AN APPLICATION OF FISHBEIN'S ATTITUDE THEORY TO THE PREDICTION OF FREE-CHOICE STUDENT BEHAVIORS IN A FIRST YEAR UNIVERSITY PHYSICS COURSE

by

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ABSTRACT

The purpose of the study was to forecast the actual performance of five extracurricular educational activities by 128 first year university Physics students using Fishbein's model for the prediction of behavior and behavioral intention. The effectiveness of achievement measures and measures of attitude toward various instructional objects in the prediction of behavior and behavioral intention was also investigated. Consideration of Fishbein's model led to the investigation of several specific problems: (a) the relationship between variables internal to and those external to the model; (b) the relationship between behavior, behavioral intention, and the attitudinal and normative variables of the model; (c) the accuracy with which behavioral intention and behavior could be predicted, and the relative importance of the predictors in the prediction equation; (d) the use of behavioral intention measures as predictors of behavior in specific educational situations; and (e) the detection of possible measurement effects.

A Likert attitude scale was used to obtain measures of attitude toward fourteen different aspects of Physics and Physics instruction. Estimates of Grade 12 Mathematics and Grade 12 Physics achievement were obtained from self-

reports. Fishbein's model was applied to measures of : students' attitudes toward performing each activity (A_{act}), their social normative beliefs (NB_s), personal normative beliefs (NB_p), motivation to comply with certain referents (Mc), and behavioral intention (BI). Behavioral intentions were also predicted for three of the voluntary activities, using measures of A_{act}, NB_s and NB_p as predictor variables. The measures of normative beliefs were taken with respect to the referents: self, closest friends, parents, majority of the class, lecturer, and religious group. The model for predicting behavioral intention was given by Fishbein in the form of a multiple regression equation, where the criterion variable is BI and the predictor variables are A_{act} and the summation (over all referents) of NB_s multiplied by Mc .

Most of the obtained results tended to agree with expectations based on Fishbein's theory. Variables external to the model were, for the most part, poorly correlated with behavioral intention and with overt behavior (B) unless they were significantly correlated with at least one of the predictors given in the model. Statistically significant correlations were consistently found between measures of BI and NB_p, A_{act}, and the normative belief with respect to students' 'best friends'. The magnitudes of correlations between measures of BI and the other social normative beliefs varied considerably across activities, several correlations

reaching statistical significance. Correlations between B and measures of BI were generally low, although three out of five were significantly greater than zero. Correlations between behavior and the predictor variables were also small, and were frequently not statistically significant. High multiple correlations obtained in the prediction of BI indicated predictive validity of the predictor variables. In all predictions of BI, NB_p had, by far, the greatest weight as a predictor. Beta weights of A_{act}, and NB_s varied greatly across activities. Low multiple correlations were obtained in the prediction of behavior from the predictor variables, substantiating the low product moment correlations obtained between BI and B. The observation that significant positive correlations between behavior and the predictor variables were reduced to nonsignificance when behavioral intention was held constant, tended to substantiate the theoretical expectation that BI is an intervening variable between behavior and the predictor variables. An unexpected result was the detection of significant measurement effects in the prediction of voluntary performance of three activities. These effects were substantiated by means of χ^2 tests of the independence of behavioral responses obtained under different measurement conditions: administration of the research instrument, a placebo instrument, and no instrument.

It was concluded that with the application of Fishbein's theory, the prediction of behavioral intention with

respect to performing free-choice activities in an educational setting could be made with considerably better than chance accuracy. The prediction of actual performance of the activities from measures of behavioral intention, however, posed serious difficulties.

It was recommended that the possibility of measurement effects influencing the prediction of behavior be given careful consideration in future educational applications of the model.

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CHAPTER I

INTRODUCTION

While many educators are engaged in assessing the attitudes of students towards various aspects of instruction, psychologists are engaged in a major controversy about the assumed relationship between the attitude of a person toward an attitude object and his behavioral response with respect to the object. Recent theory concerning predicting overt behavior from measures of attitude and normative beliefs in well defined situations appears promising but has never been fully applied in an educational context.

1. Background to the Study

Among the reasons given for current revisions of science courses is the concern for course improvement, student disinterest and declining enrollment. These concerns are reflected in a number of studies (1,2,3,4). The studies relate the decline of student enrollment to possible student disenchantment with science and technology (generally) and also to student dissatisfaction with physical science courses.

A decreasing enrollment trend in physics is clearly evident at the University of British Columbia. The U.B.C. Physics Department Task Force Report (5) states in its

introduction, that:

> The reduction in student demand for education in pure Physics at U.B.C., is not a new phenomenon. It is a trend that has been going on for at least eight years.

In order to meet the problems of declining enrollment and possible student dissatisfaction with physics courses, the Physics Department Task Force made the following recommendation (5):

> . . . as an experiment in the 1971/72 year, the second term of one section of Physics 115 be organized as sets of lectures on topical subjects given by several faculty members; and that, if this experiment is successful, other sections of Physics 105, 110, and 115 adopt this modular approach.

Some of the lecturers participating in this experiment offered a choice of optional or extracurricular learning activities. One such lecture module dealt with physics applied to problems of general social concern and was a two week (four lectures) module entitled 'The Physics in Environmental and Technological Assessment.' Among the intended outcomes of this module, as expressed by the lecturer, was the goal of student involvement in activities dealing with environmental pollution and the conservation of natural resources. The extracurricular activities included participation in a number of voluntary activities, ranging from attending lunch-hour movies and picking up optional reading

material, to taking part in actual pollution data-collecting experiments.

In this context, an individual's attitude toward participating in socially relevant extracurricular activities, and his perceived personal and social normative beliefs concerning the performance of these acts, are postulated to be good predictors of expressed plans to participate(behavioral intention) and actual participation in the activities (overt behavior). Fishbein's theory (6), which relates overt behavior and behavioral intentions, to attitudinal and normative variables, seems particularly appropriate for an empirical test of this hypothesis.

2. Statement of the General Problem

The major problem of this study is to investigate the general hypothesis that if a Physics 115 student's attitudinal and normative position with respect to performing a free-choice learning task can be determined, then his expressed intention of performing the task, and his actual performance of the task, may be predicted with better than chance accuracy. This general hypothesis may be stated in the form of a regression equation proposed by Fishbein (6). The equation constitutes a theoretical model for the prediction of behavioral intention and corresponding overt behavior :

$$B \simeq BI = [A_{act}]\omega_o + [\sum_{i=1}^{n} NB_i\ (Mc_i)]\omega_1 \qquad (1.0)$$

where:

B	is the individual's overt behavior, i.e., his actual performance of some specified task
BI	is his behavioral intention or his intention to perform the task in a given situation
A_{act}	is the individual's attitude toward the act of performing the specified task, in the given situation
NB_i	is a specific normative belief, i.e., the individual's belief concerning what he should do in this situation, depending on his perception of what he is expected to do by a specific person or group (referent group "i")
Mc_i	is the individual's motivation to comply with what he believes is expected of him by referent group "i"
n	is the number of referent persons or groups
ω_o and ω_1	are standardized regression coefficients.

3. Need for the Study

Fishbein's theory represents an important recent development in attitude research. The theory, however, has only been applied under rather carefully controlled conditions often utilizing contrived situations. There is therefore the need for extending the range of applicability of the theory and to determine how well the theory works in less restricted conditions.

The particular concern of this study is the application of the model to an educational problem. One known study,

Devries and Ajzen (10), applied the model in part to an educational situation. For educational purposes the study was somewhat incomplete in that no direct observation of behavior was undertaken nor was the instructor used as a referent in assessing the normative beliefs of the students. The present study is therefore a more extensive application of Fishbein's theory in an educational context.

Apart from its use in extending the model's range of application, the present study may provide educators with a useful means of assessing students' behavioral tendencies. A common approach to the problem of assessing students' behavioral tendencies has been the practice of assessing students' attitudes toward objects such as instructional methods, subjects, course changes, and concepts. This procedure has been generally disappointing in terms of predicting actual behavior with respect to these objects (See Chapter II, section 1).

Fishbein's model might provide a useful alternative to the above approach. The criterion variable of the model is behavioral intention. From the point of view of evaluating learning activities, the theory has shown measures of behavioral intention to predict certain behaviors with better than chance accuracy. Information of this nature might enable an instructor to select learning activities having a maximum potential for class participation. With regard to devising new teaching strategies, the model is potentially capable of

indicating the relative importance of the variables most influential in predicting behavioral intention (and thus indirectly, most influential in predicting behavior), namely, an individual's attitude toward an act and his normative beliefs with respect to the performance of the act. If the most influential of these predictors can be determined, the instructor might be able to influence overt participatory learning behaviors through the results of successful efforts to modify students' attitudes toward participating in specific learning activities and students' normative beliefs concerning those activities.

4. Definition of Terms Used

4.1 Behavior or Act

Behavior or act is to be interpreted in the context of equation (1.0) as an individual's specific, overt, volitional, and observed behavior in a specified situation arranged by the experimenter. If the behavioral activity is to attend a particular educational movie under specified conditions, then the measure of a student's behavior in this case would be whether or not the student has been observed attending that particular movie under the specified conditions. The methods used for observing student behavior are described in Chapter III.

4.2 Behavioral Intention (BI)

This term refers to a statement of an individual's intention to perform a specific act in a given situation. Operationally, behavioral intention is measured by means of the individual's response to questionnaire items dealing with the intent to perform a certain act under specified conditions. An assumption implicit in this measure is that the behavioral intention indicated will remain unchanged over time, at least until the act has been performed.

4.3 Attitude Toward the Act (A_{act})

This study will follow Fishbein (6) in adopting Thurstone's one-dimensional conceptualization of attitude as "the amount of affect[1] for or against a psychological object" (p. 478). In equation (1.0) the psychological object referred to is the performance of a specific act. Operationally, the amount of affect for or against a psychological object is assessed by means of a person's response to questionnaire items indicating favorableness or unfavorableness toward performing a specific act in a given situation.

4.4 Normative Belief (NB)

Fishbein (6) considers a belief to be a hypothesis concerning the probability that an (attitude) object has a specific relationship with some other object, value, concept,

[1] 'Affect' is used by Fishbein (6) to refer to the evaluative component of beliefs concerning the attitude object.

or goal. In keeping with this, a normative belief is defined as the strength of an individual's opinion, concerning what a certain normative referent person or group expects him to do. This referent can be personal (himself) or social (others). The strength of a particular normative belief is measured by means of the individual's response to a questionnaire item in which he indicates the extent to which he agrees with the stated expectations of a particular referent person or group.

4.5 Motivation to Comply (Mc)

This term may be defined as the degree of an individual's desire to comply with what he believes others expect of him. Operationally, a person's motivation to comply with the expectation of others is measured by his response to a questionnaire item in which he indicates the extent to which he agrees with a statement of compliance with the expectations of a particular person or group.

5. Specific Problems Investigated

The following specific problems were investigated:

5.1 The Relationship between Variables Internal to and those External to the Fishbein Model

To what extent are variables external to, or not specified by the Fishbein model, related to each of the

variables in the model, for each extracurricular activity? The external variables examined were attitudes toward: Physics in general, Physics 115, class instruction, the lecturer, the textbook, the subject matter of the course, assignments, examinations, the laboratory, and various proposed topics for the course (nuclear energy, the environment, classical (Newtonian) Physics, the human body, and electromagnetic theory and propulsion), and two non-attitudinal variables, Grade 12 Mathematics and Grade 12 Physics marks.

According to Ajzen and Fishbein (7), any variables external to the model will be unrelated to behavioral intentions and to overt behavior unless they are significantly related to at least one of the predictors given by the model.

5.2 The Relationship between Variables Internal to the Model

To what extent are behavioral intention, BI, and behavior, B, related to A_{act}, NB_i, Mc_i, $NB_i(Mc_i)$, and $\sum_{i=1}^{n} NB_i(Mc_i)$ for each of the extracurricular activities?

According to the theory, both B and BI are a function of A_{act} and of the relevant $NB_i(Mc_i)$ product, although doubt has recently been cast on the predictive value of Mc_i by Devries and Ajzen (8) and by Ajzen and Fishbein (9,10).

Further, according to Ajzen and Fishbein (10), A_{act} should be related to $\sum_{i=1}^{n} NB_i(Mc_i)$ because both terms contain a common factor (see Chapter II, section 1.3 for a detailed explanation).

5.3 The Prediction of Behavioral Intention, BI

(a) How accurately can the behavioral intention, BI, with respect to each extra-curricular activity be predicted from A_{act} and the sum of the relevant normative products, $\sum_{i=1}^{n} NB_i(Mc_i)$?

(b) Which of the two variables, attitudinal or normative, is the best predictor of BI in each different behavioral situation?

Investigations of Fishbein's model (7,8,9,10) indicate that the regression weights of the predictors in the model are statistically significant and also that BI can be predicted from A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$ with an accuracy considerably better than chance. The theory also implies that the regression weights may vary, depending on the type of act, the situation under which the act is carried out, and on individual differences between the subjects with respect to their prior learning history.

5.4 The Role of Behavioral Intention in Predicting Behavior

To what extent are A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$ related to the performance of the act, B, i.e., actually carrying out each extracurricular activity?

In a recent reformulation of the theory, Ajzen and Fishbein (10) indicated that the effects of A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$ on behavior are assumed to be mediated by BI,

that is, that BI is an intervening variable between B and

$$\omega_o[A_{act}] + [\sum_{i=1}^{n} NB_i(Mc_i)]\omega_1 :$$

> The prediction of behavioral intentions is therefore, according to the theory, a necessary as well as sufficient condition for the prediction of overt behavior. (p. 469)

If this is the case, partialling out the effect of BI should result in a reduction in the correlations of B with A_{act} and B with $NB_i(Mc_i)$.

5.5 Measurement Effect

To what extent do measurements on the components of Fishbein's model influence students' behavioral responses toward the extracurricular activities?

If measurement influences B, then, according to the model, this effect must be related to one of the variables of the model. In the educational context of this study, it was hoped that participation in extracurricular activities would come about as a result of classroom instruction and not as a result of beliefs aroused by the measurement instrument or its use.

6. Limitations of the Study

There are a number of limitations which are important with respect to the generality and the interpretation of the study.

Firstly, the expectation of a relationship between the predictors leads to the expectation of an attenuating effect on the multiple correlation values obtained through multiple regression analysis. Although complex mathematical procedures are available for the minimization of this effect, the present application of Fishbein's theory will adhere to the standardized multiple regression technique used in all previous investigations of the theory. This will enable direct comparisons to be easily made with studies related to the theory.

Related to the use of multiple regression analysis is the specificity of the situation and the population to which the results may be generalized. It has already been mentioned that the model is particularly sensitive to situational conditions and individual differences. The results obtained from the analysis must, therefore, describe only the particular sample of Physics 115 students from Section 1 who were permitted to participate in the experimental extra-curricular activities. Since the students of both Physics 115 Sections used little else than timetabling considerations in selecting one Section or the other for attendance, Section

1 is expected to be roughly comparable to Section 2 for the purpose of this study. Therefore, the results could likely be generalized to the entire Physics 115 population. Although the results of the study apply only to the population sampled, the theory is quite general in its application to various situations. It is the general applicability of the theory that the present study attempted to indicate.

Finally, a limitation that should be raised is the problem of obtaining valid and reliable measures on the variables of Fishbein's model. The predictive validity of the measures could be estimated by the magnitude of the multiple correlations of the predictors on BI. Predictive validity could also be checked by the degree to which measures on the variables agreed with the relationship expected on the basis of the theory. The additional question of construct validity is discussed in Chapter II. Reliability of the instrument used in the present study, must be judged indirectly from the predictive validity of the obtained results. Test-retest measures of reliability would be difficult to obtain under the conditions of this study, because the research instrument and measures of behavior were components in an actual, non-replicative behavioral situation; i.e., a student would not be inclined to complete the research instrument twice, attend the same movie twice, or repeat any of the behavioral activities. This problem points to a need for some method for estimating the reliability of

instruments of this kind. While it is possible to obtain a reliability measure for the A_{act} attitude scale, the high reliability of Likert type measures on this variable is well established, whereas the reliability and stability of measures of behavioral intentions and normative beliefs are not generally known. Furthermore, the limited reliability of a single act, single dichotomous observation of behavior will probably tend to reduce the correlations of observed behavior with measures of behavioral intention.

Further details concerning the validity and reliability of the instruments used are given in Chapter III.

CHAPTER II

CONTEXT OF THE STUDY

1. The Psychological Context

A major concern among social scientists has been the lack of empirical support for a strong relationship between measurements on change attitude change and subsequent behavior. Cohen (11), for example, reflects this concern as follows:

> Until experimental research demonstrates that attitude change has consequences for subsequent behavior, we cannot be certain that our procedures for inducing change do anything more than cause cognitive realignments; perhaps we cannot even be certain that the concept of attitude has critical significance for psychology.

The Dulany and Fishbein theories of attitude are seen by the present author as being significant attempts to systematically resolve the attitude-behavior prediction problem.

1.1 The Problem of Predicting Behavior from Attitudes

Psychologists have offered varied opinions about possible sources of difficulty in predicting behavior from measures of attitude. De Fleur and Westie (12) point to the problematic concept of attitude itself. Attitude has often been described as a latent intervening variable between a

stimulus and the behavioral response. They suggest dropping the idea that an individual's behavior is somehow shaped, guided or mediated by an unobservable variable. As a replacement for the latent variable notion of attitude, they would adopt a concept of attitude more closely tied to observable behavior.

In a review of fifteen studies designed to specifically assess the relationship between measures of attitude and behavior, Tittle and Hill (13) concluded that the degree of observed correspondence between attitude and behavior is a function of (a) the measurement techniques employed, (b) the degree to which the criterion behavior constitutes action within the individuals' common range of experience, and (c) the degree to which the behavioral situation occurred repetitively in the life experience of the individual. Concerning the effectiveness of common attitude measures used in predicting behavior, Tittle and Hill ranked the Likert scale as the best predictor of behavior; the Guttman scale ranked second, a self-rating scale, third, the Semantic Differential, fourth, and Thurstone scales, last of the five. The superiority of the Likert scale in this instance was attributed, at least in part, to its greater reliability, the amount of self-reference contained in the scale, and to an apparent intensity factor operating in the summated rating procedure used in its scoring. Likert scales frequently contain a larger number of self-referent items (items con-

taining the personal pronouns "I" or "me") than the other scales and are therefore expected to elicit more specific responses. The intensity factor comes into the Likert scoring procedure by a summation of the strengths of a subject's opinions about the attitude object. Irrespective of these findings, the authors conclude,

> It is clear that attitude measurement alone, as examined herein, is not totally adequate as a predictor of behavior.

Wicker's (14) review of thirty-three studies found attitude-behavior correlations ranging from .01 to .86, and summarized the results as follows:

> Taken as a whole, these studies suggest that it is considerably more likely that attitudes will be unrelated or only slightly related to overt behaviors than that attitudes will be closely related to actions. Product-moment correlation coefficients relating the two kinds of responses are rarely above .30, and often are near zero.

Wicker also pointed to the need for systematic research in order to operationalize and to test the significance of the many factors which have been offered as *post hoc* explanations for the attitude-behavior inconsistency. These explanations have included both personal (i.e., individual difference or 'intrapersonal') and situational (environmental or 'extrapersonal') factors. Drawing from many previous studies, Wicker lists the personal factors having some influence on the attitude-behavior relationship as: other

competing attitudes, competing motives, and verbal, intellectual, and social abilities. Situational factors are postulated to be: actual or considered presence of certain people, social norms and role requirements, available alternative behaviors, specificity of attitude objects, unforeseen extraneous events, and expected and/or actual consequences of various acts. In regard to the attitude-behavior problem Wicker (14) advises,

> Should consistency not be demonstrated, the alternatives would seem to acknowledge that one's research deals only with verbal behavior, or to abandon the attitude concept in favor of directly studying overt behavior.

Ehrlich (16) states the attitude-behavior problem in the form of a more general question:

> Under what conditions, how, and to what degree do aspects of social structure and aspects of personality determine interpersonal behavior?

1.2 Dulany's Approach to the Problem

In an early (1939) attempt to relate variables contributing to variation in overt behavior, Lewin (17) suggested the functional relationship:

$$B = f(P, E), \qquad \ldots . (2.0)$$

where

B is a particular behavior

P is the developmental state and character of a person

E is an individual's particular psychological environment

and f is an unspecified mathematical function.

The postulated relationship between a person's behavior and his psychological environment might be considered anticipatory to both Dulany's and Fishbein's models if one can consider 'social environment' to be at least a subset of 'psychological environment'.

Dulany (18), going somewhat further, generated the following equations:

$$BH = (RHd)\ (RHs) \quad \ldots .(2.1)$$

and $$B \simeq BI = [(RHd)\ (RSv)]w_2 + [(BH)\ (MC)]w_3, \quad \ldots .(2.2)$$

where

BH is the individual's 'behavioral hypothesis' or his expectation as to what he is supposed to do in the situation

RHd is a 'hypothesis of the distribution of reinforcement' or the subject's belief that the response will lead to certain consequences

RHs is a 'hypothesis of the significance of a reinforcer' or the subject's hypothesis that the occurrence of a particular reinforcement (or consequence) signifies that he has done what he was supposed to do (or expected to do)

B is the subject's overt verbal behavior

BI is the subject's specific 'behavioral intention' or intent to try to make a particular response or class of similar responses

RSv is the 'subjective value of a reinforcer' or the subject's evaluation of the reinforcement or consequences, i.e., favorable or unfavorable

MC is the subject's 'motivation to comply' with or his desire to carry out his expectation (BH) as to what he is supposed to do in the situation

w_2 and w_3 are standardized regression coefficients or beta weights determined empirically for a group of subjects and taking any value between -1.00 and 1.00.

The equation (2.2) will be of major importance in the subsequent discussions of the Fishbein equation, but the importance of equation (2.1) should also be noted. By the simple substitution of (RHd) (RHs) for (BH) in equation (2.2), the following equation is obtained:

$$B \approx BI = [(RHd)\ (RSv)]w_2 + [(RHd)\ (RHs)\ (MC)]w_3 \quad . \ . \ .(2.3)$$

The appearance of (RHd) in both predictor terms of the above equation leads to the expectation that both predictor terms are correlated.

Dulany's approach showed considerable promise in that personal and situational factors were accounted for in the predictor variables of the regression equation. Personal factors are implicit in (RSv) and (MC), while (RHd), (RHs), and (BH) appear to be predominantly situational. The significance of Dulany's theory to the attitude-behavior

problem is also apparent in its systematic, yet flexible framework of regression analysis which is open to the addition of new terms.

The results of Dulany's 1964 and 1965 validation studies of the prediction of verbal behavior may be examined in Tables I, III, and IV. The multiple correlation, 'R' between the criterion BI and the two predictor terms (RHd) (RSv) and (BH) (MC) was .88 and the product-moment correlation between BI and B was .94, indicating considerable support for the theory. Although 77.4 percent of the variance of BI was accounted for by the predictor terms, 22.6 percent remained unaccounted for. Dulany suggests that this amount of 'error' variance probably results from the use of standard multiple regression analysis in which the multiple correlation is probably attenuated by the use of beta weights that are estimates of 'average' weights for the group of subjects. The standard multiple regression technique is necessary because no other satisfactory method of obtaining estimates of the weights for individuals has been found.

1.3 Fishbein's Approach to the Problem

While Dulany's theory was developed in the context of verbal behavior, Fishbein's (6) extension of the theory is postulated to apply to overt verbal or non-verbal behavior in social situations. It is this generality that makes

Fishbein's theory potentially useful in many educational situations. In order to examine the similarity of constructs used in the two theories, it is first necessary to review Fishbein's approach to determining attitudes toward an object.

According to Fishbein (6), an individual's attitude toward any psychological object (A_o) can be expressed as follows:

$$A_o = \sum_{j=1}^{m} B_j a_j \qquad \ldots . (2.4)$$

where

A_o is the attitude toward some object 'o'

B_j is the strength of belief j about 'o', i.e., the probability that 'o' is related to some other object, x_j

a_j is the evaluative aspect of B_j, i.e., the subject's evaluation of the related object, x_j

m is the number of beliefs.

