euthanasia, or pollution control, or perhaps they are part of a larger psychological structure interconnected in various degrees with other attitudes and values or embedded within an ideology as suggested by Knutson (1965, p. 297).

> A person may hold an elaborate system of beliefs the substance of which is that government has no place in the private lives of its citizens as individuals, while recognizing public health as a governmental institution. This ideology may foster negative attitudes toward public health programs concerning smoking, air pollution, immunization clinics, and so forth. Or certain religious beliefs may lead to negative attitudes and opposition to family planning. Most attitudes are connected in some degree to a larger system of thought or beliefs and form and change on this basis.

This suggests the possibility that specific social issues, although felt by this researcher to be science-related, may not be perceived in a similar manner by the responder; thus, more fundamental non-science oriented attitudes may be revealed in the measurement of attitudes toward specific issues. Perhaps attitudes toward specific issues and problems are organized within more fundamental attitudes or values. In addition to gaining some understanding of the organization of these attitudes, knowledge of the attitudes of various population segments is desirable.

These and other fundamental questions cannot be answered without some method for the determination of attitudes. One method,

the measurement of attitudes through the utilization of attitude scales, has become quite common since its early development and use in the 1930's. An examination of representative scales (Shaw and Wright, 1967) reveals certain common characteristics. Typically, these scales were devised to measure attitudes toward a variety of specific attitudinal objects, such as ethnic groups, political and religious practices, the family, and war, but few of them were directed at societal concerns linked to science and technology. Generally, these scales were deductively developed based on items which the instrument designer felt would measure attitudes toward the attitudinal object, rather than being inductively developed, selecting scale items based on subject response patterns. Although the content of items on a deductively developed scale are in general oriented about the attitudinal object, this does not guarantee that the scale measures only attitudes toward the intended object; perhaps a more basic attitude may be reflected by the responses to items.

A basic concern of science education is the development of a scientifically literate citizenry. Although differing opinions exist, a general idea of the inclusiveness of this term can be perceived from various sources (Evans, 1970; Hurd, 1970; Pella, O'Hearn and Gale, 1966). One aspect common to all who expound scientific literacy is that there should exist an understanding and appreciation of the interaction of science, technology, and society. Some attempts to

measure high school students' understanding of this interaction have been made, but only in a most general way. Typically, respondents were asked only nonspecific questions regarding changes in our society as the result of science and technology. Generally, it was found that students had a fair understanding of this interaction and had favorable attitudes toward science, technology, and society interaction. It could be that in specific science-related issues that attitudes toward these issues and toward science and technology are quite different from those exhibited in very general nonpersonal instances. Since all aspects of scientific literacy are a concern of science teaching, one might ask if high school students who are oriented toward the sciences have different attitudes toward science-related social issues from those who are not oriented toward the sciences.

In addition to developing an attitude scale instrument, the present study yielded information which could be useful in considering some of the questions previously pondered. It is important to know if there are any differences in the attitudes of one small population subgroup, the high school seniors, in particular, to see whether those who are science oriented have any different attitudes toward science-related issues than those who are not science oriented.

The Study

There is a need to identify attitudinal structure and organization

of some specific science-related social issues and from this knowledge, to measure and compare the attitudes of various population subgroups.

The present study had three purposes:

First, to use factor analysis to determine the organization of attitudes toward specific issues through examination of specific attitude items under each factor,

Second, to develop valid and reliable factor attitude scales from the factored items, to measure the identified factors, and

Third, to determine the attitudes, as measured by the developed factor scales, of a representative sample of Oregon high school seniors, specifically comparing the sample in regard to amount of science, school environment, and sex.

The first two purposes were common to this researcher's study and to a study being carried out by another graduate student. Since a common need existed for the measuring instrument, it was developed in a common effort by these two researchers.

Definition of Terms

Attitude

The definition of attitude utilized in this study was

> 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).

A thorough discussion of the attitude concept, including differences and similarities in definitions and relationships to other social psychology concepts is contained in Chapter II.

Socially Significant Science-Related Issue

Socially significant science-related issues were those social issues that were found most frequently in popular and professional writings, that were most frequently referred to in conversations and commentaries, and which the author felt were linked to science and technology.

Socially Significant Science-Related Factor

These factors were extracted or obtained by factor analysis of responses to attitude statements about science-related issues and consisted of the items grouped under each factor. Each was identified and named based on a subjective examination of the items clustered under the factor. The diverse content of some items under a factor indicated that these factors represented rather basic values and attitudes whereas others were represented by items whose content was similar about a specific social issue.

These are simply referred to as factors throughout the remainder of this study.

Factor Attitude Scales

Factor attitude scales were Likert-type item attitude scales consisting of part or all of the items clustered under each identified factor. The sum of responses to all items of a scale was used as a measure of direction (favorable or unfavorable) and magnitude (degree of favorableness or unfavorableness) of the attitude toward the identified factor.

Inventory of Societal Issues

The Inventory of Societal Issues (ISI) consisted of the seven factor attitude scales.

School Environment

Each school selected for the study was classified into one of three categories, either urban, suburban, or rural. The criteria used for this classification were that of the experimenter and are discussed in Chapter IV.

Science Oriented Senior

The representative high school senior who took the equivalent of at least one year of science per year of senior high school, a total of three years or more, was classified as a science oriented senior.

Non-Science Oriented Senior

A non-science oriented senior was the representative high school senior who took no more than the minimum required amount of science for completion of high school, regarded for this study as one year or less.

Importance of the Study

Occurring with ever increasing frequency in all forms of communications is societal concern in certain areas, important not only to the citizenry of the United States, but to citizens of all the world. One identified area of societal concern, that of man's total position in nature, especially as a result of his science and technology with which we are typically confronted, includes such specific issues as man's utilization of natural resources, the population of the world, and the pollution of the earth's environment.

In attempting to select and organize material for science programs, science educators have been led to ask, "shall the social impact of science and technology be a central function of the curriculum in secondary school science or shall it remain an individual function?" (Williamson, 1966, p. 45). Much of the current student criticism of traditional educational institutions has been that of irrelevancy, that the institutions and their courses do not address themselves to or do not help in the solution of many of these issues

that must be faced and resolved by society. Of late, there seems to be a marked movement in the field in the direction of tearing down academic barriers; notable are the increasing number of classes being offered in environmental studies. While some of these courses are offered under a course heading of science, social studies, health, etc., there are an increasing number being developed independently or across departmental bounds.

Few would offer much in the way of criticism concerning the purpose of these courses. Issues considered important to society must be brought before that society for their resolution. What is considered a societal issue often does not become an issue to a subgroup or to an individual of that society until it becomes relevant or personal to that group or individual. This is borne out by research conducted in Los Angeles (Van Arsdol, Sabagh and Alexander, 1964) comparing the relationship between perception of air pollution, air traffic noise, and other congestion effects as environmental health hazards and the actual measured existence of them at hazardous levels. When their measured levels were detrimental to health, they were more significantly perceived by the individuals of the affected community as a serious problem. The authors' analysis of some demographic characteristics suggests that perception, or recognition of (hence, attitudes toward), a problem is probably more complicated than just the existence of the problem; as they conclude, "hazard perception is

jointly determined by the presence of the hazard indicated by recorded levels and social demographic characteristics of respondents" (1964, p. 145). If society is to act on the resolution of its issues, it is necessary that its members have an understanding and recognition of those issues facing it. An obvious hinderance to an adequate resolution of issues is due to their very nature, as suggested by Dykstra (1965, p. 190):

> Since the truly vital issues of the day are frequently highly controversial, the net effect is that our students condemn the obviously evil and support the virtuous, but never come to grips with the conflicting evidence and varying viewpoints by which men must make difficult decisions.

For example, it is unlikely that anyone maintains a favorable attitude toward pollution, but differences in attitudes might be expected when probed as to who or what is the main cause of pollution.

With a few prognosticators giving us approximately 30 years to decide whether we wish to continue to exist as a species on the Earth, some type of action is called for. Such an ominous outlook points to the obvious step of educating an unconcerned public.

Although societal issues are relevant to all of education, they are especially relevant to science education for it is through science and technology that many have been created, and through which help in their resolution may be found. Some typical questions which must be answered in determining society's ability to resolve its issues are:

1. What is the present attitude of the populace and its various sub-groups with respect to the socially significant issues of our time?

2. What effect do the mass media have on attitudes toward these issues?
3. What effect do various experimental school programs, instituted to change attitudes toward and understanding of these issues have?
4. What relationships exist between an individual's attitudes toward these issues and his willingness to submit to whatever means are necessary to resolve them?
5. Is there any relationship between individual personality characteristic factors, value orientations, and attitudes toward these issues?

These and a large number of equally important questions are waiting to be answered. As the number of programs increase, more questions will be generated.

It is obvious that to obtain answers dictates a plan of careful study and measurement of these attitudes and their organization. Examination of current instruments indicates that these and other questions cannot be adequately answered without devising new instruments. It has been suggested that if the researcher

> concludes that there is no substantial instrument available for his research, then he should either abandon the project or consider altering the project to an instrument development project. If this were done more often, and particularly if universities were willing to support doctoral projects of this sort we would have less research for a while, but more significant research ultimately (Fox, 1969, p. 55).

An obvious conclusion was that there was a need for an examination of the organization of attitudes toward specific science-related

issues and the development of instruments to measure attitudes or values basic to these specific issues.

Basic Assumptions

The following statements reflect assumptions made in this study.

1. Attitudes can be inferred from responses to statements directed at specific referents.
2. Application of factor analytic techniques to student responses to attitude statements is an effective means to obtain clusters of items representing the same basic attitude or value.
3. The selection procedure yielded a sample of seniors representative of the population in the state of Oregon.

Limitations of the Study

The following statements represent what were considered possible limitations of this study.

1. In order to obtain cooperation, deviation from random selection methods occurred in two cases.
2. The study was limited to the extent that students did not respond in an honest, self-reflecting manner.
3. The extent to which the researchers validly identified the factors represented by the clusters of items was a limiting factor in this study.

4. Some of the identified factors or dimensions were represented by a small number of items from which attitudes were inferred.

Delimitations of the Study

The following statements describe the limits beyond which this study did not attempt to go.

1. No value judgement was made regarding the measured attitudes of the students.
2. No attempt was made to predict behavior based on measured attitudes.
3. The social issues included in the study were limited to those judged by the experimenters, with consultation of a panel of judges, representing significant current science-related social issues. Other issues may have been deemed relevant by different judges and experimenters.

II. REVIEW OF RELATED RESEARCH

Attitudes

Brief History of the Concept of Attitude

In social psychology no concept has enjoyed a more prominent role than that of attitude; in fact, during the early 1920's the study of attitude was often equated with the study of social psychology. McGuire (1969) has suggested that the concept of attitude lost its central position in social psychology during the 1940's and 50's due to 1) preoccupation with problems of definition and the distinction of the attitude concept from other constructs, 2) imposed restrictions on qualitative work due to highly developed measurement techniques, and 3) relevance and interest in attitude measurement of social problems resulting in action research without joint theoretical development. An examination of current social psychology textbooks or Psychological Abstracts indicates that attitude study has regained its former flourishing state, but the major emphasis has now shifted from measurement to questions of attitude change and the mechanisms underlying change. Also of current interest is the study of attitudes as systems.

> Two individuals may make different responses in the same social setting--indicating that a psychological (individual difference) variable like attitude is necessary because sociological or environmental variables are not themselves sufficient to explain behavior (Kiesler, Collins and Michael, 1969, p. 38).

This role of attitudes in explaining individual differences assures for it a continued role of importance in social psychology.

Allport (1935) historically traced the concept of attitude to the convergence of three distinct roots. First, attitudes were recognized early in experimental psychology to account for some individual differences, but they were regarded as largely unconscious and felt not particularly worth further study at that time. Psychoanalytic theory provided the second root, where the dynamic nature of attitude was identified with love, hate, passion, prejudice, and their importance was stressed in the makeup of the individual. The third root comes from the field of sociology. The search for a means of supplementing cultural concepts with a psychology within which one might express, in concrete terms, the mechanism through which culture is carried, resulted in the concept of attitude being adopted. Allport concluded

> The effect of these three convergent trends within the past fifteen years has been the creation of a vigorous doctrine of attitudes, which today is bearing most of the descriptive and explanatory burdens of social psychology (1935, p. 803-804).

Definition of Attitude

The definition utilized by each researcher is often dictated by the method employed in measuring the attitude. Scott (1969) suggested that it is unrealistic to expect a single agreed upon definition of attitude to be accepted since the determinants of the definition can be

expected to develop and change over the years. Much of the written material on attitudes begins with a survey of previous definitions and then a new definition is offered, often combining the common elements of various definitions. Stern (1965) and Shaw and Wright (1967) identified the following common properties or characteristics of attitudes:

1. They are socially learned, based on cultural experience rather than being innate or as a result of constitutional development and maturation.
2. The attitudinal referent is social in nature, but can be an individual(s), an object, or a practice.
3. They vary in magnitude and intensity on a continuum from positive through neutral to negative.
4. They are based on evaluative concepts of the referent object and serve as a predisposition to behavior.
5. They are selective, providing a basis for discriminating between alternative courses of action, and introducing consistency of responses in social situations of an otherwise diverse nature.
6. They possess varying degrees of interrelatedness to one another.
7. They are relatively stable and enduring.

Shaw and Wright (1967) have also identified three general areas of greatest variation in the definitions of the concept of attitude. Two of the areas of variation are concerned with the attitudinal referent.

Some authors view attitude as a very general or pervasive predisposition of the individual, whereas others consider attitudes to be directed toward specific referents or classes of referents; the latter viewpoint is the one more commonly held in the literature.

Secondly, some authors consider any predisposition to action as an attitude, whereas to others, it involves only predispositions to respond to social aspects of the environment. The latter viewpoint considers the referent to be social in nature when dispositional characteristics such as motive, wish, intent, and desire are attributed to it.

The third source of variance lies in the theoretical conception of the structure of attitudes. Most agree that an attitude has three components: an affective (feeling or emotional), a cognitive (perceptual or informational), and a conative (action or behavioral). The disparity arises in the relationship or role of each in attitudes. Some believe that all are equally contributing components of the attitude, whereas others suggest that only the affective component which is based on cognitive processes and is an antecedent to behavior constitutes the attitude.

The definition of attitude adopted for the present research defines attitude as "a relatively enduring system of affective, evaluative reactions based upon and reflecting evaluation concepts or beliefs which have been learned about the characteristic of a social object or

class of social objects" (Shaw and Wright, 1967, p. 3). This definition is theoretically sound, is not tied to behavior other than evaluation, and coincides with most procedures for measuring attitudes.

In addition to the variable properties of attitudes of direction, magnitude, and intensity, Scott (1969) offers a more complete analysis of the characteristics of attitudes suggested by recent theoretical formulations. These include the following:

1. Ambivalence - tendency for both favorable and unfavorable aspects of the attitude referent to be manifested by the attitude holder.
2. Salience - the prominence of an attitude or readiness with which a person expresses it.
3. Affective Salience - degree that a person's view of an object is dominated by evaluative or affective laden content.
4. Cognitive Complexity - complexity and number of different ideas an individual has about the object.
5. Overtness - prominence of the action tendency.
6. Embeddedness - degree of isolation versus connectedness of attitude to other concepts as value, belief, and other attitudes.
7. Flexibility - ease with which the attitude can be modified.
8. Consciousness - the degree of consciousness or awareness of the individual holder.

Although the previously mentioned properties describe the

attitude concept, few have been operationalized sufficiently to allow measurement. In actual practice most measurement has been confined to that of direction, magnitude and intensity.

Other Personality Constructs

The properties of attitude are not necessarily unique, and although they may distinguish attitude from other constructs within the realm of personality, some of these properties or characteristics may be common to other constructs. The relation of attitude to some other personality constructs has been graphically represented by Oppenheim (1966, p. 110) (Figure 1).

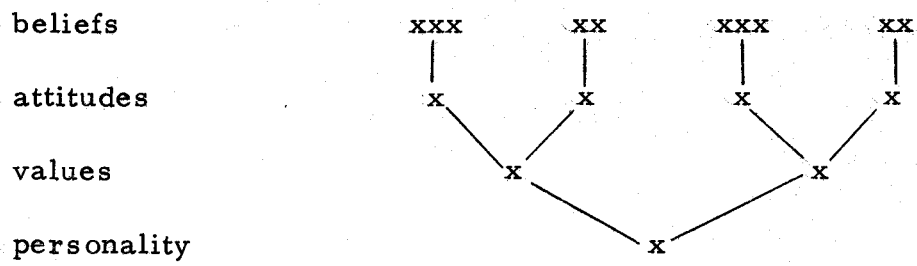

Figure 1. Relation of Attitude to Some Other Personality Constructs.

