COGNITIVE FACILITATION OF COMMUNICATION EFFECTS

PHILIP J. RUNKEL

1956

Phil Runkel's Ph.D. thesis scanned and formatted by Dag Forssell, January, 2011.

Phil's bound copy features pages mimeographed on one side. This reproduction is designed for double-sided printing. The note below is typed on a separate paper and glued inside the front cover of Phil's personal copy.

Handwritten notes on pages 46, 47, 49, facing page 88, and on page 136 are in Phil's handwriting.

In my ~~dissertation~~ doctoral dissertation (1956):

Runkel, Philip J. (1956). Cognitive facilitation of communication effects. Unpublished doctoral dissertation, University of Michigan.

P. 4: thesis of this disseration (in italics):

"... similarity of structure between two cognitive fields increases the efficacy of communication between them."

P 18, attraction to ~~two~~ women by dollars income and by weight. But see the Sociometry article for a less sexist example.

p 33: Hypotheses.

p 37: Assumptions and technicalities of collin earity.

p 57: Results.

p p 116: Summary of findings.

COGNITIVE FACILITATION OF COMMUNICATION EFFECTS:

AN EMPIRICAL STUDY

by
Philip J. Runkel

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan
1956

Committee in charge:

Professor Theodore M. Newcomb, Chairman
Professor Clyde H. Coombs
Associate Professor John R. P. French
Professor Donald G. Marquis
Professor Robert M. Thrall

PREFACE

Any piece of research is a cooperative endeavor, and a dissertation, being an institutional product, is particularly so. The thinking and the labor involved are only fractionally the author's own.

The chief sources of the concepts underlying this study will appear as direct references in the main body of the work. In addition, thanks are due Dr. William Hays and Dr. Keith Smith of the Psychology Department who spent many hours guiding my thinking about methods of analysis. Dr. Smith drew my attention to the linear hypothesis set forth in Appendix IV.

The data for the classroom experiment reported in Chapter III were gathered through the cooperation and interest of Dr. Wilbert McKeachie and the assistance of the classroom teachers: Messrs. Carrier, Diem, Fliege, Uhr, and Mrs. Carol Slater. An earlier exploratory study among zoology students was carried out through the kindness of Dr. Marston Bates, Dr. Slobodkin and Dr. Twente.

I wish to convey my gratitude to the staff of the Michigan Group Study Project for making portions of their data concerning the men's residence (Chapter IV) available to me. I am especially indebted to Dr. Joseph McGrath and Dr. Harry Burdick.

The members of my doctoral committee have been

generous in their interest, ready with their time and judicious and insightful in their criticism and comments.

I cannot omit mention of my gratitude to the subjects themselves. Social scientists in a world where people refused to be looked at, questioned, and involved in experimental studies would learn little.

CONTENTS

LIST OF TABLES

CHAPTER I

THE CENTRAL THESIS

It has long been commonly observed that the meaning of any spoken phrase or any gesture depends upon the cultural expectations within which it is embedded. The meaning further depends upon the demands of the particular situation which are perceived by the communicators. Finally, the meaning of a communication is affected by the role in which the communicator is seen to be acting, and the expectations put upon such a role. Whatever the denotation of the communication, the response of the hearer is a response to connotations and inferred relationships as well as to matters explicitly symbolized in the speaker's utterance.

Another way to say this is that the stimuli comprised by a communication impinge upon a set of potential responses belonging to the listener. Out of all responsive acts possible to human beings, only a portion will have any appreciable likelihood of occurring in a given situation. Among those with reasonable probability, some will be more probable because they are typical of the individual in any situation, some will be more probable in response to certain situations defined by the culture, some will be brought to the surface in response to particular individuals and roles, and some will occur in association with the specific content of the message which the individual receives. The set of potential responses of the hearer, being a limited selection of all human acts, and being organized by a hierarchy of probabilities, must mediate every communicative process by presenting a framework, or mechanism, within which any communicated message must find its effect. It is this framework of potentialities upon which are engraved expectations of culture and role and the demands of the situation. In the terms of this framework any communication finds its resultant.

Clearly, an act of communication is itself a response. The possibilities of response are the possibilities of communication. The transmitter as well as the receiver of communication acts within a limiting framework. The cognitions of the speaker determine both what he shall say in a given situation and what he shall omit to say, just as the cognitions of the listener specify what the speaker needs to say and what he need not say. Thus the total process may be conceived as an interaction between cognitive fields, where the stimuli which impinge upon each field bring about alterations of response not only to the stimuli explicit in the situation, but also to stimuli which are carried implicitly in the field; and where, further, the response which we see as communication arises not only from the stimuli offered by the other communicator, but also from the many stimuli implicitly associated in the cognitive field of the speaker, and from the hierarchy of potential responses which organize them.

It follows from this view that communication cannot fruitfully be conceived as a sequence in which self-contained packets of information are exchanged. It is not a process in which one person merely adds to the belongings of another by "giving" him information. It is rather a kind of guessing game. Each person carries with him his cognitive field as a map of the world. He responds not to the world, but to the map. When he receives the stimulus of a communication, the meaning it has is the way it can be fitted into the map. When the communication fits readily, one's confidence in his map of the world is increased. When an appropriate place for the "meaning" of the communication cannot be found one either alters to map to suit, or concludes that the message got garbled somehow in transit. We usually, I presume, fit new pieces into our maps with a certain tentativeness, waiting for further pieces of the puzzle to confirm our judgment.

Obviously, if we can trust this metaphor, a communication can be fitted into the recipient's map more readily and confidently if it has been produced from a map which is constructed like his own. This is a matter, let me emphasize, of the mapping of potential responses in general, and infers nothing about the emotional description of the responses. One can empathize (map easily into his own cognitive field) when another spits out the worm from a bite of apple, as well when the other receives the grand prize from a radio program. Furthermore, one's mapping of a communicated situation may agree very well with the other's mapping even though the preferences of the two persons involved are widely discrepant. When person A communicates with B by pointing a pistol at his stomach and asking for his wallet, there is likely to be high agreement as to the structure of the situation and its implications, even though there is very low agreement about the desirability of the situation. Whatever the possible effects of a communication, then, we might entertain the notion that these effects will take place more readily when the cognitive maps of the communicators are similar in structure. The effects of communication may take place more quickly where cognitive fields are similar, or an effect may occur after a briefer message, or the responses may be more regular and less random. To specify the observable characteristics of behavior which would be altered in degree or kind when communication between similar cognitive fields is studied in contrast to that between dissimilar fields will, of course, require a careful selection of concepts and the adoption of operational procedures.

This, then, is the thesis of this dissertation in its most general expression: that <u>similarity of structure between two cognitive fields increases the efficacy of communication between them</u>.

Many interesting researches have been performed, and comments made, which bear upon this thesis. Gregory Bateson (1), in connection with his concept of "deutero-learning," has pointed out how frameworks for learning affect the individual's ordering of events and values. Numerous students of culture, among whom Kardiner (13) makes the point with especial clarity, have emphasized the limitations put upon responses by cognitive and perceptual habits prevailing in a society. Some persons have noted the facilitations and hindrances in responding to the world which are offered by the structure of language, notably Korzybski (15) and Whorf (22). The manner in which the momentary cognitive field which is brought to the situation affects the "meaning" of stimuli in the situation has been ingeniously illuminated by N. R. F. Maier (17), who used the term "direction" to describe the organizing function of pre-existing cognitions. Similarity of potential response has been described at length in behavioristic terms by G. H. Mead (18). His concept of "taking the role of the other" is for me the most intuitively appealing way of visualizing the process with which the present thesis is concerned. The manner in which the predispositions of the receiver of communication filter the effects of acts of leadership has been cleverly investigated by Merei (19). This entire idea of mediation between stimulus and response by structures which carry in themselves the implications of previous stimuli and responses has been expressed in a wholly different conceptual context, with inspiring insights, by D. O. Hebb (11).

One could go on at length pointing out parallels between the present thesis and the thinking of other people. In its general form, my thesis is no doubt as old as communication. The contribution of this dissertation to the problems of communication lies not in the general terms of the problem chosen for study, but rather in the forms by means of which quantification has been applied to similarity of cognitive structure. I have tried to investigate the effects of similarity not by choosing some namable dimension of similarity which might discriminate between random and regular communicative effects, but have instead sought to provide a form of describing cognitive structure such that similarity may be invariant over content. In the present study, the particular index which furnishes operations for assessing similarity of cognitive structure is one (out of a number which might be derived from the basic concepts) which I have labeled "co-linearity" and which will be explicated in the next chapter.

The theoretical framework supporting this investigation of the mediation of communication is a deliberately imitative attempt to put into more formal terms Newcomb's (21) theory of communicative acts. The formal concepts used are in turn the result of an extensive raid upon the ideas of C. H. Coombs, particularly the monograph by Coombs and Kao (6). In putting together the theory, I was strongly conscious of the admonitions of Wilder (23) as to axiomatic method, of Coombs, Raiffa, & Thrall (7) as to the relations between theory and the world, of Estes (8) as to "data language," and of Woodger (24) as to forms of expression. Any or all of these people may of course have difficulty in identifying their ideas in these pages. If so, it is my fault, not theirs.

The next chapter will present the theory in verbally descriptive form, as well as the hypotheses of the empirical study with their derivations. A presentation of the theory in more rigorous detail, but highly condensed and put largely into symbols, will be found in Appendix I. An account of the two parts of the empirical study, and their results, will follow in Chapters III and IV.

CHAPTER II

THEORY AND HYPOTHESES

The first parts of this chapter will present the concepts and general form of the theory. The last part will present the hypotheses. Rigor will not be attempted in this chapter. Here the concepts and the relations between them which are of chief interest in the present investigation will be set forth in a descriptive and intuitive manner. The precise statements on which this description rests are exibited as Appendix I, where the model is developed largely in symbolic form. In the text of this chapter, references to Appendix I will appear in parentheses, indicating the pertinent axiom (Ax.), definition (Dfn.), psychological postulate (Psych. Post.), or theorem (Th.).

The Response Space

Stimulus relations. -- The individual lives surrounded by stimuli. Of the myriad objects in his environment, some press in more importantly than others. The several characteristics of these environmental stimuli provide respects in which they may be compared and ordered. In orienting himself to his environment, the individual must "place" himself in regard to the stimuli, and the stimuli in regard to each other. We postulate a "space" in which every stimulus has a "location" (Ax. 3(a)).

Order.-- Any set of stimuli is at any given moment ordered for the individual in some respect. Perhaps he prefers one thing to another. Or he accepts some things and rejects others. He classifies, labels, compares, evaluates. Thus the space in which stimuli are located, and within which responses are defined, must provide for ordering. We postulate a space spanned by simply ordered sets of "primitive" elements (Ax. 1). Each simply ordered set will be called an "attribute" or "dimension". To what observables, if any, these "primitive" orderings may correspond, we do not know. We postulate these orders in order to establish a space (Dfn. 1) in which "positions" of stimuli and individuals may be described.

The search for observable, or at least descriptively conceivable, primitive attributes has, of course, occupied many social scientists. Lists of instincts, basic motives, and computed factors have appeared regularly in the literature. The identification of such primitive attributes is, however, of no concern to the present study.

Nevertheless, the postulation of these orders enables us to "place" any point in the space, such as might correspond to a stimulus, by assigning it an n-tuple in which each component is an element from one of these simple orders. The parallel concept is the Cartesian space of ordinary solid geometry, spanned by the orders of the real numbers. This parallel will not be emphasized here, however, because the Cartesian space contains many restrictions which are not put upon the space presently being postulated.

The individual's position.-- We can now think of an individual's preference for $stimulus_1$, over $stimulus_2$ as an instance where the individual is "closer" to $stimulus_1$ than to $stimulus_2$. We can describe the individual's acceptance of an object as the case where he is "close enough," and rejection as the case where he is not "close enough". To choose an example, an individual's choice of ice cream over spinach might be described by saying that in regard to taste, ice cream is closer than spinach to the point representing the individual on that attribute. It is important to note that the point corresponding to the individual does not indicate how tasty the individual may be, but rather it represents the point on the taste attribute from which is determined the individual's response to the two stimuli. In order to keep this distinction clear, Coombs (e.g., in 4) uses the special label "ideal" to refer to the point in the space which corresponds to the individual. Aternatively, he sometimes speaks of the individual's "standpoint", a term which I shall adopt here.

In brief, we can locate the individual as well as the stimuli in the space (Ax. 3(b)).

Responses.-- Using this model, we view responses as indicators of order relations among the individual's standpoint and the stimulus-points in the postulated space. We follow Coombs' "quadrants" (4) in classifying responses (Ax. 8 and Psych. Post. 1). It may suffice for present purposes to say that two of these types (Ax. 4 and 6) are defined by means of a neighborhood concept and are coordinated to observable responses such as acceptance or rejection, including or excluding, etc. The other two (Ax.7) are defined by the use of a "greater than" distance concept, and coordinated to such observables as preference orders, closer to one than another, more similar in some respect to this than to that, etc. Numerous analysis methods have been worked out in connection with the various quadrants (e.g. 3, 4, 5).

Relevant attributes.-- Although the individual is constantly responding to stimuli as long as body and soul are together, he is not always responding in the same respects, or in regard to the same ordering criteria, even in situations where the same stimuli recur. Some attributes, in short, are relevant to some situations, and others to other situations. The mailbox may be an important goal when one's errand is to mail a letter, and may go unnoticed if the errand is to purchase a cabbage. We therefore postulate that a reduced set of attributes underlies the responses of any given moment (Ax. 2).

In complex situations, many attributes may be relevant to the stimuli in the situation. In such a case, the ordering of stimuli may not be simple. The primitive attributes measuring the stimuli may call for a preference for

A over B in one respect, but for B over A in another. Not only the relative placement of the stimulus-points in the space, but also the particular attributes relevant at a given moment may therefore determine the order among them observed in (or deduced from) the individual's responses. Not only can we conclude from observed responses that <u>some</u> attribute underlies a response (Ax. 5), but we can, through certain data-collection methods, ascertain also whether more than one attribute mediates a group of responses, and estimate how many attributes are required to furnish the best explanation.

A few illustrations at this point may make the concept easier to handle. For example, many attributes carrying the meaning of a communication go unspoken as a matter of course. This is emphasized when an attribute previously unmentioned must be made explicit. The new wife may complain, "But I thought you would <u>like</u> the shirt. The last two I bought for you had this kind of collar!" And the husband replies, "The coller has nothing to do with it. It's the color. I just don't see myself wearing a pink shirt to the office."

Much communication makes <u>implicit</u> attributes clearer by making order explicit:

"The <u>most</u> <u>important</u> thing to remember is..."

"The <u>first</u> thing to check is..."

"Look both ways <u>before</u> crossing the street."

"Don't fire until you see the whites of their eyes."

And distinctions are often made in regard to the evaluation of a quantity by proffering an explicit description of an attribute:

"Well, it may have been good enough for your mother, but it's not good enough for me."

"We do it because this is a child-centered, not a subject-centered, school."

"I agree he can, but the question is, will he?"

Multidimensional space and "learned" attributes. -- Responses may take place which are mediated by many attributes simultaneously. If, in such an instance, judgment on the basis of one attribute would bring a preference for A over B, but for B over A on the basis of still another, two courses are open: (a) the individual may refrain from committing himself to a decision, declaring the two stimuli to be "incomparable"; or (b) he may give more weight to one of the attributes, enabling a decision to be made by "composing" in this way the orders of the stimuli on the various relevant attributes. The adoption of some way of combining the orders given by each of a number of attributes into one order, that is, the adoption of some "composition function" (6), enables the individual to respond unidimensionally in what may be "primitively" a multidimensional space.

There is ample evidence that the composition of a multidimensional set of stimuli into a unidimensional set is a common response process. We learn in the course of socialization to construct such "learned attributes" as honesty, valor, abilities of various sort, and the like. It may well be that every adjective in the dictionary is a name for a learned attribute, since these adjectives label respects in which objects may be simply ordered.

To illustrate, the technical knowledge of a number of candidates for a job, their punctuality, their expectations of salary, and their attitudes toward Russia must all be composed somehow into an order which will enable one candidate to be hired and another rejected. Similarly, the order in which a young man rings up prospective "dates" on the telephone is somehow compounded of his ratings of them on numerous attributes.

We now see that observed responses may reflect not only orders among the stimuli, and the relevance of attributes at a given moment, but also the hierarchy of attribute weighting which may occur in multidimensional response situations.

Orientations.-- Under repeated exposures to a stimulus or set of stimuli, some regularity may be observed in a subject's responses. In such a case we say that he exhibits a particular "attitude" or "orientation" toward the stimulus. For the sake of generality, we can go further and assert that some sort of orientation exists toward the stimulus at the moment of response, regardless of how much regularity we may observe over time. Here, we define an orientation toward stimulus A(Dfn. 9) as the set of all potential responses defined by means of the point representing stimulus A in the response space. Clearly, the membership of this set of potential responses will depend on the attributes relevant, which in turn depend on the situation, the individual, and the stimulus itself.

Looking at an orientation in this way, it is obvious that we cannot consider any set of observed responses to be coterminous with the orientation in its theoretical sense. On the contrary, any observed set of responses to an object must constitute a sample of all potential responses to the object. The data of observation in this way provide us with an estimate of the membership of the set of responses which are potential at a given moment.

We may wish to characterize an orientation, or distinguish between a number of them, by means of some statistic. Three statistics for such a use seem to follow easily from the theoretical definition of an orientation used here. Interestingly enough, these three ways of characterizing collections of responses have received little attention in the literature as ways of characterizing orientations or attitudes, although they have received much attention as difficulties in the way of conceptualizing orientations or analyzing data.

First, an orientation may be characterized by the absolute number of responses (to the stimulus being considered) which it contains. Second, it may be characterized by the dimensionality required to mediate these responses. A third way to characterize an orientation would be to examine the attributes which mediate responses to stimuli which are associated in the subject's cognitive field with the stimulus the orientation toward which is being considered. To make this idea less involved, consider the stimulus A and the subject's orientation toward it. Two of the potential responses making up the orientation may be a preference for A over B and a preference for C over A. It seems meaningful to say that we would have further information about what A means to the subject if we presented him with stimuli B and C, to discover whether he would (a) prefer B over C, (b) prefer C over B, or (c) make no observable response to either. A way of characterizing the orientation toward A, then, would be to examine the orientations toward stimuli associated with A, and determine the extent to which common attributes are relevant in the various orientations involving these stimuli. We might use a phrase like "densely articulated" when a few attributes mediate the responses making up many orientations. This characterization of an orientation seems to partake somewhat of each of the characteristics of <u>strength</u> and <u>specificity</u> proposed by Krech and

Crutchfield (16).

Just as any observed set of data must represent a sample of the potential responses constituting the orientation, so likewise the attributes mediating the observed set of responses may be considered a sample of the attributes which might underlie responses to the same stimuli at other moments. The reliability of this sampling of attributes depends not only upon how "well mixed" the responses gathered at one moment may be, but also upon the constancy of the set of relevant attributes over time.

It is by means of such samplings, or estimates, of response sets and attribute sets that cognitive fields may be described. One way to state the purpose of the present investigation is to say that it seeks to compare the interaction of two cognitive fields in regard to responses with their similarity of structure in regard to relevant attributes.

Unfolding.-- Judgments of objects in regard to one attribute may result in a different preference order from that given by judgments in regard to another attribute. The converse is also true: responses yielding a given simple order among the stimuli preclude the possibility that certain attributes may be underlying the responses. In order to make this clear, let us examine a simple illustration.