Reformulated in terms of attitudes toward performing a specific act, A_o becomes A_{act}, B_j refers to a belief about the probability that the behavior (act) will result in a certain consequence, x_j, and a_j is the subject's evaluation of that consequence. It is important to note the specificity of the behavior (act) and the behavioral situation in the Fishbein equation. A_{act} cannot be replaced by a

general attitude term such as an attitude toward any object or person.

If $\sum_{j=1}^{m} B_j a_j$ is now substituted for A_{act} in equation (1.0) and if the mathematical format of the resulting equation is put into a form similar to Dulany's equation, (2.2), the following result is obtained:

$$B \simeq BI = [(B_j)(a_j)]w_o + [(NB)(Mc)]w_1 \quad \ldots (2.5)$$

compared with equation (2.2):

$$B \simeq BI = [(RHd)(RSv)]w_2 + [(BH)(MC)]w_3 \quad \ldots (2.2)$$

a correspondence between the variables of Fishbein's equation, (2.5), and those in Dulany's equation, (2.2), becomes apparent. Fishbein has reconceptualized the first predictor term of Dulany's equation (RHd) (RSv), that is, the expectation of certain consequences and the evaluation of those consequences, as the attitude toward a specific act, (A_{act} or $\sum_{j=1}^{m} B_j a_j$). Dulany's 'behavioral hypothesis', (BH), has become Fishbein's 'normative beliefs', (NB), a term that appears to be conceptually similar to Dulany's term. Fishbein's 'motivation to comply', (Mc), has remained essentially identical to Dulany's conceptualization (6).

The major conceptual change that Fishbein has made is the replacement of Dulany's (RHd) (RSv) predictor term by

an attitudinal component (A_{act}) which can be measured by such widely used attitude measuring instruments as the Guttman scale, the Likert scale, Semantic Differential scales and Thurstone scales. This reconceptualization is important in that it reinstates attitude, in part, as a predictor of behavior and suggests that behavior prediction from attitudes in the past had failed because measures of attitudes toward general objects were used instead of measures of attitudes toward specific behavioral acts.

In its present form the Fishbein approach is seen to have the following advantages over traditional attitude-behavior correlation studies involving attitudes toward objects:

(a) personal factors such as competing attitudes, past experiences, beliefs and motivation are taken into account in the variables A_{act} and Mc;

(b) situational factors such as social normative beliefs (NBs), alternative behaviors (through evaluation of the consequences) and group dynamics (different referent groups) are also considered in the equation;

(c) the attitude-behavior relationship has become consistent with observations and situation-specific in that there is not necessarily a high correlation between A_{act} and behavior. The magnitude of this

relationship depends, in part, on the weight determined for the attitudinal term, and on the close matching of BI with the behavioral situation.

Fishbein's approach has been demonstrated to predict some behaviors reasonably well. Table I shows that the correlation of BI with B ranges between .211 and .970, the average (by Fisher's Z-transformation of r) of all reported values ($\bar{r}$) is about .71.

A more detailed examination of Fishbein's approach leads to a number of interesting results that are pertinent to the present study.

First, any variables external to the model are considered to be unrelated to behavioral intention, and thus to overt behavior, unless they are related to at least one of the predictors, A_{act} or NB(Mc), given by the model (7). Included in this 'external variable' category are attitudes toward objects (A_o). A student's attitude toward his teacher, for example, is postulated to be related to school behavior, if, and only if, it is significantly related to one of the model's predictors and if that predictor is weighted by a significant beta coefficient. In Fishbein's (19) words,

> . . . even though a traditional measure of attitude may be correlated with one of the two components, it will still be unrelated to behavior if that component carries little or no weight in the determination of behavioral intentions and thus behavior *per se*.

TABLE I

CORRELATIONS BETWEEN BEHAVIORAL INTENTION (BI) AND A_{act}, NB_p, NB_s, $NB_s(Mc_s)$, and B

Study	Situation	N	BI-A_{act}	BI-NB_p	BI-NB_s	BI-NB_s (Mc_s)	BI-B
Dulany, 1964 (18)	verbal	108	.40			.86	.94
Fishbein, 1966 (36)	males	21	.518*			.843	.394NS
	females	14	.918			.759	.676
	total	35	.767			.810	.447
Ajzen & Fishbein, 1969 (9)	party	100	.523	.815	.587	Mc dropped	B not measured
	exhibit	100	.670	.630	.437		
	watching T.V.	100	.567	.662	.439		
	concert	100	.665	.713	.598		
	poker	100	.668	.767	.591		
	French movie	100	.640	.782	.499		
	discussion	100	.669	.702	.678		
	novel	100	.538	.543	.513		
Ajzen & Fishbein, 1970 (10)	Game 1, coop.	32	.370*	NB_p dropped	.752	Mc dropped	.571
	individual	32	.710		.780		.758
	competitive	32	.883		.733		.765
	total	96	.754		.838		.847
	Game 2, coop.	32	.253NS		.579		not reported
	individual	32	.673		.677		not reported
	competitive	32	.866		.741		not reported
	total	96	.735		.786		.841

TABLE I (continued)

Study	Situation	N	$BI\text{-}A_{act}$	$BI\text{-}NB_{p}$	$BI\text{-}NB_{s}$	$BI\text{-}NB_{s}$ (Mc_{s})	BI-B
Ajzen & Fishbein, 1970 (37)	risk	56	.778		.414	Mc dropped	B not measured
Fishbein et al. 1970 (20)	pretest commun.	144	.599			.666	.690
	compliance	144	.573			.493	.211
	postest commun.	144	.681			.786	.883
	compliance	144	.739			.608	.502
Hornik, 1970 (38)	GRIT	30	.854			.695	.970
	RPM	30	.800			.650	.858
	HAWK	30	.380*			.114NS	.521
	total	90	.799			.597	.861
Devries & Ajzen, 1971 (8)	cheat	146	.459		.474	Mc	.593
	copy	146	.546		.534	dropped	.583
	allow to copy	146	.526		.652		.781
Ajzen, 1971 (32)	cooperation	36	.562			.834	.578
	competition	36	.550			.247NS	.528
	total	216	.747			.529	.822
Darroch, 1971 (35)	picture release	107	.675			.537	.462[a]

[a]Average value over all cases

Note: All correlations are significant at $\alpha = .01$ except * = significant at $\alpha = .05$, NS = non-significant

TABLE I (continued)

Abbreviations:

N	=	Number of subjects
BI	=	Behavioral intention
A_{act}	=	Attitude toward the act
NB_p	=	Personal normative belief
NB_s	=	Social normative beliefs (summed over referents)
Mc_s	=	Motivation to comply (summed over referents)
B	=	Behavior

Evidence for the importance of the equation's attitudinal and normative components in behavior prediction is presented in Table II. Ajzen and Fishbein (9) have also reported that when the effects of the predictor terms are held constant, the partial correlations between A_o and behavior in most cases are low and nonsignificant.

Secondly, some correlation is expected between the predictor variables of Fishbein's model. Few results on the correlation between predictor terms have been reported. Table III discloses the results of three studies, with Dulany's (18) reported correlation between (RHd)(RSv) and (BH)(MC) included for comparison. It may be recalled from equation (2.1) that Dulany postulated BH to be equal to the product of RHd and RHs. In terms of Fishbein's equation, this means that NB_i, Fishbein's adaptation of Dulany's BH, also contains a component of the A_{act} term. With regard to the hypothesized relationship between A_{act} and NB, Ajzen and Fishbein (10) state,

> It should be noted that Dulany's (1967) theory of propositional control would lead us to expect at least some correlation between these two predictors since they are conceived to be partly determined by the same factor.

A correlation should therefore be found between A_{act} and NB_i or between A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$. This result is supported by the few results shown in Table III. The relationship between A_{act} and NB_i might be interpreted as an

TABLE II

CORRELATIONS BETWEEN ATTITUDES TOWARD OBJECTS EXTERNAL TO THE MODEL (A_o) AND VARIABLES IN THE MODEL

Study	Situation	A_o-B	A_o-BI	A_o-A_{act}	A_o-NB_s	A_o-NB_s (Mc_s)	Attitude Object
Ajzen & Fishbein, 1970 (10)	Game 1 Game 2	.256* .091NS	.237* .091NS	.354 .239*	.262* .015NS		other player
Fishbein et al., 1970 (20)	Communicative Compliance	-.024NS .262	-.003NS .279	.059NS .418		.037NS .163NS	two group-members
Hornik, 1970 (38)	GRIT RPM HAWK	.780 .730 -.117NS	.771 .763 -.085NS	.779 .718 -.015NS		.684 .741 .012NS	other player
Ajzen, 1971 (32)	risk	.265	.242*	.257*		.241*	other player
Darroch, 1971 (35)	photo releases with confederates having different color and/or sex	.212* .248* .110NS .088NS	.390 .415 .118NS .142NS	.300 .306 .082NS .148NS		.233* .334 .109NS .143NS	Negroes

Note: Correlations are significant at $\alpha = .01$ except for

* = significant at $\alpha = .05$ and
NS = non-significant

Abbreviations:
- A_o = Attitude toward an object that may be found in the behavioral situation
- B = Behavior
- BI = Behavioral intention
- A_{act} = Attitude toward the act
- NB_s = Social normative beliefs (summed over referents)
- Mc_s = Motivation to comply (summed over referents)

TABLE III

CORRELATIONS BETWEEN THE TWO PREDICTOR VARIABLES, A_{act}, AND NB_s OR $NB_s(Mc_s)$

Study	Situation	N	A_{act}-NB_s	A_{act}-$NB_s(Mc_s)$
Dulany, 1964 (18)	verbal	108		.26
Ajzen & Fishbein, 1970 (10)	Game 1, coop.	32	.199NS	
	individual	32	.647	
	competitive	32	.587	
	total	96	.627	
	Game 2, coop.	32	.024NS	
	individual	32	.601	
	competitive	32	.662	
	total	96	.614	
Devries & Ajzen, 1971 (8)	cheat	146	.361	
	copy	146	.394	
	allow to copy	146	.398	
Ajzen, 1971 (32)	unspecified by author	216		.546

Note: All correlations are significant at $\alpha = .01$ except for NS = non-significant

Abbreviations:

N = Number of subjects

A_{act} = Attitude toward the act

NB_s = Social normative beliefs (summed over referents)

Mc_s = Motivation to comply (summed over referents)

indication of the degree to which the subject perceives his attitude toward a particular act (in part, his beliefs about the consequences of performing the act) as being dependent on the expectations of particular referent persons or groups.

Another relationship to consider in detail is the BI-B correlation. The interpretation of this relationship has been premised upon the assumption that ". . . the BI selected by the experimenter is appropriate for the particular behavior under study" (9). Several factors are held to be of importance in influencing the appropriateness of BI to B:

(a) the measure of BI must be highly specific in its reference to a particular behavior (10), i.e., the behavioral situation must be essentially identical to the situation referred to in the measure of BI;

(b) the time between the measurement of BI and the observation of B must be minimized in order to prevent the possibility of a change in BI;

(c) the behavior must be, as far as possible, under volitional control by the subject; for example, if a student has indicated a low behavioral intention toward seeing an educational movie, and then is told that he will be examined on it, there is a good chance that the student's intention will change, and that he will, in fact,

see the movie (note that the time factor in (b) enters into this change of BI).

A good discussion of the above points is to be found in an article by Fishbein (19). He states that the average correlation between BI and B taken over several (seven) studies is about .70. An average using Fisher's Z-transformation of r worked out to .71. One counter-example should be noted--the pre-test compliance BI-B relationship. The correlation reported in Fishbein *et al.* (20) was .211 ($p < .01$), although the beta coefficients were moderate (.432 and .248, $p < .01$) and significant. The multiple correlation of the predictors on BI was .608 ($p < .01$). Fishbein *et al.* (20) explain that:

> . . . pre-test measures of intentions may not be the most appropriate measure for predicting behavior over a series of trials.

A post-test measure of the compliance BI-B relationship yielded a correlation of only .502 ($p < .01$) leading Fishbein *et al.* (20) to the conclusion that communicative behavior was more stable than compliance behavior and that some types of behavior are considerably more difficult to predict than others.

Although pre-test and post-test measures are obtainable over a series of trials under ideal experimental conditions, such may not be the case in 'one-shot', practical applications of the theory. A potentially useful and general

approach to the prediction of behavior has been suggested by Burhans (15):

> . . . 'behavioral intention', while probably a useful construct for simplifying research methodology, is also probably further removed from overt behavior than Fishbein has indicated. Dropping the concept of 'behavioral intention' and focusing on the utility of Fishbein's model for directly predicting overt behavior would seem the more fruitful approach.

While the present author does not propose to go to the extreme of completely dropping the behavioral intention term, its role in the prediction of behavior will be more carefully examined in the following paragraphs.

Fishbein *et al.* (20) have stated that under ideal circumstances a person's overt volitional behavior is expected to be perfectly determined by his behavioral intentions. In many situations, however, a person's volitional overt behavior may be only a small fraction of his total overt behavior. Ajzen and Fishbein (10) have pointed out that a person's total overt behavior (volitional and non-volitional) may be influenced by variables not considered by the present model, variables such as: 'habit' and 'feasibility'. The existence of these variables was suggested by Dulany's (18) use of 'H' for habitual or non-intentional overt behavior. If, in a hypothetical one-shot application of Fishbein's theory, a subject is faced with the performance of a particular task (behavior) that he has often performed in the past, then it would not be unreasonable to expect him to perform that

task in a stereotyped manner, based on the habituation of his experiences with previous similar tasks, rather than according to his behavioral intention. The BI-B correlation would be small because behavior in this hypothetical case is mostly non-intentional (habit), and therefore cannot be predicted from the terms in the Fishbein equation. The subject, however, may still profess to have a strong behavioral intention and this BI may still have a high multiple correlation with A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$.

This hypothetical habituated behavior could possibly provide one explanation for the anomalous results for the pre-test compliance behavior case reported by Fishbein *et al.* (20) (Tables I and IV). It is equally likely that one of the other previously mentioned factors influencing the BI-B relationship could have occurred (although the time factor appears to have been minimized).

The result reported by Fishbein *et al.* (20), where the relatively low ($r = .211$) BI-B relationship did <u>not</u> reflect the relatively high ($R = .608$) multiple correlation of A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$ on BI, indicates that a high multiple correlation of the predictor variables on BI does not necessarily result in a good prediction of actual behavior. The prediction of actual behavior is seen to occur with good accuracy only if BI and B are highly correlated.

Another indicator of accuracy in the prediction of behavior is obtainable from the regression of the predictor

TABLE IV

STANDARDIZED REGRESSION COEFFICIENTS AND MULTIPLE CORRELATIONS OF A_{act}, NB_p, NB_s, AND $NB_s(Mc_s)$ ON BI

Study	Situation	N	Beta Coefficients				R
			A_{act}	NB_p	NB_s	$NB_s(Mc_s)$	
Dulany, 1964 (18)	verbal	108	.19†			.81	.88
Fishbein, 1966 (36)	males	21	-.148NS			.947	.850
	females	14	.757			.232*	.935
	total	35	.374			.535	.849
Carlson, 1968 (33)	average over thirty behavioral intentions	49	.832	.105*			.910
Ajzen & Fishbein, 1969 (9)	party	100	.077NS	.714*	.083*	Mc dropped	.819
	exhibit	100	.440*	.275*	.128*		.724
	TV show	100	.255*	.423*	.180*		.709
	concert	100	.303*	.376*	.249*		.787
	poker	100	.227*	.502*	.158*		.794
	French movie	100	.190*	.649*	.191*		.794
	discussion	100	.252*	.335*	.300*		.779
	novel	100	.292*	.268*	.323*		.684
Ajzen & Fishbein, 1970 (10)	Game 1, coop.	32	.229NS	NB_p	.707	Mc	.785
	individual.	32	.353*	dropped	.552	dropped	.852
	competitive	32	.691		.327		.922
	total	96	.378		.601		.888
	Game 2, coop.	32	.239NS		.573		.626
	individual.	32	.416		.427		.754
	competitive	32	.669		.298		.894
	total	96	.405		.539		.849

TABLE IV (continued)

Study	Situation	N	Beta Coefficients				R
			A_{act}	NB_p	NB_s	$NB_s(Mc_s)$	
Ajzen & Fishbein, 1970 (37)	risk	56	.748		.139NS	Mc dropped	.793
Fishbein et al., 1970 (20)	pretest commun.	144	.295			.478	.704
	pretest compliance	144	.432			.248	.608
	postest commun.	144	.253			.607	.806
	postest compliance	144	.585			.255	.765
Hornik, 1970 (38)	GRIT	30	.757			.131NS	.859
	RPM	30	.714			.116NS	.804
	HAWK	30	.371*			.061NS	.385NS
	total	90	.712			.134NS	.806
Devries & Ajzen, 1971 (8)	cheat	146	.331		.354	Mc	.566
	copy	146	.398		.378	dropped	.647
	allow to copy	146	.317		.526		.714
Ajzen, 1971 (32)	cooperation	36	.112NS			.768	.839
	competition	36	.541			.225NS	.594
	total	216	.529			.399	.818
Darroch, 1971 (35)	photo release	107	.629 (average)			.049NS (average)	.681 (average)

Note: All beta coefficients and multiple correlations are significant at $\alpha = .01$ except
* = reported significant at $\alpha = .05$

NS = non-significant

† = significance level not reported

TABLE IV (continued)

Abbreviations:

BI	=	Behavioral intention
N	=	Number of subjects
A_{act}	=	Attitude toward the act
NB_p	=	Personal normative belief
NB_s	=	Social normative beliefs (summed over referents)
Mc_s	=	Motivation to comply (summed over referents)
R	=	Multiple correlation of the predictors on BI

variables on behavior (Table V).

Some mention should be made of the role that BI plays in the prediction of behavior. BI is theorized to be an intervening variable between B and the two predictor terms, A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$. The correlation of B with these two terms is therefore expected to be less than the correlation of BI with the same predictors. This attenuation is likely due to the non-perfect descriptive matching of a verbally assessed BI with the actual behavioral situation. Only two studies could be found (Table VI) that reported the correlation of B with each of the predictor terms. A comparison of these correlations to those between BI and the predictor terms (Table I) tends to substantiate that BI is an intervening variable between B and the predictor terms. This hypothesis is further strengthened by the fact that the correlations between B and the predictors are seen (Table VI) to be reduced to non-significance when the variance attributable to BI is partialled out. This implies that the Fishbein model cannot be claimed to be a theory for the prediction of behavior *per se*, but that the theory can lead to good behavior prediction if the behavioral intention criterion is appropriately selected to match the behavioral situation. In terms of educational practice, these results would imply that particular school behaviors may be predicted by assessing the appropriate behavioral intentions and that any change in behavior would be expected to be accompanied by a similar

TABLE V

STANDARDIZED REGRESSION COEFFICIENTS, MULTIPLE CORRELATIONS OF A_{act}, NB_s AND $NB_s(Mc_s)$ ON B, AND PRODUCT MOMENT CORRELATIONS OF B WITH BI

Study	Situation	N	Beta Coefficients			R	$r_{B,BI}$
			A_{act}	NB_s	$NB_s(Mc_s)$		
Ajzen & Fishbein, 1970(10)	Game 1, cooperative	32	.223NS	.438	Mc	.529	.571
	individual.	32	.270NS	.302NS	dropped	.519	.758
	competition	32	.664	.186NS		.788	.765
	total	96	.331	.478		.732	.847
	Game 2, total	96	.419	.464		.793	.841
Fishbein et al., 1970 (20)	pretest, commun.	144				.619	.690
	pretest, compliance	144				.356	.211
	postest, commun.	144	.199		.621	.774	.883
	postest, compliance	144	.311		.351	.593	.502

Note: All beta coefficients, correlations and multiple correlations are significant at $\alpha = .01$ except where NS = non-significant.

Abbreviations:

- N = Number of subjects
- A_{act} = Attitude toward the act
- NB_s = Social normative beliefs (summed over referents)
- Mc_s = Motivation to comply (summed over referents)
- B = Behavior
- BI = Behavioral intention
- R = Multiple correlation of the predictors on behavior
- $r_{B,BI}$ = Product moment correlation of B with BI

TABLE VI
PRODUCT MOMENT CORRELATIONS AND PARTIAL CORRELATIONS (BI HELD CONSTANT) BETWEEN THE BEHAVIOR, B, AND THE PREDICTOR VARIABLES, A_{act} AND NB_s

Study	Situation	r		r_p	
		$B\text{-}A_{act}$	$B\text{-}NB_s$	$B\text{-}A_{act}$	$B\text{-}NB_s$
Ajzen & Fishbein, 1970 (10)	Game 1, coop.	.310NS	.482		
	individual.	.465	.477		
	competitive	.773	.576		
	total	.631	.685	-.023NS	-.083NS
	Game 2, coop.	.272NS	.421		
	individual.	.506	.546		
	competitive	.734	.655		
	total	.703	.721	.233*	.178NS
Devries & Ajzen, 1971 (8)	cheat	.370	.159	.137NS	-.161NS
	copy others	.425	.216	.157NS	-.138NS
	allow to copy	.457	.535	.097NS	.055NS

Note: All correlations are significant at $\alpha = .01$ except
* = significant at $\alpha = .01$
NS = non-significant

Abbreviations:

- B = Behavior
- A_{act} = Attitude toward the act
- NB_s = Social normative beliefs (summed over referents)
- BI = Behavioral intention
- r = product moment correlation
- r_p = partial correlation (BI held constant)

change in these intentions. Given that a particular behavioral intention is linearly related to an attitudinal term and a normative term in Fishbein's model, a change of behavior would also be expected to be accompanied by a change in the value of A_{act}, $\sum_{i=1}^{n} NB_i(Mc_i)$ or both of these predictor terms.

Turning to the problem of predictive validity, it was indicated in Chapter I that the regression weights of the predictors in the Fishbein equation have been found to be statistically significant and that high reported values of multiple correlation for A_{act} and $\sum_{i=1}^{n} NB_i(Mc_i)$ on BI indicated that BI can be predicted with an accuracy considerably better than chance. Fishbein (19) reports that the average multiple correlation between the two components of the theory and behavioral intentions is about .80 (based on nine studies).

A close look at the literature, however, revealed the necessity for caution in accepting the claim for reasonably high predictive validity. Table IV indicates that five studies out of the eleven reported in the table had modified the normative predictor term by dropping Mc. Although this variation in the model's normative term would seem to raise some serious questions about the validity of the model, the inclusion of measures of NB does lead to significantly better predictions of BI than would be obtained by assessing A_{act} alone. The problem with the normative predictor appears to be one of adequately measuring it.

The importance of assessing the social environment in order to predict overt behavior was recognized long before either Dulany's or Fishbein's work (recall Lewin's equation 2.0). In their study on verbal attitudes and overt acts, DeFleur and Westie (21) found that sixty reference groups were influential in the decision-making of forty-six subjects regarding the signing of photographic releases. They further conclude,

> Thus, analysis of the beliefs of an individual about the attitudes, norms, and values held by his reference groups, significant others, voluntary organizations, peer groups, and the like may be essential for better prediction of individual lines of action with the use of verbal scales. This would represent a more distinctly sociological approach.

Concerning the problem of obtaining measures of the normative predictor, Fishbein *et al.* (20) points out the apparent crude state of this measure:

> As to normative beliefs, it seemed reasonable to assume that the relevant referents for the subject were (a) his two partners and (b) the experimenter.

They further state that,

> In the absence of any specific theory, we felt that a simple summation of the perceived expectations of these three referents would provide an adequate estimate of the normative component. This sum was denoted $\Sigma NB(Mc)$.

Measures of the 'motivation to comply'(Mc) factor of the normative component have caused similar concerns, as

illustrated by Ajzen and Fishbein (10):

> Research to this date has indicated relatively little variance in this measure, and thus the results obtained with normative beliefs alone were as good or better than those obtained when NB was multiplied by Mc. . . .

In the same study, Ajzen and Fishbein have noted that in many situations personal normative beliefs may serve mainly as an alternative measure of behavioral intentions.