This general type of organization of beliefs, attitudes, and values is also supported by Rokeach (1968, p. 124).

> An adult probably has tens or hundreds of thousands of beliefs, thousands of attitudes, but only dozens of values. A value system is a hierarchical organization - a rank ordering - of ideals or values in order of importance.

The degree of stability, generality, and fundamentalism or centrality to the individual increases from the level of belief through personality.

The construct belief, or cognition, represents some level of acceptance of a proposition regarding the characteristics of an object or event. Its content may be about the correctness or goodness of an object or event, or it may advocate a course of action; but,

> whether or not the content of a belief is to describe, evaluate, or exhort, all beliefs are predispositions to action, and an attitude then is a set of interrelated predispositions to action organized around an object or situation (Rokeach, 1968, p. 113).

A value is more central to one's belief system than an attitude and has been defined as "a type of belief . . . about how one ought or ought not to behave or about some end state of existence worth or not worth obtaining" (Rokeach, 1968, p. 124). An addition to the previous constructs is that of opinion which is most commonly recognized as a verbal expression of a belief, attitude, or value.

Determinants of Attitudes

Theorists generally regard attitudes as learned or altered by determinants of a social nature. Of these determinants, social psychology has been primarily concerned with that of verbal communication, that is, messages from other people which cause the individual to receive or change his attitude. Additional social determinants include the following:

1. Direct experience(s) with stimulus - cases in which a single traumatic experience, stimulus, or the continual repetition of a stimulus determine or alter the attitude(s) an individual holds about a specific referent.
2. Total institutions - instances in which the total environment of the individual is maintained by others, who determine what stimuli are presented, what response possibilities are available and what rewards and punishments are rendered.
3. Non-verbal - transfer of likes, dislikes, etc. between individuals without any verbal communication.

McGuire (1969) agrees with the importance of social determinants but also suggests the possibility of some important non-social determinants, including the following:

1. Genetic endowment - existence of genetic material responsible for certain attitudes or attitudinal dispositions, such as aggressiveness, which might account for innate intergroup hostilities.
2. Physiological - effects of factors such as aging, illness, pharmacological (drugs) or surgical interventions which may alter an individual's belief system, its degree of openness, or its actual content.

Functions of Attitudes

The existence of attitudes for such a wide range of issues

suggests that the concept fulfills an important psychological function for individuals. Katz (1960) among others has suggested four such functions that attitudes fulfill for the individual; more specifically, he attempts to provide an understanding of the reasons people hold the attitudes they do.

One of the functions that attitudes fulfill has been labeled the adjustive, instrumental, or utilitarian function. In fulfilling this function, attitudes are developed and maintained which help the individual achieve a valued goal, or avoid an undesirable one, and they are associated with experiences of motive satisfaction.

Attitudes also function to help the individual deal with inner conflicts, this particular function being labeled the ego defensive function; an inferiority feeling, for example, may be projected to an underprivileged group with a resultant individual attitude of superiority toward that group.

Rather than concealing one's inner identity as in the ego defense function, the third function, the value function of attitudes, allows the individual to hold and express attitudes appropriate to his most cherished and central beliefs and values and to reflect the individual's perceived self image.

The last function expressed by Katz is the knowledge function, which states that attitudes help the individual's need to develop an adequate meaning and understanding of his physical world. These

attitudes provide a simplified and practical guide for appropriate reactions toward specific objects.

The above functions of attitudes are not meant to be necessarily exhaustive or mutually exclusive; furthermore, some of an individual's attitudes may serve one function whereas other attitudes may serve others (McGuire, 1969).

The Measurement of Attitudes

Concern with the measurement of attitudes developed during the late 1920's and measurement methodology was greatly advanced during the next decade. An interesting viewpoint (McGuire, 1969) referred to previously is that the rapidly developed skill and sophistication in measuring attitudes initially was detrimental to the field of attitude study. Premature aspirations with the precision in measurement restricted the type of attitude research conducted and led to empirical research without adequate parallel development of a theoretical basis for attitudes. Some of the individuals who, during the 1930's, were especially prominent in the development, modification, and application of pioneering measurement techniques such as the method of equal-appearing intervals, the method of summated ratings, scalogram analysis, scale discrimination technique, include Thurstone and Chave, Likert, Guttman, Remmers, and Edwards and Kilpatrick. In addition to these, some relatively new techniques such as the unfolding

technique of Coombs, latent structure analysis of Lazarsfeld, and semantic differential of Osgood and Suci have been developed, but the vast majority of attitude measurement is still done utilizing the methodology developed during the 1930's and 40's.

Since an attitude is a hypothetical construct it cannot be directly measured but must be inferred from an individual's responses, behavior, or action. One must keep in mind that attitude is only a predisposition to respond; therefore, overt behavior may not always be indicative of attitude, and likewise, one cannot always predict behavior from a known attitude.

Measurement Techniques

Measurement techniques can be classified according to the basis used for inference of attitudes. These categories include:

> (a) 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; (b) measures in which inferences are drawn from observed overt behavior toward the object; (c) measures in which inferences are drawn from the individual's reactions to or interpretations of partially structured material relevant to the object; (d) measures in which inferences are drawn from performance on objective tasks where functioning may be influenced by disposition toward the object; and (e) measures in which inferences are drawn from physiological reactions to the object (Cook and Sellitz, 1964, p. 39).

In almost any attitude assessment, a standardized stimulus is presented, calculated to elicit attitude responses without, at the same time, creating or altering the individual's attitude. Although some

highly sophisticated techniques for measuring attitudes have been developed, most social psychologists rely on paper and pencil self-report techniques. Common self-report techniques include presenting either open or closed statements to responders, assuming a direct relation between attitude and expressed belief, feelings, or opinion. Although either type statement (item) has distinct advantages, the closed direct statement technique is more commonly used because direct statements channel the respondent's replies onto the dimension of interest (toward specific attitudinal referent) and allow probing of the attitude object with many different type statements. The time involved in interpretation of replies is also much less than in open statements. Closed direct statements do, however, represent a threat to rapport in that the responder may find many statements boring or insulting. In most cases, the responder could easily fake a certain response pattern. A thorough discussion of the distinct advantages of open and closed self-report statements can be found in Scott (1969).

Scott (1969) suggests that the responses of an individual to self-report attitude scales are determined by three factors; the characteristics of the responder, the characteristics of the instrument, and the circumstances in which the instrument is administered. The response from which the attitude is inferred must originate within the individual and if it does not, it then must be considered to have been

influenced by extraneous determinants and the experimenter needs to find ways of excluding or discounting the influence of these extraneous response determinants. Only characteristics of the individual which reflect an attitude toward the referent object are desired and any other individual characteristics influencing the responses must also be considered extraneous.

The most widely discussed extraneous individual characteristics have been labeled social desirability and acquiesence. In the former, the responder, desiring to present himself to the investigator and anyone else who might examine the individual's responses, in a manner which would probably be viewed as socially desirable, expresses his public attitude, which may differ from his private attitude; that is, the responder would probably view it desirable to present himself as well-adjusted, unprejudiced, rational, open-minded, and democratic, to name only a few characteristics. The responder who acquiesces, on the other hand, generally accepts all statements presented. Not all researchers classify this as a characteristic of the individual (Rorer, 1965), but rather a characteristic of the measuring of the instrument.

Other extraneous characteristics which could influence attitude scores include the psychological traits of verbosity, flamboyance, uncertainty, imaginativeness, intelligence, "if the items are constructed and scored in such a way as to reflect them as well as the intended attitude" (Scott, 1969, p. 235).

In addition to presenting himself in a socially desirable view, other modes of self-presentation which may influence the test responses might be the result of an individual's desire to be cooperative, and the responder may give fuller responses and fewer don't knows than he normally would. Also, the responder may wish to appear thoughtful and read much more into items than is normally intended. The individual may feel that he knows what kind of individual he is and how he would act and therefore responds to the items in a manner which reflects his own self-conception.

Extraneous determinants of responses characteristic of the instrument are more difficult to single out than those associated with the individual. These determinants depend on the types of instruments used and can be attributed mainly to the instrument or an interaction between the subject and the instrument and would not be present in a non-test performance. Carelessness in replies is a factor in almost any instrument, but the type of instrument determines the nature of this effect. As stated previously, Rorer (1965) has indicated that the problem of acquiescence should be listed as an instrument factor rather than a characteristic of the individual. The tendency to mark extreme responses may also be a problem when a gradation of response choices are available. Items which do not differentiate between favorable and unfavorable attitudes influence test results also. Items which can be answered on factual knowledge and are not dependent

upon differences in attitude will influence the attitude measurement.

Scott (1969) lists four basic ways that extraneous response determinants can be overcome or reduced. These include 1) modification of the administration conditions, 2) modification of the attitude determining instrument, 3) detection and elimination of responses which were largely affected by extraneous factors, and 4) correction of scores of all responders by the amount of known contamination. One important method of overcoming the extraneous determinants is through rapport building with the responders, which can be accomplished by appealing to the conscience of the responder, attempting to motivate him in an honest and careful manner; the importance of the careful, truthful, and frank responses is stressed. Stating that no correct answers exist and that the responder will remain anonymous are techniques also used to reduce the tendency to falsify responses.

Techniques for Reducing Instrument Bias

Some techniques of reducing instrument bias include lengthening the instrument so the attitude is assessed by a large number of items and not just a few. To counteract the acquiescence response set (the tendency to agree with all items), the items are usually worded in both directions; in other words, an agree answer will not always indicate a favorable attitude. Pairs of direct and reverse worded items can also be used to counteract the extremity set, the tendency to give extreme

or neutral responses. Forced choice techniques in which the responder must choose between two almost equal items, one referring to the attitude object and the other referring to a control object, are often used to counteract the social desirability or faking set. This can also be accomplished by attempting to disguise the attitude which is sought, the rationale being that the responder will not fake his responses if he does not know the purposes of the assessment. One method is to include items that are not relevant to the attitude being measured. Another strategy is to use completely disguised stimuli. Disguise techniques are not highly developed and present more difficulties than the more direct techniques, as indicated by Scott (1969, p. 242).

> From the present perspective, attitudes are most directly manifested through verbal self-reports under conditions of optimum rapport; the attempt to measure them indirectly is likely to encounter more confounding variables than it circumvents, . . . Given the relative difficulty of constructing and administering indirect instruments, it would seem desirable to ascertain first whether more convenient direct methods are sufficiently valid for the purpose.

Campbell's (1950) review of the indirect means of assessing attitudes supports Scott, for he concluded that there was no evidence for the superiority of indirect means of attitude assessment, and that direct tests also have higher reliability than indirect ones.

Classical Scaling Techniques

An examination of attitude scales (Shaw and Wright, 1967) indicates that a majority of previously developed scales utilize one of

two classical techniques developed during the early 1930's. The two techniques are 1) the method of equal-appearing intervals developed by Thurstone, and 2) the method of summated ratings developed by Likert. Both of these scaling techniques utilize self-report closed statements. The respective attitude scales usually consist of from 10 to 20 items directed at the attitudinal referent. In equal-appearing interval scales, items are used which represent equal intervals along a continuum from very favorable to very unfavorable attitudes. The responder selects only those items with which he is in agreement. The direction and magnitude of his attitude toward the referent is inferred from the statements he selects. In summated rating scales, the responder selects a weighted response along a 3, 5, 7, etc. point continuum from strong agreement to strong disagreement. The sum of his responses is used as a measure of the direction and magnitude of his attitude. Research comparing these two techniques has generally shown their reliabilities to be quite comparable; however, the Likert scales often yield a comparable reliability with a smaller number of items. The amount of time required for construction is considerably less for the Likert-type instrument. Likert scales are generally used when researchers are concerned with getting a measure of attitude differences of groups. Since the design of the present research was to compare distinctive groups and there is comparable reliability with greater ease of construction, Likert-type scales were developed.

Unidimensionality

A quality strived for in Likert-type attitude scales is that of unidimensionality, that is, the measurement of the same attitude by each item included in the scale. Since the attitude concept is viewed as existing on a continuum from a positive to a negative attitude toward the attitude object, it is desirable (necessary) that the items to which the responder replies, and from which the researcher infers the responder's attitudes, all measure the same attitude. For example, if a scale reflected two different attitudes, then two individuals may have the same final score, but may be diametrically opposed in their attitudes. Scott (1969) suggests that it is unrealistic to expect items to reflect only one thing, but we can construct items which reflect the intended trait more than it reflects others. Likert attempted to obtain this quality in his scales by internal consistency and item analysis techniques. The first technique (internal consistency) consisted of correlating the individual's response on each item to his total score on all items. The items with the highest correlation were adopted for the final scale. The second technique (item analysis) involved administering the instrument, selecting an equal upper and lower percentage of responders, based on their total score. The respective mean scores of the two groups on each item were compared, and the items which differentiated the best between the two groups were selected. Likert showed that these two techniques gave

essentially equivalent results. However, Shaw and Wright (1967) pointed out that high item total correlations do not necessarily insure unidimensionality. Scott (1969, p. 219) amplifies this, pointing out that

> this procedure [internal consistency] will yield deceptive results if the initial scale is made up of two or three different kinds of items (that is independent clusters). . . . Each item may then correlate with the total score, even though it would correlate much better with its own independent cluster, considered alone, and would thus better be included in that subscale only.

Other techniques which utilize the correlation of each item with all other items have also been suggested as a means to obtain unidimensionality of attitude scales. Two such techniques of searching for clusters of highly related items include factor and cluster analysis. Both are increasingly being used in more extensive and complex ways as computer technology enables more extensive and complicated data manipulations to be performed. Various researchers (Campbell, 1950; Oppenheim, 1966; Scott, 1969) suggest that such techniques be utilized as a means of insuring unidimensionality. Some researchers prefer factor analysis over cluster analysis in that "'factors' resulting from such analysis represent the psychological primary genotype better than do the simple clusters of intercorrelated items" (Scott, 1969, p. 221).

In any case, once a unidimensional scale is achieved the responder's attitude is inferred from the sum total of all his

responses. The weighting of the response choices to each item is consistent (dependent on whether item is positively or negatively worded) so that the higher (or lower) total score, the more favorable or unfavorable the attitude of the responder is toward the attitudinal referent.

Factor Analysis

Factor analytic techniques had their beginnings in the early 1900's but the development and application of current sophisticated techniques were seriously restricted because of the lack of high computational means, particularly the computer. Much of the pioneering theoretical work and application was carried on during the 1930's and 40's by men like Kelley, Thurstone, and Hotteling. Basically, factor analysis is a statistical tool which determines whether a few identifiable dimensions can be isolated to describe interdependence among many variables.

Eysenck (1953) in rebutting criticism directed at factor analysis indicated that much criticism was not over factor analytic methods, but rather over confusion and a lack of understanding of the aims and objectives of factor analysis. He offers three distinct aims, or uses, of factor analysis and formal definitions based on each aim. The least common use or aim is the resolution of a set of dependent variables in terms of a small number of factors for an economy of

description. The factor, in this case, serves merely as a descriptive statistic without any attempt to offer any psychological interpretation or causal implication or hypothesis for the clustering of variables under the factor. Eysenck's formal definition of a factor used for this aim is "a factor is a condensed statement of (linear) relationships obtaining between a set of variables which can be used mathematically to stand for this variable" (1953, p. 106).

The second aim or use of factor analysis is to suggest possible hypotheses whereby the factor now ceases to be purely descriptive and becomes part of theoretical psychology. Formally defined, a factor "is a condensed set of (linear) relations obtaining between a set of variables suggestive of hitherto undiscovered causal relationships" (1953, p. 107).

Finally, the third aim of factor analysis may be in support or refutation of a given hypothesis. The factor is now defined as "a condensed set of (linear) relations obtaining between a set of variables which is in agreement with predictors based on theoretical analysis" (1953, p. 107). There is a change in the implication of the term 'factor' from a purely descriptive use with no causal reference to one with causal implications in which factors may suggest hypotheses, or may be used to support or disprove a hypothesis. The nature of the isolated factors can be regarded in different manners also analogous to the aims of factor analysis.

The factor can be viewed in three ways. It can be regarded as a purely statistical concept, similar to a mean or variance. This corresponds to the purely descriptive aim. A factor can also be regarded as a principle of classification. Clusters of items which have more in common with each other than with other items are included in the extracted factors. The commonness of items is inferred from the consistency of responses. Finally, the factors can be regarded as if they were causal agencies inferring the underlying dynamics of observed relationships on the basis of the clustered items. This interpretation of a factor is closely linked with hypothesis generation or confirmation and is of the most interest and significance to psychology.

Factor analysis was originally utilized to explore underlying variables in human abilities but has more extensively been used in the search for primary interests, attitudes, and temperment traits. The technique has also been used extensively by the military in test development. Business has also used factor analytic techniques to gain information on worker morale factors, productivity, working conditions, etc.