We shall consider preferences among five women.

Table 1 shows, by the placement of the name of each, her weight and her income.

TABLE 1

HYPOTHETICAL ORDERS OF FIVE WOMEN ON TWO ATTRIBUTES

Income in Dollars	Weight in Pounds				
	100	120	140	160	180
100,000		Cluny			
20,000	Clara				
6,000			Cissy		
3,000					Cora
1,000				Carol	

Suppose that person A bases his preferences among the five women of Table 1 chiefly upon their weights. He might most prefer a woman weighing 120 pounds, next 100 pounds, and then, 140, 160, and 180. Asked to order the women from most preferred to least, he would give: Cluny, Clara, Cissy, Carol, Cora.

But suppose that person B judges the women by their income. He might prefer the richest woman, or he might not. He might prefer the poorest, so that she could be kept in her place. Or he might most prefer one with a moderate income. The important point to note is this: no matter what his "ideal" on the income scale, he could not give the preference order given by person A. If he most preferred the woman's income to be less than Clara's he could not, as did A, prefer Cluny to Clara. And if he preferred an income larger than Clara's, he could not prefer Carol to Cora. The point here is that knowledge of the preference order of a subject rules out certain attributes as underlying his responses. In carrying out research, we may not know how to describe the attributes underlying a cognitive structure, as we do in this convenient example. Nevertheless, techniques are available for comparing the observed responses of two persons in regard to possible similarities of underlying orders, even where the underlying orders are not isolable. One such technique is that developed for use in the present investigation, about which more will be said later.

To emphasize this point, consider a third subject C, Suppose he gives the preference order: Cissy, Carol, Cora, Cluny, Clara. Looking at the responses of these three subjects (and knowing that just these two attributes underlay the responses of the three), we could make the following statements:

1. Person C could be responding on the same attribute as A.

2. Person B could <u>not</u> be responding on the same attribute as A.

3. B could <u>not</u> be responding on the same attribute as C.

In anticipation of later discussion, we mention here that responses related like those of persons A and C will be termed <u>co-linear</u>. Where the responses by which the comparison is made are understood from context, we say merely that A is co-linear with C. Correspondingly, A and B are <u>non-co-linear</u>, as are B and C.

This illustration has been purposely simplified to emphasize principles. In research, comparisons between persons are complicated by the fact that we have only responses to work from, and do not know what orders may underlie the response spaces of the several individuals. However, solutions to this problem are available. These complexities are considered by Bennett (2), Hays (10), Milholland (20), and Coombs and Kao (6).

Returning to the illustration, suppose that the weights shown in Table 1 were printed on a ribbon in the same order they appear in Table 1. If the figures were appropriately spaced on the ribbon, we could pick up the ribbon pinched between two fingers at the "120" figure; then, looking down at the ribbon as it dangled from our fingers, we would see the weights in the same order as that preferred by person A. Likewise, if we folded the ribbon at "140", we would find the weights falling in the order preferred by person C. Conversely, the orders of both A and C would "unfold" into the order shown in Table 1. Because of this descriptive geometric parallel, an analysis of rank order responses to discover whether they may be underlain by the same attribute is called the "unfolding technique" (4,5).

<u>Co-linearity</u>.-- The unfolding technique provides a way of constructing an index of similarity of response spaces, or if you will, of cognitive structure. Indeed, a number of such indices might be constructed. I have termed the index developed for the present investigation "co-linearity". It depends for its use on obtaining rank order responses from the subjects. If the subject declines to give a transitive order to the stimuli, the index cannot be applied. A further qualification is important; the experimenter cannot circumvent a subject's reluctance to give a transitive order by forcing him to do so, and expect the co-linearity index to mirror the response space. The method of data collection must allow the subject to indicate to the experimenter whether he perceives the stimuli to lie in a simple order.

The co-linearity index compares two simple orders to see whether they will "unfold" into a common underlying order. A table for making this comparison for any set of five stimuli appears as Appendix II.

As we have seen in the section of this chapter on multidimensional space and learned attributes, an individual may put a simple order on stimuli positioned in a space which is primitively multidimensional. Such a simple order depends upon (a) the attributes relevant at the time of the response, (b) the composition function by means of which the individual weights or organizes the attributes so as to yield the simple order among the stimuli, and (c) the spatial relations among the stimulus-points and the individual's standpoint in the space.

The simple order of stimuli, if the individual gives a simple order, does not describe the entire space. But it serves as an <u>index</u> of the attribute-structure of the space because of the fact that a given set of relevant attributes, combined in a given way, <u>will not yield all possible orders among the stimuli</u>. This fact was illustrated in the paragraph on unfolding.

The simple order given by an individual tells us little about the response-space of an individual. It gives us no indication of what his responses need to be to stimuli not included in the rank order. But since the order depends on the underlying structure of the response-space, comparisons may be made between individuals. If two individuals give co-linear rank orders, there are similarities in the way they compose the attributes mediating their responses to the stimuli about them. Speaking more precisely, if two individuals give non-co-linear responses, it is then impossible for one individual to give certain of the responses given by the other, as long as the cognitive fields yielding the two rank orders remain unchanged.

I wish to emphasize once more that the co-linearity index is only one of the indices of cognitive structure which might be constructed from the concepts of the theory. It has the advantages of requiring very few responses from the subject and of being easily computed. It has the disadvantages of being inapplicable unless the subject yields a reliable simple order and of giving a very limited amount of information about cognitive structure. It was chosen for this research for reasons of economy. By the time the theory was elaborated to the degree exhibited in Appendix I, it was felt that empirical tests should be carried out to check the implications of the structure so far developed. It seemed good strategy to choose as simple indices as possible for a first test of the theory.

Changes Over Time

As stated earlier, one of the purposes of developing the theory in its present form was that of achieving statements about alterations of orientations such as those made by Newcomb's theory of communicative acts by using the concepts of the response space. Without having made an exhaustive analysis by symbolic manipulation, it seems probable that propositions very similar to Newcomb's, concerning the orientation-relations among two persons A and B, and some object in the environment X, can be derived from the concepts already presented and two further postulates. These two postulates are (1) that classificatory responses, when mediated by only one attribute, partition the stimuli into equivalence classes (Ax. 11), and (2) that responses are more probable which minimize the dimensionality of the response space (Psych. Post 4 and 5). These two postulates will now be considered in greater detail.

A-B-X responses in one dimension.-- Many responses are of the "yes-no" type, or the type which Coombs (e. g., 4) calls "irrelative". These include responses of acceptance or rejection, of good enough or not good enough, or rating a person tall or not tall, and the like. When we designate one alternative in each case as the positive direction of response, we say formally that a positive response to the stimulus indicates that the point representing the stimulus is "within the epsilon-neighborhood" (Ax. 4 and 6) of the standpoint of the individual. We postulate that for a unidimensional response space, the relation "within the epsilon-neighborhood of" is an equivalence relation (Ax. 11). That is, responses of this kind divide the stimuli into mutually exclusive classes, as long as the responses are mediated by a single attribute.

The case of the A-B-X system is one in which the individual A is presented with two stimuli: another person B and some environmental object X. We derive from the foregoing concepts and statements that when A responds irrelatively to B and X in one dimension, the following patterns of response are possible (Th. 2):

1. A responds positively to B and to X, and perceives B as responding positively to X.

2. A responds positively to B, negatively to X, and perceives B as responding negatively to X.

3. A responds negatively to B and positively to X, and perceives B as responding negatively to X.

4. A responds negatively to B and negatively to X, and perceives B as responding positively to X.

5. A responds negatively to B and negatively to X, and perceives B as responding negatively to X.

Given the same antecedent conditions, the following patterns are implied to be impossible (Th. 2):

6. A responds positively to B and positively to X, and perceives B as responding negatively to X.

7. A responds positively to B and negatively to X, and perceives B as responding positively to X.

8. A responds negatively to B and positively to X, and perceives B as responding positively to X.[1]

This derivation, let it be repeated, applies strictly to unidimensional responses. The theory does not deny that pattern No. 8, for example, can be observed if A

[1]It will be seen that these patterns do not fall into classes which correspond to Heider's (12) balanced and unbalanced categories. It is difficult to make any further comparison, however, since an explicit consideration of dimensionality is not a part of Heider's exposition.

responds negatively to B and positively to X _in one respect_, and perceives B as responding positively to X _in another respect_. In combination with the postulate concerning minimal dimensionality, these derivations about A-B-X patterns enable us to make predictions concerning changes in orientations over time.

Equilibrium trends.-- We postulate (Psych. Post. 4 and 5) that responses are more probable which minimize the dimensionality required for the response space. Now, if patterns 6, 7, or 8 of the previous section are observed, we must by the postulate of the previous section conclude that we are observing responses mediated by at least two attributes; and further, that responses will be more probable which enable the stimuli to be responded to in regard to one attribute only. Responses which repeat patterns 6, 7, and 8, in other words, will be less probable. Or to put it another way, patterns 6, 7, and 8 will tend to give way, over time, to patterns 1 through 5.

In regard to the situations which occur in daily life, it seems reasonable to suppose that every few A-B-X situations are unidimensional, regardless of the observed pattern. Consider, for example, the situation of persons who share living quarters. A's orientation toward B may be negative in regard to B's snoring, but positive in regard to the fact that B helps pay the rent. Furthermore, A and

B will usually figure in more than one A-B-X system, in that many X's will occur in the environment toward which orientations are demanded. These various objects of orientation may require different attributes of response.

An important object of orientation in the cognitive field of every individual is the self (Dfn. 13, Psych. Post. 3, Ax. 10). Consider the case where A's orientation toward B is positive, but he perceives that B's orientation toward himself is negative. If we assume that A responds positively to himself on at least one attribute, we then have pattern 6:

> A responds positively to B and positively to his self, and perceives B as responding negatively to his self.

This pattern, as mentioned above, we expect will alter over time. If the alterations result in changes in A's orientation toward B, the equilibrium trends of other A-B-X systems in A's cognitive field may be altered. This is likely to be particularly true if A's orientation toward B is highly generalized or highly multidimensional, as I presume to be the case when an orientation exists of the type which we call "liking". The point here is that the interrelations of A-B-self systems and A-B-X systems require that both be entered into the computations when deriving predictions about changes over time.

So far we have limited our attention to the A-B-X systems existing in the cognitive field of one individual.

Let us now consider the interaction of the fields of two individuals. In general, we shall assume that communication between individuals results in each individual receiving information about the potential responses of the other person. To put it another way, communication brings about a more accurate perception of the orientations of the other person. If B dislikes A, and they continue to communicate, A will eventually perceive that B dislikes him, if he does not at the outset. We grant that accuracy of perception does not necessarily increase with extended communication in abnormal cases. But the assumption seems appropriate for the normal situation, and we adopt the assumption for the purposes of the present investigation.

Given frequent communication between A and B, given "enforced" association between A and B such as living together in the same house, and adding the A-B-X system where X is the self to any other A-B-X system being considered, it can be shown that each pattern 3, 4, and 5 implies some A-B-X system, either that including the X being studied or that including the self, which has one of the patterns 6, 7, or 8. Therefore, under the conditions stated (high communication and enforced association), any patterns observed except Nos. 1 and 2 will imply changes over time in at least one of the constituent orientations. Patterns 1 and 2, therefore, may be called conditions of <u>equilibrium</u>. This is not to imply that patterns 1 and 2 never alter. They may do so as a product of responses to subsequent stimuli. The point is that the theoretical conditions implied by the observation of the other patterns do themselves imply that subsequent responses different from those observed at the moment will increase in probability; these implications are not present when patterns 1 and 2 are observed.

We shall speak of patterns 1 and 2 as stable A-B-X systems, and the others as strained. Note that where the special conditions of communication and continuing association are not present, we should apply the term "strained" only to patterns 6, 7, and 8. In general, however, we shall be discussing A-B-X systems under the conditions of communication and continuing association so commonly found in daily life, and we shall use the terms stable and strained in that context. When we wish to return to consideration of the isolated individual field, special mention will be made of the fact.

Objective systems.-- The terms of this theory are in the beginning terms which are associated with the individual. A response of person A, however, may be observed to be a stimulus for person B. Interaction between individuals is accordingly conceived as interaction between sets of potential responses, or cognitive fields. Examination of the detailed structure of cognitive fields is arduous, however, and it would be convenient for many problems of interest to the social psychologist if comparisons between individuals could be made with a minimum of attention to a detailed analysis of individual response spaces. A problem such as the one investigated here concerning the conditions controlling the effectiveness of communication, is one in which research would be facilitated by derivations from the theory which would enable propositions to be made directly in terms of the observable responses of the two individuals communicating.

These two levels of analysis may be considered as two tactics: the one predicting behavior in terms of the "mechanism" of the individual response space, the other in terms of patterns of responses observable in the interaction of two individuals. Newcomb[2] makes this distinction by speaking of phenomenal A-B-X systems and of objective A-B-X systems. In most of the foregoing discussion we have described A-B-X systems embedded in the cognitive structure of the individual. This is the phenomenal system. The objective system, however, will be more useful in selecting variables in terms of which to express testable hypotheses bearing upon the present thesis. We may observe orientations on the part of person A toward B and toward X. Likewise the orientations of person B toward A and X may be observed. This assortment of orientations, observed by the experimenter, we shall term the objective system.

[2]Personal communication.

In order to describe certain patterns among the orientations of the objective system, and at the same time to reduce the total number of possible patterns to a number convenient for study, we shall introduce two new terms: attraction and agreement.

The orientation of A toward B we shall call the attraction of A toward B. If A responds positively to B, we shall say that A is attracted to B. Correspondingly, if A responds positively to B and B positively to A, we shall categorize the objective A-B-X system as attracted. If A responds negatively to B and B negatively to A, we shall categorize the system as non-attracted. And if one responds positively to the other, but the other negatively to the first, we shall categorize the system as mixed. In brief, we characterize the objective system by a variable of attraction, and assign to each observed system one of three categories or "values": attracted, mixed, or non-attracted.

Degree of agreement will characterize the comparison of the orientations of A and B toward the object X. If both A and B respond positively to a stimulus (or group of stimuli), or if both respond negatively, we shall say that the objective system is an agreeing system. If one responds positively and the other negatively to a stimulus (or group of stimuli), we shall call the system disagreeing. Thus, we assign one of two categories of an agreement variable to the system: agreeing or disagreeing.

Given the conditions mentioned earlier of communication and continuing association, it is possible to examine the implications for strain and stability in the phenomenal system of each individual which obtain under each pattern of the objective system. The results of such an analysis are presented in Table 2.

TABLE 2

IMPLICATIONS FOR PHENOMENAL SYSTEMS OF THE VARIOUS OBJECTIVE SYSTEM PATTERNS, UNDER COMMUNICATION AND CONTINUING ASSOCIATION

Objective System Pattern	Phenomenal Systems of A and B	
	Containing Self	Containing Object X
Attracted agreeing	Stable	Stable
Attracted disagreeing	Stable	Strained
Mixed agreeing	Strained	Strained for A if not for B
Mixed disagreeing	Strained	Strained for A if not for B
Non-attracted agreeing	Strained	Stable
Non-attracted disagreeing	Strained	Strained

The predictions displayed in Table 2 are derived for the purpose of establishing expected conditions for change, and directions of change, in the orientations of communicating individuals. These expected conditions and directions will enable us to compare more readily the results of communication between co-linear and non-co-linear pairs of persons.

It is important to make clear that the primary purpose of the research to be recounted in the next two chapters was to test the hypothesis that conditions of co-linearity discriminate among effects of communicative acts. The design of the data collection was made with this purpose foremost. In turn, the hypotheses based on Table 2 were tested for the purpose of providing a "base line" for assessing the effects of communication when co-linearity conditions are taken into account.

Hypotheses

Two communicative situations are frequent in our society. One is the situation where one person is designated institutionally as the speaker or leader. The other is the less formal situation occurring between pairs of individuals or within a small group. Both types of situations were utilized in this investigation.

Data were collected from members and teachers of beginning classes in psychology at the University of Michigan, and also from the members of a cooperative residence on the same campus. Hypotheses pertaining to the classroom data will be considered first.

<u>Hypothesis 1</u>.-- <u>Among students who yield reliable rank orders of attitude items pertinent to the course, those</u>

who from pretest to posttest maintain rank orders co-linear with that of the instructor will receive higher grades on quizzes than those whose rank orders remain non-co-linear with that of the instructor.

Hypothesis 2.-- The difference in quiz grades predicted by Hypothesis 1 will be at least as pronounced when only those students are considered whose pretest and posttest rank orders are co-linear.

Students and teachers in the classes tested were asked to give their preferences among five attitude statements (for which see Appendix III) at the beginning and again at the end of the semester. Grades used were those from quizzes which were written and graded by the individual instructors. Details of procedure will be presented in Chapter III. The discussion here will be devoted to the connection of the hypotheses with the theory.

These hypotheses, like all the others to be presented, are phrased directly in terms of observables. The genotypic formulations which dictate the requirements that the observables must meet have been presented in the earlier parts of this chapter. The theoretical statements upon which these two hypotheses rest will be presented below, and a similar theoretical discussion will follow the other hypotheses as they appear.

The specifications for observational operations derived from the theory fall into two types. First is the kind of specification which can be translated directly into a binary operation. An example is the specification of a transitive rank order. Setting up some procedure for associating a binary relation with an individual, such as a pencil mark on a questionnaire, the experimenter observes either A before B or B before A, unequivocally. Where the theory asserts the relations to be found among rank orders observed in this manner, the analysis procedures and the permissible conclusions are plain.

Second is the observational operation which calls for selecting a certain range of a continuous (or practically continuous) variable. An example is the specification we have set up for "high" communication. Perhaps a better designation would have been "adequate" communication. The theory can say only that the number of changed potential responses in a response space per unit of time is monotonically related to frequency of communication per unit of time. But the shape and slope of the function are, so far as I know, entirely unknown. The "cutting point" for "high" communication, beyond which the predicted effects requiring "high" communication may be expected to occur, is not to be found in the theory.

The establishment of "cutting points" for such variables as amount of communication is a problem like that of "empirical constants" in the physical sciences. A theory may specify that the amount of deformation under stress will follow a given function up to the limit of elasticity, and a different function after that point. The same theory, however, rarely predicts the limit of elasticity for any given material. The task for the laboratory worker is to subject a variety of materials to stress under varying conditions of temperature, age, etc., and note the "cutting point" for each. It is my fond hope that someone will some day undertake the comparable task for social psychology.

In the meantime, one selects a condition of "high" communication by one's best judgment. The disadvantage of using such a variable when one has no knowledge of the critical points along it, is that an empirical outcome contrary to prediction is ambiguous. On the one hand, the contrary result may occur because the theory, in asserting a given relationship, fails to correspond to the real world. On the other hand, the relationship might become observable if the experimenter were to carry out the work in a further range of the variable in question. But the use of such variables can rarely be avoided.

Sometimes one compromises with economy by adopting a variable of the second type where a variable of the first type might have been possible to obtain only by the expenditure of a prohibitive amount of effort in data gathering. Such a course is adopted only where one's confidence in his ability to recognize the desired ranges of the variable is exceptionally high. Such variables occur in this research, and they will be pointed out.