In their recent review of research on the model, Ajzen and Fishbein (7) make the following points concerning the normative component of the model:

(a) normative beliefs may be considered to be a part of the belief system that determines A_{act}; e.g., one of the consequences of performing a given act is that it may please or displease relevant reference individuals or groups;

(b) one possible method for entering the normative beliefs concerning relevant reference groups into the theoretical model is in a stepwise manner, with each normative term given its own beta coefficient; e.g.,

$$B \simeq BI = [A_{act}]\omega_o + [NB_1(Mc_1)]\omega_1 + [NB_2(Mc_2)]\omega_2 + \cdots + [NB_n(Mc_n)]\omega_n \quad \ldots (2.6)$$

(c) an alternative method of entering the normative predictor terms into the equation is to form a

general normative term by summing over all relevant referents; e.g.,

$$B \simeq BI = [A_{act}]\omega_o + [\sum_{i=1}^{n} NB_i(Mc_i)]\omega_1 \quad . \ . \ . \ .(1.0)$$

(d) the motivation to comply, Mc, may be conceptualized in more than one way; e.g., a person's motivation to comply generally with a reference group, and a person's motivation to comply with the specific expectation of that referent group. Ajzen and Fishbein (7) have indicated that they favor the general conception. They further say that when Mc is measured specific to the behavior, it indicated little more than a measure of weight ω_1 (in (c)) which is also behavior-specific.

Finally, a few observations should be made concerning the size of the beta regression coefficients (ω_o and ω_1). These statistically determined weights provide an estimate of the relative degree to which the attitudinal and normative predictor terms influence the prediction of behavioral intentions. In a psychological sense, these weights determine to what degree a person's attitude toward the performance of the behavior, and to what degree his social or personal normative beliefs, will influence his intention to carry out the behavior (and, ideally, will thus influence his actual behavior).

These empirically determined weights have been found to depend upon three main factors:

(a) the type of behavior being considered,

(b) the behavioral situation or specific conditions under which the behavior is to be enacted, and

(c) the individual, i.e., the 'personality' of the individual or the characteristics of the individual who considers performing the behavior.

Examples of how these three factors affect beta weights are reported in Table IV. A detailed description of examples appears in Ajzen and Fishbein (7).

2. The Educational Context

Generally, attitudinal studies in education have resembled attitudinal studies in psychology. Varied uses of the term 'attitude' are evident and unwarranted assumptions about the attitude-behavior relationship are prevalent.

An indication of the varying educational views of 'attitude' is given by Krathwohl *et al.* (22) in their Taxonomy of Educational Objectives:

> Often when we use the term 'attitude' we imply that the individual is valuing, either positively or negatively, some behavior, phenomenon, or object. But the term 'attitude' is also used to denote quite general sets toward phenomena as well as an orientation toward them.

Mager (23), for example, calls 'attitude' "a general tendency of an individual to act in a certain way under certain conditions," thus coming very close to Fishbein's definition of a behavioral intention. Other authors have used 'attitude' as a term specific to a discipline. A 'scientific attitude', as defined by Moore and Sutman (24), is "an opinion or position taken with respect to a psychological object in the field of science."

Irrespective of how the concept should be used, 'attitude' has recently become an important element in many formulations of educational objectives. The following are but a few examples of 'attitude' as an educational objective:

Blackwood (25): Develop appreciations for the attitudes about the environment. . . .

Illinois Curriculum Program (27): To help children develop proper attitudes toward science and the world of technology. . . .

Dunfee (26): We can assume that the chief purpose of education in the United States is to help children and young people acquire those understandings, attitudes and skills which happy and useful citizens of a democratic society need. . . .

Mager (23): . . . a universal objective of instruction--the intent to send students away from instruction with at least as favorable an attitude toward the subjects taught as they had when they first arrived.

Morrison (28): That complex thing which we call motivation or attitude, the affective side of learning, is perhaps above all the human attribute which we hope to evoke.

2.1 Educational Research on the Attitude-behavior Relationship

The assumption implicit in the above educational objectives appears to be that positive attitudes toward school subjects or school instruction will lead to effective learning behavior on the part of students. Thus, Andersen (29) hypothesizes:

> If the student's attitude toward the subject is not at a high level, then the probability that he could perform the congruent cognitive task is greatly diminished.

The lack of empirical evidence to support this hypothesis has been demonstrated in the previous discussion of the attitude-behavior problem. It was pointed out that the relationship between an individual's attitude and his behavior will be consistent and high only when his attitude has been assessed with respect to a specific act or behavior, under specific conditions (6). In the educational context, this finding has been repeatedly demonstrated by low (typically < .30) or inconsistant correlations between measures of attitude and variables such as: IQ scores, achievement scores, and aptitude scores (see A. Rothman (30) and S. Khan (31)).

Nevertheless, general attitude instruments are frequently used to assess student 'attitudes' toward courses or course changes. Positive student attitudes are assumed

to indicate a good learning situation, while negative attitudes are assumed to imply a need for course improvement. While these assumptions cannot be supported by past psychological research in the attitudinal domain, the possibility of identifying a relationship between attitudes toward specific learning acts and variables specific to the learning process needs to be investigated. At the present time, based on its success in the psychological context, the application of Fishbein's theory to the prediction of student behavior from specific attitudinal and normative predictor variables would appear to be promising course of action for educational researchers to take.

2.2 The Applicability of Fishbein's Approach to Education

Up to the present time (1972), studies on Fishbein's approach have been mainly concerned with validation. Burhans (15), in assessing Fishbein's studies, concluded that

> . . . the few--though highly successful studies that he has conducted which employ his model have been concerned with very specific and limited kinds of behavior. . . . Much empirical research is needed to test the efficacy of his model in predicting behavioral intentions and behavior under a wide range of circumstances and with a wide range of classes of behavior.

In past studies, serious limitations have been imposed on experimental conditions in order to minimize experimental error. These limitations would be difficult or impossible to attain in a typical educational setting. The following

discussion is intended to assess the importance of the experimental restriction with respect to the educational context of the present study.

2.2.1. *Post factum* measures of behavioral intentions. The first restriction in question is the point at which the measure of behavior (B) has been taken in the studies referred to in the tables. In only two of the published studies, Ajzen and Fishbein (10), and Ajzen (32), have the behavioral intentions (BI) and the predictor variables A_{act} and $\Sigma NB(Mc)$ been measured prior to the measure of behavior (B). All other published studies, except for Ajzen and Fishbein (9) where no measure of behavior was taken, indicate a *post factum* measure of BI, that is, the behavior has been performed and measured before the other variables have been assessed. Furthermore, Devries and Ajzen (8) utilized self-reported estimates of students' past cheating behaviors whereas Ajzen and Fishbein (9,37) and Carlson (33) utilized hypothetical behavioral situations with no provision made for the performance or observation of actual behavior. The two unpublished studies by Fishbein (36) and Darroch (35) that used *pre factum* measures of BI, showed noticeably reduced BI-B correlations (Table I).

An implication of *post factum* measures of behavioral intentions has been suggested previously by Gerard (34). He suggested that a subject may bring his intentions into line with his actual behavior. If this is so, the studies utilizing *post factum* measures of BI, A_{act} and $\Sigma NB(Mc)$ would

be expected to 'predict' behavior and behavioral intentions with better accuracy than the studies that measured behavior after the predictors were assessed. Tables I and IV indicate that this is not always the case, although, the effect may be small and might be masked by experimental error.

In the present study the word 'predict' is used in the sense of correlating measures of behavior with measures of behavioral intentions that are taken prior to the measure of behavior. An attempt was made to predict students' performance of optional educational activities from prior assessment of their behavioral intentions toward performing the specified activities. The assessment of behavioral intentions and predictor variables, in the present study, was carried out prior to the performance of the behavior because an instructor would probably want to predict student behavior ahead of time. Information of this kind was seen as potentially useful for planning the types of activities that would be most likely carried out by the students.

2.2.2 Practice and repetitive trials. Another restriction evident in past studies of the model is the use of practice trials of the behavior in order to bolster the behavioral reliability and behavior-behavioral intention correlation stability.

Dulany (18) measured behavior during the last twenty of one hundred trials, and measured behavioral intentions after

the full one hundred trials. Ajzen and Fishbein (10) gave subjects eight practice trials during a Prisoner's Dilemma game (see Rapoport and Chammah (40)). These were followed by a questionnaire and ten more trials during which the behavior measure was taken. Similarly, practice or repetitious trials were used in studies by Fishbein *et al.* (20), and Ajzen (32). Two studies that did not utilize practice trials, Darroch (35), and Fishbein (36), are seen (Table I) to have noticeably lower BI-B correlations than the values reported in the other studies (r = .462 and .447 for the Darroch and Fishbein studies, respectively). These low BI-B correlations, however, may be partly the result of the relatively long BI-B time element present in both studies (discussed below).

The present application of the model is directed toward educational behaviors which cannot be predicted repetitively or performed repetitively. Consequently, some attenuation of the BI-B correlation might be expected in the present study because of the reduction of behavioral reliability which might have been enhanced by repetitive behavioral activities.

2.2.3 BI-B time element. One further advantage gained by the use of game-like situations in past studies, was the minimization of the crucial time between the measure of BI and the performance of B. This time was typically about an hour (10). The studies by Darroch (35) and Fishbein

(36) were the only reported attempts to measure behavioral phenomena separated from the measure of behavioral intentions by a time greater than a few hours. Darroch obtained measures of behavioral intention and the predictor variables about one month in advance of the observed behavior, and was still able to obtain a moderate, average BI-B correlation of .462 ($p < .01$). Fishbein assessed behavioral intentions at the beginning of a semester, and obtained self-reports of premarital sexual behavior at the end of the semester, obtaining BI-B correlations of .676 ($p < .01$) for females and .394 (NS) for males (Table I). As was discussed in 2.2.2, these BI-B correlations were noticeably lower than those reported in other studies, but the smaller values of these correlations could, in part, be caused by the non-repetitive behaviors that were assessed and the time interval over which BI might have changed.

The present study has provided various educational behaviors which could be performed either immediately after or up to two and one-half weeks after the measurement of the predictor variables. Accordingly, it might be reasonable to expect higher BI-B correlations in the case of activities performed close to the time of the measurement of the predictor variables. This factor will be examined in the discussion of results in Chapter IV.

2.2.4 Relevant referents. The problem of the normative predictor term has already been mentioned. It should perhaps be further stressed that in the past, the question of ascertaining the referent groups relevant to the individual, has depended largely on the type of behavioral situation in which the subject has been placed. The game situations in the majority of the previously-reported studies have usually required the experimenter to assess normative beliefs with respect to only a small number of referents (typically one to three). Dulany (18) used only one referent--the experimenter. Ajzen and Fishbein (9) used "my friends" as the only referent upon which the social normative belief, NB_s was based. Ajzen and Fishbein (10), and Ajzen (32) have also used one referent, "my partner" in their Prisoner's Dilemma game situations. Fishbein *et al.* (20) summed over three referents, "member 1", "member 2", and "the experimenter", in order to arrive at a general social normative term, $\Sigma NB(Mc)$. In an educational situation, Devries and Ajzen (8) found that a sum of four normative beliefs referent to classmates, the subject's church, family, and friends, predicted behavioral intentions significantly. The normative belief concerning the subject's friends ($FrNB_s$) was, however, a better predictor than was ΣNB_s in two of the three behavior situations. It is also interesting to note that no professor or instructor was used as a referent, even though this particular study was concerned with a definite instructional situation.

The importance of the instructor as a referent was explored in the present study, as were other referents such as: 'Closest friends', 'parents', 'the majority of the class', 'my religious group', and 'I, myself' as a personal referent. The use of these particular referents was based on a pre-experimental survey of their possible relevance (described in Chapter III).

2.2.5 Subjects. All of the reported studies used undergraduate students as subjects. Fishbein *et al.* (20), and Ajzen (32), further state that these students were drawn from introductory Psychology courses, and that they participated in the Psychology experiments as a partial fulfillment of the requirements for the course. It is not known whether these facts have played any important role in determining the results in the game situations tested. However, these results might be expected to be somewhat better than the results that would be obtained by using subjects selected from a discipline other than Psychology. It is possible that Psychology students who are playing psychological games for course credit may be biased in favor of the behavior or the test instrument and may thus exhibit a greater motivation toward and reliability in performing the activity.

Similarly, in an instructional situation, any bias of the subjects toward the behavioral activities or the test instrument may be crucial. The instrument is presumably

attempting to assess the genuine attitudes and intentions of students toward specific instructional activities, rather than their responses biased by a motivation to fulfil course requirements, to obtain higher marks, to avoid failure, or to please the instructor.

Subjects for the present study were students in an introductory physics course. These students were not expected to have a positive bias toward the questionnaire, but some precautions were taken in order to control this factor. It was expressed to the students that the activities were entirely voluntary and in no way counted toward course credit. Also, a control group was used which did not receive the research instrument but which was acquainted with the voluntary activities in the same ways as the experimental group. The use of this control group permitted an estimate of the influence of the questionnaire on the performance of behavior by the subjects.

3. Summary

Research has been unable to produce a consistent relationship between general measures of attitudes toward an object and the behavior of individuals with respect to the attitude object. Some authors (12) have suggested that the concept of attitude requires refinement. Others (13) have observed that some of the difficulty lies in the measuring

instrument used. Still others (14) have held that the difficulty has been in operationalizing the assessment of personal and situational factors associated with various behavioral situations.

Dulany (18) made an important approach to the problem by formulating a regression equation that accounted for both personal and situational variables in the prediction of verbal behavior. The operationalization of these variables led to a good prediction of behavioral intention and his multiple correlation of the predictor terms on behavioral intention equalled .88. The prediction of verbal behavior was also quite successful to the extent that the correlation between behavioral intention and verbal behavior was found to be .94.

Fishbein (6) extended Dulany's theory to the prediction of non-verbal, overt behavior in social situations. The generality of this extended model is seen to be most relevant in terms of the social setting of the modern-day educational situation. Fishbein also reconceptualized Dulany's predictors in terms of an attitudinal component and normative component, thus reinstating attitude as a predictor of behavior. Significantly, Fishbein pointed out a solution to the problem of behavior prediction from measures of attitude: the necessity for measuring attitudes toward performing a specific act, as opposed to measuring attitudes toward some general attitude object.

Recent research (7) on Fishbein's theory has indicated that the normative term is still problematic in its operationalization. Specifically, the 'motivation to comply' factor has been of little value in the prediction of behavioral intention or behavior. In spite of these difficulties, addition of the normative term has resulted in significantly better predictions of behavior and intention than would be obtained by assessing the attitudinal term alone.

Educational research in the area of attitudes has, in general, reflected the problems indicated by psychological studies of the attitude-behavior problem. The definition of 'attitude' varies considerably from application to application. Consequently, the various conceptualizations of 'attitude' have led to a number of assumptions in educational practice, few which have been supported by research. It would thus seem logical to attempt to apply Fishbein's theory to educational situations in the hope that some of the attitude-behavior confusion in the educational context might be partially resolved.

Applications of Fishbein's model have been limited in the scope of behavioral situations that have been investigated. This limitation has resulted, in part, from validation studies that required a maximization of behavioral reliability by means of repetitive behaviors in game-like situations. Other restrictive experimental conditions used in the validating studies involved: assessing the predictor terms <u>after</u>

the performance of the behavior, utilizing repeated practice trials of actual behavior before obtaining measures of B, BI, A_{act} and ΣNB_iMc_i, and limiting the time between the assessment of BI and the performance of the behavior to about one hour. These typical experimental restrictions would be unacceptable in educational practice and would have to be dropped, probably at the expense of some of the reliability and stability of the measures. While the correlations in the present study are expected to be lower than those reported elsewhere (because of fewer experimental restrictions), the literature has indicated that useful predictive results may still be obtainable.

CHAPTER III

METHOD OF THE STUDY

The previous chapters indicated the possible usefulness of applying Fishbein's theory to more varied true-to-life, and less restrictive situations. In doing so it is to be expected that a certain amount of predictive validity has to be sacrificed. Some factors contributing to the loss of predictive validity are, (a) a lack of repetition of behavior, (b) the use of *pre factum* measures of behavioral intention as opposed to *post factum* measures of behavioral intention , and (c) relatively long periods of time between the measure of the behavioral intention and the performance of the behavior. Aside from these differences in the application of Fishbein's theory and some alterations in the type of measuring instrument used in previous studies, the methods employed in this study are an attempt to carefully apply Fishbein's theory to an educational situation.

1. Pilot Study: Relevant Referent Groups

The literature gives few guidelines for the selection of relevant normative referent groups to be used in the Fishbein model. Since the normative component of the model is dependent upon the subjects' perceptions of the expectations

of relevant referent persons or groups, an exploratory referent group questionnaire (Appendix A) was devised in order to obtain an indication of the relative importance to the subjects of the study of various individuals and groups with respect to performing educational extra-curricular activities. This information was used in selecting only the most relevant referent groups for inclusion in the research instrument used for obtaining measures on the Fishbein variables.

The referent group questionnaire was administered to four different sections of Education 321 students, 64 students, in all. Education 321 is a Science Methods course for third year Education students. The students in this course were selected because of the unavailability of Physics 115 students at the time that the research instrument was under development.

As a check on the differences between the responses of Education students and the Physics 115 students, the referent group questionnaire was tried on some of the students from Physics 115 that were made available for this purpose shortly before the research instrument was administered. The referent questionnaire was administered to fifty Physics 115 students from Section 2 (the class not taking the modular lecture program). Appendix B shows the referents ranked according to percent of student responses to the 'Important' and 'Very Important' categories of the referent questionnaire. As might be expected, four of the strongest referents for

both groups of students were: 'self', 'best friend(s)', 'lecturer', and 'parents', the order of rank being slightly different from one group of students to the other. 'Parents' appeared as a slightly stronger referent than 'lecturer' for the Physics 115 students, whereas the reverse was true for the Education 321 students (this referent order may have depended on such factors as age, years of schooling and academic interests). Below the first four highest ranking referents, notable differences in the rank order of the remaining referents became apparent. The Science Education students surprisingly ranked 'religious group or church' as fifth and 'scientific community' as ninth, whereas the Physics students ranked 'scientific community' as fifth and 'religious group or church' as tenth. Education students ranked 'majority of class members' sixth, whereas Physics students ranked this referent ninth.

While these differences in ranking point toward some differences in normative beliefs between groups of students in different disciplines, the overall Spearman rank correlation (corrected for ties) between the two sets of student responses was found to be .88 ($p < .001$). Although the referents included in the research instrument were chosen on the basis of the rankings of Education students, the four highest ranking referents were the same for both Education and Physics 115 groups and were therefore included in the research questionnaire. The use of 'religious group

or church' and 'majority of class members' in the final questionnaire instead of the referents, 'scientific community' and 'university community' (more appropriate for Physics 115 students) were not expected to affect the weighting of the normative term of the Fishbein model to any significant degree because of their relative unimportance to the subjects. Nevertheless, the pilot study results do indicate the need for some care in the selection of referents for specific groups of subjects in specific situations.

2. Population and Samples

The subjects constituted a sample of 199 Physics 115 students[1] from a population of 318 students in Section 1 of Physics 115. Approximately ninety-six percent were generally between eighteen and nineteen years old and had two years of high school physics. All Physics 115 students intended to pursue studies in disciplines other than Physics (e.g., Biosciences, Chemistry, Mathematics, Medicine, etc.) The male/-female ratio was about 6.75. Of the 199 questionnaires returned, a total of 185 were usable in the analyses of data.

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[1]Students in Sections 1 and 2 were not randomly assigned to either Section. The choice of Sections was based primarily on timetable considerations. It is tacitly assumed that any sampling bias that occurred in the placement of students in the two Sections is of little importance in the present study.

These 185 questionnaires consisted of 128 questionnaires used to obtain measures on the Fishbein variables (Appendix C), and 57 questionnaires constituting a kind of placebo used to investigate the possibility of measurement instrument effect (Appendix E).

3. Experimental Procedure

The lecture module entitled, "The Physics in Environmental and Technological Assessment" consisted of a series of four lectures during the regular Physics 115 lecture times, given by a member of the Faculty of Applied Science. Students were told in the first lecture that some voluntary follow-up activities were being arranged for them to do because the block of lectures relating Physics and environmental problems was of such short duration. In the second lecture, the students were briefly told about each extracurricular activity, and that the exact details of these activities would be made available to them in the next lecture.

In the third lecture, all students picked up a detailed list of the voluntary follow-up activities for the block of lectures on 'The Physics in Environmental and Technological Assessment' (Appendix G). These sheets were also available during the fourth (last) lecture for any students who were absent during the third lecture. The shuffled placebo and research questionnaires were administered by

the author and three Physics 115 laboratory instructors toward the end of the third lecture.[2]

The five 'voluntary' activities used in the present study were as follows: (see Appendix G for detailed activity descriptions):

Activity 1: to attend a free lunch-hour movie entitled, "Environment in the Balance";

Activity 2: to sign up to receive information about a local pollution sampling experiment and how you may participate in it if you wish;

Activity 3: to pick up an assortment of information material and list of supplementary readings on Pollution and Technology;

Activity 4: to attend a free lunch-hour movie entitled, "The Time of Man";

Activity 5: to contact the lecturer in order to obtain information about assisting some professors in doing research on the leaching of landfills (dumps).

In order to obtain a direct (dichotomous) measure of behavior for Activity 1 (attending the movie entitled, "Environment in the Balance"), attendance survey slips requesting the student's Physics course number, lecture

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[2]It should be noted that an error in administration of the instruments reduced the number of research questionnaires distributed by about fifty. While this loss in data was regrettable, a reasonably large number of subjects (N = 128) were retained for the study.

Section number, name and registration number (Appendix H) were filled out by all students as they entered the theatre.

With the exception of Activity 4 (attending a movie entitled, "The Time of Man"), the performance of the activities was ascertained by secretaries checking off the names of participating students on a class list, or by the students, themselves, signing their names on lists provided.

The participation of Physics 115 students in Activity 4 could not be checked directly because this movie had been thrown open to the entire campus, and the large number of people expected to attend would have made the survey ticket method impossible to use. In order to obtain behavior data for Activity 4, and also check on the data collected from the other activities, an 'Activities Check-list' (Appendix I) was administered to all students during their lecture on the day after the Activity 4 movie. This check-list asked students to check off each activity that they had participated in up to that date.

Two valuable pieces of information were gained by comparing the student completed check-lists to the directly observed behaviors. Firstly, several students who had participated in Activity 1 were not recorded by the direct attendance survey because they had arrived in the theatre during a non-Physics 115 lecture, well in advance of the attendance survey (this was confirmed by telephoning several of the students in question). Secondly, three students were

found to have checked-off several activities which they were not observed to perform (according to the direct observations). Their questionnaires were subsequently identified, and eliminated from the final analysis as questionable data.

4. Instruments

Measures on the Fishbein variables, BI, A_{act}, NB_i, and Mc_i were built into a five part research questionnaire (Appendix C) each of the five parts dealing with a student behavioral intention to perform one of the extracurricular activities. Only Parts A to C (concerning Activities 1 to 3) attempted to measure all of the Fishbein variables. Because of the limitations of answering time (and probably student patience), only behavioral intentions were measured in Parts D and E (Activities 4 and 5).

The research questionnaire utilized a 5-choice bi-polar scale format because of the Physics 115 instructor's preference for the Likert-type instrument, and because of the availability of IBM 5-category multiple-choice response sheets (IBM Document No. 505) that could be automatically transferred onto computer data cards via the IBM Model 1232 Optical Scanner. Although Osgood *et al.* (40) have presented some incidental empirical evidence (p. 85) that a 7-choice scale appears to be optimal for use with college students, the probable gains of this scale over a 5-choice scale were

judged to be inconsequential.

The Semantic-Differential scales commonly used by Ajzen and Fishbein in the measurement of A_{act} were transformed into Likert-type attitude measures. Two Likert items resulted from each bipolar Semantic-Differential scale.

According to Osgood (40) and Edwards (41) correlations between Likert, Thurstone, and Semantic-Differential measures of attitude are typically about .90. With respect to the prediction of behavior, however, Tittle and Hill (13) suggested that the Likert scale may be slightly superior to the others (see Chapter II, section 1.1).