The literature is filled with factor analytic studies and no attempt was made to survey all, or even to present all those surveyed. Only a representative sample of studies in various areas carried out in a manner somewhat analogous to that used by the present

experimenter will be presented here.

Factor analysis, as was mentioned, has been used extensively to gain information and to develop measures of employee attitudes and morale. Baehr (1954), Baehr and Renck (1958), Struening and Efron (1965) obtained similar attitude structure on factorization of a number of self-report items. Richardson and Blocker (1963, 1966) found similar morale factors in an educational environment upon factor analysis of responses of faculty. Factor analysis has also been used to gain information on the structure of various types of tests. Wolf and Mehrotra (1969), Michael, Jones and Trembly (1959) and Shafer and Thompson (1968) used factor analysis to reduce a large number of independent variables to a small number of dimensions. Cooley and Reed (1961) used factor analysis to uncover the dimensionality of science interest among elementary school children and to develop unidimensional interest scales. The application of factor analysis in manners analogous to the above studies are common, especially in the current literature.

Studies Involving Specific Science-Related Issues

Measurement of attitudes toward specific issues which the current authors perceived as science-related has been limited and varied. While some instruments and studies have attempted to measure attitudes toward specific issues, others have sought to

correlate and account for specific attitudes with more basic attitudes and values.

Garai (1964) found that undergraduate Catholic and protestant students' attitudes toward population control could be significantly influenced by different instructional methods. He also found that although significant changes resulted, Catholic students' initial and final attitudes as measured by an attitude scale were less favorable than those of protestant students.

Hoppe and Breve (1966) examined attitudes of three different levels of employees toward automation, finding as might be predicted that attitudes were positively correlated with the employees perception of how automation affected him in his employment status.

One specific science-related issue that has been examined over the past two decades has been that of fluoridation of public water supplies. In addition to measuring basic attitudes toward fluoridation, some attempts have been made to correlate anti-fluoridation attitudes to a more general anti-scientific attitude.

The Mausmers (1955) found upon examining a sample of people, representing a New England community, who were about to vote on fluoridation, that individuals holding anti-fluoride attitudes could be characterized as being older, without children under 12, of lower income, and of middle or lower employment status. Generally the educational level was also lower for the anti-fluoride attitude

group. Of significance was that while 95% of the pro-fluoride group accepted evidence of scientific authority, those with anti-fluoride attitudes and little education generally rejected scientific authority. Those with anti-fluoride attitudes and high school or better education professed acceptance of scientific authority, indicating either unconscious rejection of scientific facts presented in favor of fluoridation, or a lack of communication of scientific findings on fluoridation to these people. The authors indicated a pervasive attitude of suspicion among those who opposed fluoridation. "They were suspicious not only of scientific organizations, but of scientists themselves" (Mausmer, 1955, p. 38). The Mausmers concluded that anti-fluoride attitudes and rejection of scientific findings supporting fluoridation reflect an even more basic attitude, that of anti-scientism.

Kirscht and Knutson (1961) investigated the Mausmers' conclusions in a study conducted in a west coast community that also was about to vote on a fluoridation measure. They agreed with the possibility that attitudes toward fluoridation are more or less structured by pre-existing attitudes toward science, but also suggested that since few anti-fluoride statements by anti-fluoride individuals make reference to scientific arguments, that more likely, two sets of beliefs may be interacting as part of more general attitudes. They further suggested that attitudes about science may be related to the fluoridation issue indirectly.

In the study, the authors also examined public citizenry attitudes about general effects of science, the relationship of science to other value areas and some specific consequences of scientific work, including perceived indirect negative consequences and the possible helpfulness of science. About 80% of the people interviewed felt that the world was better off because of science, but of the remaining 20% with less favorable attitudes toward science, significantly more also held anti-fluoride attitudes. Good effects attributed to science by both pro- and anti-fluoride attitude individuals generally related to health and medical improvements. Bad effects attributed to science centered around war and the destructive weapons, concern for misuses of science, changes in religious beliefs, overemphasis on science, loss of human values, and the creation of new problems such as overpopulation through the application of science.

An additional comparison of pro- and anti-fluoride groups indicated that the anti-fluoride group perceived science as an indirect threat, saw less helpfulness in science and rated science, as a value, lower than other values. The authors concluded that those

> supporting fluoridation differ somewhat from those opposing it in the general evaluation of the effect of science, but the relationship is far from perfect (Kirscht and Knutson, 1961, p. 42).

The attitudes and feelings of the unfavorable group were characterized "not so much by the things science does (many of these are good) but rather its diffuse unanticipated consequences plus the overemphasis

put on scientific endeavors" (p. 42). The authors further suggest that scientific attitudes and fluoridation attitudes are probably related to more general attitudes or values.

> Beliefs about fluoridation and other specific social issues as such may include very little scientific content yet be related to attitudes about particular aspects of science where both touch upon values (p. 42).

Lee (1970) found that attitude and belief structure about the computer was more complex than that which might be represented simply on a positive-negative continuum. Factor analysis of 20 Likert-type items yielded two identifiable factors. One factor represented the computer as a beneficial instrument for man's purposes, helpful in endeavors such as science, industry, and the space program; whereas, the other factor represented the computer as an awesome instrument, downgrading the significance of man to an inferior role.

Hoover and Schutz (1961) found that factor analysis of student responses to attitude statements toward conservation and conservation practices showed their attitudes to be complex and multidimensional. The Likert-type item Hoover Attitude Scale was developed to measure attitudes toward five identified factors or basic attitudes which include 1) assistance for the common good, representing a concern for rendering assistance to those in need, 2) regulation for the common good, reflecting concern with public regulation for the purposes of protecting the interests of people generally, 3) private rights versus

conservation, reflecting the conflict of good conservation practices and the private rights of the individual, 4) conservation in the case of ignorance, prejudice and myth, and 5) vested interest groups versus conservation practices.

A study (Hoover and Schutz, 1964), utilizing a revised form of the Hoover Attitude Scale, showed that the attitudes of college science, non-science, and forestry students, although slightly different, were not consistent for any group. The authors concluded that the study indicated "that ordinary 'science education' has little impact on basic attitude patterns" (p. 110).

Hoover (1967) used a further expanded form of his Hoover Attitude Scale and also semantic differential scales over some specific controversial concepts such as air pollution control, regulation of land use, and city traffic congestion to determine if curriculum instruction procedures, structured around basic clusters or identified basic attitudes or dimensions, might be effective in building consistent value systems among secondary students. A problem solving method utilizing material based on the five value dimensions was used in experimental classes, while control classes operated in a traditional manner. All experimental classes showed significantly altered attitudes as measured by one of the two attitude measures. The author concluded that basic values can be built through a systematic study of controversial issues structured around identified value

patterns.

Mahler (1953) found that attitudes toward socialized medicine were only a manifestation of a more general attitude toward political and economic patterns. Examination of characteristics of individuals with pro- and anti-social medicine programs attitudes showed differences in political party affiliation, labor union attitudes, attitudes toward religion, and attitudes toward the involvement of the federal government in the lives of individuals. No differences existed in the information level about socialized medicine, both groups were relatively uninformed. He concluded that "Those who favor socialized medicine appear to be politically and economically liberal in regard to several social issues" (p. 281).

Studies Involving Attitudes Toward Science

In the past 15 years, a number of instruments to assess attitudes toward and understanding of various aspects of the scientific enterprise have been developed and utilized on various population subgroups. Most of these instruments, in part, assessed attitudes toward science-technology-society interaction, and could be helpful in determining attitudes toward specific science-related issues.

Patterson (1966) examined attitudes about science by factor analyzing the responses of scientists, communicators, and the general public to statements about science and its purposes. The analysis

yielded four factors or attitudes about science. These included, first, an appreciation of the contributions of science, welcoming its expansion of the areas of knowledge, but showing no real interest in science. This attitude was characteristic of individuals in all three groups. A second attitude was basically economically centered, showing no real understanding of science and indicating interest only in the conveniences and controls it provided. This attitude was confined to the general public group. Thirdly, the two-culture model expressed by C. P. Snow was also exhibited by the factor analysis; on one poll of the continuum was expressed the attitude that science can do it all, and at the other end, the attitude was that the humanities, not science, has the answers. The fourth attitude, exclusive to the scientists, was that of confident enthusiasm about science, and a concern that the general public understand science.

Results of a nationwide adult population survey (Davis, 1957) indicated that the public, when asked to weigh bad against good effects of science, stressed the good, particularly improvements in health, the standard of living, and technological advances. Belief that science can tackle any problem was widespread, but substantial minorities believed that science should focus exclusively on practical problems, should avoid issues clouded with religious beliefs, and restrict research in controversial areas. The only commonly mentioned bad effect attributed to science was that connected with the

destructive potential of atomic energy. The author concluded that although science was generally seen as a good thing, it also was seen as having some negative side effects.

> The secondary, or indirect bad effects center around the effect of science on the social order. Substantial minorities see science as making things change too fast, undermining moral beliefs, and creating the possibility for manipulation of human beings. Those people who are highly concerned about these issues are more liekly to suggest limits on scientific research (p. 221).

He further suggested that

> Ambivalent or fearful reactions to science probably are associated with an increased saliency of one or more of the negative by-products in the minds of the public (p. 187).

Rothman (1968) combined factor analytic procedures and semantic differential attitude scales to assess college freshmen chemistry and physics students' attitudes toward science. He found that science-related concepts representing either positive or negative social connotations factored separately and did not form a single continuum from positive to negative.

Daley (1968) found that a sample of 11th and 12th grade middle class white students expressed a great deal of faith in the ability of science and technology to solve social problems such as disease, air pollution, and birth defects, to mention a few. Interestingly, this result suggests that science and technology are seen as means of solving our problems and not necessarily as the cause of many of our current social problems.

Mead and Metraux (1957) examined high school students' free response replies to an open ended statement about scientists. The frame of reference for the response was either one of personal involvement where the student was to respond in terms of a personal career choice as a scientist, or in terms of no personal involvement where the student was simply to indicate his description of a scientist. Analysis of student responses based on no personal involvement indicated that scientists and science were generally viewed quite favorably. Science was given credit for progress, improving the health and comfort of the population and was deemed necessary for national defense. Analysis of responses based on suggestions of personal involvement in science indicated a more negative image.

Allen (1959) found no difference between science and non-science oriented high school seniors' attitudes toward scientists and scientific careers, but he did find that attitudes were differentiated according to intelligence. Responses of students to 35 of the items on his inventory which were designed to measure attitudes toward the interaction of science and society, were analyzed, and he concluded that there was "considerable misunderstanding and ignorance among young people as to the actual impact of science on society, and the impact of society on science" (p. 39).

Another instrument often utilized to measure aspects of the scientific enterprise is Klopfer and Cooley's (1963) Test on Understanding

Science. Both Klopfer and Cooley's and Allen's (1959) instruments and their utilization represent attempts to measure general attitudes and understanding of the whole of science, rather than concentrating on a specific aspect as is done with Kimball's (1966) Nature of Science Scale, and Welch's Inventory of Knowledge on the Processes of Science (Welch and Pella, 1967). Of interest to the current research was the development and utilization of an instrument by Korth (1968, 1969) to examine the interaction of science and technology, and society, his Test on Social Aspects of Science. He examined science and non-science oriented seniors' conceptions of the social aspects of science, defined for his work "as those components of science and society and those features which are related to the social nature of the scientific enterprise itself" (p. 2). The 52 Likert-type item test was administered to about 1500 seniors with slightly over half classified as science oriented. The areas the instrument was designed to assess included 1) interaction of science, technology, and society, 2) social nature of science, and 3) social responsibility of scientists. Over half of the items in each area discriminated between the two groups indicating a major difference between the two groups. Group responses to items related to the interaction of science, technology, and society indicated some anti-scientific attitudes of non-science oriented students. Items relating to the social responsibility of scientists indicated that non-science oriented seniors were more

willing to accept judgements of scientists on social and political matters, but also were more likely to blame the scientists for contemporary problems. The author concluded that the results clearly indicated a significant difference on the general understanding of the social aspects of science between science and non-science oriented seniors as measured by this instrument.

Schwirian (1968) also developed an instrument which substantially taps attitudes toward the interaction of science, technology, and society. Her Science Support Scale consists of five subscales of eight Likert-type items each, based on Bernard Barber's (1970) list of cultural values considered conducive to the growth and development of science. These values are rationality, utilitarianism, universalism, individualism, and belief in progress and meliorism. Items included in several subscales, particularly the progress and meliorism scale, probe aspects of the responder's attitude toward science, technology, and society interaction.

Stoker and Thompson (1969) designed and conducted a high school science course which was oriented around selected current science-related social issues. Their purposes were indicated by their statement (p. 204) of purposes and goals for the course.

> The course sought to alert students to current problems at the interface of science and human affairs, to start them thinking about these problems so that they might act responsibly as citizens of this society, governed as it is by the interests of its technostructure.

> The course sought to show students that real problems are complicated; unlike textbook problems, those facing modern man are not just sociological or political or economic or mathematical or ethical, but rather they involve all the formal disciplines, and perhaps some that have not been identified, much less formalized.

Some of the issues which students examined during the year included population, world water, food and power needs, contraception and abortion, fluoridation, and teaching machines. An inventory of Likert-type items based on science-related issues, some of which were covered during the year, were given as a pre and posttest. The posttest indicated that modification of attitudes had occurred on almost all issues. This was not an experimental study utilizing a control class and no statistical tests were made to see if the attitude changes were significant. The authors pointed out that there was no conscious attempt to indoctrinate students to their views, although instructor views were made known. There was some public opposition to the course, but the general reaction of the students was very favorable.

Summary

The study and measurement of attitudes has again assumed the prominent position in social psychology which it held during the 1930's. It is a necessary concept to help account for differences in responses of individuals, in a similar social setting, which can be accounted for in no other way. Definitions vary, but most agree that

attitudes are learned, most often through verbal communication, about referents of a social nature. Attitudes vary along a continuum from positive (favorable) through neutral to negative (unfavorable) regarding the referent. Other characteristics include magnitude (how positive or negative), and intensity (how strongly adhered to). Since attitude is a hypothetical construct, it cannot be directly measured and must be inferred from an individual's responses, behavior, or action. The most frequent technique is based upon self-report to standardized stimuli, generally closed opinion type statements. New techniques have been developed, but most attitude measurement is still performed utilizing classical techniques devised during the 1920's and 30's.

The review of attitude research involving high school students indicated that the domain of science-related social issues has hardly begun to be investigated.

The utilization of factor analysis in an attempt to determine possible basic underlying attitudes or values common to attitudes toward specific issues has increased; however, these issues have not generally been what was considered by the author to be science-related social issues.

Various aspects of high school students' attitudes toward science have been investigated a number of times in the past decade. These studies have generally shown attitudes to be favorable, albeit some negative attitudes and reservations were often exhibited when the

interaction of science, technology, and society was probed. Little research has attempted to examine the possibility of a relationship between attitudes toward specific science-related issues and a more general attitude toward science-technology-society interaction.

There has been a lot of attitude research which has shown that for specific attitudes and values, individual differences such as sex, socioeconomic status, education, and intelligence correlated highly with these attitudes and values. Some research has also shown that science oriented students differ in their attitudes and understanding of science from non-science oriented students.

III. THE DESIGN OF THE STUDY

The procedure followed to fulfill the purposes of this study is schematically shown in Figure 2. In this chapter each of the steps involved in carrying out this study is discussed in more detail.

The study consisted of two parts. First, the development of factor attitude scales comprising the Inventory of Societal Issues, and second, the analysis of the attitudes of a representative sample of Oregon high school seniors as measured by the inventory. An examination of the organization of attitudes toward specific issues was a part of the development of the factor scales.

The first part of this study, the development of the attitude scales, was carried on in parallel with another doctoral candidate, Mr. Richard Barnhart. The second part, the utilization of the scales on different population samples, was done independently. The present researcher examined the attitudes of high school seniors, and Mr. Barnhart examined the attitudes of high school teachers.

Each researcher examined his own population sample and the dissertations were written independently and consequently are not the same except for the factor attitude scales.