The points of connection with the theory of Hypotheses 1 and 2 will now be set forth. The chief propositions on which these two hypotheses rest are:

> 1. The co-linearity index distinguishes pairs of response spaces (those of student and instructor) in which the composition functions may yield the same "unfolded" orders of the stimuli, from pairs of response spaces in which the stimuli could <u>not</u> be "unfolded" to give the same rank order.
>
> 2. In regard to each individual, the attributes relevant to his response to the attitude items, and the function by means of which he composes those attributes, serve to estimate the attributes and composition functions relevant to stimuli at other times during the course.
>
> 3. In regard to attributes which are relevant both to the student's responses to the teacher and to the student's responses to the subject-matter of the course, the student's orientation to the teacher will be predominantly positive.

The theoretical sources of propositions 1 and 2 are set forth by the sections in this chapter on the unfolding technique and co-linearity. The third proposition is a technical way of saying that most students will feel that the "correct" answer to a quiz question is the one the teacher would give. This assertion about the students is not a deduction from the theory, but is rather an assumption made concerning the students which is necessary for the application of the theory. It is the kind of judgment for reasons of economy which was mentioned in the preceding discussion of observational procedures. If most students were to feel that what the teacher affirmed should be taken as the criterion for a <u>wrong</u> answer, Hypothesis 1 would have to predict just the opposite from what it does in regard to quiz grades. Proposition 3 could, of course, be adopted as an hypothesis for an empirical study. But since it seemed a very safe guess as to the predominant orientation of the students, and was incidental to the central purpose of the investigation, it was taken as given.

> 4. For a significant number of the students, the classroom situation is one of a high degree of communication with the teacher.

The judgmental element in the operation indicated by proposition 4 has already been pointed out in the discussion of the "cutting point" problem, where the communication variable was used as an illustration.

Propositions 3 and 4, taken together, assert the existence of an A-B-X system. The student (A) is oriented toward the teacher (B) and toward the quiz questions (X). We assume that the student's orientation toward the teacher is positive in the sense that the teacher is accepted as establishing right and wrong answers to quiz questions. We assume (as stated in the section on objective systems) that communication increases the accuracy of the student's perceptions of the teacher's orientation toward the subject-matter of the course. The response-space of the student, then, contains the following orientations: (1) a positive orientation toward the teacher, (2) a perceived orientation of the teacher toward the course materials, and (3) an orientation on the part of the student toward the course materials.

It was asserted in the section on objective systems that under conditions of "high" communication and continued association, A-B-X systems will gravitate toward two particular patterns of equilibrium. In terms of the classroom situation, these two patterns are those in which the teacher and student are <u>attracted</u> (are positively oriented toward each other in regard to the course materials), and in which (a) both teacher and student respond positively to stimuli in the course (e.g., answer "yes" to a quiz item) or, (b) both teacher and student respond negatively to stimuli in the course (e.g., answer "no" to a quiz item).

Now, it was pointed out in the sections on unfolding and co-linearity that the relevant attributes and the composition function limited the responses which a response space could yield in regard to any given set of stimuli. It was further shown that a response which puts a simple order on stimuli in a multidimensional space can be used as an estimate of the relevant attributes of the space and the way they combine in mediating responses. It follows, then, that the number of stimuli to which both student and teacher can say "yes" is limited by the number of relevant attributes common to the response spaces of both, and by the degree to which the composition functions used by both put the same genotypic order on the stimuli.

Therefore, we can assert that teacher and student can reach the equilibrium condition characterized as attracted and agreeing more quickly where communication takes place between co-linear response spaces. Agreement in regard to at least some stimuli by non-co-linear persons would require alterations in one of the sets of relevant attributes- or in one of the composition functions.

The time interval over which communication occurs is held constant at one semester for both co-linear and non-co-linear pairs, and we therefore put the hypothesis in terms of amount of agreement, as measured by quiz grades. The foregoing steps, in brief, lead us to the statement of Hypothesis 1.

In estimating similarity of response spaces by means of the co-linearity index, it must be recognized that the response spaces change over time. For this reason, Hypothesis

1 specifies that co-linearity with the teacher should be measured at the beginning of the semester and again at the end, and comparisons made only among those pairs which exhibit stability over that time period. Hypothesis 2 differs from Hypothesis 1 only in that a more rigid criterion for stability is required. Not only must the student be observed to be co-linear (or non-co-linear) with the teacher at both pretest and posttest, but his own rank orders at pretest and posttest must be co-linear. This added indication of the stability of the composition function should result in effects which are clearer than those predicted by Hypothesis 1. Or to say it more conservatively, the results should be at least as clear.

A final assumption is implied in the measurements of co-linearity which was not mentioned earlier:

> 5. Measurements of co-linearity with the teacher at both pretest and posttest, and these together with measurement of co-linearity of the student's own responses at pretest and posttest, will select pairs of persons (student and teacher) who remain sufficiently co-linear (or non-co-linear) during the semester that the predicted effects will be noticeable.

Having indicated the derivation of Hypotheses 1 and 2, it will be interesting to consider an interpretation suggested by John R. P. French.[3] In the early section of this chapter on order, it was postulated that the ordering of stimuli by the individual rests on the fact of order among primitive elements in the response space. These primitive orders give the structure within which the individual "places" himself, and the "position" which the individual takes determines the direction of his responses to the stimuli. In the section on multidimensional space and "learned" attributes, we went further to assert that the individual can construct a simpler organization within the multidimensional space by the use of a "composition function", which puts a simple order on the stimuli. Although the individual's "position" or "ideal" may be nearer, in some sense, to a particular point in this simple order than to any other point, still he can order any two of the stimuli, regardless of their "distance" from his ideal.

This simple order given by the composition function, however, makes certain combinations of responses impossible as long as the one particular composition function is maintained. It was on this implication that the co-linearity index was built. And it is at this point that French's suggestion draws a distinction.

The composition function being estimated by the co-linearity index has been conceived as typical of the

[3] Personal communication.

individual's weighting of attributes in the classroom situation being investigated. French's suggestion, however, is that the composition function used by the individual may rather be specific to the interaction situation with the teacher. The point here is that in communication with the teacher under conditions leading toward equilibrium, the weighting of attributes which is selected may be the weighting which is perceived by the individual to be the teacher's weighting.

Now, there is no doubt that we often consciously "take the role of the other" and try to anticipate what would be his responses. Yet French's suggestion is more genotypic than this. It is that the adoption of what is perceived to be the composition function of the other is a process which may be characteristic of the communication situation. If this view should lead to better prediction, then the theoretical basis for defining a perceived orientation on the part of the other would have to be re-examined. This view does not contradict the present theory, but rather points to a finer analysis of the response space.

An obvious way of testing French's suggestion would be to instruct the subjects to take the standpoint of the other, and then look at the effects of co-linearity as indexed by the rank orders given when the subjects were under these instructions. If the co-linearity effects were different from, or better than, the effects of co-linearity given by the index used in the present investigation, then the theory would need to be made more subtle.

The reasonableness of French's suggestion makes it important to test its implications in future research. Unfortunately, appropriate data were not available from the present investigation to make possible its incorporation.

Having discussed Hypotheses 1 and 2, we now turn to a third, also to be tested with the classroom data.

Hypothesis 3.-- Students who are co-linear (or non-co-linear) with the teacher at both pretest and posttest will more frequently give pretest and posttest orders which are co-linear than will students who are co-linear with the teacher at one test, but non-co-linear at the other.

This hypothesis is a direct check on the postulated structure of the response space. We can think of the teacher's rank order as a standard or measuring-stick for the student's rank order. If the student's rank order, matched against the teacher's, shows the same condition at pretest and posttest (either co-linear or non-co-linear), then we should expect the co-linearity index to indicate no change in the composition function of the student from pretest to posttest. That is, we should expect the index in this case to indicate the co-linear condition between the student's pretest and posttest rank orders. We should expect the converse where the student's rank order alters its relation to the teacher's from pretest to posttest. In brief, the comparison of the student's rank orders with a "standard" should not be randomly related to a comparison between the student's rank orders themselves. Since the co-linearity index does not separate mutually exclusive classes, the hypothesis must be expressed in terms of relative frequencies.

The method of computing the co-linearity index does not "force" the result predicted by Hypothesis 3.

The remaining hypotheses are those to be tested with data from the cooperative residence. As in the case of Hypotheses 1 and 2, each of these hypotheses assumes the antecedent conditions of high communication and "enforced" association, such as the sharing of residence facilities.

Hypothesis 4.-- *In regard to the direction of changes in the A-B-X relations from Time 1 to Time 2,*

(a) *there will be a greater mean change toward positive attraction among pairs which are non-attracted agreeing at Time 1 than among pairs which are either attracted agreeing or attracted disagreeing at Time 1;*

(b) *there will be a greater mean change toward positive agreement among pairs which are attracted disagreeing at Time 1 than among pairs which are either attracted agreeing or non-attracted* *agreeing at Time 1.*

Hypothesis 5.-- In regard to the direction of changes in A-B-X relations from Time 1 to Time 2, the changes described in Hypothesis 4 will be more pronounced among co-linear pairs than among non-co-linear pairs.

As explained earlier, Hypothesis 4, as well as Hypothesis 6 below, was advanced so that tests of the co-linearity effects could be interpreted meaningfully in terms of the theory. While Hypotheses 1 and 2 rest upon the prediction of the trend toward the equilibrium condition of the attracted and agreeing A-B-X system, the predictions of Hypotheses 4 and 6 are more detailed.

Hypothesis 4 is based upon the predictions implied by Table 2. Table 2 in turn was constructed by examining the four simultaneously existing phenomenal A-B-X systems under each of the patterns of the objective system. The four phenomenal systems are respectively composed of (a) the orientations of A toward B and some object X, (b) the orientations of A toward himself and B, (c) those of B toward A and X, and (d) those of B toward himself and A. The ~~first~~ second column of Table 2 shows that we trace certain strains in objective systems to the phenomenal systems involving the self. Alterations leading toward equilibrium in the phenomenal systems involving the self can be brought about by changing the orientation toward the self, that toward the other, or that perceived as held by the other toward the self. Since none of these involve the object X, predictions in regard to strains indicated in the first column of Table 2 were limited to predictions of change in the attraction variable. The predictions made in regard to these strains are those of Hypothesis 4(a).

No prediction was made in regard to direction of mean change in the systems in the category of mixed attraction. Strain in these systems can be reduced with equal likelihood by changes which end in both persons having an attracted orientation toward the other, or by changes which end in both being non-attracted toward the other. Since changes in one direction or the other are implied, however, predictions were made in regard to variance, as will be seen in the discussion following Hypotheses 6 and 7.

Neither was any prediction made in regard to direction of mean change in the systems of the non-attracted disagreeing category. The phenomenal systems implied by this category of objective system are strained only when the condition of continuing association obtains. If the individuals are "free" to discontinue their association, the non-attracted disagreeing category of objective system implies only stable phenomenal systems. This point was discussed under the earlier section on equilibrium trends.

Now, one way in which an individual may "dissociate" himself from another is to perceive the attributes underlying the responses of the other to be different from the attributes underlying his own. That is, the attributes relevant to the responses he perceives on the part of the other toward himself and the object X are not the attributes relevant to his own orientations toward himself and the object X. When A-B-X systems do not have relevant attributes in common, they are not in the same space, and one system holds no implications of strain for the other.

It is clear that changes in the cognitive field which make some orientations "irrelevant" to others (in the sense of the preceding paragraph) offer a means of reducing strain in the phenomenal system. Now, a peculiar feature of the non-attracted disagreeing category of objective system is that it implies strains both in the A-B-self phenomenal system and the A-B-X phenomenal system for both individuals. In other words, no single change in orientation will serve to produce a stable state, for either person. The implication is obvious that changes bringing about "irrelevance" among orientations are particularly probable among objective systems of the non-attracted disagreeing category which are subject to "enforced" association.

Although we have traced to this point the implication that change in the orientations constituting non-attracted disagreeing systems may be reduced or obviated by the "irrelevance" process, and have indicated the implication that this process is more probable in the non-attracted disagreeing category than in other categories, we nevertheless have no way of knowing *how* probable it is, nor can we know the degree of its effect on other changes. For these reasons, Hypothesis 4 makes no prediction involving the non-attracted disagreeing category.

Hypothesis 4(b) can be read from the ~~second~~ third column of Table 2. The strains indicated in this column are those occurring in the phenomenal systems which contain the object X. It is by means of the responses to the object X that the agreement variable is computed. We therefore use the implications of strain and stability indicated in the ~~second~~ third column of Table 2 to make predictions about mean changes in agreement.

Hypothesis 4(b) omits the same categories from prediction as does Hypothesis 4(a). An inspection of Table 2 will suggest the lines of reasoning, similar to those just presented, which led to the corresponding omission of these categories from Hypothesis 4(b).

The argument for Hypothesis 5 is almost identical with that given in the discussion of Hypotheses 1 and 2, and it will not be repeated here. It may be well to emphasize once again, however, that Hypothesis 5 is the one which is directly connected to the thesis of this dissertation. The relation between Hypothesis 5 and Hypothesis 4 might be expressed as follows. *Where changes in orientations occur as a result of communication* (e.g., as indicated in Hypothesis

4), _the changes will be more pronounced for co-linear communicating pairs and less pronounced for non-co-linear pairs_ (Hypothesis 5).

The reader's indulgence is sought for offering him three pages of explanation for a subsidiary hypothesis and one sentence explaining a central hypothesis. Actually, of course, the entire present chapter has led forward to both of these hypotheses. And the explanation of the omitted categories in the predictions seemed the more courteous alternative to leaving the occasional reader who might be puzzled by these omissions with no means of satisfying his curiosity.

Hypothesis 6.-- In regard to the variability of changes in the A-B-X relations from Time 1 to Time 2,

(a) _the variance of changes in attraction will be greater among pairs in each of the Time 1 categories mixed agreeing, mixed disagreeing, non-attracted agreeing, and non-attracted disagreeing than in either of the Time 1 categories attracted agreeing or attracted disagreeing;_

(b) _the variance in change in agreement will be greater among pairs in either of the Time 1 categories attracted disagreeing or non-attracted disagreeing than in either of the Time 1 categories attracted agreeing or non-attracted agreeing._

Hypothesis 7.-- In regard to the variability of changes in A-B-X relations from Time 1 to Time 2, the comparisons described in Hypothesis 6 will be more pronounced among co-linear pairs than among non-co-linear pairs.

In the section on objective systems, it was asserted that certain patterns, called "strained" would be subject to alterations within their constituent orientations because of the postulated nature of the response space in which the systems are embedded. Other systems, called "stable", would not be subject to these intrinsic "strains". The deduction was made that strained systems would tend to move toward stable states. Under properly controlled conditions, therefore, we should expect a collection of A-B-X systems to contain a larger fraction of stable systems at the end of a period of communication than at the beginning.

However, there are a number of factors which complicate an attempt to observe directly this trend toward stable systems. First, there are extrinsic influences. Changes within A-B-X systems being observed are continually being affected by responses to stimuli which are members of other A-B-X systems, but which "overlap" with those being studied. This is one reason why the trend toward stability may never reach stability. A parallel is the ping-pong ball bouncing on a jet of air. It is continuously responding to the effects of gravity, but it never comes to rest on the floor.

Furthermore, and this is the part of the parallel most pertinent to the present discussion, the ping-pong ball shows considerable variability in its changes of position as a result of its responses to gravity and the air jet.

Second, there are a number of alterations in a strained system which may yield immediate stability in the phenomenal system. While one stability-giving change might result in higher attraction or agreement in the objective system, another might result in lower attraction or agreement. Therefore, while a mean trend may be observed toward stable patterns, there will be considerable variability among objective A-B-X systems in regard to the amount and direction of change observed at any given moment.

To put this point in the metaphor used in Chapter 1, the game of making a map of the world by means of guesses based on bits of communication gradually results in a more accurate map, but a great many wrong guesses and erasures occur in the process.

The greater variability will, of course, be expected in those categories of objective systems where strain is implied. The predictions of Hypothesis 6 may therefore be read directly from Table 2.

Here again, an omission will be noticed. The entries in the second column of Table 2 opposite the mixed categories of attraction indicate that strain is implied in these cases for the phenomenal system of only one individual. This fact makes uncertain the degree of "strain" being dealt with in the objective system, and therefore no prediction was made in regard to variability of agreement changes involving the "mixed" categories. Aside from this omission, Hypothesis 6(a) predicts that the variance in change of attraction will be greater for one objective system than another if the first is indicated as strained in the first column of Table 2 and the second is indicated in the same column as stable. Hypothesis 6(b) makes the corresponding predictions in regard to the variable of agreement, as indicated by the second column of Table 2.

Hypothesis 7 is another expression of the general principle that the co-linear condition makes communication more effective. When A communicates with B, and B's phenomenal system containing A is strained, the repertoire of possible responses available to B <u>which are the same as those of A</u> is larger if B is co-linear with A. In brief, the model argues that a greater variety of changes is possible between co-linear persons than between non-co-linear persons. Therefore the variance of changes for co-linear pairs will be greater than for non-co-linear pairs. This effect of co-linearity is predicted by Hypothesis 7 to aggravate the differences between changes within the strained and stable systems which are predicted by Hypothesis 6.

<u>Hypothesis 8</u>.-- <u>Within each Time 1 category, the</u>

variance of changes in both attraction and agreement will be greater among co-linear pairs than among non-co-linear pairs.

The derivation of Hypothesis 8 is similar to that just given for Hypothesis 7. Hypothesis 8 tests the greater effectiveness of communication within co-linear pairs than within non-co-linear, without regard to direction of change. The hypothesis is stated for each category of objective system separately, because while the chief intent of the hypothesis is to compare the amount of change within the two co-linearity conditions, it is also desirable to test the hypothesis in a way which would uncover any dependence of the hypothesis on the category of objective system being examined.

Chapter III consists of a report on the tests of Hypotheses 1, 2, and 3. Chapter IV reports on the tests of Hypotheses 4 through 8.

CHAPTER III
THE CLASSROOM EXPERIMENT

This chapter presents the conduct and results of the tests of Hypotheses 1, 2, and 3, which were set forth in Chapter II. In the first two hypotheses co-linearity between teacher and student as a communicating pair is related to the effect of communication in bringing about agreement as measured by the student's success in giving "correct" answers to quiz grades. The third hypothesis deals with expected relations among co-linearity patterns. In describing the tests of these hypotheses, it will first be appropriate to explain the construction of the variables and the methods of gathering the data for them.

Procedures

The co-linearity index.-- As is evident from the theoretical discussion of co-linearity in Chapter II, an index of co-linearity requires the observation of responses to a number of stimuli. Further, these responses must provide data from which a rank order can be inferred. For reasons which will appear later, the Method of Rank order was not used in gathering these data. The method used was the Method of Triads (4, p. 502).

Students in the introductory course in psychology at the University of Michigan were presented with five statements which could be seen as related to the content of the course, but which were not assertions of the kind which would be made as a part of the material to be learned in the course. The five statements used appear in Appendix III. The statements were presented in groups of three, all ten of the possible combinations being used. The subject was instructed to mark, in each triad, the statement with which he most agreed and the statement with which he least agreed. Data were collected in this way from the classes of five teachers during the first week of the semester, and the identical procedure was repeated during the last week but one of the semester. The same questionnaire given to the students was also given to each of the five teachers.

The response of the subject to the five stimulus-statements, if it yielded a transitive order among the stimuli, could fall into any of 120 rank orders. The theory postulates that the rank order which results depends upon the way in which the subject composes the attributes spanning the response space in which the stimuli lie.