4.1 Variables External to the Fishbein Model

Variables external to the model were assessed by means of two Likert-type instruments (Appendix J and L). The merging of external variable data with the data for variables internal to the model reduced the number of usable cases to a total of 89 from the original 128. Seventeen different sets of subscales constituted both instruments. Responses to specific items were summed for each different subscale. The external variables described in Chapter I, that included the 'Physics Evaluation Study' questionnaire items (Appendix J) and the 'Attitude Toward the Physics Laboratory' questionnaire (Appendix L), are shown in Table VII. The latter ('Attitude Toward the Physics Laboratory') questionnaire originated in a study by G. Page (42).

TABLE VII

VARIABLES EXTERNAL TO THE MODEL

External Variable	Abbreviation	Questionnaire Items[a]
Attitude toward physics in general	A_{phys}	29 - 38
Attitude toward Physics 115	A_{115}	39 - 49
Attitude toward class instruction	A_{class}	50 - 59
Attitude toward the lecturer	A_{prof}	60 - 69
Attitude toward the textbook	A_{text}	70 - 73
Attitude toward the subject matter	A_{sm}	74 - 78
Attitude toward the assignments	A_{asgn}	79 - 84
Attitude toward examinations	A_{exams}	85 - 94
Attitude toward the topic 'Nuclear Energy'	A_{nuc}	95, 106
Attitude toward the topic 'Environment'	A_{env}	99, 104
Attitude toward the topic 'Classical Physics'	A_{cp}	96, 101, 102, 107
Attitude toward the topic 'The Human Body'	A_{bod}	100, 103
Attitude toward the topic 'Propulsion and Electromagnetic Theory'	$A_{pr\&em}$	97, 98, 105, 108
Attitude toward the Physics 115 laboratory session	A_{lab}	Part B, 1 - 26 (see footnote)
Physics 12 achievement	PH_{12}	3
Mathematics 12 achievement	MA_{12}	6
Combined Physics 12 and Math achievement	$PH\&MA_{12}$	3, 6

[a]All questionnaire items are taken from the 'Physics Evaluation Study' questionnaire (Appendix J), except in the case of A_{lab}. Items for the assessment of A_{lab} were taken from the 'Attitude Toward the Physics Laboratory' questionnaire (Appendix L).

4.2 Variables Internal to the Model

The measures on the variables in the Fishbein model included in the research questionnaire were based on the kinds of measures typically used by Fishbein *et al.*, on the basis of ideas drawn from Fishbein's theory, and on the basis of critical comments made by trial subjects on a set of trial questionnaire items.

4.2.1 Behavioral intention (BI). The behavioral intention measure consists of from one to three items per activity. Each item has five response categories varying from 'strongly agree' to 'strongly disagree', indicating the intention of the student toward performing a certain voluntary act (or behavioral activity).

In discussing the Triandis Behavioral Differential instrument (43), Fishbein (6) states,

> While the correlations between attitude and the different types of behavioral intentions vary considerably, the correlation between attitude and the sum of the behavioral intentions tends to be quite stable and high (r = .70). (p. 481)

With this in mind, one conclusive BI item, "I intend to __.", and one or two conditional items, "I intend to ___ only if I have nothing else to do," and "I intend to ___ only if I have time," were used in the questionnaire. It was hoped that the summation of these BI items would give a more reliable measure of BI than a single BI item. For comparison,

each BI item was tested in a separate regression analysis.

Example item:

I intend to see this movie.

Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5 .

4.2.2 Attitude toward the act (A_{act}). Six to eight Likert-type attitude items, indicating the subject's evaluative beliefs about the consequences of performing the act, were used to assess A_{act}. The items concerning 'interesting' and 'boring' were omitted from the assessment of A_{act} in Activities 2 and 3 because they were not very meaningful to trial subjects in the context of describing these activities.

Examples:

Attending this movie would be a good thing for me to do.

Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

Attending this movie would be a boring thing for me to do.

Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

4.2.3 Normative beliefs about specific referents (NB_i). The measure of NB_i consisted of six items, each concerning a different referent group, and indicating the subject's belief concerning what the referent expected him

to do, or what he felt he "should" do with respect to the particular behavioral activity. The referent groups used in assessing the six normative beliefs were: 'Closest friends', 'parents', 'majority of the class', 'the lecturer', 'religious group', and 'myself', corresponding to NB_1, NB_2, NB_3, NB_4, NB_5 and NB_p respectively.

Examples:

My closest friends would expect me to see this movie.

Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5 .

My parents would expect me to see this movie.

Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5 .

4.2.4 Motivation to comply (Mc_i). Six items, each concerning a different referent group, and indicating the subject's desire to comply with what he believed was expected of him (NB_i), constituted the measure of Mc_i.

Examples:

Concerning my seeing this movie, I want to do what I think my closest friends expect me to do.

Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5 .

Concerning my seeing this movie, I want to do what I think my parents would expect me to do. Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5 .

4.2.5 Behavior or act (B).[3] The five behavioral activities were selected from about twice that number of possible activities, on the basis of student appeal and several criteria implicit in the model.

Firstly, the tasks selected were different from each other with regard to the type of behavior elicited. This method of task selection was employed in order to appeal to a greater overall number of students and elicit a wider variance in their responses.

Secondly, in an educational context, participation in extracurricular activities was a hoped for outcome of instruction. The activities chosen, therefore, were related to the goals of instruction.

Thirdly, there had to be a way of directly, or at least indirectly recording the actual behavioral responses of the subjects, unobtrusively, in order to avoid any suspicion that performance of the tasks was really not voluntary. In the case of such indirect methods as self-reporting, there had to be also some method for checking on

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[3]Note that behavior, as measured, was a dichotomous variable, while behavioral intentions, attitude toward the act, and normative beliefs were measured as continuous variables. Hence, any reported correlations between measures of behavior and measures of the other variables will be point-biserial.

the honesty of the subjects. In this study, all behavioral activities except Activity 4 ("The Time of Man") were directly observed and it was relatively easy to check the subjects' self-reported 'activities check lists' against the direct observations of activities 1 to 4. Only about 1 1/2% of the subjects returned questionable check lists, and this provided a method for screening out these respondents' questionnaire responses as being potentially unreliable.

Fourthly, according to the model, the BI-B time interval must be minimized, and thus the performance of the task had to be possible as soon after the measure of BI as possible. If this condition was not fulfilled, the original BI may have been replaced by an alternative with a resulting decrease in the relation between BI and B. Under conditions of long time intervals between measures of BI and B, BI may cease to be an accurate predictor of B.

Finally, all behavior tasks had to be independent of each other with respect to the location in which each activity was executed. This diminished the possibility of a subject performing another task because it was conveniently in the same location.

5. Methods of Analysis

The analyses were carried out by means of an IBM 360/67 computer, utilizing the applicable subroutines of the UBC-TRIP (44) and BMD 02R (45) regression programs. The specific research questions investigated and the methods of analysis used are described below. Commonly accepted α-levels in educational research (α = .05 or .01) were used to suggest whether or not the results were statistically significant.[4]

5.1 The Relationship between Variables Internal to and Those External to the Fishbein Model

To what extent are certain attitudinal and non-attitudinal variables, external to, or not specified by the Fishbein model, related to each of the variables in the model, for each extracurricular activity?

Pearson product-moment correlations between each of the external variables and B, BI, A_{act}, ΣBI, ΣNB_i, ΣMc_i, and $\Sigma NB_i(Mc_i)$ were computed for each behavioral activity.

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[4] From a practical standpoint, it is probably useful, for the purpose of comparison, to know that the probability of a Type I error (rejecting a null hypothesis when it is true) is greater than or less than commonly accepted probabilities (α-levels) in educational research or studies along similar lines. To arbitrarily set an *a priori* α-level and then to accept the null hypothesis if the value of the test statistic does not reach the critical value corresponding to the predetermined α-level, would be more appropriate to validation procedures than to the applicative context of the present study.

5.2 The Relationship between Variables Internal to the Model

To what extent are BI, ΣBI, and B related to A_{act}, NB_i, Mc_i, $NB_i(Mc_i)$, and $\Sigma NB_i(Mc_i)$ for each of the extracurricular activities?

Computation of a product-moment correlation matrix was performed for all variables internal to the model, for each behavioral activity.

5.3 The Prediction of Behavioral Intention

(a) How accurately can the behavioral intention with respect to each extracurricular activity be predicted from A_{act} and the sum of the relevant normative products, $\Sigma NB_i(Mc_i)$?

(b) Which of the two predictor variables, attitudinal or normative, is the best predictor of BI in each different behavioral situation?

Multiple correlation coefficients of $[A_{act} + \Sigma NB_i(Mc_i)]$ with BI were computed for each behavioral activity. Also computed were the standardized regression coefficients for the A_{act} and individual $NB(Mc_i)$ terms of the equation. The percent variance accounted for by each individual predictor was also computed by taking the product of the beta coefficient of each predictor and the correlation of the predictor with the criterion variable, BI.

5.4 The Role of Behavioral Intention in Predicting Behavior

To what extent are A_{act} and $\Sigma NB_i(Mc_i)$ related to B, the performance of the act, i.e., actually carrying out each extracurricular activity?

A computation of the product-moment correlations between B and A_{act}, and between B and $\Sigma NB_i(Mc_i)$ was carried out for the first three behavioral activities.

Partial correlations of A_{act} with B, and $NB_i(Mc_i)$ with B holding BI constant, were also computed and the statistical significance of the results indicated.

5.5 Measurement Effect

To what extent do measurements on the components of Fishbein's model influence students' behavioral responses toward the extracurricular activities?

χ^2-tests of the relationship between the type of instrument completed by the students, and frequencies of their behavioral responses was computed, using two by two contingency tables, and using Yates' correction for small cell frequencies (Appendices N to Q).

CHAPTER IV

RESULTS

During the course of the analysis of data, two results predicted in Chapter II became readily apparent: (a) the Mc factor tended to attenuate correlations between the normative component of the model and the criterion variables, and (b) the first and third BI items in each part of the questionnaire did not give the high correlations and multiple correlations with the predictor variables that were obtained by using the non-conditional BI_2 item (see Chapter III, section 4.2.1). For these reasons, the majority of the results shown in this chapter will omit measurements on Mc, BI_1, BI_3 and ΣBI. Measurements on BI_2 will be taken as the sole measurement on BI, and measurements on NB_1, NB_2, NB_3, NB_4, NB_5 and NB_p will take the place of measures on Fishbein's normative predictor term, $\sum_{i=1}^{n} NB_i Mc_i$.

1. The Relationship between Variables Internal to the Fishbein Model and those External to the Model (N = 89)

According to the theory, any variables external to the model should be unrelated to behavioral intention and to overt behavior, unless they are also significantly[1] related

to at least one of the predictors given in the model (7).

Table VIII shows the correlations between several variables external to the model and variables internal to the model. All correlations are typically low ($r < .35$). In only five instances out of eighty-five (Activities 1 to 5), was behavior significantly (statistically) correlated with an external variable, two of these cases at the $p < .01$ level and the other three at the $p < .05$ level. Behavioral intentions correlated with the external variables in thirteen instances, five at the $p < .01$ level of probability and eight at the $p < .05$ level. Curiously, the external variable, A_{nuc}, attitude toward the topic 'Nuclear Energy', correlated significantly with behavioral intentions for Activities 1, 3, 4, and 5. Also, a marginal significance trend was shown in the correlation of a_{bod} (Attitude toward the topic 'The Human Body') with BI for activities 1, 2 and 4 (the critical value of the correlation coefficient with $N = 89$, was 0.210 at $\alpha = .05$).

Although the correlations of external variables with variables internal to the model tended to be low, the adherence of these correlations to the theory was checked in the first three activities.

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[1] A 'significant' correlation, for this chapter, will refer to a correlation that is statistically different from zero correlation at the .05 level (two tailed test).

TABLE VIII

CORRELATIONS BETWEEN VARIABLES EXTERNAL TO THE MODEL AND VARIABLES INTERNAL TO THE MODEL [a]

Activity 1: attending a free lunch-hour movie entitled, "Environment in the Balance"

	B	BI	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p
A_{phys}	.054	.188	.259*	-.065	.087	.061	.017	.059	.246*
A_{P115}	.135	.103	.159	-.018	-.034	.080	-.171	.079	.043
A_{class}	.122	.009	.085	-.072	-.148	.110	.165	-.006	-.017
A_{prof}	.118	.150	.345†	.022	.039	.102	-.208	-.075	.117
A_{text}	.128	.028	.137	-.058	-.073	-.026	.002	.005	.000
A_{sm}	-.170	.096	.092	.014	.059	-.022	.074	.056	.055
A_{asgn}	-.051	-.057	.087	-.157	-.014	-.047	-.281†	-.231*	-.051
A_{exams}	-.002	-.089	-.215*	-.134	.030	-.079	-.014	.036	-.184
A_{nuc}	.042	.309†	.247*	.174	.001	-.196	-.151	-.004	.339†
A_{env}	-.025	.161	-.049	.112	.201	.102	.064	.150	.246*
A_{cp}	.061	-.007	.040	-.113	.059	.064	.144	.074	.118
A_{bod}	.176	.224*	-.015	.238*	.074	.189	-.071	.086	.097
$A_{pr\&em}$	.050	.011	.112	.099	.034	-.027	.176	-.151	.177
A_{lab}	-.063	.051	.114	-.148	-.029	.072	-.178	-.081	.023
PH_{12}	.030	.000	-.094	-.086	-.022	-.090	-.153	-.237*	.033
MA_{12}	-.034	-.028	-.123	.088	-.014	.008	-.028	-.007	-.013
$PH\&MA_{12}$	-.005	-.018	-.128	.009	-.020	-.043	-.099	-.130	.009

Activity 2: signing up to receive information about a local pollution sampling experiment

	B	BI	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p
A_{phys}	.121	.096	.153	.022	-.027	.100	.097	.023	.205
A_{P115}	.014	.004	.067	-.085	.052	.091	-.197	.036	.032
A_{class}	-.145	-.132	.025	-.026	-.047	.030	-.091	.068	-.104
A_{prof}	-.124	.000	.287†	-.061	-.025	.046	-.142	.026	.019
A_{text}	-.030	.054	.047	.032	-.008	.082	.020	.075	.092
A_{sm}	-.002	.076	.221*	.027	.012	.076	.048	-.046	.071
A_{asgn}	.062	-.174	.051	-.170	-.185	-.126	-.296†	-.211	-.028
A_{exams}	-.093	-.260*	-.192	-.116	.064	-.143	-.072	-.048	-.260*
A_{nuc}	.095	.125	.135	-.079	-.152	-.161	-.011	-.126	.142
A_{env}	-.060	-.120	-.165	.053	.254*	.122	.051	-.159	-.157
A_{cp}	-.001	.014	.002	-.046	.005	-.019	.097	.108	.009
A_{bod}	-.026	.205	.145	.152	.134	.123	-.138	.231*	.177
$A_{pr\&em}$	.240*	.158	.014	.103	.103	.015	.131	-.093	.317†
A_{lab}	-.127	-.016	-.022	-.093	.000	.068	-.144	-.094	.050
PH_{12}	.007	-.236*	-.226*	-.067	-.194	-.025	-.103	-.225*	-.073
MA_{12}	.092	-.096	-.061	.106	-.027	.069	-.026	-.076	.017
$PH\&MA_{12}$	.061	-.186	-.159	.031	-.121	.300†	-.071	-.167	-.028

Activity 3: picking up a set of information materials and reading list on Pollution and Technology

	B	BI	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p
A_{phys}	.278†	.209	.076	-.094	-.081	.000	.085	.031	.190
A_{P115}	.180	.082	.113	-.159	-.043	-.043	-.078	.097	.150
A_{class}	.154	.090	.113	-.026	.003	.127	.062	.129	.173
A_{prof}	.097	.183	.315†	-.024	.021	.105	.016	.015	.268*
A_{text}	.294†	.145	.103	-.042	-.011	.026	-.033	-.021	-.044
A_{sm}	.038	.169	.162	-.094	.027	.122	.211*	-.061	.113
A_{asgn}	.117	.008	-.037	-.243*	-.212*	-.140	-.184	-.147	.028
A_{exams}	.078	.064	-.125	-.102	-.044	-.091	.100	.073	.027
A_{nuc}	.081	.308†	.045	-.196	-.228*	-.249*	-.085	-.107	.293†
A_{env}	-.076	-.014	.030	-.018	.088	-.008	.038	-.108	.002
A_{cp}	.087	-.033	-.015	.113	.114	.002	.101	.079	.164
A_{bod}	-.003	.086	-.019	.140	.133	.024	.111	.182	.128
$A_{pr\&em}$	-.020	.218*	-.071	.069	.043	.042	-.012	-.126	.067
A_{lab}	.153	-.034	-.147	-.034	-.047	.039	-.163	.028	.070
PH_{12}	-.030	-.187	-.149	-.064	-.195	-.119	-.104	-.136	-.007
MA_{12}	-.137	-.055	-.017	.024	-.063	-.023	.107	-.024	-.044
$PH\&MA_{12}$	-.102	-.135	-.091	-.019	-.144	-.078	.012	-.088	-.031

Activity 4: attending a free lunch-hour movie entitled, "The Time of Man"

	B	BI
A_{phys}	.013	.138
A_{P115}	.126	-.083
A_{class}	.108	.050
A_{prof}	.052	.383†
A_{text}	.004	-.072
A_{sm}	-.115	.062
A_{asgn}	-.007	.113
A_{exams}	.068	-.086
A_{nuc}	-.187	.226*
A_{env}	-.075	-.118
A_{cp}	.122	.336†
A_{bod}	.114	.211*
$A_{pr\&em}$	.086	.192
A_{lab}	.133	.081
PH_{12}	-.065	.137
MA_{12}	-.132	-.007
$PH\&MA_{12}$	-.118	.070

Activity 5: contacting the lecturer to obtain information about assisting the summer landfill leaching experiment

B	BI
.101	.021
-.113	-.039
-.161	-.224*
-.204	-.114
-.022	.025
-.212*	.066
-.005	-.093
-.124	-.149
.200	.260*
-.191	.012
.016	-.057
.156	.141
.211*	.288†
-.045	.039
.141	-.003
.158	.013
.174	.007

TABLE VIII (continued)

[a]correlations have been rounded off to three significant figures and are not significant except where noted otherwise. (N = 89)

*$p < .05$

†$p < .01$

Abbreviations:

A_{phys}	=	Attitude toward physics in general
A_{Ph115}	=	Attitude toward Physics 115
A_{class}	=	Attitude toward class instruction
A_{prof}	=	Attitude toward the lecturer
A_{text}	=	Attitude toward the textbook
A_{sm}	=	Attitude toward the subject matter
A_{asgn}	=	Attitude toward assignments
A_{exams}	=	Attitude toward examinations
A_{nuc}	=	Attitude toward the topic, 'Nuclear Energy'
A_{env}	=	Attitude toward the topic, 'Environment'
A_{cp}	=	Attitude toward the topic, 'Classical Physics'
A_{bod}	=	Attitude toward the topic, 'The Human Body'
$A_{pr\&em}$	=	Attitude toward the topic, 'Propulsion and Electromagnetic Theory'
A_{lab}	=	Attitude toward the Physics 115 laboratory session
PH_{12}	=	Physics 12 marks
MA_{12}	=	Math 12 marks
$PH\&MA_{12}$	=	Combined Physics 12 and Math 12 marks
B	=	Behavior
BI	=	Behavioral intention
A_{act}	=	Attitude toward the act
NB	=	Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'.

In Activity 1, it was found that the correlations of BI with A_{nuc} and A_{bod} were .309 ($p < .01$) and .224 ($p < .05$) respectively. In accordance with the theory, A_{nuc} also correlated significantly with predictors NB_p ($r = .339$, $p < .01$) and A_{act} ($r = .247$, $p < .05$), and A_{bod} correlated with NB_1 ($r = .238$, $p < .05$).

The significant correlations under Activity 2 also show a similar tendency to conform to the theory. Attitude toward examinations (A_{exams}), and Physics 12 marks (PH_{12}) showed correlations of -.260 ($p < .05$) and -.236 ($p < .05$) respectively with BI. 'A_{exams}' also showed a correlation of -.260 with NB_p, while 'PH_{12}' showed a correlation of -.226 with A_{act} and -.225 with NB_5. The .240 ($p < .05$) correlation of B with $A_{pr\&em}$ (attitude toward the topic 'Propulsion and Electromagnetic Theory') was accompanied by a correlation of .317 ($p < .01$) between $A_{pr\&em}$ and NB_p.

This tendency to conform with the theory was not without some difficulty, as shown by the results for Activity 3 (Table VIII). While A_{nuc} tended to conform to theory by exhibiting correlations of .308 ($p < .01$), -.228 ($p < .05$), -249 ($p < .05$) and .293 ($p < .01$) with BI, NB_2, NB_3 and NB_p respectively, three other external variables did not conform. The attitude toward Physics in general (A_{phys}), showed correlations of .278 ($p < .01$) and .209 ($p < .06$) with B and BI respectively, but did not correlate significantly with any of the predictor variables (although the correlation

of A_{phys} with NB_p was associated with a probability value of $p < .075$). The attitude toward the textbook (A_{text}) showed a correlation of .294 ($p < .01$) with B, but no statistically significant correlation occurred with any of the predictor variables. Similarly, $A_{pr\&em}$ showed a marginally significant .218 ($p \simeq .05$) correlation with BI, but did not correlate significantly with any predictor.

Activity 5 produced two marginally significant ($p \simeq .05$) correlations of external variables with behavior, and Activities 4 and 5 combined gave seven significant correlations between the external variables and BI. Since predictor variables were not assessed for Activities 4 and 5, adherence to the theory could not be checked for these correlations.

2. The Relationship between Variables Internal to the Model (N = 128)

On the basis of theory, statistically significant product moment correlations were expected to occur between the criterion variables (BI and B), between the criterion and each of the predictor variables separately, and between the attitudinal and relevant normative predictor variables. Since separate, but similar normative predictor terms were used in the stepwise regression analysis, some significant correlations between these terms were also expected.

Tables IX and X summarize these correlations for each of the activities (note that A_{act} and NB_i were not assessed in Activities 4 or 5). Significant correlations were found in Activities 1, 2 and 3, between BI and the predictor variables, NB_p, A_{act} and NB_i. Correlations between B and the predictor variables, however, were small and often insignificant. A check of the BI-B relationship also revealed low correlations (non-significant in the cases of Activity 2 and Activity 4). Activity 3 showed a negative correlation of -.273 ($p < .01$) between B and NB_4 (normative belief with respect to the lecturer) although the correlation of BI with NB_4 was almost zero (.020NS).

Correlations between the predictor variables (Table X) indicated that the majority of normative beliefs were significantly and rather highly related to each other. A_{act}, however, was not very highly correlated with normative beliefs, with the exception of the personal normative belief, NB_p. The correlation of A_{act} with NB_p was about .50 for all activities analyzed. It is interesting to note that the A_{act}-NB_3 correlation in all three activities was consistently higher than the correlation of A_{act} with any other social normative belief.