The Development of Attitude Scales

The present scale development was unique from many previous

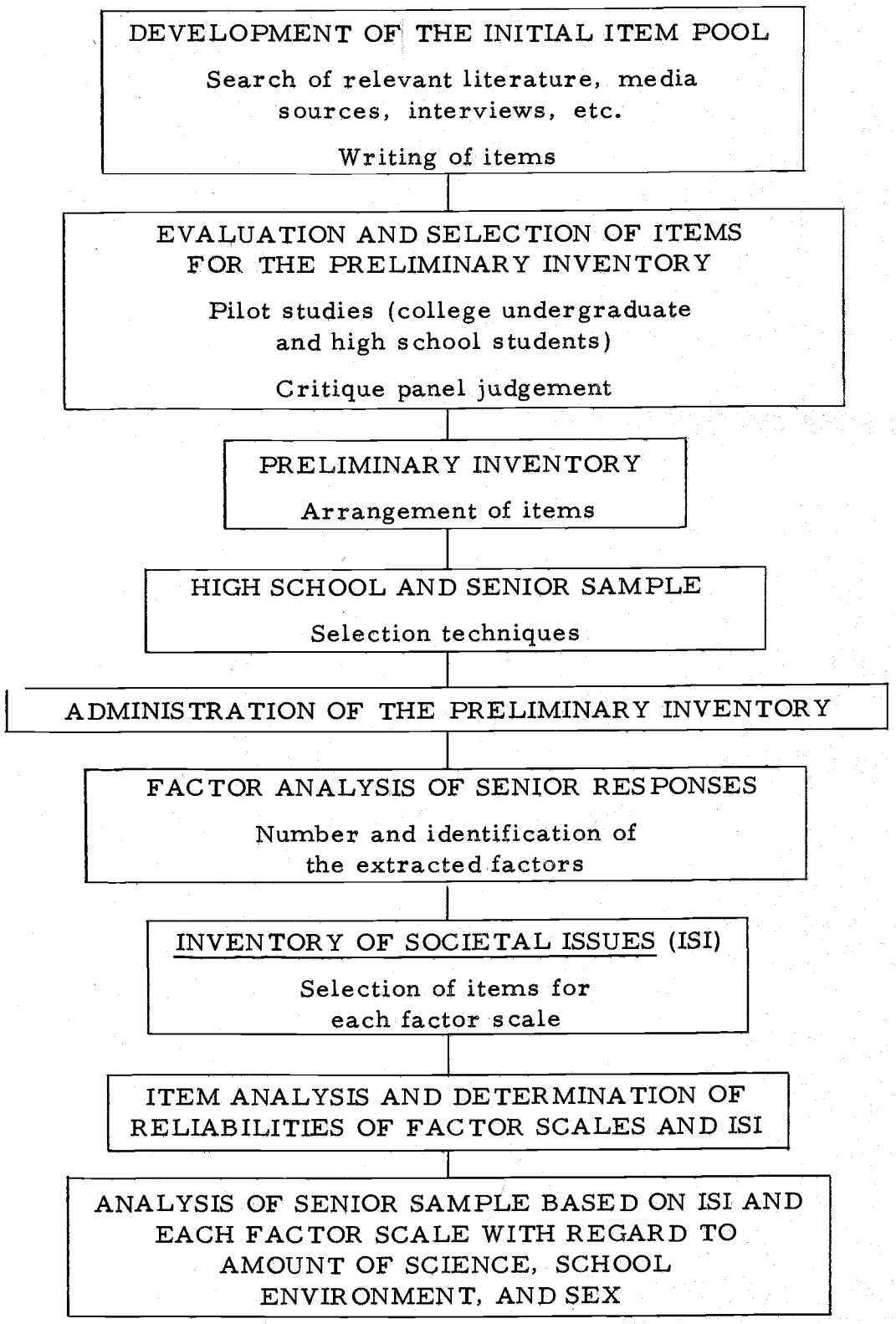

Figure 2. Flow Chart of the Design of the Study.

scale developments in two respects. First, the area of attitude assessment, that is, science-related social issues like population, pollution, and automation, has been only sparingly examined by previous researchers. Secondly, the present scales were developed inductively through factor analysis of responses, rather than utilizing the more typical deductive procedures.

The literature reviewed in Chapter II indicated that some general attitude scales have been developed to measure attitudes toward various aspects of the scientific enterprise including science, technology, and society interaction; however, scales to measure attitudes toward current social issues such as pollution, population, and conservation, which some regard as significantly related to science and its application, technology, are practically nonexistent. Science and technology either directly or indirectly are often regarded as the cause or as the panacea of many of these social issues.

Utilizing factor analysis not only helps achieve homogeneous scales, but also can be fruitful in studying attitude structure. In a deductive development, items which are content oriented about the attitude referent are administered to a sample group, and the responses correlated to total scores, those correlating highest being retained in the finished scale. As pointed out in Chapter II, this procedure does not assure a homogeneous scale (all items measuring the same referent). The procedure also does not probe into attitude

structure any deeper than the specific referent to examine the possibility that attitudes toward specific referents are dependent or determined by a more general attitude referent common to many specific referents.

The current study used factor analysis to inductively identify homogeneous clusters of items based on the sample responses. Attitude statements toward several current social issues and toward science-technology-society interaction were utilized. The items which clustered under the same factor represented (constituted) homogeneous scales and were helpful in examining attitude structure. Clusters which contained attitude statements toward several specific referents were in reality measuring attitudes toward a more general referent, common to the clustered items, not necessarily of common content. The procedure not only helped to determine attitudes toward science-technology-society interaction, but also to determine how commonly and in what manner science and technology are associated with current social issues.

Development of Item Pool

The inductive nature of this study dictated the development of a large pool of attitude statements from which a sample would be administered to the population sample and whose responses would be factor analyzed to identify the homogeneous scales of clustered items.

After examination of attitude scales and scaling techniques reviewed in Chapter II, it was decided to utilize Likert-type items due to their greater ease of construction and comparable reliabilities to other scaling techniques.

Useful criteria followed in writing the attitude statements were found in Edwards (1957, p. 113-114) and include the following:

1. Avoid statements that refer to the past rather than to the present.

2. Avoid statements that are factual or capable of being interpreted as factual.

3. Avoid statements that may be interpreted in more than one way.

4. Avoid statements that are irrelevant to the psychological object.

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

6. Select statements that are believed to cover the entire range of the affective scale of interest.

7. Keep the language of the statements simple, clear, and direct.

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

9. Each statement should contain only one complete thought.

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

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

12. Whenever possible, statements should be in the form of

simple sentences rather than in the form of compound or complex sentences.

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

14. Avoid the use of double negatives.

Preliminary work had revealed the extensiveness of social issues, most of which could be either directly or indirectly related to science and technology. The experimenter had a preconceived notion of what some of the specific issues were, but it was deemed necessary to probe various communication media in an attempt to representatively sample the myriad of social issues, and also to be representative of differing opinions and attitudes within a specific social issue.

The basic ground rules established in probing social issues were as follows:

1. Science was thought of in the popular sense and included engineering, technology, nature study, medicine, cybernetics.
2. The issue focused upon was related to science either directly or in the sense that science was viewed as the ultimate cause or possible cure of that issue.
3. The issue of the present military involvement in Southeast Asia was not included.

In most cases ideas for attitude statements were extracted from written and spoken material; but, in some cases verbatum statements were used, particularly if they were of an emotional nature, emitted

by a person with high personal involvement in the specific issue. Publications covering the last five years of several popular magazines, including Time, Life, and Newsweek, were perused for issues and specific attitude statements or ideas to help in writing statements. Professional journals in the sciences and social sciences were also examined and included Bulletin of the Atomic Scientists, Science, Journal of Social Issues, and Journal of Social Problems. Current popular books directed at specific issues, including population and pollution, were also examined. The experimenter was also receptive to local newspapers, to television and radio newscasts and specials for additional issues and opinions toward already identified issues.

In addition, college students in an undergraduate class in which the experimenter was serving as a teaching assistant were administered several open ended free response forms to express what they felt were current social issues and also to express personal opinions toward these issues. Some of these statements were utilized directly as attitude statements.

Lastly, in addition to maintaining an open ear to lectures, speeches, and sermons for additional opinions toward issues, friends and associates were probed for statements of opinion regarding identified issues, and also to help assure the coverage of the field of science-related social issues.

Utilizing the helpful suggestions of Edwards (1957) on attitude

statement development, a preliminary pool of approximately 250 items was developed.

Evaluation and Selection of Items for the Preliminary Inventory

The accessibility of undergraduate physical and biological science classes in the Department of General Science at Oregon State University in which the experimenter was a teaching assistant made a convenient group for preliminary testing and evaluation of the items. Although these students were older and more select than high school students it was felt that they would be useful to obtain a preliminary indication of the effectiveness and clarity of the attitude statements.

Individual laboratory sessions consisting of approximately 20 students each were administered different groups of five to seven items. The students were asked to indicate their attitude on a five point continuum from strongly agree to strongly disagree and to indicate why they responded in the indicated manner. They were also asked to circle any words or phrases which they did not understand. Any other comments they wished to make were also solicited. Statements with circled words or phrases were either eliminated or revised with shorter more commonly known replacement words. Statements which did not elicit a difference in attitudes were also either eliminated or revised. The clarity or lack of clarity of each statement was inferred by the free responses of the students following

each statement. If analysis of this revealed widely differing student interpretation of the attitude statements they again were either eliminated or revised.

This analysis of the original 250 statements yielded a revised pool of approximately 150 items. The items which had been rewritten were again administered to the physical and biological science laboratories and the statements analyzed in a similar manner, with the additional elimination of several items.

Since the target population was to be high school seniors, it was decided to administer the preliminary item pool to a pilot sample of high school students. Student teachers in a science education seminar were solicited to give items to the classes in which they were doing their practice teaching. It was realized that these students were not representative of high school seniors, but it was felt they would be helpful for additional editing of items before they were administered to the sample of Oregon high school seniors. To insure a minimum of time involved and encourage cooperation of student teachers and their cooperating teachers, only ten items were to be given to a class. All of the items in the revised pool were administered to at least 15-20 students and were analyzed in a manner analogous to that which had been used on the undergraduate college student responses. An interesting observation was that other than on a few specific items, there was not a great deal of difference in the range

and distribution of opinion in the high school classes and the college classes.

In order to help insure cooperation and to minimize the time involved for the administration of the attitude statements in the public high schools, a total of 100 items were selected. The pool of approximately 140-150 items were evaluated partially subjectively, based on personal opinion about individual statements, and somewhat objectively based on distribution of student attitudes. The 100 top items were retained except in cases where items seemed repetitious of other items or in cases where a social issue was not covered by many items. These 100 items were also given to professors in the sciences, humanities, and social sciences and they were asked to evaluate each item as to its appropriateness and clarity in terms of the previously established ground rules. They were also asked to offer an assessment of the representativeness of the inventory as a whole with respect to the universe of socially significant science-related issues, and to suggest any important omissions which they recognized.

The Preliminary Attitude Inventory

The product of the item pool evaluation process was a preliminary inventory of 100 items (Appendix A) to be used on the sample selected from the Oregon high school senior population. The

100 items were randomly ordered, except where similar items by chance were ordered adjacent or in close proximity; these similar items were then separated in an effort to reduce the effects of one item influencing the response of another. The items were then typed on seven stencils with 13-15 items to a stencil. It was realized that responding to a large number of items could be tiring and boring, but it was felt that the items were of such current and personal nature that this would not be a problem. Nevertheless, in order to minimize this problem, if it existed, neither the items nor the pages were numbered and the order of the seven pages of items was varied in 18 different arrangements. Stacks of the 18 different arrangements were made to facilitate distribution to the schools so no two students in a given school got the same arrangement of items unless more than 18 students took the inventory.

In order to counteract a response set, the standard procedure to write both positively and negatively worded statements (so that an agree response does not always indicate a favorable attitude) was followed in the original development of the item pool, although in the final inventory, the items were not evenly divided in positively and negatively worded items. Since the homogeneous clusters of items were to be identified by factor analysis, in some cases it was not possible to automatically decide whether the item constituted a positive or negative statement. For scoring purposes, it was

necessary to decide whether an item indicated a positive or negative attitude. To facilitate this, the doctoral students in science education were asked to mark the inventory in terms of agree or disagree, as to how they felt an ideal person would respond. On most items there was good agreement among the doctoral students, but on part of the items, wide disagreement existed. The experimenters then used their judgement in assigning a scoring direction to the item. Items which were incorrectly scored showed up on the factor analysis and were corrected then; that is, the direction of scoring became more obvious after the factor had been identified.

Selection of the High School Senior Sample

In 1969 the state of Oregon had slightly over 30,000 high school seniors in its 220+ public high schools. Based on these figures, the experimenter desired to utilize as small and manageable a sample as possible and yet maintain representativeness of the state's public high school seniors. After consultation with Dr. Lloyd Peterson (Statistics Dept., O.S.U.), it was decided that utilizing a 10% random sample of the schools and of the seniors in these schools was the smallest sufficiently representative sample that could be used. This sample consisted of approximately 300 seniors, or about 1% of the Oregon public high school senior population.

A stratified random sampling procedure was decided upon for the

selection of the sample of public high schools to be solicited for the study. A listing of the state's public high schools, their enrollments, and the grades included in determining the enrollment was obtained from Summary of Pupil Personnel for the Fiscal Year Ending June 1969 (Oregon. State Department of Education, 1969). The majority of school enrollments were on a four year basis, grades 9-12, but other grade grouping including 7-12, 8-12, 10-12, and 11-12 were also noted throughout the state. A four year (9-12 grade level) enrollment was estimated for the schools reporting enrollments based on other grade level distributions. After all of the school enrollments were obtained on a 9-12 grade level basis, the schools were ranked from the smallest to the largest. Since only a general rough order ranking was desired, the experimenters were not concerned with slight over or under estimations of school enrollments in cases where other than 9-12 enrollments were given, or that the enrollments were based on the 1969 fiscal year enrollments (ultimately, ranking probably changed only very slightly in 1970). It was not felt that any bias was being introduced by the small amount of reordering which may have taken place if exact 1970 enrollment figures had been obtained.

Since 10% of the schools were desired, it was decided to accomplish stratification through systematic random sampling. A number was randomly drawn between one and ten and every tenth school in rank following the first one drawn was included in the sample.

This essentially divided the schools into 22 strata of ten schools each. Not knowing what type of cooperation would be received from the selected schools, a double sample was drawn to insure a larger than needed school sample. Another number between one and ten was randomly drawn and again every tenth school after the drawn number was also selected. Thus, two schools in each stratum were drawn, a total of 44 schools. If one school would or could not participate, the other school in the stratum was used. It was not felt that utilizing favorable responders would bias the study as is often the case in studies where responders and non-responders may differ. In this case, the decision to participate or not was an administrative one, whereas the data analysis was based on student responses to the attitude items, not administrator responses; therefore, substituting the students of a school administrator responding favorably for the students from a school administrator responding unfavorably was not felt to bias the results.

The name of each principal for the 1969 school year was obtained and a personal letter was sent to each school principal which explained briefly the study and the time requirements for the school, and solicited the school's cooperation. A self-addressed stamped envelope and a short information form were also included. The schools were asked to return the form with the following information to be filled out if they were willing to participate in the study: number

of students in the school, number of seniors, and the person whom the researchers should personally contact in the school, during what hours, and at what telephone number.

Eighty-nine percent of the 44 schools solicited responded with 69% of the responses, or 27 schools agreeing to participate in the study. In most cases at least one of the schools per stratum responded favorably. The smaller schools, where a smaller number of students would be involved, generally were more favorably disposed than the larger schools. In two cases both schools in a stratum declined and the stratum was filled by a school in the adjacent stratum. The greatest difficulty was incurred in filling the larger school stratum. Three selected Portland schools originally declined and only after consultation with the district director of research, Dr. George Ingebo, and the district science supervisor, Dr. Donald Stotler, was participation obtained. One of the originally selected schools then agreed to participate, and another Portland school, not originally selected, but included in one of the large strata, also agreed to participate. Thus, 22 schools, representing 10% of the state's public high schools, ranging from very small to very large and geographically representing the state, were included in the sample (Appendix B).

The remaining schools which had responded favorably to the request to participate in the study, but were not needed, were thanked in a personal letter for their cooperation. They were informed of the

double sampling procedure utilized and told that since the other school drawn had also agreed to participate, their seniors would not be needed to complete the study.

The Senior Sample

A representative school senior sample was achieved by random selection of 10% of the schools' seniors. About half of the sample schools provided an alphabetized numbered listing of the seniors. Utilizing a random numbers table, 10% of the seniors were drawn to constitute the school's senior sample. An additional 2-3% were also selected as alternates to insure a 10% senior sample to replace those in the original sample who were absent or did not wish to participate in the study. For schools not providing a senior list a selection of random numbers equivalent to 10% of the senior student population of the school and 2-3% for alternates was also made. The 10% was based on the number of seniors that the school had indicated in their first reply. These numbers were matched to the alphabetized senior list at each school to determine the school's senior sample and alternates.

In all but two cases this procedure was strictly adhered to. Unfortunately in two of the large schools, cooperation could only be achieved by utilizing intact senior classes. In one case the school counselor assured the researcher that the students utilized were representative of the seniors in the school. No such assurance was

given however for seniors used in the other school, in which two classes were used. Both classes were seniors enrolled in a required senior course taught many times during the day, so the course itself was not selective of the seniors, although the time of day may have been.