The attributes underlying the responses of the subject to the stimulus-statements are taken as an estimate, however rough, of the attributes underlying his responses to the subject-matter of the course. To the end that attributes characterizing the subject's responses to the communicative situations of the course should be sampled, certain precautions were taken. The questionnaires were presented in the classroom situation, a few "psychological" words were used in the statements, and data were gathered at two times during the course. On the other hand, since it was desired to sample attributes more characteristic of the individual than of specific situations, the statements avoided any particular topics or principles of the course content.

The use of the co-linearity index reduces the number of individuals who can be studied to those whose responses will yield a reliable simple order among the stimuli. Since the hypotheses require on the part of the student the persistence of a composition function during the course which is either co-linear or non-co-linear with that of the teacher, it is necessary to eliminate from consideration those subjects whose responses give evidence of changeability, as well as those students whose responses fail to yield a simple order. This necessity of course restricts certain of the conclusions to interaction situations where the individuals respond with composition functions which yield a simple order among the stimuli, but it does not restrict the conclusions to individuals of low changeability, since vacillation is relative to the time period being studied. I chose a long time period in order to maximize differences, at the expense of a high attrition rate among the subjects for whom the co-linearity index could be computed.

The selection of subjects for whom co-linearity with the teacher was computed went through the following stages:

(1) Out of seven classes in introductory psychology (taught by five teachers), some students responded only to the pretest or only to the posttest. The number responding to both administrations of the questionnaire was 145.

(2) Of 145 subjects responding at both pretest and posttest, 15 gave responses at one time or the other which were intransitive, indicating that they were "unwilling" to compose the stimuli into a simple order. This left 130.

(3) The 130 transitive subjects gave responses which contained varying degrees of inconsistency. The Method of Triads presents each pair of stimuli to the subject three times when five stimuli are used. It is therefore possible for the subject to express a preference for stimulus A over stimulus B at one moment and for B over A at a later moment. If a subject is highly inconsistent, there is some ponderable possibility that the weight of his responses would have yielded an <u>intransitive</u> relation among the stimuli, had he responded a moment later than he did. In this sense, inconsistency may be interpreted as "uncertainty" on the part of the subject about putting a simple order on the stimuli. An arbitrary criterion was established at 70% of the paired comparisons. Subjects who gave inconsistencies in 30% or more

of the pairs of stimuli were dropped from consideration. This removed 54 subjects, leaving 76. All five teachers gave transitive responses containing at least 80% consistency.

(4) Hypothesis 1 makes explicit the next step in selection. Once the co-linearity index is applied to two rank orders, it provides in itself evidence for change of viewpoint between the two responses. (In this chapter and the next, I shall frequently use the more comfortable term "viewpoint" as a synonym for "composition function".) Subjects whose pretest responses were co-linear with the teacher's, but whose posttest responses were non-co-linear, or conversely, would have been exposed to one condition and then to the other in some unknown proportion, and could not reliably be used to test the hypothesis. Using only those subjects who were co-linear with the teacher at both pretest and posttest, or non-co-linear at both, reduced the number of subjects by 34 of the 76, leaving 42. At this level of "purity", so to speak, I judged that the co-linearity index should be effective enough to separate sheep from goats.

(5) Hypothesis 2 specifies a further step in selection. If the co-linearity index is applied to the subject's own two responses, one at pretest and one at posttest, non-co-linearity "pre-to-post" would imply that the subject has changed his viewpoint in the interim, even though the viewpoints at both times are co-linear (or non-co-linear) with that of the teacher.

Of the 42 students used in testing Hypothesis 1, six gave non-co-linear pre-to-post responses, leaving 36 subjects in the test of Hypothesis 2.

Quiz grade z-scores.-- Co-linearity, then, applied in the manner described, is the independent variable for Hypotheses 1 and 2. The dependent variable is the mean grade made by the subject on quizzes written and graded by his teacher. Within each of the seven classes, each quiz was given equal weight in the total score. In order to compare quiz grades across classes, z-scores were then computed for each class. The z-scores were used as data in all further computations.

Results for Hypothesis 1

Hypothesis 1 stated that among students who yield reliable rank orders of attitude items pertinent to the course, those who from pretest to posttest maintain rank orders co-linear with that of the instructor will receive higher grades on quizzes than those whose rank orders remain non-co-linear with that of the instructor.

Dividing the 42 subjects used to test Hypothesis 1 into those co-linear with the instructor at both pretest and posttest (21 subjects) and those non-co-linear with the instructor at both tests (also 21 subjects), and applying the t-test (two tails) to the two arrays of quiz scores, a significance level of .07 is reached, in the proper direction.[4] Kendall's (14, p. 310) Q-statistic reaches a critical value of only 1.77.

Although this result would make acceptance of this hypothesis dubious by itself, it will be seen that this result is entirely consistent with the results of the test of Hypothesis 2, which reaches traditionally acceptable levels of significance.

Results for Hypothesis 2

Hypothesis 2 stated that the difference in quiz grades predicted by Hypothesis 1 will be at least as pronounced when only those students are considered whose pretest and posttest rank orders are co-linear.

In the test of Hypothesis 2, there were 17 subjects in the group co-linear with the instructor and 19 in the non-co-linear group. The t-test applied to the quiz scores of these two groups yields a significance level beyond .03. Kendall's Q gives a critical ratio of 3.44.

It should be pointed out that the t-test is not entirely appropriate for testing these hypotheses. When the co-linearity index gives a value of non-co-linear, it may

[4]In the interests of being conservative, all probability figures in this dissertation derived from Student's t-distribution, from the Tchebycheff inequality, or from the chi-square distribution will be two-tailed probabilities, unless expressly noted otherwise.

be said according to the theory that the subject could not, from any position on the composite attribute mediating his response, give a rank order of the stimuli which would unfold with that of the other person. But when the index gives a value of co-linear, the converse cannot be said. An index value of "co-linear" indicates only that it cannot be said, according to the theory, that the subject's viewpoint is not co-linear with that of the other person. It may or may not unfold with his. For this reason, a test of co-variation such as product-moment correlation, chi-square, or the t-test demands more of the data than can be predicted. The chi-square test, for example, in the four-fold table, reaches a "perfect" relation only when two cells of the table reach zero. The appropriate test for these predictions, on the other hand, would be one in which the relation was "perfect" when one cell of the table reached zero. Kendall's Q is such a statistic. Unfortunately, no distribution function is available for Q, but the Tchebycheff inequality can always be employed where a critical ratio can be computed, and in such a case a critical ratio beyond 3.0 is customarily considered grounds for rejecting the null hypothesis.

For the reason that a test such as chi-square or the t-test is treating the data more stringently than the prediction undertakes, the probability of .07 given by the t-test for Hypothesis 1 becomes more acceptable. Likewise, a comparison with the ratio for Q of 3.44 obtained in testing

Hypothesis 2 may be made with a level of confidence of .05 obtainable from the same table by the use of chi-square.

As was suggested earlier, the result of Hypothesis 1, when compared to that for Hypothesis 2, argues for the correctness of the theoretical derivations, since it was expected on theoretical gounds that the criteria for the co-linearity index used in Hypothesis 2 would give better results than the less stringent criteria used in Hypothesis 1.

Tests of Alternative Hypotheses

Before going on to Hypothesis 3, it will be well to raise a few questions about the findings so far given. The first of these has to do with the effect of co-linearity, as contrasted with similar preferred positions among the stimuli, in predicting mean grades.

Preferred position among the stimuli.-- It may occur to the reader to wonder whether it might be that the co-linearity index has picked out, among the data, co-linear rank orders which contain the same stimuli in preferred positions. That is, it might be that co-linear persons are those who agree that certain stimuli are most preferable. If this were the case, it might be argued that the theoretical derivations were unnecessary, and that agreement with the teacher on quiz answers was foreshadowed by agreement with the teacher on the choice of the most preferred among the five attitude statements.

The tau statistic, which measures rank order similarity, was used as a measure of the degree to which a student and his teacher chose the same stimulus-statements as best. Since the scatter-diagrams suggested that both the tau values and the quiz z-scores were distributed with approximate normality, the product-moment correlation was computed between them. The correlation figure was .23 for 34 degrees of freedom, which is far short of a value at which the null hypothesis of no association could reasonably be rejected. In short, the data fail to give evidence that quiz grades follow a preference for the same stimulus-statements preferred by the teacher.

Existence of an attitude norm.-- Another possibility which should be examined is that co-linearity with one's particular teacher is not the determining factor, but rather co-linearity with a normative ordering of the stimuli. That is, it might not be the interaction of cognitive fields of teacher and student which accounts for the difference in grade-achievement, but rather the sensitivity of the student to a more general "cultural" frame of reference which is merely mediated by the teacher. If this were the case, the data should show a tendency for mutual co-linearity among the responses of the teachers. That this is not the case is shown in Table 3.

TABLE 3

CO-LINEARITY OF RESPONSE BETWEEN PAIRS OF TEACHERS

(Margins of the table show identification numbers of the teachers. Each cell shows whether the responses of the two indicated teachers are co-linear or non-co-linear.)

2	3	4	5	
Co-lin.	Non-co.	Non-co.	Co-lin.	1
	Non-co.	Non-co.	Co-lin.	2
		Co-lin.	Non-co.	3
			Co-lin.	4

Table 3 shows that while teachers 1 and 2 are co-linear, and teachers 3 and 4 are co-linear, neither 1 nor 2 is co-linear with either 3 or 4. This indicates that at least two incompatible viewpoints exist among the five teachers. As to teacher 5, little can be said. He has a possibility of unfolding with three of the other teachers. Whether he shares the viewpoint of teachers 1 and 2 or has his own third viewpoint cannot be said.

In any case, these data demonstrate that no single viewpoint exists among the teachers.

Scholastic aptitude.-- In any investigation where symbolic responses are being studied, the possibility can always be entertained that the performance of the subjects may be related to performance on some measure of symbolic skills such as a test of intelligence, scholastic aptitude, or scholastic achievement. If a relation were found between such an ability and the quiz z-score, the novelty of the present findings would be weakened to the extent that co-linearity with the instructor was not independent of the symbolic skill.

The American Council on Education test of scholastic aptitude seemed an appropriate measure with which to examine this possible relationship. A.C.E. scores were available for 100 of the subjects who responded to both pretest and posttest, including 26 of the 36 subjects used in testing Hypothesis 2.

A t-test was carried out to see whether the co-linearity index somehow selected groups which differed in A.C.E. scores. No difference was demonstrable between the group co-linear with the teacher and the group non-co-linear with the teacher in regard to mean A.C.E. score.

One would conclude from this result that members of the co-linear group were drawn from the same level of A.C.E. scores as members of then on-co-linear group. The difference in z-scores between the two groups could then be attributed to the co-linearity condition, and not to any difference in scholastic aptitude. To check whether scholastic aptitude could in any case have differentiated among quiz grades, A.C.E. scores for the 100 available cases were correlated with quiz grades, and a positive correlation of .42 was found, which is significant beyond the .01 level. The non-significant result of the t-test of the 26 cases in the co-linearity groups, nevertheless, argues that the effect on quiz grades was not due to differential selection of scholastic ability.

However, A.C.E. scores were available for only 26 of the 36 subjects involved in the test of the effect of co-linearity. This fact leads one to consider the possibility that some bias may be responsible for determining the individuals for whom A.C.E. scores were not obtained, and that it might be this bias, rather than a reliably random relation between co-linearity and A.C.E. scores, which brought about the non-significant difference between the two co-linearity groups in regard to A.C.E. scores.

It seemed desirable, therefore, to use more than 26 A.C.E. scores to estimate the mean effect of A.C.E. scores on quiz grades among the 36 members of the co-linear and non-co-linear groups. To achieve this result, the 100 cases mentioned above were first divided into bands of cases, each band covering 12 score-units along the scale of A.C.E. scores. The mean quiz grade within each band was then computed. Next, the deviation of the quiz grade of each individual in the co-linearity groups from the mean grade in his A.C.E. band was computed. In this manner, the quiz grade of each person in the co-linearity groups was adjusted by the mean quiz grade to be expected among persons in his range of A.C.E. scores, where the expected grade was estimated by the use of all 100 cases. A t-test was then made of these deviations, which gave a confidence level beyond .05. This test represents a test of Hypothesis 2 in which the variable of scholastic ability is controlled.

In sum, it seems clear that the co-linearity index predicts a difference among quiz grades which is not attributable to the relation between A.C.E. scores and quiz grades, to response to an attitude norm, or to a preference for the stimulus-statements preferred by the teacher.

Results for Hypothesis 3

The purpose of Hypothesis 3 was to test in a more general manner the characteristics of the response space postulated in the theory. Certain relations between co-linear and non-co-linear rank order responses were asserted to be more probable than others. The statement was that students who are co-linear (or non-co-linear) with the teacher at both pretest and posttest will more frequently give pretest and posttest orders which are co-linear than will students who are co-linear with the teacher at one test, but non-co-linear at the other.

Chi-square is the proper statistic for testing Hypothesis 3. The results of the test are shown in Table 4. The p-value of .005 for the null hypothesis clearly supports Hypothesis 3.

The statement of Hypothesis 3 was meant to include all subjects who yielded rank orders at pretest and posttest, and these provided the 130 cases shown in Table 4. The availability of this number of cases made it possible to test two sub-hypotheses concerning combinations of co-linearity.

<u>The group co-linear pre-to-post</u>.-- A deduction from Hypothesis 3 would be that when only those subjects are considered whose pretest and posttest rank orders are co-linear, there will be a positive association between giving a rank order co-linear with the teacher at the pretest and giving a response co-linear with the teacher at the posttest. Results supporting this deduction are shown in Table 5.

<u>Consistency</u>.-- Hypothesis 3 and the deduction described just above were tested with all rank order responses, regardless of their reliability. If consistency, as described

TABLE 4

NUMBER OF RESPONSES, AMONG ALL TRANSITIVE RESPONSES TO FIVE STIMULUS-STATEMENTS, FALLING IN INDICATED CO-LINEARITY CATEGORIES

	Co-linearity of Subject's Pre-to-post Responses	
	Co-linear	Non-co-linear
Either co-linear with teacher at both pretest and posttest, or non-co-linear at both	58	14
Co-linear with teacher at one test, and non-co-linear at the other	31	27

Chi-square = 10.93
p less than .005

N = 130

TABLE 5

NUMBER OF RESPONSES, AMONG TRANSITIVE RESPONSES WHICH ARE CO-LINEAR PRE-TO-POST, FALLING IN INDICATED CO-LINEARITY CATEGORIES WITH THE TEACHER AT PRETEST AND POSTTEST

		Pretest Co-linearity with Teacher	
		Co-linear	Non-co-linear
Posttest Co-linearity with teacher	Co-linear	22	17
	Non-co-linear	14	36

Chi-square = 7.34
p less than .01

N = 89

TABLE 6

NUMBER OF RESPONSES, AMONG TRANSITIVE RESPONSES WITH CONSISTENCY OF 80% OR GREATER, FALLING IN INDICATED CO-LINEARITY CATEGORIES

	Co-linearity of Subject's Pre-to-post Responses	
	Co-linear	Non-co-linear
Either co-linear with teacher at both pretest and posttest, or non-co-linear at both	38	6
Co-linear with teacher at one test, but non-colinear at the other	18	18

Chi-square = 12.47 N = 80

p less than .005

TABLE 7

NUMBER OF RESPONSES, AMONG TRANSITIVE RESPONSES WHICH ARE CO-LINEAR PRE-TO-POST AND HAVE A CONSISTENCY OF 80% OR GREATER, FALLING IN INDICATED CO-LINEARITY CATEGORIES WITH THE TEACHER AT PRETEST AND POSTTEST

		Pretest Co-linearity with Teacher	
		Co-linear	Non-co-linear
Posttest Co-linearity with teacher	Co-linear	17	11
	Non-co-linear	6	20

Chi-square = 7.81 N = 54

p less than .01

earlier in this chapter, indicates a more stable response space, we should expect results at least as favorable as those described above when only those subjects are considered who give rank orders of high consistency. The test of Hypothesis 3 using only high-consistency responses is shown by Table 6. The test of the deduction from Hypothesis 3 is shown by Table 7. The expectation of obtaining results at least as favorable among high-consistency responses as among all responses is borne out in comparing the chi-square value in Table 6 (12.47) with that in Table 4 (10.93), and in comparing that in Table 7 (7.81) with that in Table 5 (7.34).

Conclusions

The results of two kinds of predictions were examined in this chapter. The first type of prediction related the co-linearity conditions to the effects of communication in the classroom situation. The tests of Hypotheses 1 and 2, taken together, provide ample supporting evidence. Hypothesis 2 gave better support than Hypothesis 1, as was expected according to theory.

The second type of prediction related certain types of co-linear and non-co-linear responses to each other. The tests in connection with Hypothesis 3 gave clear evidence in support of the predictions.

There was no evidence that the results of Hypotheses

1 and 2 were associated with the members of a communicating pair taking a common attitude "position", with adherence to a norm, or with differential scholastic aptitude.

CHAPTER IV

THE MEN'S RESIDENCE EXPERIMENT

The general thesis of this dissertation, as stated in Chapter I, is that similarity of structure between two cognitive fields increases the efficacy of communication between them. In the classroom experiment reported in Chapter III, it was assumed that the general effect of communication between teacher and student would be an increase of agreement in regard to the "correctness" of statements dealing with the content of the course. Similarity of cognitive structure was indexed by means of co-linearity, and an analysis of the data showed that the mean agreement between teacher and student in regard to quiz answers was indeed higher in the co-linear group than in the non-co-linear group.

Just as agreement on correct quiz answers was used as a reference-direction against which to compare the effects of co-linearity in the classroom situation, so it was felt desirable in analyzing the data from the men's cooperative residence to state the expected directions of change in the attraction and agreement variables, in order that these directions of change could be contrasted between co-linear and non-co-linear communicating pairs. Hypothesis 4 states the expected directions of change.

The men's residence seemed an appropriate situation in which to examine a second effect of communication; namely, that of dispersion along the variables of attraction and agreement. While in the classroom situation we might expect strong orientations toward goal-objects to restrict the variability in agreement concerning quiz answers,[5] the informal discussions held in the men's residence offer a more "free" situation where a number of different changes in orientation might readily occur in the strained systems. Hypothesis 6 states the categories of objective system which are expected to show greater and lesser dispersion.

The hypotheses of central importance to the present thesis are those which seek to separate augmented and decreased effects of communication by means of the co-linearity index, whatever the measure may be of the unseparated effects of communication. Hypothesis 5 applies the co-linearity conditions to the analysis of the mean changes in attraction and agreement predicted by Hypothesis 4. Hypothesis 7 applies the co-linearity conditions to the expectations of greater variance set forth by Hypothesis 6.

Probably the most general hypothesis in this dissertation (in the sense of making the weakest assertion about the largest collection of data) is Hypothesis 8. It asserts

[5] This kind of assertion is more appealing without the technical language; to wit, you have to know the answers if you want to get the grade.

that whatever the effect of communication on any category of objective system, the changes which occur will be more extreme in the case of co-linear communicators.

As in the previous chapter, the conditions under which the data were collected and the manner of constructing the variables will be described before presenting the results.

Procedures

The Michigan Group Study Project maintained a residence for seventeen male students of the University during the first semester of the 1954-'55 academic year. Each week, with few exceptions, these students met with the Project experimenters for discussions, and for decisions when appropriate, concerning matters of topical interest and problems of living together. In the course of these sessions, a wide variety of data was gathered. At each session, data for an attraction variable were obtained, as well as data from which agreement could be indexed concerning some attitude-object. Pretests and posttests were administered at most sessions.