In summary, the students' personal normative beliefs, attitudes toward the act, and normative beliefs with respect to 'closest friends', appeared to be most closely related to

TABLE IX

CORRELATIONS BETWEEN PREDICTOR AND CRITERION VARIABLES [a]

Predictor Variable	Activity 1		Activity 2		Activity 3		Activity 4	Activity 5
	BI	B	BI	B	BI	B	B	B
A_{act}	.383	.206*	.483	-.068NS	.498	.105NS		
NB_1	.385	.253	.368	.002NS	.185*	-.145NS		
NB_2	.192*	.118NS	.210*	-.009NS	.111NS	-.142NS		
NB_3	.236	.186*	.303	.007NS	.160NS	-.154NS		
NB_4	-.029NS	-.039NS	.107NS	-.032NS	.020NS	-.257		
NB_5	.182*	.080NS	.326	-.074NS	.080NS	-.107NS		
NB_p	.692	.267	.771	.114NS	.677	.180*		
BI	1.000	.280	1.000	.111NS	1.000	.268	.142NS	.339

[a] All correlations have been rounded off to three significant figures and are significant at $p = .01$ except where noted otherwise. (N = 128)

* $p < .05$

Abbreviations:

NS = Not significant

BI = Behavioral intention

B = Behavior

A_{act} = Attitude toward the act

NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'

TABLE IX (continued)

Activity 1 = attending a free lunch-hour movie entitled, "Environment in the Balance"

Activity 2 = signing up to receive information about a local pollution sampling experiment

Activity 3 = picking up a set of information materials and reading list on Pollution and Technology

Activity 4 = attending a free lunch-hour movie entitled, "The Time of Man"

Activity 5 = contacting the lecturer to obtain information about assisting the summer landfill leaching experiment

TABLE X

CORRELATIONS BETWEEN PREDICTOR VARIABLES [a]

	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p	A_{act}
Activity 1							
NB_1	1.000	.398	.550	.082NS	.339	.408	.223*
NB_2		1.000	.636	.245	.470	.268	.100NS
NB_3			1.000	.241	.500	.357	.227*
NB_4				1.000	.310	.074NS	.086NS
NB_5					1.000	.252	.125NS
NB_p						1.000	.505
Activity 2							
NB_1	1.000	.642	.697	.113NS	.519	.344	.125NS
NB_2		1.000	.600	.287	.496	.248	.138NS
NB_3			1.000	.250	.516	.366	.247
NB_4				1.000	.212*	.172NS	.168NS
NB_5					1.000	.330	.273
NB_p						1.000	.483
Activity 3							
NB_1	1.000	.687	.680	.146NS	.454	.178*	.062NS
NB_2		1.000	.702	.209*	.449	.208*	.150NS
NB_3			1.000	.186*	.487	.084NS	.166NS
NB_4				1.000	.269	.151NS	.126NS
NB_5					1.000	.164NS	.001NS
NB_p						1.000	.450

[a]All correlations have been rounded off to three significant figures and are significant at $p = .01$ except where noted otherwise. (N = 128)

* $p < .05$

TABLE X (continued)

Abbreviations:

NS	=	Not significant
A_{act}	=	Attitude toward the act
NB	=	Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'

Activity 1 = attending a free lunch-hour movie entitled, "Environment in the Balance"

Activity 2 = signing up to receive information about a local pollution sampling experiment

Activity 3 = picking up a set of information materials and reading list on Pollution and Technology

the behavioral intention in each activity. The other social normative beliefs tended to be somewhat less related to BI (generally having correlations of $r < .25$). The BI-B relationship tended to be low, but significant in Activities 1, 3 and 5, ranging between $r = .27$ and $r = .34$. The BI-B correlations for activities 2 and 4 were $r = .111$NS and $r = .142$NS respectively. Correlations of the predictor variables with BI tended to be larger than correlations of the same predictor variables with B. Fifty percent of the variables internal to the model correlated significantly with behavior or behavioral intention (in Activities 1 to 3), compared to a nine percent figure for significant correlations of the external variables with B or BI.

3. The Prediction of Behavioral Intention (N = 128)

Table XI shows the beta weights of the predictor variables and the multiple correlation of these variables with behavioral intention. The large multiple correlations obtained tend to indicate that behavioral intention can be predicted to a high degree of accuracy by the use of attitude toward the act and various relevant normative beliefs as predictors. The beta weight of A_{act} for Activity 1 was found to be non-significant, indicating that normative beliefs, specifically NB_1 and NB_p were the variables responsible in the prediction of BI for this activity. Activities 2 and 3 showed significant beta weights for A_{act}, indicating that

TABLE XI

STANDARDIZED REGRESSION COEFFICIENTS AND MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES ON BEHAVIORAL INTENTION [a]

Activity	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p	R
1	.054NS	.157	.025NS	-.095NS	-.085NS	.026NS	.627	.710
2	.164	.219	-.068NS	-.109NS	-.023NS	.043NS	.666	.797
3	.240	.131NS	-.228	.178	-.096NS	-.038NS	.608	.739

[a]All beta coefficients and multiple correlations have been rounded off to three significant figures and are significant at p = .01 except where noted otherwise. (N = 128)

Abbreviations:

NS = Not significant

A_{act} = Attitude toward the act

NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'

R = Multiple correlation of predictors on behavioral intention

Activity 1 = attending a free lunch-hour movie entitled, "Environment in the Balance"

Activity 2 = signing up to receive information about a local pollution sampling experiment

Activity 3 = picking up a set of information materials and reading list on Pollution and Technology

attitude toward the act as well as the relevant normative beliefs were important considerations in the prediction of behavioral intentions for those two activities. The only social normative belief found to be significant was NB_1 the normative belief with respect to 'closest friends'. The NB_1 beta weight was insignificant in Activity 3, but NB_2 (the normative belief with respect to 'parents') was seen to have a significant negative beta coefficient, and NB_3 (the normative belief with respect to 'majority of the class') had a significant positive weighting. The largest beta weight in all three activities was that of the personal normative belief (NB_p) which appeared to be the major contributor to the prediction of BI in each activity. The quantities of total variance in the prediction of BI accounted for by the predictor variables were .50, .63 and .55 for Activities 1, 2 and 3 respectively, leaving about forty to fifty percent unaccounted for. Table XII shows the percent of total variance accounted for by each predictor variable in the prediction of BI. NB_p accounted for the largest portion of the predictable variance in each activity, with A_{act} and NB_1 contending for the next largest quantity of variance.

TABLE XII

PERCENT OF TOTAL VARIANCE ACCOUNTED FOR BY EACH PREDICTOR VARIABLE IN THE PREDICTION OF BEHAVIORAL INTENTION [a]

Activity	A_{act}%	NB_1%	NB_2%	NB_3%	NB_4%	NB_5%	NB_p%	R^2%
1	2.05	6.06	0.48	-2.25	0.25	0.48	43.39	50.47
2	7.94	8.07	-1.42	-3.29	- .24	1.40	51.30	63.48
3	11.93	2.43	-2.54	2.85	- .20	- .30	41.17	54.67

[a]Although figures are given to two decimal places, these last two decimal places are not significant (N = 128). Percentages $\leq$ 5% are not significant.

Abbreviations: A_{act} = Attitude toward the act

NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3)'majority of the class', (4)'lecturer', (5) 'religious group', (p) 'myself'

R = Multiple correlation of predictors on behavioral intention

Activity 1 = attending a free lunch-hour movie entitled, "Environment in the Balance"

Activity 2 = signing up to receive information about a local pollution sampling experiment

Activity 3 = picking up a set of information materials and reading list on Pollution and Technology

4. The Prediction of Behavior (N = 128)

The prediction of behavior was found to be considerably less accurate than the prediction of behavioral intention. The beta coefficients and multiple correlations of the predictor variables with behavior are shown in Table XIII. The portion of total variance accounted for by the predictor variables in the prediction of behavior was found to be only .11, .04 and .14 for Activities 1, 2 and 3 respectively, leaving eighty-six to ninety-six percent of the variance unaccounted for. This poor prediction of behavior was also indicated by the low BI-B correlations shown in Table IX.

Although the beta weights of the predictors in the regression on B (Table XIII) were in most instances insignificant, they presented an interesting deviation from the pattern shown in the prediction of BI. A_{act} did not carry a significant weight for any activity, and NB_p was significant only in Activities 2 and 3. The only instance of a significantly weighted social normative belief came in Activity 3, with NB_4 (the normative belief with respect to the lecturer). The beta weight for NB_4 was negative and greater than the weight of NB_p. Such was not the case in the regression on BI, where NB_4 had a small, non-significant weight, and NB_p was highly significant ($p < .001$).

TABLE XIII

STANDARDIZED REGRESSION COEFFICIENTS AND MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES ON BEHAVIOR [a]

Activity	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p	R
1	.093NS	.155NS	<.01NS	.059NS	-.077NS	-.028NS	.149NS	.331*
2	-.146NS	-.034NS	.018NS	.043NS	-.034NS	-.114NS	.220	.210NS
3	.061NS	-.092NS	-.064NS	-.036NS	-.282	.014NS	.234	.376

[a]All beta coefficients and multiple correlations have been rounded off to three significant figures and are significant at $p = .01$ except where noted otherwise. (N = 128)

*$p < .05$

Abbreviations:

NS = Not significant

A_{act} = Attitude toward the act

NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'

R = Multiple correlation of predictors on behavior

Activity 1 = attending a free lunch-hour movie entitled, "Environment in the Balance"

Activity 2 = signing up to receive information about a local pollution sampling experiment

Activity 3 = picking up a set of information materials and reading list on Pollution and Technology

5. The Role of Behavioral Intention in Predicting Behavior (N = 128)

The results given in Tables XIII and XIV tend to support the hypothesis that BI is an intervening variable between overt behavior and the predictors of the Fishbein model. Each of the significant positive correlations between behavior and a predictor variable (Table XIV) was reduced to non-significance when the effect of BI was partialled out (Table XV). The negative product moment correlations given in Table XIV increased in value in the negative direction when BI was held constant (Table XV). Some non-significant negative product correlations became significant in the partial correlation matrix (Table XV).

6. Measurement Effect

In order to investigate measurement effects on actual performance of the extracurricular activities, a χ^2 test of independence was carried out for each activity. The 2 x 2 contingency tables used in these analyses are shown in Appendices N, O, P and Q.

The values of χ^2 (corrected for small cell frequencies) obtained for each activity, comparing the effect of the research instrument to the effect of the placebo instrument are given in Table XVI.

The possible presence of a measurement effect in Activity 3 led to the speculation that the placebo instrument

TABLE XIV

PRODUCT MOMENT CORRELATIONS OF BEHAVIOR WITH THE PREDICTOR VARIABLES [a]

Behavior	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p	BI
B_1	.206*	.253	.119NS	.188*	-.040NS	.081NS	.267	.280
B_2	-.068NS	.003NS	-.010NS	.008NS	-.032NS	-.074NS	.114NS	.111NS
B_3	.108NS	-.149NS	-.146NS	-.159NS	-.273	-.114NS	.192*	.268

[a] All correlations have been rounded off to three significant figures and are significant at $p = .01$ except where noted otherwise ($N = 128$); slight differences between the correlations shown in this table and those shown in Table X are due to different rounding errors between computer programs.

* $p < .05$

Abbreviations:

- NS = Not significant
- A_{act} = Attitude toward the act
- NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'
- BI = Behavioral intention
- B_1 = The performance (or non-performance) of Activity 1
- B_2 = The performance (or non-performance) of Activity 2
- B_3 = The performance (or non-performance) of Activity 3

TABLE XV

PARTIAL CORRELATIONS OF BEHAVIOR WITH THE PREDICTOR VARIABLES, HOLDING BEHAVIORAL INTENTION (BI) CONSTANT [a]

Behavior	A_{act}	NB_1	NB_2	NB_3	NB_4	NB_5	NB_p
B_1	.111NS	.164NS	.069NS	.131NS	-.033NS	.031NS	.106NS
B_2	-.140NS	-.043NS	-.035NS	-.028NS	-.032NS	-.118NS	.044NS
B_3	-.032NS	-.211*	-.184*	-.212*	-.289	-.142NS	.012NS

[a]All correlations have been rounded off to three significant figures and are significant at $p = .01$ except where noted otherwise. (N = 128)

*$p < .05$

Abbreviations:

- NS = Not significant
- A_{act} = Attitude toward the act
- NB = Normative beliefs with respect to: (1) 'Closest friends', (2) 'parents', (3) 'majority of the class', (4) 'lecturer', (5) 'religious group', (p) 'myself'
- B_1 = The performance (or non-performance) of Activity 1
- B_2 = The performance (or non-performance) of Activity 2
- B_3 = The performance (or non-performance) of Activity 3

TABLE XVI

CHI-SQUARE TESTS OF INDEPENDENCE OF THE PERFORMANCE OF ACTIVITIES, FROM THE RECEIVING OF A QUESTIONNAIRE**

Activity	Research vs placebo questionnaire		Placebo vs no questionnaire		Research vs no questionnaire		Research vs no questionnaire (absentees corrected)	
	χ^2	p<	χ^2	p<	χ^2	p<	χ^2	p<
1	.64	.50	5.78	.02	16.66	.001	6.23	.02
2	.04	.90	-*	-*	1.04	.50	.07	.80
3	3.53	.10	-*	-*	15.08	.001	8.52	.005
4	.53	.50	7.94	.005	21.33	.001	9.49	.005
5	.005	.95	1.36	.25	3.93	.05	1.24	.30

p is the probability of obtaining a χ^2 value greater than or equal to the corresponding tabled value, for one degree of freedom, given the null hypothesis H_d

H_d is the hypothesis that the performance of an activity is independent from receiving a questionnaire

*cell frequencies were too small for an accurate calculation of χ^2

**complete contingency tables are shown in Appendices N, O, P and Q

itself might produce some measurement effect and thus mask the measurement effect of the research instrument. This possibility was checked out by utilizing the students who received no instrument at all, as a control group. χ^2 tests comparing the behavior performance (or non-performance) of the students who received the placebo instrument, to the responses of those who received no instrument were carried out. Although cell frequencies were too small for computation of χ^2 in Activities 2 and 3, the χ^2 values obtained for Activities 1, 4 and 5 are shown under the 'Placebo vs no questionnaire' column of Table XVI. The contingency tables used in these calculations are given in Appendix O.

Another series of χ^2 tests was conducted, comparing the behavior responses of the students who received the research instrument to the responses of those who received no instrument (Appendix P). The results are given in Table XVI.

Measurement effect is apparently considerable for Activities 1, 3 and 4, marginal in Activity 5, and non-significant in Activity 2. One possible confounding factor should be mentioned; included in the group of students who received no measuring instrument were the absentees. No record of the exact number of absentees per lecture was kept, but a rough estimate by the professor in charge of Section 1

placed the number of daily absentees at an average of fifty. Assuming the worst case, i.e., that the same fifty students were absent for the entire lecture series, χ^2 values were recalculated[2] (Appendix Q) and gave the result shown in Table XVI. The fact that χ^2 values for Activities 1, 3 and 4 were still significant after being corrected for absentees would lend support to the existence of the measurement effect in at least these three activities.

7. Discussion of Results

The results indicate that Fishbein's model can be usefully applied in an educational situation. Problems in application of the theory noted in the literature and a few problems more specific to the present study became apparent. These problems are pointed out in the sections below, but not accounted for. The present study attempted to collect information about the applicability of Fishbein's theory to classroom practice and not information accounting for deviations from theory.

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[2]Correction for absentees (N = 50) was accomplished by subtracting fifty from the group of 132 students who received no questionnaire at all (there was no way of telling if those students were present or absent during the assessment lecture period except by behavior performance, since they did not turn in response sheets). From each contingency table given in Appendix P, fifty has been subtracted from the cell representing the number of students in the no instrument group who did not perform the behavior. This subtraction resulted in the contingency tables given in Appendix Q.

7.1 The Relationship between Variables Internal to and those External to the Fishbein Model

For Activity 3, the correlations (Table VIII) that appear not to conform with the theory were the correlations of attitude toward the textbook (A_{text}) with behavior ($r = .294$, $p < .01$), and attitude toward the topic 'Propulsion and Electromagnetic Theory' ($A_{pr\&em}$) with behavioral intention ($r = .218$, $p < .05$). Neither of these measures on attitude correlated significantly with any of the predictor variables.

The Activity 3 correlation of A_{phys} with B ($r = .278$, $p < .01$) might be interpreted with respect to the possibility of statistical fluctuation and the marginal significance of the correlation of A_{phys} with BI. The critical values for the correlation coefficient ($N = 89$) are $r = .274$ ($p = .01$) and $r = .210$ ($p = .05$). The correlation of A_{phys} with BI may be, within statistical fluctuation, considered marginally significant at the .05 level ($r = .209$). The correlation of A_{phys} with NB_p was previously shown to be $r = .190$, $p < .075$. Given the almost significant size of these correlations, plus the highly significant value of the beta coefficient for NB_p in Activity 3 (Table XI), the correlations of the external variable A_{phys} with the internal variable BI tends to conform to expectations based upon the theory, i.e., that any variables external to the model will be unrelated to

behavior and to behavioral intention, unless they can be shown to be statistically related to at least one of the predictors given in the model (7).

7.2 The Relationship among Variables Internal to the Model

The correlations of the predictor variables with BI (Table IX) tended to substantiate the theory that BI is a function of A_{act} and of the relevant normative beliefs. The observation that all significant correlations between BI and each normative belief were considerably reduced when each normative belief term was multiplied by its respective Mc variable, supports the conjecture (8, 9, 10) that the predictive value of Mc as measured is in serious doubt. Suggestions concerning this variable are made in the present chapter, section 7.4, and Chapter V, section 4.1.

The result that all significant correlations of the predictor variables with B were smaller than the corresponding correlations of the predictors with BI, (Table IX), is consistent with the theory that BI is an intervening variable between B and the predictor terms, but this effect could also have been due to method variance.[3] The negative relation-

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[3]Since behavior was assessed in a different manner than the other variables, it is possible that variance due to differences in method could account for the observation that behavioral intention consistently correlates more highly with the predictor variables than does behavior. Ajzen and Fishbein (10), however, have shown that variance due to method was not responsible for a similar effect observed in their work (p. 484).

ship between social normative beliefs and B in Activity 3 suggests that normative beliefs may actually shift polarity in the interval between the assessment of BI and the performance of the behavior. This, too is consistent with theory, in that behavioral intentions may change over time, or that the actual behavioral situation may not correspond with the individual's expectation of the behavioral situation. The low obtained BI-B correlations suggest the possibility that in these particular activities, the actual behavioral situations were not adequately described in the assessment of behavioral intentions, or that BI had changed considerably over a period of time. These possibilities suggest a need for determining the stability of a BI measure and also a need for procedures with which to estimate BI-B correspondence.

The consistently high ($r \simeq .48$) correlations (Table X) between NB_p and A_{act} suggests that these two predictor variables may have a component in common with each other. This specualtion is in accordance with Dulany's RHd variable which occurred in both the attitudinal and in the normative predictor variables of equation (2.3). Further, correlations between NB_p and BI ($r \simeq .71$) tend to indicate that in Activities 1 to 3, NB_p was not quite an alternative measure of BI as Ajzen and Fishbein (10) had found previously. This finding was further substantiated by the relative magnitudes of the beta coefficients of other predictor variables (Table XI).

The high ($r \simeq .65$) correlations between NB_2 and NB_3 for Activities 1 to 3 indicate the possibility of a common component or similarity between these two predictors. This result may also be applied to NB_1 and NB_2 ($r \simeq .58$), NB_3 and NB_5 ($r \simeq .50$), NB_2 and NB_5 ($r \simeq .47$), and NB_1 and NB_5 ($r \simeq .44$).

7.3 The Prediction of Behavioral Intention

Although the predictor variables accounted for at least fifty percent of the total variance in the prediction of BI (Table XII), forty to fifty percent was unaccounted for. This "error" variance may be speculatively explained by several possible attenuating factors. One factor might be the inherent reliability of the scales used in the measuring instrument. The reliability of the scales used was not determined directly because of practical limitations.[4]

A more important factor may have been the construct validity of the items in the instrument. The problems involved in developing valid measures on the various normative beliefs, relevant referents, the motivation to comply (Mc) variable, and the personal normative belief have been previously discussed. In the case of this particular study,

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[4] These practical limitations were discussed in Chapter I, section 6.

Chapter III indicated that the referent groups, 'scientific community' and 'university community', might have been more relevant to Physics 115 students than 'religious group' and 'majority of the class', the referents that were actually used.

Associated with the problem of predictive validity are the correlations of the predictors with each other. The fact that a number of predictor variables were highly related to each other necessarily resulted in some statistical attenuation of the multiple correlation values in the multiple regression analysis (46).

Response bias was largely an unexpected occurrence which may have negatively affected student response reliability. Several students were heard to make negative remarks about the questionnaire during the course of its completion. In addition, three response sheets that were handed in appeared to have been purposely spoiled. A total of fourteen response sheets were visually rejected as being potentially unreliable, but it is possible that others escaped detection.

Finally, the possibility that some unknown factors might be important predictors of BI should not be excluded. Dulany's (18) original theoretical framework maintained an openness to the addition of new terms. In Fishbein's model it is possible that a motivational component may in future be found to contribute significantly and consistently to the prediction of BI. It is also possible that specific

variables such as 'achievement anxiety', 'need achievement' or 'academic interest', might be required specifically in educational situations [Khan (31)] and that other specific variables might be required in other situations.

The question of the relative importance of the type of predictor variable (attitudinal or normative) used in predicting BI may be answered by reference to Table XI. For all three activities, normative beliefs outweighed the attitudinal variable by a large margin, although the value of the attitudinal beta coefficient increased from non-significance (.054NS) in Activity 1, to .164 ($p < .01$) and .240 ($p << .01$) for Activities 2 and 3 respectively. This increase in the weight of A_{act} from Activity 1 to Activity 3 shows up very distinctly in terms of percent of the total variance (Table XII), but is difficult to explain. Perhaps it depends on the degree to which students perceive each activity as contributing to their achievement in the lecture module concerned with environmental and technological assessment. It is possible that Activity 1 (attending a free lunch-hour movie entitled, "Environment in the Balance") and Activity 2 (signing up to receive information about a local pollution sampling experiment) were perceived by students as having few positive achievement consequences, resulting in A_{act} having little relative importance in the determination of BI. On the other hand, Activity 3 (the

picking up of a set of information materials and reading list on pollution and technology) appears to have had instructional value which may have been perceived by students as having beneficial consequences, if performed. This interpretation would be in line with Fishbein's conceptualization of A_{act} being, in part, a function of beliefs about the probability of an act resulting in certain consequences.

The large amount of variance (Table XII) accounted for by NB_p, compared to the amount accounted for by all social normative beliefs combined,might be a situational effect. Situations involving social interaction might be expected to show a greater combined weight in measures of social normative beliefs. This possibility should perhaps be investigated more thoroughly in future studies. From a strictly applicative point of view retaining both the personal normative belief variable and the social normative belief variables in the model seems advisable until this point is clarified.

7.4 The Prediction of Behavior

Low BI-B correlations (Table IX) and low multiple correlations of the predictor variables (Table XIII) on behavior made the interpretation of predictor variances in the prediction of behavior extremely difficult. The eighty-six to ninety-six percent of the total variance unaccounted for might, in part, be attributable to the factors discussed

in connection with other studies, namely, the time interval between the measurement of BI and the observation of B, the degree of volitional control that the individual had over his behavior in the specific situation, and the specificity of the measure of BI to the behavioral situation. These possibilities are discussed in order below. The observation was made that the magnitude of the beta coefficients given in Table XIII(in the regression on behavior), did not correspond to the rank order of beta coefficients in the case of a BI criterion (Table XI). Since the BI-B correlations were low in all activities, it was to be expected that the predictor variables would show different relative weighting in the regression on behavior than in the regression on behavioral intention.

While the relatively long time interval between measures of BI and measures of B may have had some effect in reducing the overall BI-B correlation values, it does not appear to have contributed to the differences in these correlations for different activities (Table IX). Activity 1 (the movie, "Environment in the Balance"), for example, had to be attended on February 11, four days after the assessment of the model variables. Activities 2 and 3 could have been completed immediately after the assessment (February 7), up to February 11. On the basis of time interval alone, Activities 2 and 3 should have higher BI-B correlations than Activity 1. Such was not the case. The BI-B correlation

for activity 1 was .280 and the BI-B correlations for Activities 2 and 3 were 111NS and .268 respectively. Furthermore, Activity 5 (contacting the lecturer about assisting in a summer landfill leaching experiment) could have been performed between February 7 and 29, a possible time interval of twenty-two days (including weekends), and yet this activity produced the highest BI-B correlation (.339, $p < .01$).

Constraints on student volition could have played some part in the size of the BI-B correlations in Activities 1 and 4 (the two lunch-hour movies). A few days after the showing of the Activity 4 movie, "The Time of Man", it was learned that one of a popular B.B.C. movie series ("Civilization") was being shown on campus at exactly the same time as "The Time of Man". Some of the Physics 115 students who initially expressed the behavioral intention of performing Activity 4 might have changed their minds in favor of seeing "Civilization", resulting in the BI-B correlation for Activity 4 being very low (.142NS).