Administration of the Preliminary Inventory

The individual in each school who was responsible for coordinating the administration of the preliminary inventory was personally contacted during early April. Due to the number of schools and large distances involved, the researchers asked, whenever possible, if the school would administer the preliminary inventory. It was felt that in many cases this would be a convenience to both the school and the researchers. The experimenters administered the preliminary inventory in seven of the 22 schools. In the other 15 schools the preliminary inventories, along with adequate instructions and a listing of the seniors or random numbers to determine the sample, were mailed to each school.

The schools were to administer the preliminary inventory at their convenience in one block of time and return the completed preliminary inventories in a stamped mailer. The completed preliminary inventories were all received by mid May.

In the other schools the experimenters had set up an appointment

to administer the preliminary inventory. The schools had been previously notified of the students who were to participate. The researchers welcomed the opportunity to administer the preliminary inventory personally in these seven schools because it afforded the opportunity to obtain additional feedback on the preliminary inventory.

Whether the preliminary inventory was administered by the researcher or by a school official, the establishment of rapport with the seniors was given primary attention. The seniors were informed briefly about the type of statements they would be responding to and that there were differences in opinion regarding the statements, with no correct answers existing. In addition, the seniors were assured of anonymity and were encouraged to read and indicate how they personally felt about each statement and not to respond in a manner which they felt someone else would want them to respond.

It was found that the preliminary inventory of 100 items took less than the two hours originally thought necessary. Most seniors finished in about one-half hour, and certainly, none took longer than one hour. This indicated to the researchers that the seniors were responding spontaneously to the items without pondering over each one. After each administration, the experimenter engaged several of the seniors in conversation to explain the research and to obtain additional feedback. These conversations indicated that the items were generally at the reading level of the seniors and were for the

most part clearly interpreted. The most frequent comment was that the seniors enjoyed taking the preliminary inventory because the items were of the type for which they had some real personal convictions and feeling. Almost all of the feedback was encouraging, indicating that the seniors' responses were spontaneous, conscientious and honest.

Attitudes of Oregon High School Seniors

The attitude scales developed by the factor analytic procedures previously described were used to measure the attitudes of Oregon high school seniors. The present researcher also collected individual senior and school information necessary to compare high school senior subgroups during the administration of the attitude inventory. This procedure eliminated the necessity of a second representative sampling of high school seniors.

Of prime concern to the researcher was a comparison of the attitudes as measured by the developed scales of the senior subgroup based on the amount of science taken in high school, grades 10-12 inclusive. The three subgroups established were 1) a science group, consisting of those seniors who had taken at least three years of science, 2) a non-science group, consisting of seniors who had taken one year or less (this is normally the amount required to graduate from high school), and 3) an intermediate group, consisting of those

seniors who had taken 1-1/2 to 2-1/2 years of science. The science and non-science groups were compared on each item in addition to the total scales. The other subgroups established for comparison were that of sex of the individual, and whether the senior lived and went to school in an urban, suburban, or rural environment. A classification of the total sample into their respective subgroups is shown in Table 1.

Statistics Used in the Analysis of the Data

The responses of all 304 seniors who completed the preliminary attitude inventory were factor analyzed utilizing the University of Oregon adapted program FACTØL at the University of Oregon Computer Center. The principal components method was used to extract factors which were rotated orthogonally by the Varimax criterion.

The split-half method was used to calculate the reliability of each scale and the total Inventory of Societal Issues (ISI). The total score of each individual on one-half of the items of a scale was correlated with his score on the other half of the items on the scale by the Pearson Product-Moment Correlation Coefficient. The Spearman-Brown Prophesy Formula was then used to estimate each total scale reliability. Reliabilities were also estimated by the Kuder-Richardson Formula 20.

The determination of discriminating items on each scale was done utilizing approximately the upper and lower 27% of the seniors

Table 1. Classification of Senior Population.

Years of Science		0-1		1-1/2 - 2-1/2		3+		
Sex		M	F	M	F	M	F	Totals
School Environment	Urban	8	26	20	6	12	3	75
	Suburban	17	41	18	24	18	4	122
	Rural	20	25	18	15	18	11	107
Subtotals		45	92	56	45	48	18	
Totals		137		101		66		304

based on their total score on each scale. A chi-square was made of the upper and lower groups to see if a significant difference existed, and if the item discriminated between people with favorable and unfavorable attitudes as measured by each item of the scale.

The BioMed General Linear Hypothesis program at the Oregon State University computer center was used in an unbalanced analysis of variance design with three factors, or group differences, under examination, that of amount of science, school environment, and sex. F tests were made to determine if significant main and first order interaction effects existed. In addition, the science and non-science groups were compared by chi-square on each item on the inventory.

Processing the Data

The original senior data was transferred from the preliminary inventories to IBM cards for analysis. Separate factor analysis of the data was carried out at both the University of Oregon and Oregon State University computer centers on IBM 1650, Model 50 and CDC 3300 computers respectively. The General Linear Hypothesis and also the tabulation of data for reliability determination and chi-square tests were done at the Oregon State University computer center. The Department of General Science's Olvitti Underwood Programma 101 was used to compute the chi-square values and reliabilities.

IV. THE STUDY

The data used for the development of the individual factor attitude scales, called the Inventory of Societal Issues (ISI), and for the subsequent examination of high school seniors' attitudes, as reported in this chapter, was obtained from a spring 1970 administration of a 100 item preliminary version of the attitude inventory. The 100 items were selected from approximately 250 items after pilot studies with college students and high school students.

The preliminary inventory was administered throughout the month of May to over 300 seniors in 22 high schools throughout the state. This 1% sample was randomly selected in order to obtain a sample which was representative of the 1970 seniors in the state of Oregon to enable generalization to the entire senior population from results reported in this chapter.

The Factor Analysis

The responses of the senior sample to 99 of the 100 items in the preliminary inventory were submitted to factor analysis. The University of Oregon program FACTØL adapted from the sample program FACTØ found in the IBM System/360 Scientific Subroutine Package was used for the analysis. A limitation of the program required the omission of one of the original items in the factor analysis. The program performed a principal component solution and varimax

rotation of the factor matrix. Principal component analysis was used to account for the minimum number of independent dimensions needed to account for most of the variance in the original set of variables. Guilford (1954) suggests that this method is more rigorous mathematically and can be applied completely objectively, but often can lead to factors which are difficult to interpret psychologically. The type of factor extraction and rotation was essentially dictated by the availability of the University of Oregon factor analysis program FACTØL.

Experience gained from previous unsuccessful factor analyses of the data indicated that approximately 40% of the total variance of the data was removed with the extraction of 12 factors, the number of factors extracted in this investigation.

All items loading over 0.300 on a factor were considered to be significantly related to that factor and the factors were named or identified subjectively based on the items significantly loading on each factor. A loading of 0.300 was consistently used in the present study as well as in factor analytic studies which were reviewed in Chapter II. The loading of an item is essentially a measure of how the item or variable correlates with the extracted factor. Rotation of the extracted factors ideally maximized the loading of each variable to one factor while minimizing its loading to the other extracted factors. A loading or correlation of 0.300 was significant for 304 students at beyond the 0.01 level and would rise due to chance less than one in 100 times.

The number of items loading under each factor is given in Table 2.

The original keying of the items was arbitrary since it was not known which items would cluster under each factor or what attitude each factor would measure. The sign of the loading, whether positive or negative, for each item was dependent on the original keying. Examination of the loading of items under each factor indicated the necessity of rekeying some of the items under each factor in order for the responses to items to consistently measure the factor. The researchers arbitrarily decided what a high score would measure in terms of the factor and rekeyed each factor so that the sum of all items under a factor would give an appropriate measure of that factor. A senior's factor score was simply the sum of his rekeyed response choices to the items included in each factor scale. Not all of the items which clustered under a factor were used in the calculation of each senior's factor score; that is, those items subjectively judged as being dissimilar to the other items under the factor were omitted, and if an excess of items existed under a factor, only those with highest loadings were used. Some items loading under more than one factor were included in the final attitude scales.

Factor I

As indicated by Table 3, all eight items under Factor I loaded singly. The item loadings for this factor were higher than the item

Table 2. Number of Items Loading Under Each Factor.

Rotated Factor	Total Number of Items Loading Over 0.300	Number of Items Loading Only on Indicated Factor	Number of Items Used in Factor Attitude Scales
I*	8	8	8
II*	9	7	7
III*	8	7	8
IV*	13	8	10
V	5	5	-
VI	2	2	-
VII*	15	13	12
VIII	4	2	-
IX*	11	9	10
X	3	3	-
XI*	6	4	5
XII	4	4	-
Totals	88	72	60

*Factor attitude scales used for analysis of high school seniors' attitudes.

Table 3. Factor I Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
30.*	Abortion is the taking of a life.	-786											
15.*	Personally, I would probably never have (or recommend that my wife have) an abortion.	-749											
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.	-738											
91.*	A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	-684											
68.*	Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	-547											
78.	I would probably try some type of drug if their use were legalized.	506											
42.	The law should allow a person to choose freely whether or not he wishes to experience drugs.	485											
24.	Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	436											

*Items rekeyed for scoring purposes.

loadings of any other factors.

The content of the items suggests that this factor relates to a general regard for the human life, and those things which may be detrimental to it. An individual scoring high on this factor would disapprove of abortion and would consider the fetus as an individual with rights to survival, superseding the mother's rights to decide if she wished to bear the child. A high score would also be indicative of opposition to euthanasia under any circumstances. Lastly, an individual scoring high would not take drugs nor give others the freedom to experiment with drugs which might be harmful to the individual.

Factor II

The items and the respective loadings for Factor II are shown in Table 4. This factor seems to reflect a rather disillusioned and pessimistic attitude toward the outcomes and implications of the relationship of man to nature, with his science and technological progress and achievements. This pessimism is particularly reflected by Items 54 and 47, while Items 90, 53, and 96 express a great deal of disillusionment with what some might regard as progress. Items 26 and 87 reflect a laissez-faire, non-involvement attitude toward nature.

A high score on this factor would reflect an attitude that the results of many technological advances are not good, and have created

Table 4. Factor II Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
90.	It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.		496										
54.*	America, in the near future, will be filthy and foul, and our air will be unfit to breathe.		-465										
47.*	Science can never solve the problems which are really important to man.		-417										
26.	Man should not tamper with the grandeur of nature.		417	-323									
53.*	Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.		-411										
87.*	Technological devices which make it easier for man to exploit nature should be banned.		-401										
96.	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			

*Items rekeyed for scoring purposes.

more problems than they have solved; therefore, they conclude that nature is a thing with which man should not tamper.

Items 21 and 93 were omitted in the final scale. Item 21 does fit the general factor interpretation but was of the lowest loading of the items. Item 93 multiple loaded and the content does not seem consistent with the other items under this factor.

Factor III

The items and the respective loadings for Factor III are shown in Table 5.

Factor III seems to be specifically related to conservation of our environment and natural resources. An individual scoring high on this factor would feel that representative wilderness areas should be preserved in their natural state just for the sake of maintaining some wilderness areas, and that the natural environment should not be altered by man by modification or extinction of individual species.

Factor IV

The items and the respective loadings for Factor IV are shown in Table 6.

Factor IV clearly reflects a concern for the problem of increased population and the implications or consequences of this increase. Also contained within the factor are attitudes on methods of dealing with or

Table 5. Factor III Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
50.	Extinction of some species of wildlife is a necessary result of man's involvement with nature.			-545									
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.			-537									
63.	There is no point in attempting to take nature back to pristine purity.			-529									
62.	After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.			-487									
51.	It is unjustifiable to set aside large expanses of marketable timber for recreation.			-475									
36.	Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.			-443									
58.	Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.			-385									
48.	Conservationists' pleas for total protection of an area rich in natural resources (e.g., Alaska) are unrealistic.			-432								-340	

Table 6. Factor IV Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
46.*	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.				577								
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.				550								
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 toward the population and environment of the United States.				-499								
49.	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.				-495								
85.*	It has been suggested that this country determine which countries are beyond help population wise. Massive surplus food efforts would then be directed toward areas with a greater hope of success.				377								
22.	The tax system should be redesigned to encourage small families rather than large ones.				-364								
75.*	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.*	Sterilization should be mandatory after the birth of a couple's second child.				434			352					
71.*	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.	The population growth of the United States should be halted.				-326			-304					

*Items rekeyed for scoring purposes.

combatting the increasing population. Agreement with the factor would be indicative of a great concern for our increasing population, and a belief that population is the cause of many of our social problems including pollution and famine which, they feel, will inevitably occur. Factor agreement would also indicate the attitude that our population growth must be halted and that the Catholic Church and probably anyone opposing or not advocating birth control are partially responsible for our increasing population problem. A variety of population control methods would be considered favorable including massive sterilization after a finite number of children, tax incentive programs, involuntary contraceptive methods, the involvement of federal government to deal with the population and resulting problems, and selective food distribution programs to only those countries which are not beyond the point-of-no-return, population-wise.

It is of interest that abortion, suggested by its pro-advocates as a means to help control birth rates, hence population, did not factor under this area. Evidently, abortion is not viewed as a population control method; that is, it seems that preventing conception is viewed differently from destroying that which has already been conceived.

Factor V

The items and the respective loadings for Factor V are shown in Table 7.

Table 7. Factor V Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
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							

Items 43, 66, and 69 seem to reflect an internationalistic outlook regarding the resources of our country and the world. Items 81 and 61 reflect the attitude that desired ends do not necessarily justify the means used to achieve them. The factor was not utilized as a final attitude scale due to the small number of items and the seemingly two different attitudes reflected by the factor. Interestingly, the student sample generally favored Items 43 and 66. Of interest would have been a more specific resources item, such as sharing of Pacific Northwest water or west coast salmon. It is possible that the included items were so general that no specific implications were drawn from them by the senior sample.

Factor VI

The items and the respective loadings for Factor VI are shown in Table 8.

This factor was not used for analysis. The factor seemed to be specifically oriented to sonic boom and the adjustment of people to it. Possibly additional items would show this to be a noise pollution factor, although preliminary inventory Item 83, dealing with noise pollution, factored elsewhere.

Factor VII

The items and the respective loadings for Factor VII are shown

Table 8. Factor VI Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
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						

in Table 9.

Although a large number of items included in this factor relate specifically to the automobile, the factor itself seems to be concerned with the responsibilities and sacrifices demanded of the individual in order to deal with current social problems.

A high score would suggest the attitude that many individual conveniences and pleasures should be sacrificed, whether through legislation or by individual assumption of responsibility. Items 74, 41, 18, 8 and 57 relate specifically to the automobile. Those in agreement with the factor would advocate less dependence of the family on the automobile for transportation and pleasure restricting ownership to smaller automobiles, and individual assumption of the responsibility of discarded automobile disposal. Factor agreement would also reflect feelings that the pleasure and conveniences of fireplaces and incinerators, both of which may be viewed as contributing to air pollution, should be restricted. Other responsibilities assumed or conveniences restricted included the limitation of family size and the limitation of the use of pesticides.

Factor VIII

The items and the respective loadings for Factor VIII are shown in Table 10.

Factor VIII consists of only four items, two of which loaded

Table 9. Factor VII Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
74.	Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.							-706					
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.							625					
18.	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.							-616					
8.	Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.							-575					
76.*	Citizens should not be allowed to use fireplaces in pollution-prone areas.							543					
57.	The cost of automobile disposal should be paid by the auto owner, not by society as a whole.							-408					
95.*	The automobile is incompatible with our health and well being.							391					
65.*	Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contributions to air pollution.							385					
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.							354					
73.*	Our current cities are a lost cause; we need entirely new experimental cities.							344					
79.	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					

(Continued on next page)

Table 9. (Continued)

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
86.*	Most of the man-made objects along the highway are degrading.							303					
80.*	Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.				374			509					
44.	Environmental quality is generally neglected when economic considerations are involved.			-304				-350					

*Items rekeyed for scoring purposes.

Table 10. Factor VIII Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
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				

under an additional factor. The limited number and diversity of these items under the factor rendered this factor uninterpretable. Items 31 and 100 are content oriented about skins and furs of wild animals and might be related to preservation of extinction threatened animals due to commercial exploitation; however, the other items do not fit this interpretation.

Factor IX

The items and the respective loadings for Factor IX are shown in Table 11.

Factor IX is clearly a science and technology factor. The items suggest an optimistic belief in the ability of science and technology to solve societal problems and deficiencies in our environment. Not only is an optimism expressed but also the attitude or belief that this is indeed the proper function of science and technology.

A person scoring high on this factor would favor the involvement of science and technology in nature, as clearly expressed by Items 32, 34, 94, 14, 77, and 67. Items 72, 64, 60, 35, and 37 reflect the optimism in the ability of science to serve man in contributing to his comforts and needs in daily life, and meeting future problems.