Attraction.-- In the sessions selected for study, the members of the Group Study Project were asked to indicate, on a list of their fellow members, those persons whom they liked and disliked. Each person liked was indicated with a plus sign (+). At early sessions, the minus sign (-) was offered for use to indicate persons "disliked". This description brought objections from the subjects, however, that very few of their fellows merited such an adjective. In middle and later sessions, therefore, the minus sign was described as indicating persons "not liked". A zero (0) was used to indicate persons who could not happily be placed in either of the other categories, or about whom the subject was undecided.

Taking for each pair of persons the rating of person B by person A, and that of A by B, six categories of objective attraction in the A-B-X system result:

++,
+0,
+-,
0 0,
- 0, and
- -.

A preliminary tally was made, comparing pretest attraction with posttest attraction at a number of sessions. The finding resulted that the plus-plus cell, both at pretest and posttest, outweighed every other cell, and in most sessions outweighed all other cells combined. The strongly negative cells typically contained three or four cases, and sometimes none. This result clearly made it impossible to use enumeration statistics in treating this variable, and consequently in treating the agreement variable also. It was also clear that a strong normative tendency existed to respond with the plus symbol rather than with either of the others.

The fact of the heavy frequency of the plus response brought another decision. For clarity of interpretation, it might have been desirable to omit cases in which the "in-between" response of "zero" occurred, had the proportion of "minus" responses been adequate. But the omission of zero responses would have reduced seriously the spread of the responses. An inspection of the preliminary tally indicated that the zero-zero cases distributed themselves in a manner very similar to that of the plus-minus cases. It therefore seemed reasonable to retain the zero responses, in the hope that zero-zero A-B-X systems would respond similarly to plus-minus systems.

If this seems a catch-as-catch-can manner of handling zero ratings, let it be recalled that there could in any case be little certainty about the "meaning" of these zero responses. The interpretation of these responses was dubious because (a) it was necessary to modify the instructions to the subjects in the course of the experimentation, and (b) the high preponderance of plus responses made it seem probable that at least some of the zero responses represented something other than a point of indifference. In view of the need for a workable range in the attraction variable, then, it seened worth while to look for an empirical clue to the nature of the zero ratings. The fact that the zero-zero cases distributed themselves similarly to the plus-minus cases made it seem reasonable to act on the assumption that both cases represented unstable systems susceptible to communicative influence.

To recapitulate, three problems were urgent: (1) enumeration statistics were ruled out by low frequencies; (2) the strong normative trend toward plus responses brought into question the point of passage from positive attraction to negative; and (3) it seemed desirable that any statistics used treat zero-zero cases as equivalent to plus-minus cases.

<u>The linear hypothesis</u>.-- These three factors urged the adoption of the hypothesis of linear components of variance. The mathematical background of the linear hypothesis, as applied here, is explained in Appendix IV. Briefly, a score obtained from a pair of persons is assumed to result from the summation of (1) the mean score for all pairs in the population, (2) the deviation from that group mean contributed by person A, (3) the deviation from the group mean contributed by person B, and (4) the deviation attributable to the interaction of persons A and B. An interaction score can therefore be computed for each pair by estimating the group mean and the contribution made by each person to his pair-scores, and performing the appropriate

arithmetic on the obtained pair scores.

Accordingly, the intervals between plus, zero, and minus responses were taken to be equal, and scores were obtained for each pair by taking the sum of the responses of each member of the pair. The indices computed from these scores according to the linear hypothesis represent the portion of the obtained score attributable to the *interaction* of the two persons, which is exactly what we wish to study. The portions attributable to a normative group tendency, and to individual tendencies of the members of the pair, are removed. The indices distribute themselves around zero in a unimodal and roughly symmetrical manner.

Agreement.-- With the adoption of the linear hypothesis, an index of change over time may be attributed solely to the interaction, or communication, taking place between the members of the pair during the interval spanned by the measurements. Without the computation of the interaction index, a raw score for one pair would not ordinarily be considered to be independent of the raw score for another pair if the same person were a member of the two pairs. Likewise, measurements of the same pair over two different time intervals would usually be considered to give non-independent change scores, since individual response tendencies would be common to the two intervals. Since, however, these components are removed under the linear hypothesis, a full degree of freedom may be assigned to the computed interaction index for each pair, regardless of common membership. It is only necessary, in studying change, that the time intervals spanned from pretest to posttest do not overlap.

With this advantage of the linear hypothesis in mind, a topic of communication was sought in the Group Study data which was the subject of discussion over a number of different intervals. In this way the number of cases could be maximized. It was also necessary, of course, that this attitide object satisfy a number of other requirements, such as having comparable pretest and posttest measures, and yielding multidimensional response patterns among the rank orders.

The topic chosen was that of pre-marital and extramarital sexual conduct. The subjects were presented with five statements on this topic, and instructed to check those which they found acceptable. (The statements are reproduced in Appendix V.) The raw score for agreement was computed by counting the number of statements which both members of the pair indicated as acceptable, as well as those which both indicated as unacceptable. The raw score for agreement could thus take on any integer from zero through five. From these raw scores, the interaction agreement index for each pair was computed.

Co-linearity.-- As well as being asked to indicate which of the five statements concerning sexual conduct they found acceptable, the subjects were also asked to rank the statements in order of preference. These orders were used for the co-linearity index. The co-linearity index is statistically independent of the agreement index, since two persons who find the same items acceptable or unacceptable can order them co-linearly or non-co-linearly in as many ways as persons who do not accept and reject the same items. A normative tendency may occur, as in fact it did, for persons whose rank orders unfold into a certain common rank order to agree also that a particular end of the order is acceptable and the other is not. This relationship adds complexities to the analysis of the data and the interpretation of the results, but the results are not biased by the manner of computing the indices.

The five statements were ordered by each subject nine times during the semester. Each pair was examined for co-linearity at each of these nine times. Pairs who were either co-linear or non-co-linear at more than 70% of these times were retained in analyses involving co-linearity; other pairs were dropped. This procedure supplies a means of estimating the stability of the composition functions used by the members of the pair. In the analysis of the data from Psych. 31 classes, this criterion was met by the consistency of responses to paired comparisons, which was possible because the statements used were presented in triads. Since triads were not presented to the members of the Group Study Project, but nine replications of the rank ordering were presented, the stability of co-linearity was established by the procedure described.

It will be seen that the co-linearity index constructed from the men's residence data differs in two respects from that constructed from the classroom data. The first respect in which the two indices differ is in the relation of the stimuli used to provide data for the co-linearity index to the stimuli used to provide data for the agreement variable. In the classroom experiment, the co-linearity stimuli were different from the agreement stimuli. The two sets of stimuli were connected by the assumption that common relevant attributes underlay the responses to both. It was up to the best judgment of the experimenter (aided by the judgment of the teachers involved) to select stimuli for the co-linearity index which would justify this assumption. This method of gathering data for the co-linearity index permits more freedom in experimental design and produces fewer complications in analysis, but it also runs the risk that the experimenter's judgment in regard to attributes of response will not be good enough.

In the men's residence experiment, the same stimuli elicited the responses which provided the data for both the co-linearity index and the agreement variable. In this method no exercise of judgment in regard to common relevant attributes is required of the experimenter, and therefore no risk in this respect is taken. On the other hand, the risk is run that the spread of the agreement variable will be reduced by a tendency for co-linear individuals to show a normative preference for stimuli in the same portion of the underlying rank order, as did indeed occur in the present investigation. Such "bunching" of preferences tends to make a change variable based on pairs behave with some discontinuity.

The second respect in which the co-linearity indices of the two experiments differ is in the manner of winnowing the rank orders of greater reliability from those of lesser. In the Method of Triads, used in the classroom experiment, inconsistency of response to replicated paired comparisons was used to indicate "uncertainty" on the part of the subject in yielding a simple order from a multidimensional space. This method amounts to using vacillation over a short period of time (about five to ten minutes) as a sample of that to be expected during the semester. In the men's residence experiment, the Method of Rank Order was used to collect the data for the co-linearity index, and the number of non-co-linear instances occurring between pairs in the nine replications of the rank ordering was used to indicate change in the co-linearity condition of each pair during the semester. This method amounts to using change over a long period of time as evidence of "uncertainty" during that period of time. Which of these methods is the more advantageous is a question which could well be investigated in future studies.

The different conditions in the two experiments made it possible, however, to try out these two ways of constructing a co-linearity index. Although a controlled comparison of the two indices has not been made, an opportunity to apply a new concept in two different ways can hardly be spurned. The fact that both indices succeed in discriminating among the data argues that the risk of having no controls was well taken.

Categorizing of Pairs

Now that the methods of constructing the several variables have been described, it will be appropriate to describe the selection of the data which were used in the tests.

There were four periods during the semester which provided pretests and posttests regarding the topic of sexual conduct. The posttests in each case also furnished data for attraction and co-linearity. Since there were seventeen individuals, the maximum number of pair scores on one variable would be $4 \times N(N-1)/2$, or 544. This number was reduced a little by the occasional failure of an individual to answer a question.

As explained in Chapter II, the predictions concerning the objective A-B-X systems depend on the existence of a condition of relatively high communication between the members of the pairs. It seemed wise, therefore, to select pairs for study where there was some evidence for high frequency of communication. In two of the periods studied (viz., the eleventh and twelfth weeks of the semester) the subjects were organized into concentrated discussion groups. Only those pairs of persons sharing membership in a discussion group were selected for study from these periods. In the other two periods, subjects were asked how much they had discussed the topic with others (see Appendix V). Only pairs whose responses averaged to a value in the upper half of the response scale were accepted for study from these two periods. The dropping of cases of low communication reduced the number under study to less than half the original number.

As explained under the discussion of the co-linearity index, some pairs were removed from consideration because of inconsistency of co-linearity over time. After removals of pairs because of failure to answer questions, low communication, or inconsistent co-linearity, there remained 214 pairs satisfying the demands of the hypotheses.

In order to test the hypotheses, it was necessary to categorize pairs by means of the pretest of each period into the attraction categories of _attracted_, _mixed_, and _non-attracted_, and also into the agreement categories of _agreeing_ and _disagreeing_. To do this, the standard deviation was computed for the interaction attraction index at each period.

A sigma value was then chosen which would divide all the pairs into groups, each of which contained about one-third of the cases. This established the cutting-points for the attraction variable. The boundary between the middle category and the extreme is entirely arbitrary, but the mean value of the continuum is established by the central tendency of the group, as explained earlier under the discussion of the linear hypothesis. For the agreement variable, the boundary between agreeing and disagreeing is the mean of the distribution. The mean value of any interaction index computed in the manner described is always zero, since the interaction index is a deviation score.

After establishing the categories of the pairs by means of the pretest at each period, the pretest and posttest were used to furnish data for computing interaction attraction change indices and interaction agreement change indices. These are the dependent variables specified in the hypotheses.

Although the introductory material in this chapter has grown longer than one might wish, I feel that a full account should include mention of an artifact which occurs in both the attraction change index and in the agreement change index. There exists a correlation, due to the manner of collecting the data and the computation of the interaction index, between the pretest category of a pair and its direction of change. This artifact prevents the adoption of a null

Handwritten note on the back of page 87, facing page 88.

Compute regression of parents agree on parties agree (or vice versa), and correct the change scores by regression equation!

for all pairs.

hypothesis of no change for pairs in some one pretest category, since there is no way of determining the amount of change attributable to the artifactual change which occurs. Nevertheless, comparisons can be made between the changes in two groups of pairs. If we assume that the correlation is linear, then the amount of artifactual change can be taken to be equal between two groups which are in the same category of a variable, or which are in categories at equal distances from the mean. The difference between the changes of the two groups can then be attributed to the A-B-X-strains within the pairs.

For example, the artifactual change would tend to move attracted pairs negatively, and non-attracted pairs positively. Suppose that we obtain a mean change for attracted pairs of -.200 and a mean change for non-attracted pairs of +.500. This would be interpreted to mean that the positive change for non-attracted pairs exceeded that of the attracted pairs by .300. On the other hand, if the change on the part of the attracted pairs had been +.100, the interpretation would be that the attracted pairs exceeded the non-attracted by .600. It will be seen that this is a conservative interpretation, since <u>all</u> of the change in one group is <u>always</u> attributed entirely to the artifact. The differences tested and reported in the following sections on results are always computed in this manner.

This page intentionally left blank to maintain page numbering and placement of odd and even pages with double-sided printing, following the insertion of note facing page 88.

Results for Hypotheses 4 and 5

Hypothesis 4 stated that in regard to the direction of changes in the A-B-X relations from Time 1 to Time 2,

(a) there will be a greater mean change toward positive attraction among pairs which are non-attracted agreeing at Time 1 than among pairs which are either attracted agreeing or attracted disagreeing at Time 1;

(b) there will be a greater mean change toward positive agreement among pairs which are attracted disagreeing at Time 1 than among pairs which are either attracted agreeing or non-attracted agreeing at Time 1.

Hypothesis 5 stated that in regard to the direction of changes in A-B-X relations from Time 1 to Time 2, the changes described in Hypothesis 1 will be more pronounced among co-linear pairs than among non-co-linear pairs.

The results of testing Hypotheses 4 and 5 are presented in Tables 8 through 15, along with some findings about which no predictions were made. The predictions of Hypothesis 4(a) are indicated by the blacked-in arrows in Table 8, and those of Hypothesis 4(b) by the blacked-in arrow and black-surrounded arrow in Table 9. The arrow points to the group in which the larger mean change was obtained. The findings concerning which no predictions were made are indicated by the open arrows. Tables 8 and 9 are based on an analysis of all high communication pairs.

The analysis of all pairs (high communication will hereafter go understood) shows no support for Hypothesis 4. This finding will be discussed shortly.

The same analysis performed in testing Hypothesis 4 was carried out with co-linear pairs and again with non-co-linear pairs. Tables 10 and 11 show the comparisons of mean change among co-linear pairs, and Tables 12 and 13 show the comparisons of mean change among non-co-linear pairs. The predicted comparisons in regard to mean change of attraction and agreement are summarized in Table 14. Looking at Table 14, we see that the prediction of Hypothesis 4, taken as a whole, is supported for co-linear pairs, but not for non-co-linear pairs. The confidence level of .05 is given by Fisher's method of combining probabilities, described by Gordon, Loveland, and Cureton (9). The effect of the co-linearity analysis, in other words, is to separate a group of pairs in which mean changes follow the general pattern predicted by Hypothesis 4 from a group in which that pattern is not evident.

Without the analysis in terms of co-linearity, the assertions of Hypothesis 4 would have had to be relinquished. The fact that the co-linearity index clearly (even if not strongly) separates the predicted trend from its opposite

TABLE 8

ATTRACTION CHANGES AMONG PAIRS:
PREDICTED AND UNPREDICTED DIFFERENCES IN MEAN CHANGES IN ATTRACTION
(Arrow points to group yielding greater mean change. See text for explanation of pair categories.)

ATTRAC AGREE N = 31	⇦ NS	⬇ NS	⇩ NS
	ATTRAC DISAG N = 46	⬇ NS	⇩ NS
		NON-ATT AGREE N = 14	⇩ NS
			NON-ATT DISAG N = 45

Groups of pairs categorized by pretest

KEY:

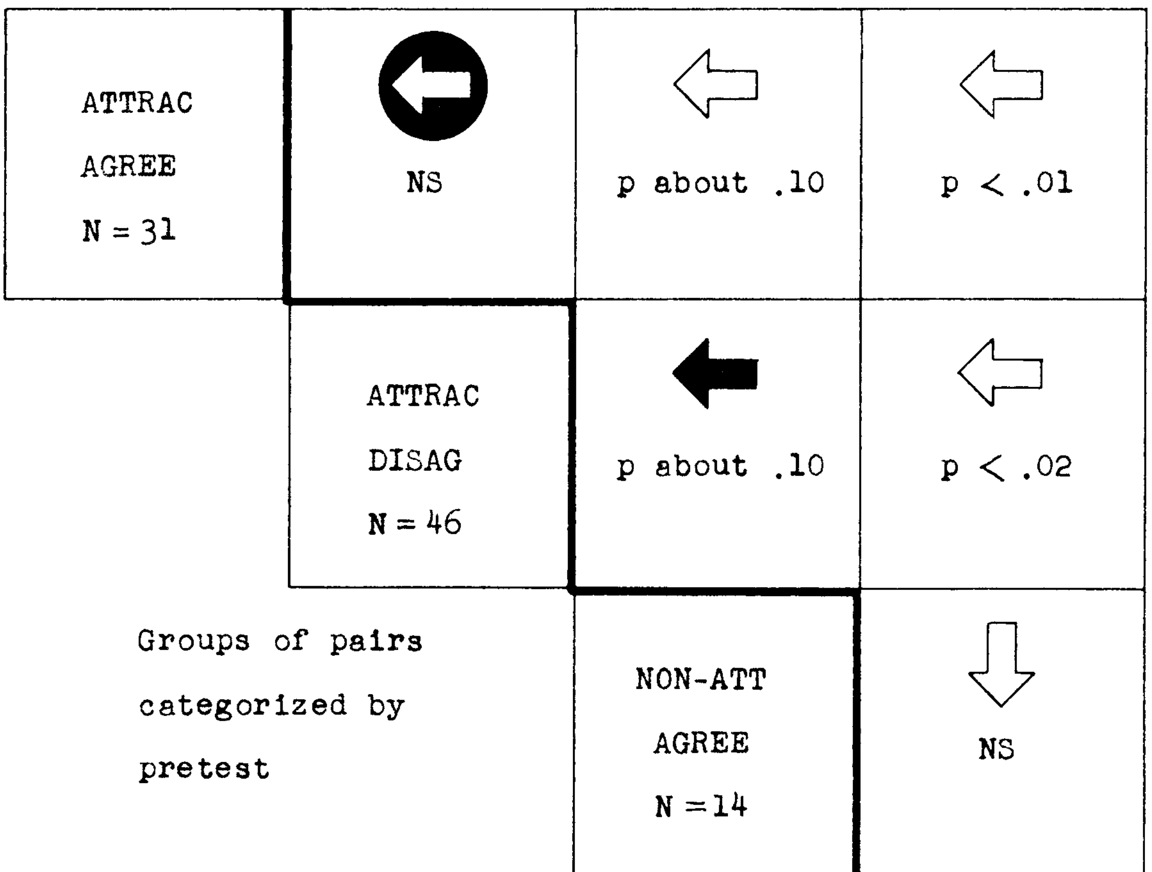
➡ Larger change obtained in direction predicted.

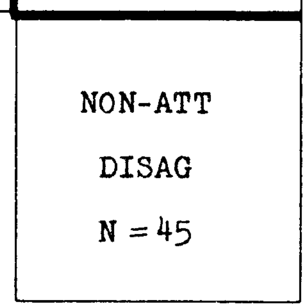
⇨ No prediction made.

NS Significance level fails to reach .10.

TABLE 9

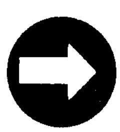
AGREEMENT CHANGES AMONG PAIRS:
PREDICTED AND UNPREDICTED DIFFERENCES IN MEAN CHANGES
IN AGREEMENT
(Arrow points to group yielding greater mean change.
See text for explanation of pair categories.)

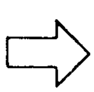




<u>KEY</u>:

 Larger change obtained in predicted direction.

 Larger change obtained opposite to predicted direction.

 No prediction made.

NS Significance level fails to reach .10.

p Probability value given by two-tailed t-test.

TABLE 10

ATTRACTION CHANGES AMONG CO-LINEAR PAIRS:

PREDICTED AND UNPREDICTED DIFFERENCES IN MEAN CHANGES IN ATTRACTION

(Arrow points to group yielding greater mean change.)