The degree which 'non-specificity of BI assessment to the behavioral situation' played a part in reducing the BI-B relationships is unknown. In the absence of any rigorous methodological guidelines in the assessment of BI (several authors have used several methods), BI assessment questionnaire items were formulated on the basis on methods used in the majority of past studies, keeping any reference to the behavioral situation as specific as possible.

The relatively large BI-B correlation for Activity 5 gave rise to some speculation concerning the observed performance of behavior and the possibility of motivation as an influencing factor. Activity 5 was the only activity where the lecturer mentioned the possibility of students being paid on a summer job basis. Could this added incentive have increased the predictability of the performance of Activity 5 (contacting the lecturer about assisting in a summer landfill leaching experiment)? Perhaps in situations having little social interaction, 'motivation to comply' is less important than some other unknown motivational variable such as 'pay motivation', 'achievement motivation', 'entertainment motivation', or some general form of combined motivation variable. For example, 'entertainment motivation' might be a variable to consider when dealing with movie-going behavior.

Finally, in attempting to explain the error variance in the prediction of behavior in this particular study, it must again be stressed that this study did not employ the laboratory-type of reliability controls employed in most of the other studies. There were no replicative behaviors, or practice trials. There were no *post factum* measures of behavioral intentions or self-reports of behavior. The time between the measures of BI and the performance of B was substantially longer than in studies utilizing game situations. Also, the subjects, themselves were somewhat negative in their

reaction to the instrument used in assessing the variables. Another factor which also may have attenuated the BI-B correlations was a probable measurement effect. This subject discussed in detail in section 7.6 below.

7.5 The Role of Behavioral Intention in Predicting Behavior

The observation that any significant positive correlation between behavior and a predictor variable (Table XIV) was reduced to non-significance when BI was held constant (Table XV), tended to correspond with the findings of Ajzen and Fishbein (10) and Devries and Ajzen (8). This result thus tends to lend strength to the theory that BI is an intervening variable between behavior and the predictor variables. According to theory,the assessment of BI or its predictors must therefore be considered to be necessary for the prediction of behavior.

The tendency for negative correlations between behavior and predictor variables to become more negative when BI was held constant (Table XV), also tends to show that the addition of a measure of BI will influence behavior-predictor correlations in the positive direction, that is, the addition of a measure of BI enhances the prediction of behavior.

7.6 Measurement Effect

The problem posed by the results of the χ^2 tests is how to interpret the apparent presence of a measurement effect (of the type described in Chapter III, section 5.5) in some activities but not in others.

One possible explanation may be the differences in the measuring instrument with respect to the number of items used in assessing each of the variables. However, the differences in the items for Activities 1 to 3 (see Appendix C) appear to be very slight, the main difference being that an extra item (Number 1 in the questionnaire) was used in assessing BI for Activity 1. This particular item was later discarded in the final analysis of the data. All other items used for the assessment of variables were virtually identical for Activities 1 through 3. This similarity of questionnaire items used in the assessment of variables for the first three activities would appear to negate the possibility that the questionnaire composition could account for the differences in measuring effect indicated by the χ^2 tests for Activities 1 to 3. Furthermore, a significant χ^2 indication of measurement effect was obtained for Activity 4, and a non-significant χ^2 indication was obtained for Activity 5, and yet the only variable assessed by the questionnaire for these two activities was BI. It might therefore be inferred that in some cases the assessment of only one variable (BI), or even the distribution of a questionnaire, is sufficient to give rise to a significant measurement effect!

If such is the case, the particular behavioral situation may be postulated as playing a role in the observed differences in degree of measuring effect. Some speculation must again be called upon in order to provide a plausible explanation of an interaction between situation and measurement effect. If a student's response to a behavioral intention assessment item in the questionnaire was perceived by the student as a commitment to perform particular activity, then, whether or not he carried out this commitment might have depended on the student's perception of what the possible consequences would be if he fulfilled or changed his commitment. The student's perception of the consequences of fulfilling a commitment, in turn, might have depended upon his perception of the nature of the activity to be performed in fulfilment of his commitment.

If the student viewed the consequences of fulfilling a negative commitment (i.e., his intention not to go to a movie) as potentially bad, then he would perform the activity, even 'against his will' (or against his behavioral intention). This behavior, inconsistent with the original BI, might be interpreted as having arisen from a newly acquired BI, and could give rise to a low BI-B correlation as well as a significant measurement effect.

If the student, on the other hand, viewed the consequences of fulfilling his commitment as unimportant, then he would probably perform the activity in accordance with his assessed behavioral intention and no measurement

effect should arise. Also, if students perform an activity in accordance with their assessed BI, high BI-B correlations should result.

This explanation appears to work fairly well for most, but not all of the activities in this study. The specific reasoning for each case is given below.

In the case of Activity 1 ('to attend a free lunch-hour movie entitled "Environment in the Balance". . .'), the marginal χ^2 probability level ($p < .02$), indicated that the degree of measurement effect was low, but not negligible. This may have been due to the possibility of some students feeling a responsibility to carry out the activity even though they had made a BI response (commitment) indicating that they didn't intend to go to the movie. This behavior, inconsistent with the original BI, might have been initiated by the assessment of the original BI. The students may have contemplated the motives of the instructor asking that particular BI question. They may also have felt a strong possibility that material from the movie could appear on some examination in the near future.

The χ^2 result (.072NS) for Activity 2 ('to sign up to receive information about a local pollution sampling experiment . . .') indicated that the measurement effect for this activity was negligible. Students may have perceived this activity as being of such a voluntary nature, and so unrelated to their school work (the words 'no

obligation to participate' were used in the description of the experiment), that whether or not the BI commitment was honored was of little consequence. The low BI-B correlation ($r_{BI,B}$= .111NS) might be interpreted as a possible change of BI having occurred as a result of the students having a weak original BI (or commitment).

The highly probable ($p < .005$) measurement effect for Activity 3 ('to pick up a set of information materials and reading list on Pollution and Technology') might be interpreted in the following way: the students thought that the reading list and information materials might be advantageous for examination purposes, and therefore felt compelled to perform the activity, even though their original BI commitment indicated otherwise.

Activity 4 ('the attendance of a free lunch-hour movie entitled "The Time of Man" . . .') also resulted in a large measuring effect ($\chi^2 = 9.49$, $p < .005$). Why the measurement effect was greater for this activity than for Activity 1 (also a lunch-hour movie) is not known, but there are some possible explanations. One confounding factor was the concurrent showing of the B.B.C. series "Civilization". However, a more likely possibility was the emphasis placed on seeing "The Time of Man" by the lecturer--after the assessment of BI. This may have caused some of the students who did not intend to carry out Activity 4 to change their BI and perform Activity 4, fearing the consequences of what

might happen if they fulfilled their negative BI (commitment) and did not see the movie.

The non-significant measurement effect for Activity 5 ('to contact Dr. Phelps in order to obtain information about assisting the summer landfill leaching experiment') may be explainable in a manner similar to the lack of measurement effect in Activity 2. The BI response for Activity 5 may have been perceived by the student as constituting only a weak commitment because of the voluntary, non-examinable nature of this activity. The students were not under any compulsion to perform this activity because it pertained to an experiment that would be carried out during the summer months, after their completion of the Physics 115 course.

In the above discussion of the measurement effect, the assessment of BI, acting as a commitment, has been postulated to be a major source of this effect. The fact that a highly significant instance of measurement effect was also found in the case of the placebo instrument indicates that the assessment of other variables may have a similar effect. The above remarks must therefore be taken as highly speculative and not exclusive of other alternative explanations. It might be worthwhile, however, for some future study to investigate the possibility of reducing the measurement effect by eliminating the direct assessment of BI, by assessing only the predictor variables.

8. Summary

Most of the observed results tended to be explainable in terms of the Fishbein model and its associated theoretical concepts. Several results were obtained and interpreted according to the theory in order to clarify the specific problems investigated in the application of Fishbein's theory to an actual educational situation.

8.1 The Relationship between Variables Internal to and Those External to the Fishbein Model

The correlations of variables external to the model with variables internal to the model tended to agree with the theory, namely, that any variables external to the model should be unrelated to behavioral intention and to overt behavior unless they are significantly related to at least one of the predictors given in the model. There were nine observed instances out of a possible 102, where external variables correlated significantly (both positively and negatively) with B or BI. All of these cases but three (Table VIII, Activity 3) also showed significant correlations between the external variable and at least one predictor variable. The three cases that did not appear to agree with theory, could be accounted for by the statistical probability of obtaining significant correlations by chance alone.

8.2 The Relationship between Variables Internal to the Model

Significant correlations (Table IX) were consistently found between measures of BI and the predictor variables NB_p, A_{act} and NB_1. The magnitudes of correlations between measures of BI and the other social normative beliefs (NB_2 to NB_5) varied considerably between activities, several reaching significance.

Correlations between behavior and measures of behavioral intentions were disappointingly low, although three were significantly greater than zero ($p < .01$). Correspondingly, correlations between behavior and measures of the predictor variables were also small, and frequently insignificant.

The majority of normative beliefs were found to be significantly and rather highly related to each other (Table X). The correlation between measures of A_{act} and social normative beliefs (NB_1 to NB_5) tended to be low and often non-significant, but the correlation between measures of A_{act} and NB_p was always relatively large ($\simeq .50$) and significant.

Correlations of measures of the predictor variables with BI tended to be larger than correlations of the same predictor variables with B (Table IX).

8.3 The Prediction of Behavioral Intention

Multiple correlations of .710, .797 and .739 were obtained for Activities 1, 2 and 3 respectively, in the prediction of behavioral intention from measures of the specified predictor variables. The amounts of total variance (in the prediction of BI) accounted for by the predictor variables were .50, .63 and .55 for Activities 1 to 3 respectively, leaving about forty to fifty percent unaccounted for.

The predictor term showing the largest beta coefficient was the normative, rather than the attitudinal term (Table XI). Specifically, the personal normative belief variable (NB_p) was observed to have the greatest weight, with A_{act} and NB_1 trailing far behind.

8.4 The Prediction of Behavior

The prediction of behavior was found to be considerably less accurate than the prediction of behavioral intention. Multiple correlations of measures of the predictor variables on B were only .331 ($p < .05$), .210NS, and .376 ($p < .01$) for Activities 1, 2 and 3 respectively, accounting for only four to fourteen percent of the total variance in the prediction equation.

8.5 The Role of Behavioral Intention in Predicting Behavior

The observation that any significant positive correlation between behavior and a predictor variable (Table XIV) was reduced to non-significance when BI was partialled out (Table XV) tended to agree with the theory that BI is an intervening variable between behavior and the predictor variables. According to Ajzen and Fishbein (10), the prediction of BI is therefore a necessary, as well as sufficient, condition for the prediction of overt behavior.

8.6 Measurement Effects

χ^2 tests of independence in the performance of the extracurricular activities under research instrument and no instrument conditions resulted in the detection of a significant measurement effect in Activities 1, 3 and 4 (Table XVI). The assessment of BI and the particular behavioral situation have been postulated as possible contributors to the occurrence of the type of measurement effect found by this study. BI was likened to a commitment, the degree of commitment possibly determining the degree of the measurement effect when negative BI s (low probabilities of intention) are held by individuals in specific situations.

The measurement effect may have some importance in the prediction of B from BI. If B is, to a great degree,

influenced by a particular measuring instrument, then B would not be expected to be predictable from a measure of BI alone. The BI-B relationship should therefore be much lower in the presence of a significant measuring effect.

CHAPTER V

CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS, AND SUMMARY

1. Recapitulation of the Problem

The major problem of this study was the investigation of the general hypothesis that if a Physics 115 student's attitudinal and normative position with respect to performing a free-choice learning task can be determined, then his intention of performing the task, and his actual performance of the task, may be predicted with better than chance accuracy. This prediction of behavioral intention and overt behavior might be accomplished by the application of Fishbein's theory (6) to the educational situation provided in the experimental program instituted by the Physics Department.

Consideration of this general hypothesis led to the investigation of the following specific problems:

(a) identification of the relationship between variables internal to and those external to the Fishbein's model;

(b) determination of the relationship between behavior, measured behavioral intention, and the attitudinal and normative predictor variables of the model;

(c) analysis of the accuracy of the prediction of behavioral intention and behavior and

the relative importance of the predictors in the prediction;

(d) analysis of behavioral intention measures as predictors of overt behavior in specific educational situations; and

(e) the detection of possible measurement effects.

2. Conclusions

The general hypothesis that the application of Fishbein's theory to free-choice learning situations would accord better than chance accuracy in the prediction of behavioral intention and overt behavior appeared to be substantiated in the case of behavioral intention, but was problematic in the case of behavior prediction. Nevertheless, better than chance accuracy was obtained for the prediction of behavior in two out of the three activities for which the full complement of model variables were assessed, and in three out of five activities when behavioral intention was the only predictor considered.

Analysis of the specific problems tended to indicate that the measuring instrument devised for use in the free-choice learning situations of this study, obtained measures of variables equivalent in most relational characteristics, to the variables assessed by Fishbein and his co-workers in past studies. The assessed variables exhibited relationships that largely agreed with those given in Fishbein's theory.

One result not observed in past studies was a significant measurement effect in certain of the free-choice situations. This effect could possibly be detrimental to the prediction of behavior in certain situations and therefore potentially limit the applicability of the Fishbein model in an educational context.

Specific to the learning activities described in this study, it may be apparent that measures of behavioral intention alone would not give a Physics instructor sufficient information for accurately choosing activities that students would perform in accordance with their intentions. It is suggested that this problem may be due, in part, to measurement effects, to differences between the actual situation and the situation description used in the assessment of the behavioral intention, or to changes in behavioral intention brought about by the many possible competing activities constantly emerging in student environments.

On the other hand, the model provided better than chance predictions of behavior in three fifths to two thirds of the situations examined in this study, or at least sixty percent of the time, an achievement that would probably be difficult to accomplish by means of guesswork or chance. Furthermore, the model provides an instructor with a <u>systematic</u> means for behavior prediction and provides information concerning the nature of some of the variables that appear to influence behavior. The correlations of behavior

with behavioral intentions obtained in this study, for example, might indicate to a Physics instructor, that Activities 1, 3, and 5 elicited behavior responses that are more in accordance with student intentions than the responses in Activities 2 and 4. A comparison of the standardized regression coefficients in the regression on behavioral intention and on behavior suggests that for Activities 1 to 3, the variable that is most influential in predicting BI and B is the measure of the personal normative belief. Small contributions to the prediction appear to be due to the attitude toward the act and the social normative belief concerning students' best friends. The contribution of A_{act} to the prediction of BI also appears to increase with salience. If the instructor is interested in effecting behavior changes in Physics 115 students, he should consider the possibility of modifying students' personal normative beliefs concerning the activities, modifying their attitudes toward performing the activities, and modifying their social normative belief with respect to their best friends. Similarly, if the instructor is interested in matching his teaching strategy to the belief systems of his Physics 115 students, he should somehow work personal normative beliefs, attitude toward the act, and social normative beliefs (with respect to 'closest friends') into the curriculum.

3. Implications and Recommendations for Educational Application

In view of the above discussion, the application and refinement of Fishbein's model in educational research appears worthy of serious consideration. Inherent in the theory and the presented results of its application, are a number of implications that could generally have important consequences for educational practice. Some of these implications will now be examined.

3.1 The Fishbein Model versus Traditional Approaches to Attitude Measurement

The traditional measures of attitude toward various educational and instructional objects (for example, attitude toward Physics in general, Physics 115, method of class instruction, the lecturer, the textbook, the subject matter, assignments, examinations, and specific topics) showed few significant correlations with behavior or behavioral intention. Those attitudes that were significantly related to behavior or behavioral intention, were almost always related to one of the predictor variables of the theory. This would tend to imply that traditional measures of attitude are poor predictors of educational behavior and that Fishbein's theory should be considered in any attempts to relate attitudes and overt behavior. Specifically, the assessment of attitudes toward an act, social normative beliefs,

personal normative beliefs and behavioral intention, would probably give educators a more accurate indication of the means of effecting behavioral modification, than would the attitude scales commonly used.

3.2 The Modification of Behavior

Since behavior and behavioral intention were seen to be a function of attitude toward the act and various normative beliefs, an educator should best be able to effect a strengthening or weakening of specific behaviors and behavioral intentions by operating on (attempting to strengthen or weaken) the predictor variables having the greatest importance (beta weights) in the regression equation. Once these influential variables have been identified, the problem immediately becomes one of selecting the treatments by which a teacher can influence desired changes in these variables over a reasonable period of time. Can the teacher influence A_{act}, by making students aware of, or by actually manipulating the probable consequences of their specific behaviors? Can social normative beliefs be modified by placing students in direct contact with relevant referents in certain situations, by engaging students in role playing or simulation games, or by conducting counselling sessions about relevant referents? The interpretation of the personal normative belief is not yet clear in the theory, but perhaps

this variable could be influenced by placing students into guided introspective situations, for example, encouraging students to analyze their own mistakes, evaluate their own achievement, or to justify their own position (or an opposite position) in debate. Educational research into the efficacy and the methodology of effecting changes in the predictor variables is strongly recommended.

3.3 Specificity of Attitudes, Normative Beliefs, Intentions and Behavior

Teachers should expect students to exhibit different attitudes toward an act and normative beliefs in even minimally different situations. Applications of the Fishbein model have shown that the weights and polarities of the predictor variables vary considerably between situations. Since behavioral intention and behavior have also been found to be specific with respect to the situation, behavior and behavioral intention cannot empirically be expected to remain constant from one situation to another, unless both situations are virtually identical.

3.4 Generalization in the Prediction of Behavior and Behavioral Intention

The results of the pilot study indicated that the relevance of the referent groups used in assessing the various

normative beliefs, varies with respect to the particular population sampled. The relative importance of the predictor variables is therefore specific to the population sampled. While this factor did not appear to be critical in the present study, populations having vastly different characteristics such as ability, interests, cultural background, or socioeconomic background would be expected to exhibit different relative weightings for the predictor variables. A teacher might therefore be required to treat one group of students very differently from another group, when attempting to effect a behavior change through attempts to modify characteristics represented by the predictor variables.

3.5 Measurement Effects and the Nature of the Situation

Since significant measurement effects were found for certain activities in the present study, the behavior of students in specific educational situations may, in part, result from an attempt to assess one or more variables of the Fishbein model. If measurement effects play a large role in the determination of educational behavior, then the accuracy of behavior prediction may be considerably reduced.

The detection of these effects, however, may give educators a useful indication of the extent of psychological threat or volitional constraint on students, posed by the testing situation and/or the educational situation. It is

therefore recommended that these effects be monitored in any future applications of the Fishbein model to educational research.

Furthermore, measurement effects might actually be useful in producing desired behavior changes. If the distribution of a questionnaire can influence student behaviors in particular situations, as some results of this study indicate, then simulated devices of a similar nature might also influence student behavior significantly. Irrespective of the ethical questions raised by this possibility, any possible useful applications of such effects should be fully investigated.

3.6 The Fishbein Model and Curriculum Development

The identification of the relevant variables that enter into the prediction of a group's educational behavior, may give curriculum developers a method for tailoring some of the psychological aspects of course content to the needs of the majority of the class. This might be a more viable approach to 'humanizing' or making a course 'more interesting' than the indiscriminant addition of attitudinal and value-laden concepts to subject matter. If, as was discussed in section 3.2 of the present chapter, teachers would be willing to match their teaching strategies to the dominant belief systems of the students (as indicated by the multiple regression analysis), then there may be a possibility for

developing curricula containing 'contingency programs', i.e., alternative teaching programs that the teacher could use in order to influence one, or any combination of the dominant predictors. The author wishes to stress that he is not advocating this scheme as a substitute for existing programs, but is only pointing to a possible direction for further research. This caution is prompted by the notion that if teachers were to completely tailor the courses of study toward dominant student beliefs and attitudes, students might suffer a lack of personal growth in other important areas.

Perhaps Fishbein's model could be investigated by educators, from a point of view of an attitudinal component of one or another teaching models as discussed in a recent book by B. Joyce and M. Weil (47).

4. Recommendations for Further Research

4.1 The Psychological Context

Several of the problems encountered in the present application of Fishbein's model to an educational situation pointed to needs for more research in the areas of validation, instrumentation and cross-validation.

In the area of validation, the possibility of a motivational variable other than Mc entering into the regression should be investigated, and measures of other

variables such as values, traditions, and conditioned behavior might also be considered.[1] The validity of Mc or the way in which Mc is entered into the normative term should also be clarified as should the interpretation of the personal normative belief (NB_p).

The observation that past studies have used various methods for the assessment of the variables given in the regression equation tends to substantiate Fishbein's (6) claim that instrumentation is not a critical factor in the theory. However, Tittle and Hill (13) suggested the superiority of a Likert-type attitude scale over the Semantic-Differential instrument in predicting behavior. The Behavioral-Differential instrument has been used by Carlson (33), and Ajzen and Fishbein (9) who also have used a percentage of intent question (10, 32) and probability scale (8) for the assessment of BI. Perhaps a comparative study of assessment techniques would clarify the question of whether some measures of B, BI, A_{act}, NB and Mc yield better predictions of behavior than others.

Associated with instrumentation is the method used in

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[1] In a recent paper, Maehr and Sjogren (48) propose the use of Atkinson's (49) theory of achievement motivation as a first step toward a theory of academic motivation. The theory is essentially based on a multiple regression equation having three predictor terms that are used in a linear combination for the prediction of T_a--an active impulse to undertake a particular achievement-oriented activity. In educational settings a variable such as 'achievement motivation' might conceivably function (in a prediction model) in a manner similar to 'motivation to comply' (with an experimenter) in a laboratory situation.

analyzing the obtained data. Standard multiple regression analysis was said to attenuate multiple correlation values when there are significant intercorrelations among the predictor variables. This technique is therefore primarily suited to regression equations involving independent variables. Canonical correlation analysis, however, takes predictor intercorrelation into account and can also be used to treat multiple criteria (50). The practicability of using B and BI as multiple criteria and accounting for the intercorrelations between the predictor variables by means of canonical correlation analysis should be investigated.

Cross-validation of measures derived from the theory over various populations is another area requiring further research. Specifically, more should be done in the areas of anthropology (i.e., cultural differences) and sociology. Of particular interest to educators would be a study involving the application of Fishbein's model over various age levels, from primary grades through university.

Finally, a need for some method of estimating the test-retest reliability and stability of the type of instrument used in this study, was indicated by the lack of such information in this and past studies and the number of assumptions that had to be made concerning the predictive validity of the model (see Chapter I, section 6).

4.2 The Educational Context

The implications of applying Fishbein's model in educational situations have raised some interesting prospects for educational research.

One possibility mentioned was to use the Fishbein model rather than solely traditional approaches to attitude measurements for assessment of behavior tendencies in students.

Another area requiring considerable research would be behavior modification. What teaching methodologies could be used to modify student attitudes toward an act or to modify normative beliefs in order to possibly effect a change of behavior in educational situations (see section 3.6 of the present chapter)?

Can Fishbein's model be used to assess student intentions, beliefs and influential referent groups concerning troublesome behavioral situations outside the classroom (for example: drug behavior, sex behavior, smoking behavior and various destructive types of behavior)? Fishbein's study on sexual behavior in university students (36) indicates that limited (but potentially useful) results may be obtained even from self reported behavior. The model might eventually provide a basis for counselling students on such problems.

Finally, although a previous study by Ajzen and Fishbein (10) investigated measurement effects, the present study appears to be the only application of Fishbein's model in which a significant measurement effect has been detected.

Are educational situations more prone to this effect than other situations? Can this effect be reduced by avoiding the direct assessment of BI? Research into the mechanism, interpretation of, and reduction of this effect is strongly recommended.