Table 11. Factor IX Items and Their Respective Loadings.

		Factor											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
72.*	Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.									579			
32.*	Man's vast technological abilities should be used to put water where people want to be.									541			
64.*	The oceans represent an almost limitless source of food and resources for the future.									534			
60.	Technology's positive contribution to our lives far outweighs the negative.									-439			
34.*	The primary objective of the working scientist is to improve human welfare.									352			
94.*	When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.									335			
14.	We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.									-320			
35.*	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 manipulate those relationships to his advantage.									310			
37.*	There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.				367					372			
67.	Science and technology should attempt to control the weather.		-313							-333			

*Items rekeyed for scoring purposes.

Factor X

The items and the respective loadings for Factor X are shown in Table 12.

Limited and diverse items rendered Factor X uninterpretable.

Factor XI

The items and the respective loadings for Factor XI are shown in Table 13.

Factor XI was tentatively identified as related to individual freedom and rights. Items 84, 39, 16, and 83 reflect a belief in human rights to decide what to do with personal property, to unrestricted use of national park lands, and to privacy from collection of personal information in large computer banks. Finally, the right to be free from excessive noise, rather than simply attempting to mask it out was noted.

Factor XII

The items and the respective loadings for Factor XII are shown in Table 14.

Factor XII was limited and diverse also, rendering interpretation difficult. Tentatively, the factor seems to be related to the individual basis for decision making, whether rational, economic or moral.

Table 12. Factor X Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
4. 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		
82. Automation will degrade the industrial machine operator even more as he assumes the role of button pusher.										-513		
9. 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		

Table 13. Factor XI Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
84. If a farmer finds it unprofitable to harvest his crops he should have the right to let them rot in the field.											454	
39. Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.											396	
16. 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. The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.						-309					467	
89. Scientists should not meddle in matters which are inappropriate for scientific methods.										-316	393	

Table 14. Factor XII Items and Their Respective Loadings.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
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

The seven interpreted factors and the items which made up each of the factor attitude scales of the Inventory of Societal Issues are given in Table 15.

Remaining Items

The remaining 11 items which did not load greater than 0.300 under any of the 12 extracted factors are given in Appendix C, showing all loadings greater than 0.200.

Factor Scale Reliabilities

As indicated in Table 2, not all factors were used in the analysis of the attitudes of the high school population. Only those factors which were readily interpretable and had a sufficient number of items were used.

Reliabilities for the final factor attitude scale were computed using split half methods. The sum of each student's responses to the odd items on each respective scale was correlated by the Pearson Product-Moment Correlation Coefficient with the sum of his responses to the even items. The total scale reliabilities given in Table 16 were estimated using the Spearman-Brown Prophesy Formula:

$$\text{S-B} \quad r = \frac{2r}{1 + r}$$

In addition to the Spearman-Brown reliabilities, total scale reliabilities were also calculated using the Kuder-Richardson Formula 20:

Table 15. Summary of Interpreted Factors and Items Included in Factor Scales of the Inventory of Societal Issues.

Factor	General Referent	Items
I	Regard for Human Life	30, 15, 12, 91, 68, 78, 42, 24
II	Disillusionment and Pessimism Regarding Man's Involvement in Nature	90, 54, 47, 26, 53, 87, 96
III	Preservation and Conservation of Nature and Resources	50, 1, 63, 62, 51, 36, 58, 48
IV	Population and Related Problems	46, 99, 45, 49, 85, 22, 75, 6, 71, 59
VII	Individual Responsibility and Sacrifices	74, 41, 18, 8, 76, 57, 95, 65, 13, 73, 80, 44
IX	Optimism and Utility of Science and Technology	72, 32, 64, 60, 34, 94, 14, 35, 37, 67
XI	Individual Freedom	84, 39, 16, 83, 89

Table 16. Reliabilities of Total ISI and Individual Factor Scales.

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
Total ISI	60	0.624	0.768	0.647
Total less XI	55	0.719	0.835	0.663

$$\text{KR-20} \quad r = \frac{k}{k-1} \frac{\sigma_t^2 - \Sigma\sigma_i^2}{\sigma_t^2}$$

This reliability is an average of all possible split halves for the respective scales and is generally lower than that given by the Spearman-Brown Prophesy Formula, due to the lack of homogeneity of the items.

Test-retest reliabilities were not established. This procedure is less frequently used to establish reliabilities in affective instruments compared to cognitive instruments. If the time interval is too small between test and retest, memorization and consistent responses often result in spuriously high reliabilities. Furthermore, actual attitude changes frequently occur if long time intervals pass between test and retest, giving inappropriate reliabilities.

The reliabilities calculated for the present scales are quite acceptable, especially considering the limited number of items included in each factor scale. The reliabilities may be somewhat inflated due to the factor analytic procedure used in divising the scales. Future administration of the instrument on new populations would give additional information on the reliability of each factor scale and that of the total instrument.

Item Discrimination

All of the items included in the inventory had been shown in pilot

work to elicit a spectrum of responses, to help insure that the finished scales would consist of discriminating items. The factor analytic procedures used to develop the scales also assured that discriminating items were included in each factor. The level of discrimination was determined by comparing the response patterns of the upper and lower 27% (82 students in each group) on each factor. The two populations were compared on each item under a respective factor by a chi-square test. All items were found to differentiate between the two populations at significantly greater than the 0.001 level.

Attitudes of Oregon High School Seniors

All of the students in the representative sample of Oregon high school seniors were classified as to school environment, amount of science, and sex. The school environments used were rural, suburban, and urban. The decision of environmental classification of each school was somewhat subjective based on the experimenter's judgement as to what constituted each of the environments. The general criteria were as follows: 1) For rural areas, agriculture was an important industry for the local people, the schools generally were small and were not situated near a large metropolitan area. 2) The suburban schools were those situated in areas where a large number of professional people lived or worked. Generally, suburban schools were considered to be in the proximity of larger metropolitan areas

and served as bedroom communities for workers in the metropolitan areas. Also communities such as Corvallis, Bend, Eugene, and Salem were classified as suburban because of their size and number of professional people. The only schools considered to be urban were those of the Portland School System.

The amount of science that the seniors had in high school was classified into three levels: 1) one year or less, 2) 1-1/2 to 2-1/2 years, and 3) over three years. This classification was objective, based on student self-reports.

The sex classification was also based on self-reports.

The purpose of the senior characteristics information was to examine and compare the attitudes of the various senior subgroup populations to determine if significant attitude differences existed within the senior populations with regard to those characteristics.

To examine the possible differences of attitudes among the three population subgroup classifications (amount of science, environment, and sex) an analysis of variance was carried out for the total instrument composed of all factors, and an analysis of variance was also carried out for each factor individually (Table 17). The factor attitude scale scores were used as the dependent variables, and the population subgroups were used as the independent variables. There were then three levels for science, three levels for school environment, and two levels for sex. In addition, the science and non-science

Table 17. Analysis of Variance of the Factor Scale Scores and Total Inventory Scale Score of 304 Seniors Classified According to Amount of Science (A), School Environment (B), and Sex (C).

Source of Variation	df	Factor								Total
		I	II	III	IV	VII	IX	XI	T-XI	
A	2	0.20	0.79	1.89	1.38	3.76[a]	0.13	2.20	2.72	2.56
B	2	0.87	0.27	1.73	0.41	1.20	6.57[b]	0.12	0.17	0.12
C	1	0.01	2.21	1.37	0.05	1.87	0.99	7.48[b]	0.15	0.12
A x B	4	1.30	0.76	0.49	0.94	1.36	0.75	1.45	0.14	0.35
A x C	2	0.68	0.88	0.04	0.13	0.56	1.21	0.06	0.36	0.29
B x C	2	0.39	0.24	1.82	0.61	0.16	0.81	1.81	0.82	1.11
A x B x C	4	0.02	0.53	0.56	0.19	2.09	0.94	0.56	0.27	0.36
Within	286									
Totals	303									

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

subgroups were compared by chi-square on each item to determine if any items differentiated between these two populations.

In order to facilitate the chi-square comparison of the non-science and science oriented seniors, and also to readily present the percentages of seniors agreeing and disagreeing with each item, strongly agree and agree were combined under agree, neutral was left intact, and disagree and strongly disagree were combined under disagree. (Agree + Neutral + Disagree = 100%.)

Results of the Analysis of Variance

Total Test Analysis Results

The senior subgroups were first compared on two versions of the total instrument. One version included all seven factors or a score based on 60 items. The other version of the instrument consisted of the first six factors, and contained a total of 55 items. Factor XI was omitted in the second version due to the limited number of items in the scale, and its lower reliability. In both cases, none of the calculated F values were significant at the 5% level. The only variable even approaching significance was that of amount of science, with a calculated F value of 2.72 for the dependent variable with all seven factors, and 2.56 for the total instrument including only the first six factors. To have been significant at the 5% level, a calculated F value of 3.04 would have been necessary.

Factor I Analysis Results

Analysis of Factor I, dealing with a general regard for life, indicated that no significant differences existed for the various senior population subgroups. In addition, none of the first order interactions approached significance (Table 17).

Examination of the responses to each of the statements under Factor I (Table 18) indicated that the seniors did not consistently agree or disagree with the factor. With reference to abortion, they highly agreed that a mother should have the right to decide if she wants an abortion, but were not as willing to say that they themselves would have one or recommend that their future wives have one. A slight majority did not regard the fetus as an individual or that a life is taken during an abortion. The seniors were about equally split in regard to euthanasia, the majority being slightly in favor of the practice in some cases. The most surprising items were those dealing with drugs; the seniors generally were not in favor of allowing the freedom to experience drugs, and also indicated that they personally would not try drugs. With all indications that the amount of teenage drug experimentation and usage has increased in the past couple of years, this response pattern was somewhat surprising. The individual decision of whether or not to try drugs (Item 78) was the only item under this factor which significantly differentiated between the science and non-science oriented seniors.

Table 18. Seniors' Responses (in percent) to the Individual Items of Factor I and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
30. Abortion is the taking of a life.	All	41.4	12.3	46.4	
	NS	48.2	10.9	40.9	5.85
	S	31.8	19.7	48.5	
15. Personally, I would probably never have (or recommend that my wife have) an abortion.	All	51.7	9.5	39.8	
	NS	49.6	8.0	42.3	1.52
	S	53.0	12.1	34.8	
12. A women should have the right to an abortion, that is to terminate pregnancy prior to the time the fetus would live if born naturally.	All	71.0	7.9	21.1	
	NS	69.3	4.4	26.3	4.55
	S	72.7	10.6	16.7	
91. A fetus should be certified as an individual as soon as the mother has knowledge of its existence.	All	31.6	19.3	49.0	
	NS	33.6	19.0	47.4	4.16
	S	19.7	22.7	57.6	
68. Mercy killing or benevolent neglect (not treating an apparently fatal disease) is sometimes justifiable.	All	47.0	12.3	40.8	
	NS	48.9	9.5	41.6	0.82
	S	45.5	13.6	40.9	
78. I would probably try some type of drug if their use were legalized.	All	27.0	10.5	62.5	
	NS	31.4	9.5	59.1	6.41[a]
	S	15.2	9.1	75.8	
42. The law should allow a person to choose freely whether or not he wishes to experience drugs.	All	38.2	10.2	51.6	
	NS	38.7	10.9	50.4	0.93
	S	33.3	9.1	57.6	
24. Society should discourage prolonging the lives of individuals who are in a state of permanent and complete mental and/or physical incapacity.	All	41.4	21.1	37.5	
	NS	39.4	22.6	38.0	0.06
	S	40.9	21.2	37.9	

[a]Significant at the 0.05 level.

All (All Seniors N = 304)

NS (Non-Science Oriented Seniors N = 137)

S (Science Oriented Seniors N = 66)

Factor II Analysis Results

No main level or first order interaction differences were present for Factor II (Table 17), dealing with the pessimism and disillusionment regarding the involvement of man in nature. Attitudes toward the referent were not dependent or influenced by the amount of science, school environment, or sex.

The majority of seniors basically agreed with Factor II (Table 19). The only item in which the majority of seniors' responses differed from the general factor agreement was item 47. Although the seniors generally felt disillusioned and pessimistic about man's technological intrusion in nature, they did sound a note of optimism in that they very definitely did feel that science could solve problems of importance to man. It is somewhat surprising that this item did not factor under Factor IX.

The comparison of science and non-science students on each item indicated that Items 47 and 53 differentiated at the 1% level and Item 93 differentiated at the 5% level. The science oriented seniors expressed even more faith in the ability of science to solve meaningful problems of mankind. They did not view the computer as a threatening instrument to man's privacy whereas the non-science oriented seniors most definitely did.

Table 19. Seniors' Responses (in percent) to the Individual Items of Factor II and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
90. It is unfortunate that there are fewer and fewer areas in this country where man has never set foot.	All	69.7	10.5	19.7	
	NS	71.5	9.5	19.0	1.78
	S	63.6	15.2	21.2	
54. America, in the near future, will be filthy and foul, and our air will be unfit to breathe.	All	57.6	12.3	30.3	
	NS	61.6	9.5	29.2	2.17
	S	51.5	9.1	39.4	
47. Science can never solve the problems which are really important to man.	All	23.4	18.1	58.5	
	NS	29.9	20.4	49.6	11.52[b]
	S	10.6	16.7	72.7	
26. Man should not tamper with the grandeur of nature.	All	68.7	11.5	19.7	
	NS	71.5	10.2	18.2	1.62
	S	63.6	10.6	25.8	
53. Computers with their storage and retrieval capacities represent a serious threat to the privacy of the individual.	All	44.1	23.7	32.2	
	NS	49.6	27.0	23.4	11.75[b]
	S	36.4	16.7	47.0	
87. Technological devices which make it easier for man to exploit nature should be banned.	All	42.1	23.7	34.2	
	NS	38.7	31.4	29.9	3.11
	S	47.0	19.7	33.3	
96. Science and technology often create products and services that man does not really need.	All	72.4	13.8	13.8	
	NS	71.5	13.1	15.3	1.25
	S	78.8	9.1	12.1	
21.* The vast majority of people in the world probably don't care about wilderness areas.	All	47.0	8.6	44.4	
	NS	46.7	9.5	43.8	0.73
	S	50.0	6.1	43.9	
93.* People should be free to do whatever they wish about birth control.	All	59.9	22.4	17.8	
	NS	59.9	5.8	34.4	6.35[a]
	S	45.5	15.2	39.4	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

*Items omitted in final factor scale.

All (All Seniors N = 304)

NS (Non-Science Oriented Seniors N = 137)

S (Science Oriented Seniors N = 66)

Factor III Analysis Results

Factor III, regarding conservation of the environment and resources, also indicated no main level or first order interaction effects based on the three independent variables (Table 17), although some significant differences did exist between the science and non-science group on several items (Table 20). The seniors generally agreed with the factor. The science and non-science oriented seniors differed on Items 51 and 36 at the 5% level, and Item 48 at the 1% level. The science oriented seniors were even more convinced that selected timber and wilderness areas should be preserved; however, they were not quite as much in favor of unlimited preservation, but rather that reason must be used in deciding how much to preserve.

Factor IV Analysis Results

Analysis of Factor IV, dealing with the concern for population, indicated that no significant differences in attitudes occurred within any of the three independent variables (Table 17). No significant interaction effects were present.