ATTRAC AGREE N = 29	⇦ NS	⬇ NS	⇩ NS
	ATTRAC DISAG N = 29	⬇ NS	⇩ $p < .02$
Groups of pairs categorized by pretest		NON-ATT AGREE N = 12	⇩ NS
			NON-ATT DISAG N = 27

<u>KEY</u>:

➡ Larger change obtained in predicted direction.

⇨ No prediction made.

NS Significance level fails to reach .10.

p Probability value given by two-tailed t-test.

TABLE 11

AGREEMENT CHANGES AMONG CO-LINEAR PAIRS:
PREDICTED AND UNPREDICTED DIFFERENCES IN MEAN CHANGES
IN AGREEMENT
(Arrow points to group yielding greater mean change.)

ATTRAC AGREE N = 29	⬇ NS	⇦ NS	⇦ p about .08
	ATTRACT DISAG N = 29	⬅ p about .07	⇦ $p < .05$
Groups of pairs categorized by pretest		NON-ATT AGREE N = 12	⇩ NS
			NON-ATT DISAG N = 27

KEY:

➡ Larger change obtained in direction predicted.

⇨ No prediction made.

NS Significance level fails to reach .10.

p Probability value given by two-tailed t-test.

TABLE 12

ATTRACTION CHANGES AMONG NON-CO-LINEAR PAIRS: DIFFERENCES IN MEAN CHANGES IN ATTRACTION (Arrow points to group yielding greater mean change.)

ATTRAC AGREE N = 2	⇦ NS	●⇦ NS	◯⇦ $p < .02$
Groups of pairs categorized by pretest	ATTRAC DISAG N = 17	⬇ NS	◯⇦ NS
		NON-ATT AGREE N = 2	◯⇦ p about .09
			NON-ATT DISAG N = 18

KEY:

- ➡ Larger change in same direction as that predicted for co-linear pairs
- ●⇨ Larger change opposite that predicted for co-linear pairs.
- ⇨ No prediction made for co-linear pairs, but larger change in same direction as that obtained for co-linear pairs.
- ◯⇨ Larger change in direction opposite to that obtained for co-linear pairs.

NS Significance level fails to reach .10.

p Probability value given by two-tailed t-test.

TABLE 13

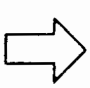
AGREEMENT CHANGES AMONG NON-CO-LINEAR PAIRS
DIFFERENCES IN MEAN CHANGES IN AGREEMENT
(Arrow points to group yielding greater mean change.)

ATTRAC AGREE N = 2	⬇ NS	⇦ NS	⇦ NS
	ATTRAC DISAG N = 17	⬇ (circled) NS	⇦ NS
Groups of pairs categorized by pretest		NON-ATT AGREE N = 2	⇩ NS
			NON-ATT DISAG N = 18

KEY:

 Larger change in same direction as that predicted for co-linear pairs.

 Larger change opposite that predicted for co-linear pairs.

 No prediction made, but larger change in same direction as that obtained for co-linear pairs.

NS Significance level fails to reach .10.

TABLE 14

SUMMARY OF PREDICTED MEAN CHANGES SHOWN IN TABLES 8 THROUGH 13.
(Results are in direction predicted except where noted by the abbreviation "opp. to pred.")

Variable and Groups Compared	p-values		
	All Pairs	Co-linear Pairs	Non-co-linear Pairs
ATTRACTION:			
Non-att agree vs Attrac disag	.196	.190	.352
ATTRACTION:			
Non-att agree vs Attrac agree	.650	.664	.580 opp. to pred.
AGREEMENT:			
Attrac disag vs Non-att agree	.104	.078	.450 opp. to pred.
AGREEMENT:			
Attrac disag vs Attrac agree	.750 opp. to pred.	.728	.660
COMBINED TEST*	NS**	$p < .05$	NS**

*Combined tests require the one-tailed hypothesis. All other p-values in the table are for two tails.

**p greater than .10.

TABLE 15

SUMMARY OF NON-PREDICTED MEAN CHANGES
SHOWN IN TABLES 8 THROUGH 13
(Results for non-co-linear pairs are in the same direction as those for co-linear pairs except where noted by the abbreviation "opp. to co.")

Variable and Groups Compared, Showing Direction Taken by Co-linear Pairs	p-values	
	Co-linear Pairs	Non-co-linear Pairs
ATTRACTION:		
Attrac agree greater than attrac disag	NS*	NS*
Non-att disag greater than attrac agree	NS*	$p < .02$ opp. to co.
Non-att disag greater than attrac disag	$p < .02$	NS* opp. to co.
Non-att disag greater than non-att agree	NS*	$p < .09$ opp. to co.
AGREEMENT:		
Attrac agree greater than non-att agree	NS*	NS*
Attrac agree greater than non-att disag	$p < .08$	NS*
Attrac disag greater than non-att disag	$p < .05$	NS* opp. to co.
Non-att disag greater than non-att agree	NS*	NS*

*p greater than .10. All p-values are for two tails.

provides good support for Hypothesis 5, and also argues that the theoretical basis for Hypothesis 4 need not be jettisoned, even though the results support it only weakly and indirectly.

The difference in the effects of communication seen when the results for co-linear pairs are contrasted with the results for non-co-linear pairs is as evident among the non-predicted results as among the predicted. The non-predicted comparisons of mean change are summarized in Table 15. (Table 15 shows no test for combined probability because the direction of change was not predicted.) Looking over the twelve comparisons of change listed in Tables 14 and 15, it will be noticed that in no case does a significant difference in change occur in the same direction for both co-linear and non-co-linear pairs.

A note needs to be inserted here about the presentation of p-values. Where a probability can be computed without specifying the direction of the outcome, I have presented the figure for two tails. Some significance tests, like the F-test or Fisher's test for combined probabilities, require the specification of direction, and probability figures computed from these tests must of course be given for the one tail.

It is my cherished belief that a reader of technical literature does so for the profit he can make of it for his own work. If this is so, the reader will approach a report with any motivation from a desperate hope for any glimmer of inspiration to a hypercritical desire to illustrate an elaborated theory of his own. The author who reports work of a novel sort should not, therefore, demand that the reader accept the author's dictum of a proper significance level. The acceptability of a significance level must depend on the purposes of the person who will use the results reported. For my own purposes, I am inclined to use as guides for future research any of these results which yield a one-tailed significance level of .05. For the convenience of the reader, I report the p-value for any two-tailed test which reaches .10, and the exact p-values for all tests used in a computation of combined probability.

Results for Hypotheses 6 and 7

While Hypotheses 4 and 5 dealt with the effects of communication on mean changes of attraction and agreement in various categories of co-linear and non-co-linear pairs, Hypotheses 6 and 7 deal with the comparative dispersion to be found in the categories of pairs after communication.

Hypothesis 6 states that in regard to the variability of changes in A-B-X relations from Time 1 to Time 2,

(a) the variance of changes in _attraction_ will be greater among pairs in each of the Time 1 categories _mixed agreeing_, _mixed disagreeing_, non-attracted agreeing, and non-attracted disagreeing than in either of the Time 1 categories attracted agreeing or attracted disagreeing.

(b) the variance in changes in agreement will be greater among pairs in either of the Time 1 categories attracted disagreeing or non-attracted disagreeing than in either of the Time 1 categories attracted agreeing or non-attracted agreeing.

Hypothesis 7 states that in regard to the variability of changes in A-B-X relations from Time 1 to Time 2, the comparisons described in Hypothesis 6 will be more pronounced among co-linear pairs than among non-co-linear pairs.

The results of testing Hypotheses 6 and 7 are presented in Tables 16 through 21. Only results in regard to which predictions were made are presented in these tables. Here the arrow points to the group in which the larger mean square was obtained. Let us look first at the tables showing the comparative variances of changes in the attraction variable: Tables 16, 18, and 20. Here the same pattern is evident that was seen in the results for Hypotheses 4 and 5. The analysis of all pairs (Table 16) fails to support Hypothesis 6(a). The analysis of co-linear pairs shown in Table 18, however, yields a general pattern which supports the hypothesis. Fisher's combined test gives a p-value less than .01. Table 20, in turn, shows that non-co-linear pairs yield not a single comparison in support of the

TABLE 16

VARIANCE OF ATTRACTION CHANGES AMONG PAIRS
(Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by the F-test.)

	MIXED AGREE N = 25	MIXED DISAG N = 53	NON-ATT AGREE N = 14	NON-ATT DISAG N = 45
ATTRAC AGREE N = 31	⬆ NS*	⇦ NS*	⇦ NS*	⬆ NS*
ATTRAC DISAG N = 46	⬆ NS*	⇦ NS*	⇦ NS*	⬆ p < .05

*p greater than .10.

TABLE 17

VARIANCE OF AGREEMENT CHANGES AMONG PAIRS
(Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by F-test.)

	ATTRAC DISAG N = 46	NON-ATT DISAG N = 45
ATTRAC AGREE N = 31	⇦ NS*	⇦ p about .10
NON-ATT AGREE N = 14	⇦ p < .05	⇦ p < .01

*p greater than .10.

TABLE 18

VARIANCE OF ATTRACTION CHANGES AMONG CO-LINEAR PAIRS
(Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by the F-test.)

	MIXED AGREE N = 21	MIXED DISAG N = 32	NON-ATT AGREE N = 12	NON-ATT DISAG N = 27
ATTRAC AGREE N = 29	⬆ .150	⬆ .107	⇦ .233	⬆ .017
ATTRAC DISAG N = 29	⬆ .066	⬆ .096	⇦ .147	⬆ .001

Fisher's combined test yields $p < .01$.

TABLE 19

VARIANCE OF AGREEMENT CHANGES AMONG CO-LINEAR PAIRS
(Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by F-test.)

	ATTRAC DISAG N = 29	NON-ATT DISAG N = 27
ATTRAC AGREE N = 29	⇦ NS*	⇦ NS*
NON-ATT AGREE N = 12	⇦ p about .05	⇦ $p < .05$

*p greater than .10.

TABLE 20

VARIANCE OF ATTRACTION CHANGES AMONG NON-CO-LINEAR PAIRS (Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by the F-test.)

	MIXED AGREE N = 4	MIXED DISAG N = 21	NON-ATT AGREE N = 2	NON-ATT DISAG N = 18
ATTRAC AGREE N = 2	⇦ NS*	⇦ NS*	⇦ NS*	⇦ p about .08
ATTRAC DISAG N = 17	⇦ NS*	⇦ NS*	⇦ NS*	⇦ NS*

*p greater than .10.

TABLE 21

VARIANCE OF AGREEMENT CHANGES AMONG NON-CO-LINEAR PAIRS (Arrow points to group with larger mean square. Solid arrow indicates predicted direction, open arrow contrary to prediction. Figures are p-values given by F-test.)

	ATTRAC DISAG N = 17	NON-ATT DISAG N = 18
ATTRAC AGREE N = 2	⬆ NS*	⬆ NS*
NON-ATT AGREE N = 2	⬆ p about .07	⬆ NS*

*p greater than .10.

hypothesis. As before, the co-linearity index distinguishes pairs showing stronger and weaker effects of communication, and the stronger effects are generally in the expected direction.

An inspection of Tables 17, 19, and 21, dealing with the agreement variable, turns up a surprise. In these tables the pattern to which we have become accustomed is reversed. The direction of greater variance between categories of co-linear pairs turns out opposite from that predicted, with two out of four p-values reaching .05 or less. Furthermore, one of the comparisons of non-co-linear pairs reaches a p-value of .07 in the direction expected for co-linear pairs! The best that can be said for this unexpected result is that co-linearity again seems to make a difference. Unfortunately, the difference is made in the direction contrary to prediction.

This contrary result, involving Hypotheses 6(b) and 7, occasioned re-computation of the tests and much searching through the theory in search of clues to errors in reasoning. These efforts were fruitless. The theory makes no distinction between attraction and agreement in regard to the expected effects of the co-linearity conditions. I can only conclude that further empirical work, under conditions different from those of the present experiment, offers the most economical solution to the problem. This matter will be discussed further in Chapter V.

Results for Hypothesis 8

The dependent variables with which Hypothesis 8 deals are variance of attraction change and of agreement change. The independent variable is co-linearity. The greater variance among co-linear pairs than among non-co-linear is predicted to hold over all pretest categories of pairs. In the sense that the same effect is predicted for all categories previously considered, and in the sense that a minimum number of parameters is required to specify the dependent variable, Hypothesis 8 is the most general of the hypotheses tested. High generality is not a quality which must characterize every theoretical statement, but any theory must contain some general statements. It is therefore satisfying when an empirical study will permit an assertion to be tested which is more general than the majority of the hypotheses, and orthogonal to them.

Hypothesis 8 stated that within each Time 1 category, the variance of changes in both <u>attraction</u> and <u>agreement</u> will be greater among <u>co-linear pairs</u> than among <u>non-co-linear pairs</u>.

The results for this hypothesis are shown in Table 22. Taking each pretest category separately, we observe that two out of the twelve individual tests yielded the greater mean square among the non-co-linear pairs, which is opposite to the prediction. Looking at the p-values, however, we find the lowest p-values in the predicted direction. Most important, we find no evidence that Hypothesis 8 is applicable only to certain of the pretest categories. In fact, evidence for the general trend in the predicted direction is given by Fisher's combined test, which turns out a significance level beyond .05 for each of the variables of attraction and agreement, and a significance level beyond .005 for both variables taken together.

With the results just given for Hypothesis 8, we come to the end of the list. Chapter II described the evolution of the eight hypotheses, and Chapters III and IV set out the results of their tests. A brief review of these results and a few comments on their implications will make up Chapter V.

TABLE 22

SIGNIFICANCE LEVELS OF THE VARIANCE RATIOS OF CO-LINEAR PAIRS TO NON-CO-LINEAR PAIRS WITHIN EACH PRETEST CATEGORY

Pretest Category	F-tests of variance ratios			
	Attraction Change Index		Agreement Change Index	
	Greater Mean Square	p	Greater Mean Square	p
Attrac agree	Non-co	.161	Co-lin	.130
Attrac Disag	Non-co	.245	Co-lin	.227
Mixed Agree	Co-lin	.058	Co-lin	.241
Mixed Disag	Co-lin	.191	Co-lin	.281
Non-att Agree	Co-lin	.450	Co-lin	.030
Non-att Disag	Co-lin	.006	Co-lin	.009
Combined Tests*	Co-lin	< .05	Co-lin	< .005
Grand Combined Test*	Co-lin p < .005			

*Fisher's method (9).

CHAPTER V

SUMMARY AND CONCLUSIONS

In Chapter I, the thesis was put forward that similarity of structure between two cognitive fields increases the efficacy of communication between them. In order to demonstrate this thesis, it was first necessary to elaborate a theory which would point to pertinent data and state the relations to be expected among them, and then it was necessary to collect the appropriate data and test them for the expected relations.

Theory

Communication or interaction between two persons was conceived as being mediated by the cognitive structure, or space of potential responses, associated with each individual. Cognitive structure, or the response space, was considered to be characterized by conditions of equilibrium and by conditions of strain. The conditions of equilibrium and strain were defined by utilizing the specifications in Newcomb's (21) theory of communicative acts. The structure of the response space was laid out in terms of concepts taken in large part from the monograph of Coombs and Kao (6).

The theory implied that response spaces could be described in terms of the attributes which mediate the responses; that is, the attributes in respect to which the individual makes his responses. Further, the theory asserted that an individual may combine the attributes mediating his responses into one composite attribute. This composite attribute is compounded in different ways by different individuals, and such a composite attribute underlying responses permits some responses and precludes others. The theory therefore pointed to methods of examining observed responses to discover whether or not a composite attribute could be inferred to underlie the responses, and if so, whether or not the composite attributes being used by two communicating individuals might be permitting or precluding the same responses.

If it were concluded that the composite attributes (or composition functions, to speak more technically) of two individuals permitted the same responses, then the responses of the two individuals were called "co-linear". Co-linearity was taken as the index of similarity between cognitive fields. Computation of this index rests on the unfolding technique of Coombs.

Setting forth the terms of the theory and defining the co-linearity concept enabled us, in Chapter II, to put the general hypothesis into more precise terms; namely, that where changes in orientations occur as a result of communication, the changes will be more pronounced for co-linear communicating pairs and less pronounced for non-co-linear pairs.

Tests

The ability of the co-linearity index to distinguish between strong effects and weak effects of communication was tested in a number of situations, as follows.

(1) Interpreting the classroom situation as one in which a strain toward agreement with the teacher exists in regard to "correct" answers, the co-linearity index was predicted to distinguish a group scoring higher on quizzes from a group scoring lower. This situation was treated under Hypotheses 1 and 2.

(2) Using data from discussion groups conducted in a residence for men, certain categories of pairs of persons were established according to the orientations of the persons toward each other and toward statements about sexual conduct. Defining these categories of pairs in terms of the variables of attraction and agreement, comparisons were made between certain categories in regard to the amount and direction of change in the two variables which followed communication. The co-linearity index was predicted to separate pairs in which the expected differences in change of attraction and agreement were stronger from pairs in which the expected differences were weaker. Hypotheses 4 and 5 dealt with this application of the theory.

(3) In the same men's residence, and using the same categories of pairs, changes in attraction and agreement were expected to be more extreme in some categories than in others. That is, the variance of changes was compared between categories. It was predicted that the variance ratios would be larger in the expected direction among co-linear pairs than among non-co-linear pairs. These predictions were stated in Hypotheses 6 and 7.

(4) The data from the men's residence were also used to test the hypothesis that the extremity of change in attraction and agreement would in general be greater among co-linear than among non-co-linear pairs. This was Hypothesis 8.

(5) The data from the classroom experiment were used to test certain deductions about the intra-personal relations among composite attributes. These deductions were given by Hypothesis 3.

Results

The weight of the evidence from the five applications of the co-linearity concept listed above is strongly in favor of the assertion that a given communication situation brings about greater changes between co-linear pairs of persons than between non-co-linear pairs. Since the co-linearity index is only one of a number of possible ways of comparing cognitive structure, it is to be hoped that further research with indices which reflect the cognitive field in more detail will further elucidate the conditions for effective communication.

In regard to predictions based on A-B-X system structure (Hypotheses 4 and 6) and tested with data from the men's residence, none of the comparative changes expected were found in the data until the communicating pairs were sorted by co-linearity. When this was done, the predicted trends appeared weakly in most instances; that is, in the data examined in connection with Hypotheses 4(a), 4(b), and 6(a). Although these results were weak, they were sufficient to yield a significance level for combined probabilities beyond .05. In the case of Hypothesis 6(b), which dealt with comparative variance in agreement change, the trend was opposite to that predicted. A scrutiny of the computations and the theoretical statements failed to yield an explanation for this contrary result.

A possible clue to the anomalous result of Hypothesis 6(b) may lie in the variable and in the setting involved in the test. Specifically, the test of Hypothesis 6(a), involving the attraction variable in the men's residence setting, gave results as expected, but the test using the agreement variable did not. Again, the tests of Hypotheses 1 and 2 involving agreement on quiz answers in the classroom setting gave results as expected, whereas the trial of another agreement variable in the men's residence setting failed. In short, two comparisons seem apposite: (a) the observation that a prediction about agreement in the classroom setting was supported while a prediction about agreement in the men's residence setting was not, and (b) the observation that a prediction about attraction in the men's residence setting was supported while a prediction about agreement in the same setting was not.