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APPENDIX A

PILOT STUDY QUESTIONNAIRE ON REFERENT GROUPS

ACTIVITIES SURVEY

(your name is not required)

Listed below are some people or groups whose opinions you might feel are important for you to consider when it comes to making decisions about participating in educational activities apart from coursework. For example, some activities may involve your going to an educational lunch-hour movie, or your possible participation in an environment conservation club, etc.

DIRECTIONS:

Please indicate the importance of the opinions of the following persons or groups, by circling the number corresponding to the particular degree of importance that you feel is appropriate for each person or group.

Person or Group	Very Important	Important	Neutral or Undecided	Unimportant	Insignificant
	1	2	3	4	5
1. Your Parents	1	2	3	4	5
2. Your Relatives	1	2	3	4	5
3. Your best friend(s)	1	2	3	4	5
4. Your lecturer(s)	1	2	3	4	5
5. Yourself	1	2	3	4	5
6. Majority of class members	1	2	3	4	5
7. Society in general	1	2	3	4	5
8. Scientific community	1	2	3	4	5
9. University community	1	2	3	4	5
10. Religious group or church	1	2	3	4	5
11. Club members	1	2	3	4	5
12. Other (specify)_____	1	2	3	4	5

APPENDIX B

PERCENT OF STUDENT RESPONSE TO "IMPORTANT" AND "VERY IMPORTANT" CATEGORIES FOR VARIOUS REFERENTS, FOR TWO SETS OF STUDENTS

PRELIMINARY DATA

PERCENT OF STUDENT RESPONSE TO "IMPORTANT" AND "VERY IMPORTANT" CATEGORIES FOR VARIOUS REFERENTS, FOR TWO SETS OF STUDENTS [a]

Referent	% Response Educ. 321 Students (N = 64)	% Response PH. 115 Students (N = 50)
Yourself	100	100
Your best friend(s)	62	66
Your lecturer(s)	39	46
Your parents	39	54
Religious group or church	25	16
Majority of class members	22	20
Society in general	16	28
Club members	11	30
Scientific community	9	46
University community	9	32
Relatives	6	16
Others (combined)	8	0

[a]The Spearman rank correlation (corrected for ties) between the two sets of student responses was found to be 0.882 ($p < .001$)

APPENDIX C

RESEARCH QUESTIONNAIRE

Part A Follow-up Activity No. 1

To attend a free lunch-hour movie entitled "Environment in the Balance" on Friday, February 11 at 12:30 P.M. in the Hebb Theatre. This British colour film presents an effective all-round study of the impact of technology on the environment.

Please indicate your thoughts about seeing this movie:

1. I intend to see this movie only if I have nothing else to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

2. I intend to see this movie.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

3. I intend to see this movie only if I have time.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

4. My closest friends would expect me to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

5. My parents would expect me to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

6. The majority of the class would expect me to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

7. Dr. Phelps would expect me to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

8. My religious group would expect me to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

9. I would expect myself to see the movie.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

10. Concerning my seeing the movie, I want to do what I think my closest friends expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

11. Concerning my seeing the movie, I want to do what I think my parents would expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

12. Concerning my seeing the movie, I want to do what I think the majority of the class expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

13. Concerning my seeing the movie, I want to do what I think Dr. Phelps expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

14. Concerning my seeing the movie, I want to do what I think my religious group expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

15. Concerning my seeing the movie, I want to do what I would expect myself to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

16. Attending this movie would be a good thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

17. Attending this movie would be a boring thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

18. Attending this movie would be a useful thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

19. Attending this movie would be a bad thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

20. Attending this movie would be a pleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

21. Attending this movie would be a useless thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

22. Attending this movie would be an interesting thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

23. Attending this movie would be an unpleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

Part B Follow-up Activity No. 2

To sign up to receive information about a local pollution sampling experiment. You will also receive information on how you may participate in the experiment if you wish. Sign the list on the front counter of the Physics Office (Hennings 323) by Friday, Feb. 11, in order to receive this information (no obligation to actually participate).

Please indicate your thoughts about signing up to receive information about this experiment:

24. I intend to sign up to receive this information only if I have time.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

25. I intend to sign up to receive this information.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

26. My closest friends would expect me to sign up for this information,
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

27. My parents would expect me to sign up for this information.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

28. The majority of the class would expect me to sign up for this information.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

29. Dr. Phelps would expect me to sign up for this information.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

30. My religious group would expect me to sign up for this information.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

31. I would expect myself to sign up for this information.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

32. Concerning signing up to receive this information, I want to do what I think my closest friends expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

33. Concerning signing up to receive this information, I want to do what I think my parents would expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

34. Concerning signing up to receive this information, I want to do what I think the majority of the class expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

35. Concerning signing up to receive this information, I want to do what I think Dr. Phelps expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

36. Concerning signing up to receive this information, I want to do what I think my religious group would expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

37. Concerning signing up to receive this information, I want to do what I would expect myself to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

38. Signing up for this information about the pollution sampling experiment would be a good thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

39. Signing up for this information would be a useful thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

40. Signing up for this information would be a bad thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

41. Signing up for this information would be a pleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

42. Signing up for this information would be a useless thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

43. Signing up for this information would be an unpleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

Part C Follow-up Activity No. 3

To pick up a set of information materials and reading list on Pollution and Technology. These materials may be picked up (one set per student) from Hebb 11 (the Physics Lab. Office) up to Friday, February 11.

Please indicate your thoughts about picking up this set of Pollution information materials:

44. I intend to pick up this set of Pollution information materials only if I have time.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

45. I intend to pick up this set of Pollution information materials.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

46. My closest friends would expect me to pick up this set of materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

47. My parents would expect me to pick up this set of materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

48. The majority of the class would expect me to pick up this set of materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

49. Dr. Phelps would expect me to pick up this set of Pollution information materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

50. My religious group would expect me to pick up this set of materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

51. I would expect myself to pick up this set of materials.
Highly likely 1 Likely 2 Undecided 3 Unlikely 4 Highly unlikely 5

52. Concerning picking up this set of materials, I want to do what I think my closest friends expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

53. Concerning picking up this set of materials, I want to do what I think my parents would expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

54. Concerning picking up this set of materials, I want to do what I think the majority of the class expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

55. Concerning picking up this set of materials, I want to do what I think Dr. Phelps expects me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

56. Concerning picking up this set of materials, I want to do what I think my religious group would expect me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

57. Concerning picking up this set of materials, I want to do what I expect myself to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

58. Picking up this set of Pollution information materials would be a good thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

59. Picking up this set of materials would be a useful thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

60. Picking up this set of materials would be a bad thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

61. Picking up this set of materials would be a pleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

62. Picking up this set of materials would be a useless thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

63. Picking up this set of materials would be an unpleasant thing for me to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

Part D Follow-up Activity No. 4

To attend a free lunch-hour movie entitled "The Time of Man" on Wed., Feb. 16 at 12:30 P.M. in the Hebb Theatre. This film examines man's relationship with his environment, where he is headed - and why.

Please indicate your thoughts about seeing this movie:

64. I intend to see this movie only if I have nothing else to do.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

65. I intend to see this movie.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

Part E Follow-up Activity No. 5

To contact Dr. Phelps (Civil Engineering Rm. 444) in order to obtain information about assisting the summer landfill leaching experiment. (contact Dr. Phelps before the end of February).

Please indicate your thoughts about this activity:

66. I intend to contact Dr. Phelps for information concerning this summer project.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

HAVE YOU GIVEN YOUR NAME AND IDENTIFICATION NUMBER CORRECTLY AT THE TOP OF THE ANSWER SHEET?

APPENDIX D

RESPONSES TO THE RESEARCH QUESTIONNAIRE

NOTE.
1. BEHAVIOR IS CODED IN THE LAST 5 RESPONSES
   IN EACH CASE. 1=BEHAVIOR NOT PERFORMED,
   5=BEHAVIOR WAS PERFORMED.
2. POLARITIES OF RESPONSES HAVE BEEN REVERSED
   FOR SUMMATION IN THE FOLLOWING ITEMS:
   2,4-16,18,20,25-39,41,45-59,61,65,66.

STUDENT NUMBER	RESPONSES TO ITEMS
1567718	3321115333331333334343443222 51
	11115133333333311151
	31112133333334321 1111
1755719	41412121111111545344444222212 1
	21333352433330000000
	0C0C0C00C0CCCOC011111
2236719	3151115115553355155111551111 51
	1111153551513122441 1
	14344333324442311111 1
2439719	22212153245133543444443212143
	15511355554332311153
	15511353333331311111 1
2442713	24422243422223444444444422243
	42222324444444422243
	42222344444424251151
2459717	23222242433442442444443322242
	32233244343433322242
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EXECUTION TERMINATED

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APPENDIX E

PLACEBO QUESTIONNAIRE

Physics 115

Reassessment of Student Opinions About the Course

A Note to the Student:

The purpose of this questionnaire is to see whether or not your opinions about the course have changed since the first term. Please forgive the intrusion, but there really is no other way for us to obtain a valid estimation of your opinions. As before, your responses to this questionnaire will in no way count toward or affect any marks for the course.

By indicating your honest response to each statement, you will be helping us to decide whether or not our efforts in modifying the course have been in the right direction.

Directions: USE ONLY PENCIL

1. Please PRINT your name and registration number (seven digits) on the PRINTED ANSWER SHEET. Give your registration number both in numerical form and by blackening the appropriate spaces.

2. Indicate your response to each statement by blackening the appropriate spaces on the PRINTED ANSWER SHEET. Blacken only ONE of the five small-numbered spaces indicated for each statement.

3. When you have finished, hand in this booklet and your answer sheet. Place your completed answer sheet on the front counter, under the alphabetic letter corresponding to the first letter of your surname.

NOTE: Begin at question number 29 on the printed answer sheet and leave numbers 1 to 28 blank.

I - PHYSICS IN GENERAL

DO NOT WRITE IN THIS BOOKLET. Use the answer sheet.

29. Physics is something everyone should know something about.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

30. Physics is worthless.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

31. Physics is a dehumanizing subject.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

32. Physics is enjoyable.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

33. Physics is a fascinating subject.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

34. Physics is far too difficult for most students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

35. Physics is intellectually stimulating.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

36. Physics is boring.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

37. Physics is related to everyday things.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

38. Physics is unrelated to problems that really matter.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

II - PHYSICS 115 COURSE

39. Physics 115 is more interesting than Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

40. Physics 115 is nothing more than a review of Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

41. Physics 115 is a challenging course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

42. Physics 115 is irrelevant to the interests of the students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

43. Physics 115 is a boring course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

44. Physics 115 is more worthwhile than Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

45. Physics 115 is relevant to the interests of the students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

46 Physics 115 should only be taken by students who are interested in becoming physicists.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

47. Physics 115 is too difficult for most students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

48 Physics 115 is frustrating because students do not know what is expected of them.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

49. Physics 115 is a valuable course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

III - INSTRUCTION IN LECTURES

50. Lectures should only be given by instructors who are first-rate physicists.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

51. The method of teaching used in lectures does not allow for enough student participation to suit me.
Strongly agree 1 agree 2 Undecided 3 Disagree 4 Strongly disagree 5

52. Lectures should include more up-to-date teaching techniques.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

53. Instruction in lectures helps to make the important ideas clear to me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

54. Instruction in lectures is of great help to me in solving physics problems.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

55. Instruction in lectures is too fast.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

56. Instruction in class is boring.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

57. Instruction in lectures encourages students to express their own viewpoints.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

58. Instruction in class should be more individualized.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

59. Instruction in lectures is good.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

IV - LECTURER

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60. The lecturer knows his subject well.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

61. The lecturer's explanations are unclear.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

62. The lecturer has the ability to hold the interest of the class.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

63. The lecturer is one of the best things about the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

64. The lecturer is inconsiderate toward students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

65. The lecturer's pace is too fast.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

66. The lecturer reviews course material adequately.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

67. The lecturer has a rigid teaching style.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

68. The lecturer acts as if teaching is a chore.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

69. The lecturer makes me dislike physics.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

V - VARIOUS ASPECTS OF THE COURSE

70. The textbook is easy to understand.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

71. The textbook is of little value in the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

72. The textbook does not explain things adequately.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

73. The textbook is well written.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

74. The subject matter in the course is well organized.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

75. The subject matter of the course is excellent.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

76. The subject matter of the course should be more closely related to things that really matter.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

77. The subject matter of the course is too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

78. The subject matter of the course is a valuable asset to my education.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

79. The outside readings in the course are too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

80. The assignments are reasonable in length.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

81. The assignments are too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

82. The assignments should deal with more practical problems.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

83. The assignments are a worthwhile part of the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

84. Outside readings in the course should be increased.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

VI - EXAMINATIONS

85. The exams provide a good learning experience.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

86. The exams emphasize marks too much.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

87. Exams are too long to complete on time.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

88. The exams cover a fair sample of the material studied in the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

89. The exams are generally very poor.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

90. The exams are marked fairly.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

91. The examinations are too difficult.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

92. The exams stress memorization too much.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

93. The examinations really make me think.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

94. Exams are not given often enough.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

APPENDIX F

BEHAVIOR OF STUDENTS RECEIVING THE PLACEBO QUESTIONNAIRE

BEHAVIOR OF STUDENTS - PLACEBO QUESTIONNAIRE

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2486710	0	0	0	0	0
2938710	0	0	0	0	0
2496719	0	0	0	0	0
3736717	0	0	0	0	0
2497717	1	0	0	1	0
6871719	1	0	0	0	0
2512713	0	0	0	0	0
2514719	0	0	0	0	0
3409703	0	0	0	0	0
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7433717	0	0	0	0	0
5231717	0	0	0	0	0
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2671717	0	0	0	0	0
6553705	0	0	0	0	0
6802714	0	0	0	0	0
6809719	0	0	0	0	0
2702710	0	0	0	1	0
3085719	0	0	0	0	0
3089711	1	0	0	1	0
3102712	0	0	0	0	0
3112711	0	0	0	0	0
2756716	0	0	0	0	0
6824718	0	0	0	0	0
3122710	0	0	0	1	0
3134715	0	0	0	0	0
2773711	1	1	1	0	0
6830715	0	0	0	0	0
2779718	0	0	0	0	0
2807717	0	0	0	1	0
3824711	0	0	0	0	0
3172715	1	0	0	1	0
2838712	0	0	1	0	0
2846715	0	0	0	0	0
6348718	0	0	0	0	0
1707710	0	0	0	0	0
5078704	0	0	0	0	0
6849715	0	0	0	1	1
3200714	0	0	0	0	0
6090716	1	0	0	0	0
6611719	0	0	0	0	0
3220712	1	0	0	0	0
7227713	1	0	0	1	1

APPENDIX G

LIST OF FOLLOW-UP ACTIVITIES

Voluntary Follow-up Activities for the Block of Lectures on "THE PHYSICS IN ENVIRONMENTAL AND TECHNOLOGICAL ASSESSMENT"

1. You may attend a free lunch-hour movie entitled "Environment in the Balance" on Friday, February 11 at 12:30 P.M. in the Hebb Theatre. This British colour film presents an effective all-round study of the impact of technology on the environment. It vividly documents how geological, topographical, and social development have helped to shape the environment, and discusses the problems of industrial expansion, population growth and pollution.

2. You may sign up to receive information about a local pollution sampling experiment and how you may participate in it if you wish. This is an experimental project which will be collecting data on particular pollutants over the entire Greater Vancouver region. This information will be used in a major study involving U.B.C., the City of Vancouver, the Greater Vancouver Regional District, the Provincial Government and the Federal Government. If you are interested in receiving information about this project, please sign the list on the front counter of the Physics Office (Hennings 323/325) by Friday, February 11. Signing this list does not obligate you to participate in the project; you will receive information about the project and how you may participate in it if you wish.

3. You may pick up an assortment of information material and list of supplementary readings on Pollution and Technology. This information material may be picked up (one set per student;) from Hebb 11 (the Physics Lab. Office) up to Friday, February 11.

4. You may attend a free lunch-hour movie entitled "The Time of Man" on Wednesday, February 16 at 12:30 P.M. sharp! in the Hebb Theatre. This is a feature length (50 min.) CBS colour documentary, produced in cooperation with the American Museum of Natural History. It examines man's relationship with his environment, where he is headed--and why. "The Time of Man" is a brilliant exposition of the basic meaning of the word "environment". By examining the relationships of various animal species to their environments, and examining the cultures of primitive tribes, leading authorities reconstruct millions of years of evolution. Man may well learn to control his future by studying his past.
   For example:
   * Dr. Margaret Mead revisits her Manus friends
   * Dr. Jane Goodall discusses chimpanzee behavior
   * Dr. C. Lavett Smith talks about fish communities
   * Dr. Ray Capman Andrews is shown discovering dinosaur eggs
   * Dr. Malcolm McKenna relates the stories of ants and dinosaurs
   * Dr. Harry Shapiro studies the evolution of populations
   * Dr. Colin Turnbull visits the pygmies and the Ik.

   The Time of Man's message is simple and powerful - if man's time on earth is to be endless, he must maintain the environment that sustains him.

5. You may obtain information about assisting some professors in doing research on the leaching of landfills (dumps). This possible summer job involves handling and sorting municipal solid waste (garbage, etc) and placing it in storage tanks. If interested, contact D. Phelps, Room 444, Civil Engineering Building sometime between now and the end of February.

A P P E N D I X H

ACTIVITY 1 ATTENDANCE SURVEY TICKET

Environment in the Balance			
Circle the Physics course you are taking	Lecture Section	Name	Registration number (7 digits)
P 105 P 110 P 115 P 120 Other (specify)_____			

APPENDIX I

ACTIVITIES CHECK-LIST

Physics 115 Activities Check-list

NAME _____ REGISTR. NO. _____

Please check off each of the follow-up activities that you have participated in, so far. Do not check off those that you haven't participated in, even if you intend to do so in the near future. We just want to know the extent of your use of these activities up to this date.

☐ 1. Saw the lunch-hour movie "Environment in the Balance" on Friday, Feb. 11.

☐ 2. Signed up (in Physics Office) to receive information about the local pollution sampling experiment.

☐ 3. Picked up the assortment of information material and list of readings (from Physics Lab Office, Hebb 11).

☐ 4. Saw the lunch-hour movie "The Time of Man" yesterday (Wed., Feb. 16).

☐ 5. Contacted D. Phelps to find out about assisting a research team studying leaching of landfills.

At the end of this lecture, please leave this check-list on the front counter, under the alphabetic letter corresponding to the first letter of your surname.

APPENDIX J

PHYSICS 115 EVALUATION STUDY QUESTIONNAIRE

Ph 115 EVALUATION STUDY

Purpose:

The purpose of this evaluation is to improve the Ph 115 course. You, as a student, can be of great help by indicating how you really feel about various aspects of the course.

This booklet contains statements of beliefs some students have expressed about the course. We would like to know to what extent you agree or disagree with these statements. This is not a test. The answers you give will not be used in any way to determine your mark for this or any other course.

The reason for asking you to give your registration number is that the statistical analysis of the data requires your registration number for various sorting procedures.

Note:

Your frank and honest answer to each question will help to improve this course. Careless or dishonest answers may have the opposite effect!

TURN TO NEXT PAGE

DIRECTIONS

USE ONLY PENCIL

On the printed answer sheet:

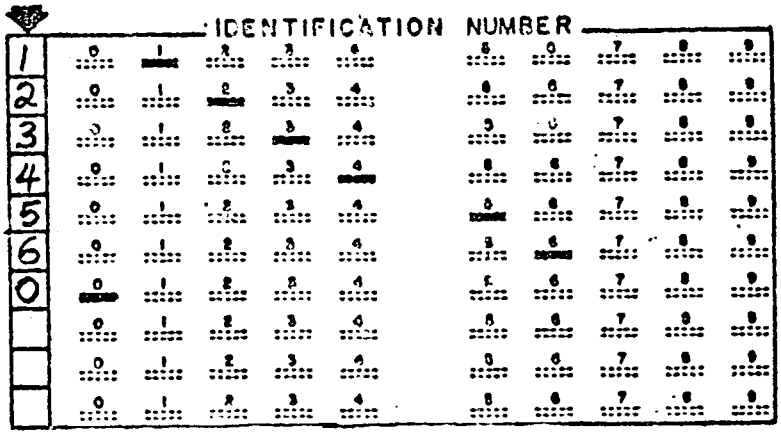
a. Fill in all spaces on the top line. On line 2, opposite SCHOOL, print the name of the high school last attended. Opposite CITY, print the name of the city and province (abbreviate) in which the high school last attended was located.

b. Leave the spaces for GRADE OR CLASS, INSTRUCTOR, NAME OF TEST and PART (lines 2 and 3) blank. Give your identification number (student registration number) both in numerical form (in the boxes below the red arrow) and by blackening the appropriate spaces. Your identification number consists of digits three to nine of the number at the top of your library/ AMS card (i.e.: the group of seven digits).

Example:

50 - (1234560) - 2

The identification number is 1234560. The number on the printed answer sheet would be indicated as shown below:



c. Opposite the number on the printed answer sheet that corresponds to the item number in the questionnaire, BLACKEN one of the small-numbered answer spaces. Note that the items and answer spaces are numbered horizontally across the printed answer sheet.

COURSE INFORMATION

PART A

Blacken one space for each of the following items.

1. Ph 115 lecture section
   Dr. Livesey (Sec. 1) (1) Dr. McMillan (2)

2. Year of high school graduation
   1971 (1) 1970 (2) 1969 (3) 1968 (4) none of these (5)

3. Physics 12 final mark
   A (86-100%) (1) B (72-85%) (2) C+(65-71%) (3) C or C⁻(50-64%) (4)
   none of these (5)

4. Biology 12 final mark
   A (86-100%) (1) B (72-85%) (2) C+(65-71%) (3) C or C⁻(50-64%) (4)
   none of these (5)

5. Chemistry 12 final mark
   A (86-100%) (1) B (72-85%) (2) C+(65-71%) (3) C or C⁻(50-64%) (4)
   none of these (5)

6. Mathematics 12 final mark
   A (86-100%) (1) B(72-85%) (2) C+(65-71%) (3) C or C⁻(50-64%) (4)
   none of these (5)

7. How long did you take to complete Physics 12?
   (Choose the answer which best describes how long you ~~took to complete~~ the course)
   1 semester (1) 1½ semesters (2) 2 semesters (3) 3 semesters (4)
   one school year (non-semester system) (5)

8. Intended coursework in Physics
   honors in physics (1) major in physics (2) more than one course in physics (3) PH 115 only (4) undecided (5)

PART B

Items 9 - 12 contain tutorial group numbers. Blacken the one space which corresponds to your tutorial group number (lab group number). Leave all other spaces blank.

9. Tutorial group number
   30 (1) 31 (2) 32 (3) 33 (4) 34 (5)

10. Tutorial group number
    35 (1) 36 (2) 37 (3) 38 (4) 39 (5)

11. Tutorial group number
    40 (1) 41 (2) 42 (3) 43 (4) 44 (5)

12. Tutorial group number
    45 (1) 46 (2) 47 (3) 48 (4) 49 (5)

PART C

Items 13—18 contain professional goals. Blacken the one space which corresponds to your professional goal. Leave all other spaces blank.

13. agriculture (1) architecture (2) armed services (3) biological sciences (4) business & commerce (5)

14. chemistry (1) civil service (2) dentistry (3) education (4) engineering (5)

15. forestry (1) geology (2) home economics (3) journalism (4) library (5)

16. law (1) mathematics (2) medicine (3) ministry (4) music (5)

17. pharmacy (1) physics (2) physical education (3) social work(4)

18. none of the above (1) undecided (2)

PART D

Items 19 - 23 have to do with laboratory science courses other than Ph 115. Indicate which other laboratory science courses you are taking this year by blackening space (1). Do not blacken space (1) if you are not taking a course in that science.

19. Biology, or any other life science (botany, zoology, etc.)
(1)

20. Chemistry
(1)

21. Engineering
(1)

22. Geology
(1)

23. None of the above
(1)

PART E

Items 24 - 28 have to do with grade 12 science and mathematics courses. Indicate which of the following grade 12 courses you took in high school by blackening space (1). Do not blacken space (1) if you did not take the courses listed.

24. Physics 12
(1)

25. Biology 12
(1)

PART E - cont.