The seniors' responses (Table 21) indicated that they were not consistent in their attitudes toward the identified factor and agreed with the factor on slightly less than one-half of the items. Their concern for the population problem and some of the consequences of over population was expressed in responses to Items 59 and 23,

Table 20. Seniors' Responses (in percent) to the Individual Items of Factor III and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
50. Extinction of some species of wildlife is a necessary result of man's involvement with nature.	All	33.2	7.0	59.9	
	NS	39.4	4.4	56.2	5.49
	S	25.8	10.6	63.6	
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	20.7	10.2	68.7	
	NS	21.9	13.9	64.2	4.24
	S	21.2	4.5	74.2	
63. There is no point in attempting to take nature back to pristine purity.	All	27.0	15.7	58.2	
	NS	26.3	19.0	54.7	1.57
	S	22.7	13.6	63.6	
62. After cutting redwood forests, a higher yield, faster growing tree, like fir, should be used for reforestation.	All	39.5	16.7	43.7	
	NS	40.9	18.2	40.9	3.66
	S	28.8	16.7	54.5	
51. It is unjustifiable to set aside large expanses of marketable timber for recreation.	All	18.4	12.5	69.1	
	NS	19.0	15.3	65.7	6.14[a]
	S	7.6	10.6	81.8	
36. Selected wilderness areas should be preserved from man's technological utilization no matter what the cost.	All	79.2	8.9	11.9	
	NS	75.9	9.5	14.6	6.59[a]
	S	90.9	4.5	4.5	
58. Pollution of the environment is due to an unaware, unconcerned, and uncommitted public citizen.	All	76.3	7.6	16.0	
	NS	76.6	7.3	16.1	1.25
	S	83.3	4.5	12.1	
48. Conservationists' pleas for total protection of an area rich in natural resources (e. g., Alaska) are unrealistic.	All	17.1	18.4	64.5	
	NS	13.1	26.3	60.6	10.62[b]
	S	25.8	9.1	65.2	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

All (All Seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science Oriented Seniors N = 66)

Table 21. Seniors' Responses (in percent) to the Individual Items of Factor IV and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

			Agree	Neutral	Disagree	X^2
46.	The Roman Catholic Church's position on birth control can be blamed for much of our current population crisis.	All	29.6	22.4	48.0	
		NS	31.4	19.0	49.6	0.69
		S	25.8	21.2	53.0	
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.	All	29.9	22.4	47.7	
		NS	24.8	26.3	48.9	4.04
		S	34.8	15.2	50.0	
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 toward the population and environment of the United States.	All	69.7	13.8	16.4	
		NS	66.4	24.1	18.2	0.83
		S	72.7	12.1	15.2	
49.	In order to keep raw materials from being used up too fast, an international authority must be established to ration them.	All	58.2	22.4	19.3	
		NS	57.7	24.1	18.2	0.36
		S	57.6	21.2	21.2	
85.	It has been suggested that this country determine which countries are beyond help population wise. Massive surplus food efforts would then be directed toward other areas with a greater hope of success.	All	24.7	22.4	53.0	
		NS	26.3	25.5	48.2	3.77
		S	16.7	21.2	62.1	
22.	The tax system should be redesigned to encourage small families rather than large ones.	All	68.7	12.5	18.7	
		NS	62.0	11.7	26.3	6.56[a]
		S	75.8	13.6	10.6	
75.	In order to encourage a lower birth rate single people should be assessed much lower taxes.	All	37.8	20.0	42.1	
		NS	35.0	19.0	46.0	2.57
		S	45.5	19.7	34.8	
17.*	It is inevitable that world wide famine will occur in the next decade.	All	29.0	23.4	47.7	
		NS	33.6	21.9	44.5	1.44
		S	27.2	28.8	43.9	
6.	Sterilization should be mandatory after the birth of a couple's second child.	All	17.1	9.9	73.0	
		NS	13.9	10.9	75.2	7.12[a]
		S	22.7	1.5	75.8	
71.	No one but the family should make decisions regarding the size of the family.	All	49.7	8.2	42.1	
		NS	56.9	5.8	37.2	3.86
		S	42.4	9.1	48.5	
23.*	Environmental pollution is a direct consequence of increased population.	All	68.7	10.9	20.3	
		NS	59.9	13.1	27.0	4.06
		S	74.2	9.1	16.7	

(Continued on next page)

Table 21. (Continued)

		Agree	Neutral	Disagree	X^2
52.* Science and technology are removing the last barriers that have kept man from controlling his life.	All	31.6	27.6	40.8	
	NS	34.4	26.3	39.4	1.10
	S	27.2	27.2	45.5	
59. The population of the United States must be halted.	All	55.9	16.0	28.0	
	NS	54.0	17.5	28.5	2.27
	S	65.2	13.6	21.2	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

*Items omitted in final factor scale.

All (All Seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science Oriented Seniors N = 66)

although not to the extent that some assert, as Item 17 suggests. The seniors were generally in favor of less drastic means of dealing with the population problem (Items 45, 49, and 22), but disagreed strongly with some more drastic, less humanistic methods of coping with the problem (Items 99, 85, and 6).

The science and non-science oriented seniors differed significantly at the 5% level on only two items, Items 22 and 6. Examination of the science oriented seniors' responses to these items and the other population items indicated a slightly harder line in terms of facing up to the problems of population control.

Factor VII Analysis Results

The amount of science a senior had taken in high school was found to be significant on Factor VII, dealing with individual responsibility and sacrifice. The calculated F value was significant at the 5% level (Table 17). The mean score of the science oriented seniors was the highest of the three science subgroups and the lowest for the non-science oriented seniors, indicating a positive correlation between more favorable factor scale attitudes and amount of science taken by the senior.

Other than Items 76 and 73 (Table 22), the seniors agreed with the factor, indicating a general attitude that man should assume a more responsible role for the effects of his actions and many conveniences

Table 22. Seniors' Responses (in percent) to the Individual Items of Factor VII and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
74. Until technology can make substantial reduction in auto pollutants, families should be encouraged to have only one automobile.	All	47.4	14.5	38.2	
	NS	44.5	14.6	40.4	2.22
	S	54.5	9.1	36.4	
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	38.5	16.7	44.7	
	NS	32.8	16.1	51.1	7.88[a]
	S	48.5	21.2	30.3	
18. To reduce petroleum consumption, only small efficient automobiles should be manufactured.	All	48.7	19.3	31.9	
	NS	43.1	24.8	32.1	3.22
	S	54.5	15.2	30.3	
8. Considering the problems of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.	All	62.3	9.2	28.6	
	NS	56.9	7.3	35.8	6.80[a]
	S	75.8	4.5	19.7	
76. Citizens should not be allowed to use fireplaces in pollution prone areas.	All	36.5	22.7	40.8	
	NS	38.7	17.5	43.8	3.44
	S	34.8	28.8	36.4	
57. The cost of automobile disposal should be paid by the auto owner, not by society as a whole.	All	51.3	24.0	24.7	
	NS	50.4	25.5	24.1	0.28
	S	47.0	28.8	24.2	
95. The automobile is incompatible with our health and well being.	All	45.1	16.7	38.2	
	NS	43.1	19.7	37.2	0.82
	S	42.4	15.2	42.4	
65. Private citizens should not be allowed to burn rubbish and trash in outdoor incinerators because of their contributions to air pollution.	All	54.6	13.8	31.6	
	NS	55.5	9.5	35.0	4.27
	S	47.0	19.7	33.3	
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	49.7	17.1	33.2	
	NS	46.7	18.2	35.0	3.05
	S	59.1	16.7	24.2	
73. Our current cities are a lost cause; we need entirely new experimental cities.	All	21.1	15.7	63.5	
	NS	16.8	16.8	66.4	3.05
	S	27.2	15.2	57.6	
79.* The internal combustion engine, a major source of air pollution, is the backbone of our industrial society, and, therefore, its elimination is not feasible.	All	24.7	20.3	54.9	
	NS	23.4	27.7	48.9	12.81[b]
	S	28.8	6.1	65.2	
25.* Until foolproof means of obtaining undersea oil deposits are developed, offshore oil drilling should be halted.	All	67.4	15.4	17.1	
	NS	62.8	21.9	15.3	7.00[a]
	S	69.7	7.6	22.7	

(Continued on next page)

Table 22. (Continued)

		Agree	Neutral	Disagree	X^2
86.* Most of the man-made objects along the highway are degrading.	All	47.0	17.8	35.2	
	NS	43.1	24.1	32.8	5.13
	S	51.5	10.6	37.9	
80. Since population growth is a critical problem facing mankind it is irresponsible to have more than two children.	All	46.7	10.5	42.8	
	NS	41.6	10.2	48.2	2.80
	S	48.5	15.2	36.4	
44. Environmental quality is generally neglected when economic considerations are involved.	All	73.7	19.0	7.2	
	NS	69.3	24.8	5.8	7.22[a]
	S	81.8	9.1	9.1	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

*Items omitted in final factor scale.

All (All Seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science Oriented Seniors N = 66)

on the environment, and that he should consider sacrificing some of these things for the good of society. Interestingly, the seniors were willing to sacrifice many things, but sacrificing the family fireplace was asking too much.

The science oriented seniors were more in agreement on almost all statements. This difference was significant at the 5% level on Items 41, 8, 79, and 25. Examination of these items indicated that the science oriented seniors were significantly more willing to see the use of the automobile reduced as a major means of transportation due to its many adverse effects on society and the environment.

Factor IX Analysis Results

On Factor IX, concerning the optimism and belief in the utility of science and technology, the independent variable, school environment, was significant (Table 17). The mean factor scale score of the rural seniors was the highest, the suburban seniors next, and the urban seniors the lowest. The higher the factor score the greater the optimism and belief in the ability of science and technology to solve our many societal problems. Perhaps, the rural and suburban seniors were less exposed to the many societal problems which are especially manifested in the large cities. Maybe, they did not see the apparent inability of society, including its scientists, social scientists, civic leaders, and politicians to work out meaningful solutions, and

therefore, had greater optimism and belief in the utility of science to solve society's problems.

The majority of all seniors agreed with factor IX (Table 23), except in two cases, Items 37 and 67; their responses to these items were contradictory to the rest of their responses. These items indicated that the seniors believed that some problems were too complex to be solved by science and technology; nonetheless, they felt that science and technology should attempt to correct or improve deficiencies in nature, except in the realm of weather control.

Even though the amount of science was not significant on Factor IX, the responses of science and non-science oriented seniors were significantly different on three items, Items 94 and 35 at the 1% level, and Item 67 at the 5% level. The science oriented seniors definitely felt that the positive contributions of science and technology far outweighed any adverse effects. They were also more in agreement with using science and technology to make up for nature's deficiencies.

The response pattern to Item 34 is perhaps the most revealing item under this factor. The seniors indicated a belief in the utility of science and that the primary objective of scientists should be that of improving human welfare. It is surprising that even science oriented seniors viewed the role of a scientist as utilitarian and not as a quest for the understanding of natural phenomena. Non-utilitarian, pure research did not seem to be recognized even by science oriented

Table 23. Seniors' Responses (in percent) to the Individual Items of Factor IX and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
72. Science and technology will probably develop new foods that can be mass produced to feed the world's hungry.	All	62.5	22.4	15.1	
	NS	58.4	30.7	10.9	4.56
	S	63.6	18.2	18.2	
32. Man's vast technological abilities should be used to put water where people want to be.	All	40.1	33.9	27.0	
	NS	40.1	33.6	26.3	0.03
	S	39.4	34.8	25.8	
64. The oceans represent an almost limitless source of food and resources for the future.	All	65.1	9.2	26.7	
	NS	67.2	8.8	24.1	1.93
	S	59.1	7.6	33.3	
60. Technology's positive contribution to our lives far outweighs the negative.	All	49.0	31.9	19.0	
	NS	43.1	35.8	21.2	5.53
	S	60.6	25.8	13.6	
34. The primary objective of the working scientist is to improve human welfare.	All	69.4	15.4	16.1	
	NS	73.7	16.1	10.2	2.01
	S	71.2	12.1	16.7	
94. When nature is deficient in doing what it should for human welfare, science and technology must make up for that deficiency.	All	59.9	22.4	17.8	
	NS	48.2	30.7	21.2	11.83[b]
	S	72.7	12.1	15.2	
14. We should strive to make advances in genetics to give man the ability to rid himself of hereditary defects, traits, etc.	All	62.3	15.4	22.4	
	NS	66.4	11.7	21.9	0.53
	S	65.2	15.2	19.7	
35. Automation holds the promise of the future with new abundance for all, new leisure and new freedoms.	All	45.7	20.3	33.9	
	NS	41.6	28.5	29.9	9.69[b]
	S	53.0	9.1	37.9	
77.* 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.	All	51.3	18.7	30.9	
	NS	50.4	19.7	29.9	0.50
	S	47.0	18.2	34.8	
37. There is no social problem so complex that it cannot be solved once science and technology are committed to its solution.	All	32.6	17.5	50.0	
	NS	35.8	19.0	45.3	3.61
	S	28.8	12.1	59.1	
67. Science and technology should attempt to control the weather.	All	20.3	15.1	64.5	
	NS	15.3	12.4	72.3	8.01[a]
	S	31.8	13.6	54.5	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

*Items omitted in final factor scale.

All (All Seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science Oriented Seniors N = 66)

seniors.

Factor XI Analysis Results

Attitudes as measured by Factor XI, dealing with individual freedom and rights, were found to be different for boys and girls. This difference was significant at the 1% level (Table 17). The mean score of senior boys was higher than that of senior girls. The total senior sample of responses to the individual items (Table 24) did not indicate a consistent response pattern of agreement with the factor. Science and non-science oriented seniors differed significantly only on Item 83. Although none of the differences on any other items were significant, the science oriented seniors seemed to be more extreme in their responses.

The responses by percentages of the seniors to the items included on the preliminary inventory, but omitted from the developed Inventory of Societal Issues is given in Appendix D. In addition, the results of a chi-square comparison of the non-science and science oriented seniors is also given in this appendix.

Table 24. Seniors' Responses (in percent) to the Individual Items of Factor XI and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors.

		Agree	Neutral	Disagree	X^2
84. If a farmer finds it unprofitable to harvest his crops he should have the right to let them rot in the field.	All	39.1	8.9	52.6	
	NS	38.7	10.2	51.1	2.37
	S	50.0	9.1	40.9	
39. Hikers should be prohibited from using parts of National Parks which are known to be inhabited by grizzly bears.	All	26.7	17.1	56.2	
	NS	29.9	17.5	52.6	3.15
	S	19.7	15.2	65.2	
16. Personal information useful for combating tax evasion should be collected and stored in computers.	All	39.8	37.5	22.7	
	NS	37.2	40.9	21.9	1.89
	S	39.4	31.8	28.8	
38.* Computers represent a reliable means of unbiased decision making.	All	52.0	21.7	26.3	
	NS	50.4	24.8	24.8	1.67
	S	50.0	18.2	31.8	
83. The development of a noise filter to be worn for ear protection is a satisfactory way to combat noise pollution.	All	24.0	21.1	54.9	
	NS	26.3	24.8	48.9	11.29[b]
	S	18.2	9.1	72.7	
89. Scientists should not meddle in matters which are inappropriate for scientific methods.	All	28.6	29.6	41.8	
	NS	32.1	29.9	38.0	1.59
	S	25.8	27.2	47.0	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

*Items omitted in final factor scale.

All (All Seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science Oriented Seniors N = 66)

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purposes of the present study were threefold:

First, to use factor analysis to determine the organization of attitudes toward specific issues through examination of specific attitude items under each factor,

Second, to develop valid and reliable factor attitude scales from the factored items, to measure the identified factors, and

Third, to determine the attitudes, as measured by the developed factor scales, of a representative sample of Oregon high school seniors, specifically comparing the sample in regard to amount of science, school environment, and sex.

In the present study the scales were inductively developed based on senior response patterns to individual items. This procedure was to insure unidimensional attitude scales and also to obtain content validity.

In order to gain an understanding of more basic attitudes which underlie specific science-related social issues, a large number of specific Likert-type items was developed. The items were researcher written, lifted or modified from professional and popular literature and spoken material, and solicited from students and friends.

Suggestions offered by Edwards (1957) were followed in developing the pool of attitude items.

The items were submitted to undergraduate non-major physical and biological science classes to evaluate the items. Items which were ambiguous or unclear, which used an unfamiliar vocabulary, or which were concensus items, were eliminated or rewritten. The initial pool of about 250 items was reduced to approximately 140-150 items which were given to local high school students for additional evaluation. From this administration, 100 items were selected for the preliminary inventory which was used for the collection of data that was analyzed in this study.

The 100 item preliminary inventory was administered in the spring of 1970 to a representative sample of Oregon high school seniors consisting of slightly more than 300 seniors from 22 high schools. The schools were selected by systematic random sampling and the seniors in these schools were randomly drawn. The sample represented approximately 1% of the seniors in the state of Oregon in 1970.

The seniors' responses to the items were key punched on IBM cards and submitted to a factor analysis utilizing the University of Oregon program FACTØL. A principal components solution with varimax rotation was performed with the extraction of 12 factors accounting for about 40% of the variance in the 100 preliminary

inventory items. The basic attitudes of specific science-related social issues were determined by an examination of the items which clustered under each factor.

The factor attitude scales, the Inventory of Societal Issues (ISI), were obtained by utilizing some or all items loading 0.300 or more under each interpretable factor. Some items were also rekeyed in order to give a consistent measure of the basic attitude represented by the factor scales.

Reliabilities were determined by the Pearson Product-Moment Correlation Coefficient of an odd-even split half of each factor scale. The total scale reliability was estimated by the Spearman-Brown Prophesy Formula. Scale reliabilities were also calculated using the Kuder-Richardson Formula 20.

Item analysis was also performed using a chi-square to see if items discriminated between the upper and lower 27% of responders to the factor scales.

Determination of the attitudes of the Oregon seniors was obtained from the data of the original representative sample of seniors. They were classified in one of three levels for amount of science, one of three designations for school environment, and as to sex. The number in each classification was shown in Table 1, Chapter III.