A closer examination of these comparisons suggests certain changes in data collection which in future research may yield better information about the variables which in this research appear to be related in a manner contrary to prediction. A closer look at the agreement variable in the men's residence setting will not give us an explanation of the contrary outcome, but it may suggest an association of conditions within which an explanation may profitably be sought.

Let us, then, contrast the agreement measure used in the classroom with that used in the men's residence. One may speculate that agreement with the teacher in the classroom situation would be a matter of foremost concern to the subjects in the vast majority of class sessions, while the problem of sexual conduct would be expected to play a much lesser role in the total response space associated with living in the men's residence. This is not to say that the topic of sexual conduct was not important to the members of of the residence. Observation within the residence indicates, in fact, that the men probably devoted more time and emotion to this topic than to any other introduced by the experimenters. The point is that there still were no doubt many other matters pertinent to living in the residence which were of importance to strain and stability in interpersonal relations. The speculation is that, important as the topic of sexual conduct may have been in the men's residence, it nevertheless sampled the total response space less adequately than did the quizzes in the classroom situation. In this sense, the agreement variable in the men's residence situation was "weaker" than that in the classroom situation. If this speculation is justifiable, it suggests selecting stimuli of a higher dimensionality when measuring agreement in future research.

We have also to contrast the attraction variable in the men's residence with the agreement variable. In this case it seems reasonable that orientations toward the other individuals in the residence would characterize almost all response situations associated with living in the residence, while sexual conduct was no doubt only one of the many matters pertinent to opinions about other persons. The obtained outcome according to prediction in the test of attraction may have rested upon a much better sampling of the response space than the contrary outcome of the test involving agreement.

Because of the foregoing comparisons, it seems possible that a more extensive sampling of attitude objects, thereby obtaining a "stronger" agreement variable, might reduce the confusion in which the outcome of Hypothesis 6(b) has left us.

In summarizing the results of the investigation, then, the following statements seem reasonable:

(1) The ability of the co-linearity index to distinguish among strong and weak communicative effects stands out clearly enough to give good confidence in its use in future research.

(2) The results of the deductions concerning objective A-B-X systems, though weak, encourage further empirical tests of the modified version used here of Newcomb's theory of communicative acts.

(3) In general, the theoretical basis of the present investigation is strengthened by the empirical findings.

Finally, there are two possible misinterpretations which might result from a hasty or partial reading of the preceding chapters, and against which I wish to warn. First, co-linear persons do not necessarily take the same attitude position. Similarity of "position", or choice of the same stimulus as most preferred, has no necessary relation to co-linearity. Second, none of the results reported here should be taken to mean that co-linear persons are more likely to agree with each other than non-co-linear pairs. The theory claims, with weak but encouraging support from most of the results of this investigation, that increase or decrease in agreement is related to the structure of the A-B-X system and the implications of the communicative acts which impinge upon it. The effect of the co-linear condition, on the other hand, is to amplify whatever changes are brought about by these communicative acts.

Implications

One of the hopes of the scientist is to discover relationships which hold over as many situations as possible. One of the most obvious features of Newcomb's theory of communicative acts is that its statements deal with structural relations among orientations which do not depend on the "content" of the particular orientation. It is likewise true of Coombs' theory of data that its concepts are independent of the "content" of observation. It was with the generality of these two theories in mind that I allied myself with their viewpoints in approaching the problems of communication in small groups. The concept of co-linearity is, I feel, commensurate in its generality with the theories in which it has its roots.

In the present research, the co-linearity index was constructed in two versions. The index was applied in two experimental situations, and its ability to discriminate communicative effects was measured against an attraction variable and two agreement variables. Its ability to discriminate groups showing high and low degrees of change in these variables was further checked against the parameters of mean change and of variance. In all of these instances, the ability of co-linearity to "make a difference" was demonstrated, even to the case in which the direction of the difference was contrary to prediction.

This is not to say that I consider the co-linearity index itself to be of wide applicability. Its use in empirical work is obviously limited by the willingness of the subject to yield a simple order, by the number of stimuli with which the experimenter wishes to work (the labor of data collection and analysis mounts exponentially with the number of stimuli), by the number of persons which the experimenter wishes to consider at a time (it is applicable only to pairs), and by a number of other complexities, many of which were encountered in this research. Although co-linearity was demonstrated in this investigation to have the same effects in a number of situations, without the necessity of specifying the content of the communication in the theoretical derivation of the predictions, nevertheless the index itself, and the co-linearity concept also, are limited in their usefulness.

Rather, I hope that the theoretical basis from which the co-linearity concept was derived will yield further indices and hypotheses which are also as free of the necessity to consider content. In sum, the chief implication for me in this research is that the first empirical tests of the theory, limited though they may be, gave encouraging results. A re-examination of the theoretical structure and the design of new hypotheses will, I hope, yield more firm and more widely applicable results in the next experimental trials.

APPENDIX I

THEORETICAL BASIS

Symbols in Typescript

{ } a set

| such that, as in A = { a | a has certain properties } , to be read: A is the set of all a such that a has certain properties.

∍ such that. This symbol is written a little below the line. It is used, for example, to specify restrictions on properties.

∈ is a member of

not-∈ is not a member of

= is identical with

≠ is not identical with

⊆ is a subset of

∅ the empty set; i.e., the set in which the number of elements is zero.

∩ intersection

∪ union

⟹ implies

⟺ implies and is implied by

ε epsilon

Ω omega

Undefined Terms

The following sets are taken as undefined.

S is the set of stimuli, where

$$S = \{ s_j \mid j \in J,\ J \text{ is a finite set of integers} \} .$$

R is the set of responses, where

$$R = \{ r_g \mid g \in G,\ G \text{ is a finite set of integers} \} .$$

U is the set of individuals, where

$$U = \{ u_i \mid i \in I,\ I \text{ is a finite set of integers} \} .$$

D is the set of attributes, where

$$D = \{ d \mid d \text{ is one of a finite set of integers} \} .$$

H is the set of moments or trials, where

$$H = \{ h \mid h \text{ is one of a finite set of integers} \} .$$

The sets S, U, D, and H are taken from Coombs and Kao (6).

<u>Axiom</u> <u>1</u>, adapted from Coombs and Kao.--

There exist distinct sets K_d where d ranges from 1 to z, and where a simple order is defined on the elements of each set K_d.

<u>Definition</u> <u>1</u>, adapted from Coombs and Kao.--

$$K = \{ x \mid x = (x_1, x_2, \ldots, x_d, \ldots, x_z) \} \text{ where } x_d \in K_d .$$

That is, K is the set of all vectors x such that the components of the vector x are drawn respectively from the simple orders K_1, K_2, ..., K_d, ..., K_z.

__Axiom__ __2__, adapted from Coombs and Kao.--

There exists a mapping $\{(h,i,j)\} \xrightarrow{D'} D$.

That is, to each triple (h,i,j) there is associated a subset D' of D.

__Definition__ __2__, adapted from Axiom 2 of Coombs and Kao.--

(a) D' will be called the __set__ __of__ __relevant__ __attributes__, and may be written $D' = \{d_1, d_2, \ldots, d_{z'}\}$ where $z' \leqq z$, and z has the meaning indicated by its use in Dfn. 1.

(b) $x(D') = (x_{d_1}, x_{d_2}, \ldots, x_{d_{z'}})$

(c) The set of all $x(D')$ may be denoted

$K(D') = \{ (x_{d_1}, x_{d_2}, \ldots, x_{d_{z'}}) \}$.

(d) The triple (h,i,j) will also be called the __event__ (h,i,j).

__Axiom__ __3__, adapted from Coombs and Kao.--

(a) There exists a function $S \xrightarrow{q} K$. That is, to each $s_j \in S$ there corresponds a vecter $x = q(s_j)$ in K. In other words, each $s_j \in S$ has exactly one image vector $x = q(s_j)$ in K. This unique image will be denoted by q_j.

(b) There exists a function $U \xrightarrow{c} K$. That is, to each $u_i \in U$ there corresponds a vector $x = c(u_i)$ in K. In other words, each $u_i \in U$ has exactly one image vector $x = c(u_i)$ in K. This unique image will be denoted by c_i.

__Definition__ __3__, adapted from Coombs and Kao.--

(a) $q_{hij} = q_j(D'(h,i,j))$ is the projection of the vector q_j on the attributes determined by D'. The components of q_{hij} comprise a subset of the components of q_j.

(b) $c_{hij} = c_i(D'(h,i,j))$ is the projection of the vector c_i on the attributes determined by D'. The components of c_{hij} comprise a subset of the components of c_i.

<u>Axiom 4</u>.—

(a) Associated with every vector c_{hij} is a neighborhood which will be distinguished and called the <u>epsilon neighborhood</u>. The term "epsilon neighborhood" (abbreviated "ε-nbd") is not meant to carry any meaning it may have in other mathematical contexts.

(b) There exists at least one <u>composition function</u> which designates every vector x(D') either as being a member of the epsilon neighborhood of c_{hij}, or as not being a member.

<u>Definition 4</u>.—

The set of vectors in K(D') which are members of the ε-nbd of c_{hij} will be denoted by $\varepsilon(c_{hij})$.

<u>Axiom 5</u>.—

For every triple (h,i,j) and any other triple (h,i,j') there exists a mapping

$$\{ (h,i,j) \} \xrightarrow{L_{j'}} \{ D'(h,i,j) \cap D'(h,i,j) \}$$

. That is, for each pair of triples (h,i,j) and (h,i,j') having h and i constant, there corresponds to (h,i,j) a subset of the relevant attributes D'(h,i,j); namely, the subset $L_{j'}(h,i,j) = D'(h,i,j) \cap D'(h,i,j')$. This intersection can of course be empty.

Definition 5.--

With each vector $q_{hij} \in K(D')$ there is associated a vector $L_{j'}(q_{hij}) = q_j(L_{j'}(h,i,j))$. That is, $L_{j'}(q_{hij})$ is a vector whose components are a subset of the components of the vector q_{hij}. The attributes indexing the components of $L_{j'}(q_{hij})$ are the attributes of the intersection $D'(h,i,j) \cap D'(h,i,j')$.

Axiom 6.--

(a) Associated with every vector $L_{j'}(q_{hij})$ is a neighborhood which will be distinguished and called the epsilon neighborhood.

(b) There exists at least one composition function which designates every non-trivial vector $L_j(q_{hij'})$ either as being a member of the ϵ-nbd of $L_{j'}(q_{hij})$ or as not being a member.

Definition 6.--

The set of vectors in $K(D')$ which are members of the ϵ-nbd of $L_{j'}(q_{hij})$ will be denoted by $\epsilon(q_{hij})$.

Definition 7.--

(a) The pairs of vectors (c_{hij}, q_{hij}) will be labelled p_{hij}.

(b) The pair of vectors $(L_{j'}(q_{hij}), L_j(q_{hij'}))$ will be labelled $L_{j'}(p_{hij})$.

(c) p_{hij} and $L_{j'}(p_{hij})$ will be called quantities.

Axiom 7.--

(a) There exists at least one composition function imposing a linear order $>$ on any two quantities p_{hij} and $p_{hij'}$, provided $D'(h,i,j) \cap D'(h,i,j') \neq \emptyset$.

(b) There exists at least one <u>composition</u> <u>function</u> imposing a linear order $>$ on any two quantities $L_{j'}(p_{hij})$ and $L_{j''}(p_{hij})$, provided $D'(h,i,j) \cap D'(h,i,j') \cap D'(h,i,j'') \neq \emptyset$.

<u>Axiom 8</u>.--

Let R be partitioned into R^+ and R^- and again into R_I, R_{II}, R_{III}, and R_{IV} such that no intersection of the two partitionings is empty. Then consider the conditions on the vectors in each of (a) through (h) below. There exists a function for which the domain is the set of these conditions and where the set of relevant attributes underlying the vectors being considered is not empty; and the range consists of the intersections of the partitions of R just mentioned. The rules for these mappings are as follows:

(a) The image in R of $p_{hij'} > p_{hij}$ is $r_g \in R^+ \cap R_I$.

(b) The image in R of $p_{hij} > p_{hij'}$ is $r_g \in R^- \cap R_I$.

(c) The image in R of the vectors c_{hij} and q_{hij} such that $q_{hij} \in \mathcal{E}(c_{hij})$ is $r_g \in R^+ \cap R_{II}$.

(d) The image in R of the vectors c_{hij} and q_{hij} such that q_{hij} not-$\in \mathcal{E}(c_{hij})$ is $r_g \in R^- \cap R_{II}$.

(e) The image in R of the vectors $L_{j'}(q_{hij})$ and $L_j(q_{hij'})$ such that $L_j(q_{hij'}) \in \mathcal{E}(q_{hij})$ is $r_g \in R^+ \cap R_{III}$.

(f) The image in R of the vectors $L_{j'}(q_{hij})$ and $L_j(q_{hij'})$ such that $L_j(q_{hij'})$ not-$\in \mathcal{E}(q_{hij})$ is $r_g \in R^- \cap R_{III}$.

(g) The image in R of $L_{j''}(p_{hij}) > L_{j'}(p_{hij})$ is $r_g \in R^+ \cap R_{IV}$.

(h) The image in R of $L_{j'}(p_{hij}) > L_{j''}(p_{hij})$ is

$r_g \in R^- \cap R_{IV}$.

<u>Definition 8</u>.--

(a) The condition that at least one of the conditions (a) through (h) of Axiom 8 is non-trivial will be designated by $r_g \in R$. A trivial condition is one in which the set of relevant attributes underlying the pertinent vectors is empty.

(b) $r_{hi}(s_j, s_{j'}, s_{j''}) \overset{dfn}{\Longleftrightarrow} r_g \in R_{IV}$.

$r_{hi}(s_j, \ldots) \overset{dfn}{\Longleftrightarrow} r_g \in R$ such that at least one of the vectors required by the applicable condition of Axiom 8 bears the subscript triple hij. Thus, $r_{hi}(s_j, \ldots)$ designates any $r_g \in R$ involving a vector mapped from s_j.

$r_{hi}(s_j, s_{j'}, \ldots) \overset{dfn}{\Longleftrightarrow} r_g \in R_I \cup R_{III} \cup R_{IV}$.

It will often be useful to use the superscripts "+" and "-" to indicate the stimulus in respect to which the category "positive" or "negative" is being defined, as for example $r_{hi}(\overset{+}{s_j}, s_{j'}) \in R_I$ will indicate $r_g \in R^+ \cap R_I$, positive in respect to s_j.

<u>Psychological postulate 1</u>.--

Coordinations of $r_g \in R$ to observation are to be made as described below.

(a) <u>Quadrant I</u>:

$r_g \in R_I^+ = r_{hi}(\overset{+}{s_j}, s_{j'}) \in R_I \Longleftrightarrow$ a response such as the experimenter observes when:

the subject prefers s_j to $s_{j'}$;

the subject approaches s_j and avoids $s_{j'}$;

etc.

Exchange j and j' for implications of $r_{hi}(\bar{s}_j, s_{j'}) \leftarrow R_I$.

(b) <u>Quadrant II</u>:

$r_g \leftarrow \overset{+}{R}_{II} = r_{hi}(\overset{+}{s}_j) \leftarrow R_{II}$ $\Longleftrightarrow$ a response such as the experimenter observes when:

the subject accepts s_j;

the subject eats s_j;

the subject passes s_j;

etc.

$r_{hi}(\bar{s}_j) \leftarrow R_{II}$ $\Longleftrightarrow$ the subject rejects, spits out, fails s_j, etc.

(c) <u>Quadrant III</u>:

$r_g \leftarrow \overset{+}{R}_{III} = r_{hi}(s_j, \overset{+}{s}_{j'}) \leftarrow R_{III}$ $\Longleftrightarrow$ a response such as the experimenter observes when:

the subject indicates that s_j is associated with $s_{j'}$;

the subject indicates that $s_{j'}$ labels s_j;

the subject says, "s_j him belong $s_{j'}$";

the subject says that s_j includes $s_{j'}$;

the subject says that s_j is characterized by $s_{j'}$;

etc.

$r_{hi}(s_j, \bar{s}_{j'}) \leftarrow R_{III}$ $\Longleftrightarrow$ the subject indicates non-association, exclusion, etc.

(d) Quadrant IV:

$r_g \in \overset{+}{R}_{IV} = r_{hi}(s_j, \overset{+}{s}_{j'}, s_{j''}) \in R_{IV} \Longleftrightarrow$ a response such as the experimenter observes when:

the subject says that $s_{j'}$ is closer to s_j in some respect than is $s_{j''}$;

the subject indicates that s_j and $s_{j'}$ are more similar in some respect than are s_j and $s_{j''}$;

etc.

Exchange j' and j'' for implications of $r_{hi}(s_j, \bar{s}_{j'}, s_{j''}) \in R_{IV}$.

Definition 9.--

An orientation toward s_j on the part of person u_i at moment h,

$\Omega_{hij} = \{ r_{hi}(s_j, \ldots) \in R \}$.

That is, an orientation toward s_j consists of the set of all potential responses whose definitions include a vector corresponding to s_j.

Definition 10.--

A symbolic orientation toward s_j on the part of person u_i at moment h,

$\underline{Sym}\,\Omega_{hij} = \{ r_{hi}(s_{j'}, \ldots) \in R_{III} \cup R_{IV} \mid r_{hi}(s_j, s_{j'}) \in R_{III} \}$.

That is, a symbolic orientation toward s_j consists of the set of all R_{III} and R_{IV} potential responses to all $s_{j'}$ such that the R_{III} response to s_j and $s_{j'}$ is non-trivial.

<u>Definition 11</u>.--

Co-orientation toward s_j and $s_{j'}$ on the part of person u_i at moment h,

$$\Omega_{hi(j,j')} = \{ r_{hi}(s_j, s_{j'}, \ldots) \in R_I \cup R_{III} \cup R_{IV} \} .$$

That is, the co-orientation toward s_j and $s_{j'}$ consists of the set of all responses such that both q_{hij} and $q_{hij'}$ enter into the response definition.

<u>Psychological postulate 2</u>.--

There exists a transitive time-relation T on H such that

$$h\ T\ h' \overset{dfn}{\Longleftrightarrow} h' \text{ is later than } h.$$

<u>Axiom 9</u>.--

Given $h\ T\ h'$, then $r_{hi}(s_j, s_{j'}, \ldots) \in R_I \cup R_{III} \cup R_{IV}$ $\Longrightarrow D'(h,i,j) \cap D'(h,i,j') \subseteq D'(h',i,j)$ for every h'.

That is, if a response is defined for a pair of stimuli at moment h, then the relevant attributes mediating the response are a subset of the relevant attributes mediating the response to either of the stimuli at any subsequent event.

<u>Theorem 1</u>.--

Given $h\ T\ h'''$, $h'\ T\ h'''$, $h''\ T\ h'''$, and given j, j', and j'' distinct, if $r_{hi}(s_j, s_{j'}, \ldots) \in R_I \cup R_{III} \cup R_{IV}$ and $r_{h'i}(s_{j'}, s_{j''}, \ldots) \in R_I \cup R_{III} \cup R_{IV}$ and $r_{h''i}(s_j, s_{j''}, \ldots) \in R_I \cup R_{III} \cup R_{IV}$, then for some h''' there exist non-trivial vectors $L_j(q_{h'''ij''})$ and $L_{j'}(q_{h'''ij''})$ associated with the events (h''',i,j) and (h''',i,j').

Definition 12.--

(a) Standpoint vectors such as those treated in Theorem 1, which contribute to the definition of responses by means of mappings from earlier responses, will be called implicit standpoints.