26. Chemistry 12
(1)

27. Mathematics 12
(1)

28. None of the above
(1)

PART F COURSE OPINIONS

DIRECTIONS

a. Indicate your opinion about each statement by completely BLACKENING one of the five small-numbered spaces indicated for each statement.

b. The answer code is as follows:

Mark 1 if you Strongly Agree with the statement.

Mark 2 if you Agree with the statement.

Mark 3 if you are Neutral or Undecided.

Mark 4 if you Disagree with the statement.

Mark 5 if you Strongly Disagree with the statement.

Example: The following is a possible answer for statement 7:

7 1 2 **3** 4 5

That is, the person was neutral or undecided about statement 7.

c. Mark only one space for each statement. If you change your mind about an answer, erase it completely and cleanly. Make your new mark heavy and dark. Indicate an answer for EVERY statement in this part.

d. WORK AS QUICKLY AS POSSIBLE. If you have any questions about what to do, ask a person in charge.

e. When you have finished, hand in this booklet and your answer sheet. Place your finished answer sheet on the front counter, under the alphabetic letter corresponding to the first letter of your surname.

I - PHYSICS IN GENERAL

DO NOT WRITE IN THIS BOOKLET. Use the answer sheet.

29. Physics is something everyone should know something about.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

30. Physics is worthless.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

31. Physics is a dehumanizing subject.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

32. Physics is enjoyable.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

33. Physics is a fascinating subject.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

34. Physics is far too difficult for most students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

35. Physics is intellectually stimulating.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

36. Physics is boring.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

37. Physics is related to everyday things.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

38. Physics is unrelated to problems that really matter.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

II - PHYSICS 115 COURSE

39. Physics 115 is more interesting than Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

40. Physics 115 is nothing more than a review of Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

41. Physics 115 is a challenging course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

42. Physics 115 is irrelevant to the interests of the students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

43. Physics 115 is a boring course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

44. Physics 115 is more worthwhile than Physics 12.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

45. Physics 115 is relevant to the interests of the students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

46. Physics 115 should only be taken by students who are interested in becoming physicists.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

47. Physics 115 is too difficult for most students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

48. Physics 115 is frustrating because students do not know what is expected of them.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

49. Physics 115 is a valuable course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

III - INSTRUCTION IN LECTURES

50. Lectures should only be given by instructors who are first-rate physicists.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

51. The method of teaching used in lectures does not allow for enough student participation to suit me.
Strongly agree 1 agree 2 Undecided 3 Disagree 4 Strongly disagree 5

52. Lectures should include more up-to-date teaching techniques.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

53. Instruction in lectures helps to make the important ideas clear to me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

54. Instruction in lectures is of great help to me in solving physics problems.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

55. Instruction in lectures is too fast.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

56. Instruction in class is boring.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

57. Instruction in lectures encourages students to express their own viewpoints.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

58. Instruction in class should be more individualized.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

59. Instruction in lectures is good.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

IV - LECTURER

60. The lecturer knows his subject well.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

61. The lecturer's explanations are unclear.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

62. The lecturer has the ability to hold the interest of the class.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

63. The lecturer is one of the best things about the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

64. The lecturer is inconsiderate toward students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

65. The lecturer's pace is too fast.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

66. The lecturer reviews course material adequately.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

67. The lecturer has a rigid teaching style.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

68. The lecturer acts as if teaching is a chore.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

69. The lecturer makes me dislike physics.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

V - VARIOUS ASPECTS OF THE COURSE

70. The textbook is easy to understand.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

71. The textbook is of little value in the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

72. The textbook does not explain things adequately.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

73. The textbook is well written.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

74. The subject matter in the course is well organized.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

75. The subject matter of the course is excellent.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

76. The subject matter of the course should be more closely related to things that really matter.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

77. The subject matter of the course is too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

78. The subject matter of the course is a valuable asset to my education.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

79. The outside readings in the course are too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

80. The assignments are reasonable in length.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

81. The assignments are too difficult for me.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

82. The assignments should deal with more practical problems.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

83. The assignments are a worthwhile part of the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

84. Outside readings in the course should be increased.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

VI - EXAMINATIONS

85. The exams provide a good learning experience.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

86. The exams emphasize marks too much.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

87. Exams are too long to complete on time.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

88. The exams cover a fair sample of the material studied in the course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

89. The exams are generally very poor.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

90. The exams are marked fairly.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

91. The examinations are too difficult.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

92. The exams stress memorization too much.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

93. The examinations really make me think.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

94. Exams are not given often enough.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

VII - TOPICS

95. Nuclear energy is a good topic for the Ph 115 course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

96. There should be less concentration on classical (Newtonian) physics in Ph 115.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

97. The electromagnetic theory is an important topic for a first year physics course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

98. 'Propulsion systems' is a topic of little interest to students in Ph 115.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

99. Topics such as 'the environment', 'pollution', 'recycling', and 'energy demand', are just as important to the Ph 115 course as are 'mechanics' and 'wave motion'.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

100. 'The human body' is a topic that is not relevant to first year physics.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

101. There should be electronics included in Ph 115.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

102. There should be less optics in Ph 115.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

103. 'The human body' is a worthwhile topic to include in the Ph 115 course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

104. Topics centered around 'pollution' and 'the environment' should not be included in Ph. 115.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

105. It would be useful to include some discussion of propulsion systems in the Ph 115 course.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

106. Nuclear energy is not a useful topic for Ph 115 students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

107. Ph 115 should place the greatest emphasis on 'mechanics'.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

108. The electromagnetic theory is of little value to Ph 115 students.
Strongly agree 1 Agree 2 Undecided 3 Disagree 4 Strongly disagree 5

HAVE YOU INDICATED YOUR IDENTIFICATION NUMBER CORRECTLY?

APPENDIX K

STUDENT RESPONSES TO PHYSICS 115 EVALUATION STUDY QUESTIONNAIRE

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$R AC+WEBB:1130_LIB 1=81.SR2
EXECUTION BEGINS

      RESPONSES TO PHYSICS 115
     EVALUATION STUDY QUESTIONNAIRE:

      NOTE.
      POLARITIES OF RESPONSES HAVE BEEN REVERSED
      FOR SUMMATION IN THE FOLLOWING ITEMS:
      32,33,35,37,39,44,45,49,53,54,59,62,63,
      66,70,73,74,75,78,80,83,85,88,90,93,95,
      97,101,105.


     STUDENT            RESPONSES TO ITEMS
      NUMBER
      1087717   211324120000300020010001111044
                455545543334434455342243543244 54
                255445543434335445535243434444 33
                24434235223234
      1103712   222552130002350000C10001001045
                444454444324444443534344442355 54
                444234523233444424434324343444 24
                24334244223324
      1587708   222522140001C0C003CC10001011044
                333443431223323144344342433444 45
                344445433433224353434433444443 34
                34432423453343
      1642719   212121330040000200010001111045
                233422444223443443241342435255 55
                555553111143242344242424414424 2
                42252251551152
      2094712   211522350002C0C002C10001011025
                444444444333443244342244443244 54
                444444534434324344435243444443 43
                42332343343434
      2187714   222532350040C00001C100C1011044
                433434443434444444344322442145 24
                554434442444334444424115443444 33
                33332143343333
      2370708   222551140050 4CCCC0110001001044
                332444423423422442244434432144 44
                454445511114224234454543424444 22
                24331543453453
      2443711   212111430003050000010001111044
                344432425223453554444344442444 44
                444444433232444444444341444444 44
                41443442444443
```

2447712 21151215001005CCCCC10001011055
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544321341444 34

2454718 21153215003CC00002C100C1011045
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443532442354 23

2460715 21202215004CCCCC02C10101011044
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45452343444 24

2473718 21254253002CCCC002C10001110045
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43331443454443

2477719 21252155002004CCCC010001011054
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5543455313353333342241114445444 1
33331545553343

2487718 21252114001CCCCCC01C10001011055
5344335454333535424233454433454 4
3444455243233252345353434442444 3
34331433444433

2488716 21255255002CCCC001C10001001023
3222224344523322122333424323443 3
2444444111122222244344422434222 4
25242233242233

2490712 21241314005CCCCC10C10001011055
5334445544344434444434444423455 4
4544344223344444444443214444434 5
443423433444 43

2499713 21455214003040000011C001001044
3324244444334434424252444434454 4
4444344111142244242214112434111 5
42441242254444

2509719 21155113000205000C010101001034
4444454343244444443444445424454 4
2554444423244344345443444444534
444422543444 45

2511715 21215155005030C0001100011101045
5454344424233234432333444323344 3
3443444323323342343343324444434 2
42423434422444

2523710 21152135001CC0C010C10001011044
3333234424332334322232333323332 3
2332434422223243343233324434444 3
24333223233233

2526713 21351253000205CC0001000101104 4
4444444353444541444322454323444 4
4444455344244444444454414424424 1
44452255445554

2533719 22141112002CC00002110001011044
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54542242245124

2537710 21112153000100030011000111055
5544445532343444444134453311443 3
3434234454443244355153525325443 2
24231244243333

2543718 213534143410400CCC0110001011044
4443434224212344313441454215244 1
4442533442111331355344431224211 2
43351533554241

2548717 213522130001050CCCCC10001011044
3444345453344544433443454414454 4
3444444232253344345443435445434 4
34424243323 24

2571719 213423150050002CCC010101011044
4334444344433244323132443423354 4
4434444222333234334344423434324 3
32322344443343

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5444545524344345444444445423555 4
4454345544443355545442424544433 2
43453345335424

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44232244243444

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3444444443343343344245544445453 2
52445341344434

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EXECUTION TERMINATED


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EXECUTION BEGINS
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APPENDIX L

ATTITUDE TOWARD THE PHYSICS LABORATORY QUESTIONNAIRE

1. Please complete the spaces in the top line of the accompanying printed answer sheet.

2. On line 2 opposite the word "SCHOOL", print the name of the high school you last attended. Opposite "CITY" print the city and province (abbreviation) in which the indicated high school was located (or the country in which your high school education took place, if not in Canada).

3. Leave the spaces for "GRADE OR CLASS", "INSTRUCTOR", "NAME OF TEST" and "PART" (lines 2 and 3 of answer sheet) blank, but give your identification number both in numerical form (in the spaces below the red arrow) and by blackening the appropriate spaces.

4. Note that the items are numbered horizontally on the printed answer sheet.

PART A Course Information

Please respond to each item. Do not indicate more than one answer for each item except where indicated.

1. Physics 115 Lecture Section
(1) Section 1 (Dr. Livesey) (2) Section 2 (Dr. McMillan)

2. Tutorial group number (make one response to each of questions 2to6)
(1) G 30 (2) G 31 (3) G 32 (4) G 33 (5) None of these

3. Tutorial group number
(1) G 34 (2) G 35 (3) G 36 (4) G 37 (5) None of these

4. Tutorial group number
(1) G 38 (2) G 39 (3) G 40 (4) G 41 (5) None of these

5. Tutorial group number
(1) G 42 (2) G 43 (3) G 44 (4) G 45 (5) None of these

6. Tutorial group number
(1) G 46 (2) G 47 (3) G 48 (4) G 49 (5) None of these

7. Year of high school graduation
(1) 1971 (2) 1970 (3) 1969 (4) 1968 (5) None of these

8. Physics 12 final mark
(1) A (86%-100%) (2) B (72%-85%) (3) C+ (65%-71%) (4) C or C- (50%-64%) (5) None of these

9. Biology 12 final mark
(1) A (86%-100%) (2) B (72%-85%) (3) C+ (65%-71%) (4) C or C- (50%-64%) (5) None of these

10. Chemistry 12 final mark
(1) A (86%-100%) (2) B (72%-85%) (3) C+ (65%-71%) (4) C or C- (50%-64%) (5) None of these

11. Math 12 final mark
(1) A (86%-100%) (2) B (72%-85%) (3) C+ (65%-71%) (4) C or C- (50%-64%) (5) None of these

12. Duration of Physics 12 course (choose the answer which best describes how long you took to do the course)
(1) 1 semester (2) 1½ semesters (3) 2 semesters (4) 3 semesters (5) one school year (non-semester system)

13. Other laboratory science courses other than Physics 115 being taken this year (you may indicate more than one answer)
(1) Biology (or any other life-science) (2) Chemistry (3) Engineering (4) Geology (5) Other

14. Intended coursework in Physics
(1) Major in Physics (2) Honors in Physics (3) Physics 115 only (4) undecided (5) Other

15. Professional objective (make one response to <u>each</u> of questions 15 to 20)
(1) agriculture (2) architecture (3) armed services (4) biosciences (5) none of these

16. (1) business & commerce (2) chemistry (3) civil service (4) dentistry (5) none of these

17. (1) education (2) engineering (3) forestry (4) geology (5) none of these

18. (1) home economics (2) journalism (3) library (4) law (5) none of these

19. (1) mathematics (2) medicine (3) ministry (4) music (5) none of these

20. (1) pharmacy (2) physics (3) physical education (4) social work (5) none of these

21. Grade 12 science and math courses taken in high school (you may indicate more than one answer)
(1) Physics 12 (2) Biology 12 (3) Chemistry 12 (4) Math 12 (5) Other

End of Part A

PART B ATTITUDE TOWARD THE PHYSICS LABORATORY

The answers to items in this part are to be completed on the second answer sheet provided. Only your name and identification number are required in the spaces provided at the top of the answer sheet.

This scale represents a controlled study to determine the success of the laboratory program as the student sees it. The statements on the scale represent opinions put forth by previous physics students.

You are presented with 5 response categories for each statement: (1) strongly agree, (2) agree, (3) neutral, (4) disagree, (5) strongly disagree. The numbers (1) to (5) correspond to the numbers of the blank spaces found on the accompanying printed answer sheet. Choose the response category which best expresses your degree of agreement or disagreement with each statement.

Your responses to the statements will undergo a programmed statistical analysis, and the results will be used to aid in redesigning the present laboratory.

NOTE: Statistical analysis by computer requires that every statement be responded to. If you are undecided about the statement use response no. (3). Also note that the numbering system on the answer sheet runs horizontally as opposed to the vertical numbering of the statements in the scale.

1. In most instances I feel the labs aid me in my understanding of physics.
2. I find that most experiments are too difficult.
3. The lab to me is primarily a waste of time.
4. I regard the laboratory as an extremely beneficial activity.
5. I find the instructions in the laboratory manual confusing.
6. I usually find it necessary to just fumble my way through experiments.
7. I feel the laboratory is essential for learning physics.
8. This laboratory has killed my interest in physics.
9. I think too much time is demanded by the laboratory for the benefit that is being derived.
10. I find the experiments assume we know more than we actually do.
11. I like the laboratory because it offers opportunity for individual initiative.
12. The laboratory outline seems to explain ideas previously foreign to me.

PART B cont.

13. The laboratory's good and bad points balance each other.

14. I feel the need for a laboratory program, and am pleased with ours.

15. I hate the laboratory.

16. I have found no value in the laboratory.

17. The laboratory to me is synonymous with frustration.

18. I have found this laboratory the most interesting aspect of any of my courses.

19. I find the time allotted to prepare a write-up for handing in is ample.

20. I actually believe the experiments have taught me some basic ideas of physics far better than books could.

21. I feel we are presented with apparatus too far beyond our present level of understanding.

22. I like our laboratory because the experiments demand we think, rather than providing us with a step by step procedure.

23. I believe the laboratory has value in that it stimulates my interest in physics.

24. My experience is that the laboratory is a hopeless turmoil of confusion.

25. With reasonable effort, I regard the ideas presented in the laboratory well within my reach.

26. To me the laboratory is more or less boring.

APPENDIX M

STUDENT RESPONSES TO ATTITUDE TOWARD THE PHYSICS LABORATORY QUESTIONNAIRE

RESPONSES TO ATTITUDE TOWARDS THE
PHYSICS LAB. QUESTIONNAIRE:

NOTE.
POLARITIES OF RESPONSES HAVE BEEN REVERSED
FOR SUMMATION IN THE FOLLOWING ITEMS:
1,4,7,11,12,13,14,18,19,20,22,23,25

STUDENT NUMBER	RESPONSES TO ITEMS
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1087717	44444455444324555345534554
1103711	43442434421334342223433433
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EXECUTION TERMINATED
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APPENDIX N

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS PLACEBO INSTRUMENT

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS PLACEBO INSTRUMENT

H_d: performance of the activity and receiving the research instrument are independent of one another.

Activity 1	Received research instrument	Received placebo instrument	Totals
Performed the activity	34	12	46
Did not perform the activity	94	45	139
Totals	128	57	N = 185

$\chi^2 = .641$

$P(\chi^2 \geq .641 \mid 1 \text{ d.f.}, H_d) < .50$; accept H_d at $p = .05$ and $p = .01$ levels of significance.

Activity 2	Received research instrument	Received placebo instrument	Totals
Performed the activity	7	2	9
Did not perform the activity	121	55	176
Totals	128	57	N = 185

$\chi^2 = .041$ (Yates' correction applied)

$P(\chi^2 \geq .041 \mid 1 \text{ d.f.}, H_d) < .90$; accept H_d at $p = .05$ and $p = .01$ levels of significance.

Activity 3	Received research instrument	Received placebo instrument	Totals
Performed the activity	18	2	20
Did not perform the activity	110	55	165
Totals	128	57	N = 185

$\chi^2 = 3.527$ (Yates' correction applied)
$P(\chi^2 \geq 3.527 \mid 1 \text{ d.f.}, H_d) < .10$; reject H_d at the .10 level, accept at .05 and .01 levels of significance.

Activity 4	Received research instrument	Received placebo instrument	Totals
Performed the activity	35	12	47
Did not perform the activity	93	45	138
Totals	128	57	N = 185

$\chi^2 = .525$
$P(\chi^2 \geq .525 \mid 1 \text{ d.f.}, H_d) < .50$; accept H_d at the .05 and .01 levels of significance.

Activity 5	Received research instrument	Received placebo instrument	Totals
Performed the activity	11	4	15
Did not perform the activity	117	53	170
Totals	128	57	N = 185

$\chi^2 = .005$ (Yates' correction applied)
$P(\chi^2 \geq .005 \mid 1 \text{ d.f.}, H_d) < .95$; accept H_d at the .05 and .01 levels of significance.

APPENDIX O

CHI-SQUARE CONTINGENCY TABLES: PLACEBO INSTRUMENT VERSUS NO INSTRUMENT

CHI-SQUARE CONTINGENCY TABLES: PLACEBO INSTRUMENT VERSUS NO INSTRUMENT

H_d: performance of the activity and receiving the placebo instrument are independent of one another.

Activity 1	Received placebo instrument	Received no instrument	Totals
Performed the activity	12	10	22
Did not perform the activity	45	122	167
Totals	57	132	N = 189

$\chi^2 = 5.781$ (Yates' correction applied)
$P(\chi^2 \geq 5.781 \mid 1 \text{ d.f.}, H_d) < .02$; reject H_d at the .02 level, accept H_d at the .01 level of significance.

Activity 2	Received placebo instrument	Received no instrument	Totals
Performed the activity	2	3	5
Did not perform the activity	55	129	184
Totals	57	132	N = 189

Cannot compute accurate χ^2 because of small cell frequencies.

Activity 3	Received placebo instrument	Received no instrument	Totals
Performed the activity	2	1	3
Did not perform the activity	55	131	186
Totals	57	132	N = 189

Cannot compute accurate χ^2 because of small cell frequencies.

Activity 4	Received placebo instrument	Received no instrument	Totals
Performed the activity	12	8	20
Did not perform the activity	45	124	169
Totals	57	132	N = 189

$\chi^2 = 7.938$ (Yates' correction applied)
$P(\chi^2 \geq 7.938 \mid 1 \text{ d.f.}, H_d) < .005$; reject H_d at the .005 level of significance.

Activity 5	Received placebo instrument	Received no instrument	Totals
Performed the activity	4	3	7
Did not perform the activity	53	129	182
Totals	57	132	N = 189

$\chi^2 = 1.359$ (Yates' correction applied)
$P(\chi^2 \geq 1.359 \mid 1 \text{ d.f.}, H_d) < .25$, accept H_d at the .05 and .01 levels of significance.

APPENDIX P

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS NO INSTRUMENT

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS NO INSTRUMENT

H_d: performance of the activity and receiving the research instrument are independent of one another.

Activity 1	Received research instrument	Received no instrument	Totals
Performed the activity	34	10	44
Did not perform the activity	94	122	216
Totals	128	132	N = 260

$\chi^2 = 16.663$

$P(\chi^2 \geq 16.663 \mid 1 \text{ d.f.}, H_d) < .001$; reject H_d at the .001 level of significance.

Activity 2	Received research instrument	Received no instrument	Totals
Performed the activity	7	3	10
Did not perform the activity	121	129	250
Totals	128	132	N = 260

$\chi^2 = 1.035$ (Yates' correction applied)

$P(\chi^2 \geq 1.035 \mid 1 \text{ d.f.}, H_d) < .50$; accept H_d at the .05 and .01 levels of significance.

Activity 3	Received research instrument	Received no instrument	Totals
Performed the activity	18	1	19
Did not perform the activity	110	131	241
Totals	128	132	N = 260

$\chi^2 = 15.075$ (Yates' correction applied)
$P(\chi^2 \geq 15.075 \mid 1 \text{ d.f.}, H_d) < .001$; reject H_d at the .001 level of significance.

Activity 4	Received research instrument	Received no instrument	Totals
Performed the activity	35	8	43
Did not perform the activity	93	124	217
Totals	128	132	N = 260

$\chi^2 = 21.326$
$P(\chi^2 \geq 21.326 \mid 1 \text{ d.f.}, H_d) < .001$; reject H_d at the .001 level of significance.

Activity 5	Received research instrument	Received no instrument	Totals
Performed the activity	11	3	14
Did not perform the activity	117	129	246
Totals	128	132	N = 260

$\chi^2 = 3.931$ (Yates' correction applied)
$P(\chi^2 \geq 3.931 \mid 1 \text{ d.f.}, H_d) < .05$; reject H_d at the .05 level, accept H_d at the .01 level of significance.

APPENDIX Q

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS NO INSTRUMENT

(corrected for absentees)

CHI-SQUARE CONTINGENCY TABLES: RESEARCH INSTRUMENT VERSUS NO INSTRUMENT (corrected for absentees)

H_d: performance of the activity and receiving the research instrument are independent of one another.

Activity 1	Received research instrument	Received no instrument	Totals
Performed the activity	34	10	44
Did not perform the activity	94	72	166
Totals	128	82	N = 210

$\chi^2 = 6.229$

$P(\chi^2 \geq 6.229 \mid 1 \text{ d.f.}, H_d) < .02$; reject H_d at the .02 level, accept H_d at .01 level of significance.

Activity 2	Received research instrument	Received no instrument	Totals
Performed the activity	7	3	10
Did not perform the activity	121	79	200
Totals	128	82	N = 210

$\chi^2 = .072$ (Yates' correction applied)

$P(\chi^2 \geq .072 \mid 1 \text{ d.f.}, H_d) < .80$; accept H_d at the .05 and .01 levels of significance.

Activity 3	Received research instrument	Received no instrument	Totals
Performed the activity	18	1	19
Did not perform the activity	110	81	191
Totals	128	82	N = 210

$\chi^2 = 8.518$ (Yates' correction applied)
$P(\chi^2 \geq 8.518 \mid 1 \text{ d.f.}, H_d) < .005$; reject H_d at the .005 level of significance.

Activity 4	Received research instrument	Received no instrument	Totals
Performed the activity	35	8	43
Did not perform the activity	93	74	167
Totals	128	82	N = 210

$\chi^2 = 9.494$
$P(\chi^2 \geq 9.494 \mid 1 \text{ d.f.}, H_d) < .005$; reject H_d at the .005 level of significance.

Activity 5	Received research instrument	Received no instrument	Totals
Performed the activity	11	3	14
Did not perform the activity	117	79	196
Totals	128	82	N = 210

$\chi^2 = 1.244$ (Yates' correction applied)
$P(\chi^2 \geq 1.244 \mid 1 \text{ d.f.}, H_d) < .30$; accept H_d at the .05 and .01 levels of significance.