An analysis of variance using the student classifications of amount of science, school environment, and sex as the independent

variable and the seniors' factor scale scores as the dependent variable was performed. This was to determine what effect the amount of science, school environment, sex, or any interaction of these might have on the identified attitudes. This analysis was performed on each of the seven interpretable factors and on two versions of the total inventory, one including all seven factors and the other omitting the factor with the lowest scale reliability. In addition, the science and non-science subgroups were compared by chi-square on each of the items in the inventory.

Conclusions

Basic Factor Identified Attitudes

Factor analysis of the preliminary inventory yielded 12 factors accounting for about 40% of the variance of the items. Eighty-eight of the items had a factor loading greater than 0.300 and of these 72 loaded on one factor only.

Seven of the 12 factors were interpretable, and identified subjectively by the researchers based on the content and implications of the items under each respective factor. The seven identified factors were as follow.

Factor I. A regard for human life and those things which may be detrimental to it. The factor content was based on abortion,

euthanasia, and drug usage.

Factor II. Disillusionment and pessimism regarding the involvement of man in nature, especially through his industrial, scientific, and technological progress.

Factor III. Concern for the conservation and preservation of our wildlife, wilderness areas, and natural resources.

Factor IV. Concern for the problem of increased population and the resultant problems associated with over population, including degradation of the environment and pollution. Attitudes toward methods of halting population growth were also expressed.

Factor VII. The necessity of the individual to assume individual responsibility for making personal sacrifices in order to help alleviate social problems.

Factor IX. Optimism and faith in the utility of science and technology to solve the many problems facing mankind. Also expressed was the belief that this is indeed the proper role that scientists, science, and technology should occupy.

Factor XI. Belief in having and granting individual rights and freedoms.

The number of items under each factor is included in Tables 2 and 15, Chapter IV. The item factor loading and a more complete discussion of each factor is also contained in Chapter IV.

Factor Attitude Scales

The factor attitude scales used to measure response groups' attitudes toward the identified factors were prepared by selecting some, or in cases, all of the items loading under that factor. The number of items and those items used in the final attitude scales are shown in Table 15. The shortest scale consisted of five items, and the longest one consisted of 12 items. The total Inventory of Societal Issues (ISI), consisting of all seven factors, contained 60 individual Likert-type items. In most cases, those items which were eliminated either loaded under two or more factors or seemed very similar to another item under the factor and had a lower factor loading. Some items were also eliminated which did not seem to fit the factor as interpreted by the researchers. It was assumed that these were included in the factor due to chance.

The very nature of developing the scale by factor analysis assured that the items would be discriminating, although the level of significance was not known. In order to determine the discriminating power, a chi-square was performed on the responses of the top 27% (82 seniors) and the bottom 27% (82 seniors) based on total scores for each factor. The calculated chi-square value was significant at well beyond the .001 level.

The reliabilities were estimated by the Spearman-Brown Prophesy Formula applied to the Pearson Product-Moment

Correlation Coefficient for odd-even split halves. The reliabilities of the factor scales ranged from 0.48 to 0.85. In addition, factor scale reliabilities were calculated using the Kuder-Richardson Formula 20, which is, essentially, the mean of all possible split-half reliabilities. These reliabilities were generally lower. Both the split-half method and the Kuder-Richardson Formula 20 are measures of internal consistency of the items and may be somewhat inflated, due, again, to the factor analytic procedure used in obtaining the factor scales.

Attitudes of Oregon High School Seniors

An analysis of variance performed on each factor attitude scale and the total inventory (ISI) yielded significant differences on three individual factor scales, but no trends or consistencies were noted for all the scales. No significant differences based on amount of science, school environment, or sex were shown for the total inventory, or individually for factors I, II, III, or IV. None of the interactions of the independent variables were significant for the total inventory or these factors either.

Factor Scale I. Oregon seniors were somewhat ambivalent in their attitude as measured by Factor Scale I, dealing with a general regard for life and its quality. They were opposed to relaxing drug usage laws by almost a two to one margin. They also indicated that

they themselves would not experiment with drugs, even if its use were legalized. This attitude was expressed by science oriented seniors even more so than non-science oriented seniors. The seniors were about equally split in regard to euthanasia, with the slight majority being in favor of the practice in some cases. They did not feel that a fetus in early stages should be recognized as an individual or that abortion constitutes the taking of a life, but the non-science oriented seniors were not nearly as in agreement with this last position as the science oriented seniors. A high majority of the seniors felt that the mother should have the right to decide on an abortion, but interestingly, the seniors themselves indicated that they would not have, or recommend that their future wives have, an abortion.

Factor Scale II. The seniors responded consistently, with the exception of one item, to Factor Scale II. They expressed an attitude of disillusionment and pessimism regarding the present and future state of nature resulting from man's technological intrusion. This pessimism and disillusionment was also expressed with regard to many of the products of science and technology.

Factor Scale III. The seniors, as might be expected, generally favored preserving or conserving our natural environment, including its wildlife and resources. The science oriented seniors, even more so, favored the selected preservation of wilderness areas from man's involvement, but were more conservative in their attitude

that total conservation of an area was unrealistic.

Factor Scale IV. Ambivalent attitudes were also expressed by the seniors as measured by Factor Scale IV, dealing with population, its control, and the problems associated with over population. Their responses indicated concern for this problem, and expressed favorable attitudes toward some of the methods proposed to help control population; however, they were not in favor of more drastic methods proposed, including compulsory sterilization and mass involuntary contraceptive programs.

Factor Scale VII. The mean scores of the seniors with differing amounts of science on Factor Scale VII were found to be significantly different at the 0.05 level. A positive relationship between amount of science and favorable attitude, or high score, on the factor scale was indicated. All of the seniors were generally in agreement that man must assume a responsible role for the effects of his actions and conveniences, and should make personal sacrifices for the good of society.

No other main or interaction effects were significant for this factor.

Factor Scale IX. The attitudes of seniors as measured by Factor Scale IX were found to be significantly different at the 0.01 level dependent on whether the student was from an urban, suburban, or rural school environment. Rural seniors expressed the highest

level of optimism and faith in the utility of science and technology and its application to solve most of our societal problems and crises; the suburban seniors were next, and finally the urban seniors were lowest on the attitude scale. Although attitudes differed according to school environment, the seniors generally agreed with the factor. They did feel that some problems were too complex for scientific and technological solutions, and moreover, that some areas such as weather control should be left to nature, not science and technology.

The amount of science did not differentiate between the seniors on this factor, but examination of some individual items in the scale indicated that science oriented seniors hold more favorable attitudes toward the positive contributions of science and technology than do non-science oriented seniors.

No other main or interaction effects were significant for this factor.

Factor Scale XI. Attitudes as measured by Factor XI Scale were found to be significantly different at the 0.01 level for boys and girls, with the boys being more in agreement with having and granting individual rights and freedoms. The other variable and interaction effects were not significant. The response pattern of the seniors was inconsistent, indicated by responses which were favorable to the factor on some items and unfavorable to the factor on other items.

The almost completely non-significant results of the analysis of

seniors' attitudes as measured by each factor scale and the total inventory indicated that, although significant differences in attitudes did exist, these differences could not be attributed to differences in amount of science taken in high school, school environment, or sex.

Few would disagree that science and technology directly or indirectly has caused and is causing the greatest change in the mode of living of the individuals in scientifically and technologically developed countries. Yet, seniors who had taken a maximum of science in high school did not have attitudes toward science-related social issues that were any different from those seniors who had taken a minimum of science in high school. This might suggest that attitudes toward the effects of science and technology on society are formed by students outside of the science classroom as well as those in the science classroom.

Recommendations

Recommendations for future research based on the results of the current research include the following:

Recommendations with Regard to the Instrument

1. Replication of the factor analysis on the responses to the preliminary inventory for another sample to help determine the uniqueness of the factor structure obtained in the current

research. Also of interest would be the factor analysis of responses of samples with different characteristics from the one used in the current research, such as age and schooling.

2. Administration of the Inventory of Societal Issues (ISI) to other population samples to assess their attitudes and also to provide additional information on the discriminability of the items and the reliability of the factor scales of the total inventory.

3. Enlargement and refinement of each factor scale utilizing the more traditional attitude scale construction techniques of item analysis and correlational methods. The application of cluster analysis could be employed.

4. Identification of external criterion groups, and administration of the factor scales to help establish validity of the scales.

Recommendations with Regard to Utilization of the Inventory

1. Development of a cognitive instrument based on knowledge and understanding of many societal issues and problems to be used in conjunction with the factor scales. The cognitive and affective instruments could then be used to investigate the relationship between understanding and knowledge of societal problems and issues, and attitudes toward these problems and issues.

2. Utilization of the inventory as a criterion measure for

experimental treatments to alter or change attitudes of students toward societal issues and problems.

3. Utilization of the inventory to carry out correlational studies, utilizing inventory and personality inventories to assess relationships between attitudes toward societal issues and various personality characteristics.

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APPENDICES

APPENDIX A

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 it 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 problem of pollution and crowding, we need to decrease the use of the automobile as a major means of transportation.
SA	A	N	D	SD	Emotional and exaggerated views of water pollution are common. In such a mental environment it is often difficult to establish realistic needs and priorities.
SA	A	N	D	SD	A license should be required for the conception and eventual birth of any child.
SA	A	N	D	SD	The standards for pollution, land use, etc., should not be so rigid as to discourage industrial growth and development.
SA	A	N	D	SD	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.
SA	A	N	D	SD	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.
SA	A	N	D	SD	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	Personally, I would probably never have (or recommend that my wife have) an abortion.
SA	A	N	D	SD	Personal information useful for combatting tax evasion should be collected and stored in computers.
SA	A	N	D	SD	It is inevitable that world wide famine will occur in the next decade.
SA	A	N	D	SD	To reduce petroleum consumption, only small, efficient automobiles should be manufactured.
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, off-shore 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 population wise. 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 B

Schools and Number of Seniors Participating in Data Collection

Schools	Participating Seniors
Dayville	1
Griswold	1
Crane	2
Riverside	3
Weston	1
Condon	4
Glendale	3
Knappa	6
Dayton	5
Rogue River	7
Clatskanie	7
Toledo	11
Seaside	11
Madras	14
Central	14
Baker	17
*Forest Grove	20
*Rex Putnam	25
*Bend	33
**Jackson	31
*Lake Oswego	44
**Franklin	44

classified as rural.
*classified as suburban.
**classified as urban.

APPENDIX C

Remaining Items and Their Respective Factor Loadings Greater than 0. 200.

	Factor											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
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 any child.		276		227			252					
11. The standards for pollution, land use, etc., should not be so rigid as to discourage industrial growth and development.		-263	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 by used in other endeavors.									-298			

APPENDIX D

Seniors' Responses (in percent) to the Remaining Items not used in the Inventory of Societal Issues and a Chi-Square of the Responses of Non-Science and Science Oriented Seniors

		Agree	Neutral	Disagree	X^2
Factor V					
43. All regions of the United States should have equal rights to the resources of the country.	All	59.2	28.7	22.1	
	NS	63.5	18.2	18.2	3.86
	S	50.0	21.2	28.8	
66. The world's supply of resources belongs to all people, not strictly to the countries in which they are found.	All	45.1	20.0	34.9	
	NS	47.4	18.2	34.3	1.49
	S	39.4	24.2	36.4	
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.	All	46.1	22.7	31.3	
	NS	47.4	16.8	35.8	7.02[a]
	S	51.5	28.8	19.7	
69. Advanced nations should discourage emigration of scientists and technologists from developing nations.	All	27.6	31.9	40.5	
	NS	23.4	34.3	42.3	3.07
	S	34.8	27.2	37.9	
61. The only way to meet future power supply needs is with nuclear sources regardless of their possible hazards.	All	20.7	27.5	61.9	
	NS	19.0	17.5	63.5	2.10
	S	25.8	21.2	53.0	
Factor VI					
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.	All	41.1	22.7	36.2	
	NS	44.5	27.0	28.5	7.14[a]
	S	36.4	16.7	47.0	
19. Sonic boom is only a temporary annoyance to which people can soon adjust.	All	34.5	15.7	49.7	
	NS	38.0	22.6	39.4	9.82[b]
	S	27.2	10.6	62.1	
Factor VIII					
31. It should be illegal to possess products made from the skin or fur of wild animals.	All	24.0	17.5	58.5	
	NS	21.9	15.3	62.8	3.19
	S	19.7	25.8	54.5	
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.	All	53.3	12.5	34.2	
	NS	49.6	12.4	38.0	2.43
	S	60.6	7.6	31.8	
98. Considering population projections for the next fifty years, it is not realistic to expect all of our water to be pollution free.	All	67.7	10.2	22.1	
	NS	67.9	10.9	21.2	0.58
	S	71.2	12.1	26.7	
92. The advertising along the highway is an invasion of privacy.	All	26.3	19.3	54.3	
	NS	24.8	16.8	58.4	2.41
	S	30.3	22.7	47.0	

Appendix D.(Continued)

		Agree	Neutral	Disagree	X^2
Factor X					
4. 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.	All	42.4	14.1	43.4	
	NS	37.2	14.6	48.2	0.61
	S	42.4	15.2	42.4	
82. Automation will degrade the industrial machine operator even more as he assumed the role of button pusher.	All	48.4	27.0	26.7	
	NS	54.7	26.3	19.0	4.1
	S	45.5	22.7	31.8	
9. Emotional and exaggerated views of water pollution are common. In such a mental environment it is often difficult to establish realistic needs and priorities.	All	45.1	19.3	39.8	
	NS	35.0	26.3	38.7	12.39[b]
	S	51.5	6.1	42.4	
Factor XII					
97. Individual tax payers should help industry pay the cost of elimination of industrial pollution.	All	30.9	14.1	54.9	
	NS	24.8	17.5	57.7	1.62
	S	33.3	15.2	51.5	
29. Typically a community will allow pollution from its industries if increased revenues are likely to result.	All	63.1	18.1	18.7	
	NS	62.8	22.6	14.6	10.45[b]
	S	77.2	4.5	18.2	
55. People who believe that pollution producing industries should be immediately stopped are short sighted concerning the consequences of that action.	All	60.3	7.2	32.6	
	NS	63.5	10.2	26.3	5.37
	S	54.5	4.5	40.9	
56. We are mistaken to think that we can control man's breeding habits by appealing to his conscience.	All	45.4	17.5	37.2	
	NS	51.8	19.0	29.2	8.62[a]
	S	31.8	19.7	48.5	
Remaining Items					
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.	All	33.6	20.7	45.7	
	NS	24.1	21.9	54.0	8.72[a]
	S	43.9	19.7	36.4	
7. There is no reason why one 50 horsepower motorcycle should be allowed to make as much noise as four 300 horsepower Cadillacs.	All	46.7	32.7	29.6	
	NS	45.3	24.1	30,7	0.26
	S	48.5	21.2	30.3	
10. A license should be required for the conception and eventual birth of any child.	All	12.5	8.6	79.9	
	NS	13.9	8.0	78.1	0.46
	S	10.6	7.6	81.8	
11. The standards for pollution, land use, etc., should not be so rigid as to discourage industrial growth and development.	All	34.9	16.0	49.0	
	NS	31.4	18.2	50.4	0.90
	S	36.4	13.6	50.0	

Appendix D. (Continued)

		Agree	Neutral	Disagree	X^2
20. Technology can rid us of pollution.	All	46.1	21.1	32.9	
	NS	40.9	27.7	31.4	9.88[b]
	S	57.6	9.1	33.3	
27. Military preparedness is one of the best ways to prevent war.	All	37.8	23.0	39.1	
	NS	33.6	25.5	40.9	0.40
	S	37.9	22.7	39.4	
28. Vivisection (surgical procedures on live animals) should not be allowed.	All	15.7	29.8	55.3	
	NS	19.7	33.6	46.7	7.28[a]
	S	10.6	22.7	66.7	
33. We should not have to tolerate even a little bit of filth.	All	39.5	14.8	45.7	
	NS	38.7	13.9	47.4	1.77
	S	34.8	21.2	43.9	
40. The cost of introducing new technological advances should be borne by the people who immediately benefit from their uses.	All	32.9	29.0	38.2	
	NS	32.8	28.5	38.7	4.15
	S	47.0	25.8	27.2	
70. Industry is not truly concerned with pollution cleanup.	All	56.9	7.9	35.2	
	NS	50.4	10.9	38.7	6.24[a]
	S	68.2	4.5	27.2	
88. The facilities, personnel and money necessary to extend life by artificial stimulation or with organ transplants could better be used in other endeavors.	All	33.2	24.7	42.4	
	NS	38.0	24.1	38.0	3.05
	S	27.2	22.7	50.0	

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

All (All seniors N = 304)
NS (Non-Science Oriented Seniors N = 137)
S (Science-Oriented Seniors N = 66)