(b) In order to facilitate discussion of responses, a "dummy" symbol will be used where it is necessary to indicate that a response is defined on an implicit standpoint. Namely, $h_0(s_j)$ will indicate that a stimulus vector is mapped not from a stimulus which is part of the present event, but from a previous event or events.

Definition 13.--

(a) The symbol A will be used to refer to the "self" corresponding to the individual u_i.

(b) A self-stimulus, $s_A = s_j \ni \underline{Sym}\,\Omega_{hij'} \neq \emptyset \implies \{ r_{hi}(s_{j'}, \ldots) \in R_{III} \cup R_{IV} \mid r_{hi}(h_0(s_{j''}), s_j) \in R_{III} \} \cap \underline{Sym}\,\Omega_{hij'} \neq \emptyset$, for all j'.

That is, a self-stimulus s_A is any stimulus s_j such that if a symbolic orientation toward any stimulus $s_{j'}$ is non-empty, then the symbolic co-orientation toward $s_{j'}$ and toward an implicit standpoint associated with s_j is non-empty.

(c) The subscript A will be used as a member of the index set J; that is, $A = j$ for some $j \in J$.

Psychological postulate 3.--

$r_{hi}(s_A, \ldots) \in R \iff$ an observation by the experimenter of any symbol of self-reference, such as:

the subject speaks a word such as I, me, myself, his name, etc.;

the subject is presented with a word such as <u>you</u>, <u>your</u> <u>Honor</u>, his name, his title, etc.;

the subject gestures toward himself;

someone gestures toward the subject;

etc.

<u>Axiom</u> <u>10</u>.--

To every triple (h,i,j') there corresponds exactly one standpoint $L_{j'}(q_{hij})$, such that $s_j \in \{s_A\}$. This standpoint may alternatively be written $L_{j'}(q_{hiA})$.

<u>Definition</u> <u>14</u>.--

(a) The symbol B will be used to refer to the "other" perceived by person u_i.

(b) An other-stimulus is any stimulus s_j such that person u_i perceives an orientation of s_j toward himself.

(c) The subscript B will be used as a member of the index set J; that is, B = j for some $j \in J$.

<u>Definition</u> <u>15</u>.--

A perceived orientation of B toward s_j is the set of all R_{III} responses to s_j from the standpoint of s_B, together with all R_{IV} responses to s_j and some other stimulus $s_{j'}$ from the standpoint of s_B.

A perceived orientation of B toward s_j on the part of person u_i at moment h will be written $\Omega_{hiB:j}$.

Definition 16.--

(a) If there exists a set of non-empty orientations such that the set includes at least one orientation from each of the columns of Table 23 below, then that set will be called an A-B-X system.

TABLE 23

CONSTITUENT ORIENTATIONS IN A-B-X SYSTEMS

(1)	(2)	(3)	(4)
Ω_{hij}	Ω_{hiB}	$\Omega_{hiB:j}$	$\Omega_{hiB:A}$
Sym Ω_{hij}	Sym Ω_{hiB}	Sym $\Omega_{hiB:j}$	Sym $\Omega_{hiB:A}$
$\Omega_{hiA:j}$	$\Omega_{hiA:B}$		
Sym $\Omega_{hiA:j}$	Sym $\Omega_{hiA:B}$		
Ω_{hiA}			
Sym Ω_{hiA}			

(b) The symbol $\underline{ABX}_{hi}$ will be used to indicate any set of non-empty orientations on the part of individual u_i at moment h satisfying (a) above.

Axiom 11.--

If, for a particular h and i, a simple order exists on a set of vectors in K(D'), then the relation "is a member of the δ-nbd of" is an equivalence relation.

<u>Theorem 2</u>.—

Within this theorem, let $\underline{ABX}_{hi}^{(1)}$ represent any of the following systems satisfying Definition 16(a), with the condition that only the intersection of the system with $R_{II} \cup R_{III}$ is being considered, and where the vectors c_i, q_A, q_B, and q_j are projected into a simple order:

(1) $\Omega_{hiB} \cup \Omega_{hij} \cup \Omega_{hiB:j}$

(2) $\Omega_{hiA:B} \cup \Omega_{hiA:j} \cup \Omega_{hiB:j}$

(3) $\Omega_{hiB} \cup \Omega_{hiA} \cup \Omega_{hiB:A}$

In each case above, only three orientations are specified, because it can be shown that Column 4 of Table 23 is satisfied if the first three columns are satisfied.

To repeat, $\underline{ABX}_{hi}^{(1)}$ represents any of the above unions of orientations, where the intersection of each orientation with $R_{II} \cup R_{III}$ is non-empty, and where the vectors involved are projected into a simple order.

Some abbreviated notation will be used in this theorem, as follows. Within this theorem, let A represent the projection into the simple order of the vector c_i or of the self-standpoint, whichever is defining the responses in $\underline{ABX}_{hi}^{(1)}$. Let B represent the projection into the simple order of the vector corresponding to s_B. And let X represent the projection of the vector for s_j.

Further, let the symbol δ mean "is a member of the δ-nbd of." Thus, $X \,\delta\, B$ indicates $r_{hi}(s_B, \overset{+}{s_j}) \in \overset{+}{R}_{III}$. The symbol $\not\delta$ will mean "is <u>not</u> a member of the δ-nbd of."

With this preamble, Theorem 2 asserts that, given the orientations in (1), (2), or (3) above, and given a single attribute of response, the following statements are true.

(a) For a particular h and i, there exists $\underline{ABX}^{(1)}_{hi}$ such that $B \in A$, $X \in A$, and $X \in B$.

(b) For a particular h and i, there exists $\underline{ABX}^{(1)}_{hi}$ such that $B \in A$, $X \notin A$, and $X \notin B$.

(c) For a particular h and i, there exists $\underline{ABX}^{(1)}_{hi}$ such that $B \notin A$, $X \in A$, and $X \notin B$.

(d) For a particular h and i, there exists $\underline{ABX}^{(1)}_{hi}$ such that $B \notin A$, $X \notin A$, and $X \in B$.

(e) For a particular h and i, there exists $\underline{ABX}^{(1)}_{hi}$ such that $B \notin A$, $X \notin A$, and $X \notin B$.

(f) For a particular h and i, there cannot exist $\underline{ABX}^{(1)}_{hi}$ such that $B \in A$, $X \in A$, and $X \notin B$.

(g) For a particular h and i, there cannot exist $\underline{ABX}^{(1)}_{hi}$ such that $B \in A$, $X \notin A$, and $X \in B$.

(h) For a particular h and i, there cannot exist $\underline{ABX}^{(1)}_{hi}$ such that $B \notin A$, $X \in A$, and $X \in B$.

<u>Definition 17</u>.—

(a) The field of individual u_i at moment h defined on $s_1, s_2, \ldots, s_n$

$$F_{hi}(s_1, s_2, \ldots, s_n) = \bigcup_{j=1}^{n} \Omega_{hij}$$

(b) We shall use F_{hi} as a general symbol for a field.

(c) The symbolic field of individual u_i at moment h defined on $s_1, s_2, \ldots, s_n$

$$\underline{Sym}\, F_{hi}(s_1, s_2, \ldots, s_n) = \bigcup_{j=1}^{n} \underline{Sym}\, \Omega_{hij}$$

<u>Psychological</u> <u>postulate</u> <u>4</u>.--

If F_{hi} is partitioned into subsets so that the observation of an r_g in one subset precludes the observation of r'_g in any other subset, then with each such subset of $r_g \in F_{hi}$ there is associated a measure $Pr\{r_g\}$ of the probability that some member r_g of the subset will be observed. It is of course required that $0 \leqq Pr\{r_g\} \leqq 1$, and

$$\sum_{\{r_g\} \subseteq F_{hi}} Pr\{r_g\} = 1.$$

<u>Psychological</u> <u>postulate</u> <u>5</u>.--

If $r_g \in \{r_g\} \subseteq F_{hi}$ results in a field $F_{h'i}$ requiring z' attributes to mediate the constituent responses, and $r_{g'} \in \{r_{g'}\} \subseteq F_{hi}$ results in a field $F'_{h'i}$ requiring more than z' attributes, then $Pr\{r_g\}$ is greater than $Pr\{r_{g'}\}$.

APPENDIX II

CO-LINEAR RANK ORDERS FOR FIVE STIMULI

Table 24 lists rank orders which will unfold into the rank order shown at the top of the list. Any two rank orders in this list are co-linear unless connected by lines meeting at a dot. By rotating the letters representing the stimuli, 59 other tables ~~may~~ can be constructed, each headed by a permutation of A B C D E and ending in the reverse rank order. If two rank orders cannot both be found in any of the 60 tables except where connected by a dot, they are non-co-linear.

TABLE 24

CO-LINEAR RANK ORDERS

A B C D E

B A C D E

B C A D E

B C D A E

B C D E A

C B A D E

C B D A E

C B D E A

C D B A E

C D B E A

C D E B A

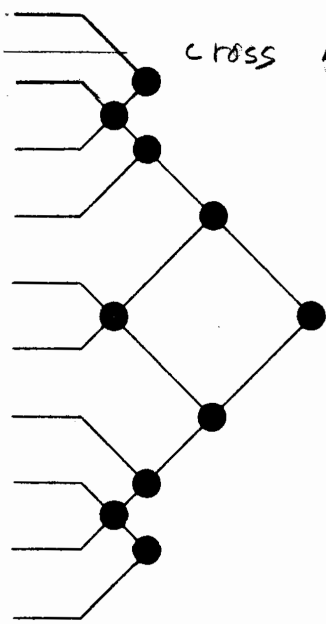
D C B A E

D C B E A

D C E B A

D E C B A

E D C B A



APPENDIX III

QUESTIONNAIRE ON STUDENT VIEWPOINTS

Please fill out these three items first:

1. Name (please print) ______________________________

2. Days of week and hour at which section meets (please circle):

Days: MWF TuTh TuThS

Hours: 8 9 10 11 1 2 3

3. Name of instructor: ______________________________

On the following pages some statements appear in groups of three.

You will find the statements repeating themselves in different combinations as you go from group to group. The reason for this is that we can, in this way, ask you to compare each of these statements with the others, without making any one comparison too complicated.

Although these statements are on different topics, some of them may be fairly close to what you yourself might say or believe. With others you may disagree, more or less strongly.

In other words, one statement in each group of three will seem <u>more</u> reasonable than the others, according to your own viewpoint, and one will seem <u>least</u> reasonable of the three.

IN EACH GROUP, MAKE TWO (but <u>only</u> two) MARKS:

<u>M</u> Of the three statements, choose the one with which you <u>most</u> fully agree (or, if you disagree with all three, this would be the one with which you least disagree). Put an "M" beside this statement.

<u>L</u> Then choose the statement with which you <u>least</u> agree (or with which you most disagree). Put an "L" beside this statement.

1.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

_____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

2.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

_____ The biggest weakness in present-day psychology is that it is too theoretical.

_____ Individuals could be changed in practically any way one might wish if the environment could be appropriately controlled.

3.

_____ Individuals could be changed in practically any way one might wish if the environment could be appropriately controlled.

_____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

4.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

_____ Individuals could be changed in practically any way one might wich if the environment could be appropriately controlled.

_____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

5.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

_____ Individuals could be changed in practically any way one might with if the environment could be appropriately controlled.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

6.

_____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

_____ The biggest weakness in present-day psychology is that it is too theoretical.

7.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

_____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

8.

_____ Individuals could be changed in practically any way one might wish if the environment could be appropriately controlled.

_____ The biggest weakness in present-day psychology is that it is too theoretical.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

9.

_____ The biggest weakness in present-day psychology is that it is too theoretical.

_____ People who have a firm moral code are in general better adjusted than those who haven't.

_____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

10.

____ The strongest influence in shaping a person into the kind of person he becomes, is his mother.

____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

____ The biggest weakness in present-day psychology is that it is too theoretical.

11.

____ Individuals could be changed in practically any way one might wish if the environment could be appropriately controlled.

____ The biggest weakness in present-day psychology is that it is too theoretical.

____ The conditions of living in the U.S.A. tend to narrow the range of things we are able to decide to do, think about, etc.

Note: Item 1 was used as a "warm up" item and was not tallied.

APPENDIX IV

THE LINEAR HYPOTHESIS

Given an array of observed pair-scores y_{ij} on all possible pairs of a group, or on any subset of all possible pairs, let

μ = the population mean pair-score over all pairs,

b_i = the deviation from the mean due to person i,

b_j = the deviation from the mean due to person j, and

$(b)_{ij}$ = the deviation from $\mu + b_i + b_j$ due to the interaction of persons i and j.

Then let the observed pair-score be linearly comprised as follows:

$$y_{ij} = \mu + b_i + b_j + (b)_{ij}$$

and for any person i,

$$y_{i.} = \mu + b_i + b_. + (b)_{i.} \qquad (1)$$

Now, since $\sum i = \sum j =$ the population of persons, the sums of deviations from the mean are:

$$\sum_i b_i = \sum_j b_j = 0, \text{ and}$$

$$\sum_i (b)_{ij} = \sum_j (b)_{ij} = \sum_{i,j} (b)_{ij} = 0 .$$

Then, summing the pair-scores containing person i, we have from (1):

$$\sum_j y_{ij} = (N-1)\mu + (N-1)\, b_i + 0 + 0$$

where N is the number of persons, and N-1 the number of pairs which include person i. Or,

$$\frac{\sum_j y_{ij}}{N-1} = \mu + b_i$$

And for all pairs, similarly,

$$\frac{\sum_{i,j} y_{ij}}{\frac{N(N-1)}{2}} = \mu$$

And for any sample,

$$E\left(\frac{\sum_j y_{ij}}{N-1}\right) = \mu + b_i$$

$$E\left(\frac{\sum_{i,j} y_{ij}}{\frac{N(N-1)}{2}}\right) = \mu$$

Further, the estimated deviation score of person i is

$$\hat{b}_i = \frac{\sum_j y_{ij}}{N-1} - \frac{2\sum_{i,j} y_{ij}}{N(N-1)}$$

Now from our original equation we have

$$(b)_{ij} = y_{ij} - \mu - b_i - b_j$$

and substituting the estimates we have

$$\widehat{(b)}_{ij} = y_{ij} - m_{ij} - \hat{b}_i - \hat{b}_j$$

and substituting the expressions given earlier for these terms, we have

$$\widehat{(b)}_{ij} = y_{ij} + \frac{2\sum_{i,j} y_{ij}}{N(N-1)} - \frac{\sum_j y_{ij} + \sum_i y_{ij}}{N-1} \qquad (2)$$

for the estimated interaction between persons i and j.

Now the variance of the interaction within pairs is

$$s^2_{(b)_{ij}} = \frac{\sum_{i,j} \widehat{(b)}^2_{ij}}{\frac{N(N-1)}{2}} - \left[\frac{\sum_{i,j} \widehat{(b)}_{ij}}{\frac{N(N-1)}{2}}\right]^2$$

and since the last term is zero,

$$\frac{N(N-1)}{2} s^2 = \sum_{i,j} \widehat{(b)}^2_{ij}$$

Now let the pairs be divided into a group containing n_1 pairs which are given one treatment, and another containing n_2 pairs which are given another treatment. Then for the first group,

$$n_1 s_1^2 = \sum_{i,j} \widehat{(b)}^2_{ij}$$

with $(n_1-1)^2$ degrees of freedom, since $(b)_{ij}$ is the interaction between the effects i and j, which are of equal numbers. Similarly for the second group.

<u>Computation of the difference between mean interaction effects</u>.--For the pair (i,j) in a group of N(N-1)/2 pairs, the estimated interaction effect on the pair-score is given by equation (2). Now, since $\sum (b)_{ij} = 0$, the mean interaction effect on a subset of the N(N-1)/2 pair-scores will be significantly differant from the mean effect on the remaining pair-scores if and only if the effect on the first-mentioned subset is significantly different from zero.

Therefore, the effect of a treatment on the pair-scores of a subgroup may be tested for its effect on the mean interaction level by computing the estimated interaction for each score in the subgroup (using all pairs of the original group when computing the second term on the right-hand side of equation (2)), and testing by the t-test whether the mean interaction is different from zero for that subgroup.

<u>Computation of variances among interaction effects</u>.— In comparing the variances in two groups of interaction scores containing n_1 and n_2 pairs respectively,

$$F = \frac{\dfrac{\sum_{i,j} (b_1)_{ij}^2}{(n_1-1)^2}}{\dfrac{\sum_{i,j} (b_2)_{ij}^2}{(n_2-1)^2}}$$

where the null hypothesis is that the variance of group 1 is not larger than that of group 2.

In the present investigation (Chapter IV), all possible pairs did not enter into the computation of the F-ratio, and therefore (n_1-1) degrees of freedom were used, rather than $(n_1-1)^2$, and similarly for group 2. This is the more conservative test.

APPENDIX V

THE MEN'S RESIDENCE QUESTIONNAIRE

What are the proper standards concerning pre-marital and extra-marital sexual activity?

Check	Rank	
_____	_____	a. Sexual activity for either men or women before marriage, and extra-marital sexual activity after marriage, are wrong.
_____	_____	b. Some sexual freedom for men but not for women should be permitted before marriage, but not after marriage for either.
_____	_____	c. Freedom in sexual activity for both men and women should be permitted before marriage but not afterward.
_____	_____	d. Both sexes should be allowed sexual freedom before marriage, and some extra-marital sexual activity is O.K. after marriage for men but not for women.
_____	_____	e. Both sexes should be allowed sexual freedom both before and after marriage, provided both partners agree on the arrangement.

To what extent, if at all, have you talked to any of the other men in the house about the subject on the previous page?

(Cross out own name)

(Check one for each man)

	NEVER	ONLY ONCE	SEVERAL TIMES	MANY TIMES
B29				
C36				
D37				
E28				
F34				
G26				
H25				
I23				
J32				
K21				
L24				
M30				
N31				
O22				
P35				
Q33				
R27				

REFERENCES

1. Bateson, Gregory. Social planning and the concept of "deutero-learning." In Newcomb, T. M. & Hartley, E. L. (Eds.) Readings in social psychology. New York: Henry Holt, 1947. Pp. 121-128.

2. Bennett, J. F. A method for determining the dimensionality of a set of rank orders. Unpublished doctor's dissertation, Univer. of Michigan, 1951.

3. Coombs, C. H. A method for the study of interstimulus similarity. Psychometrika, 1954, 19, 183-194.

4. Coombs, C. H. Theory and methods of social measurement. In Festinger, L & Katz, D. (Eds.) Research methods in the behavioral sciences. New York: Dryden, 1953. Pp. 471-535.

5. Coombs, C. H. A theory of psychological scaling. Ann Arbor, Mich.: Univer. of Michigan Press, Engineering Research Bulletin No. 34, 1952.

6. Coombs, C. H. & Kao, R. C. Non-metric factor analysis. Ann Arbor, Mich.: Univer. of Michigan Press, Engineering Research Bulletin No. 38, 1955.

7. Coombs, C. H., Raiffa, H., and Thrall, R. M. Mathematical models and measurement theory. In Thrall, R. M., Coombs, C. H., and Davis, R. L. (Eds.) Decision Processes. New York: Wiley, 1954. Pp. 19-37.

8. Estes, W. K. Kurt Lewin. In Estes, et al. (Eds.) Modern learning theory. New York: Appleton-Century-Croft, 1954.

9. Gordon, M. H., Loveland, E. H. & Cureton, E. E. An extended table of chi-square for two degrees of freedom, for use in combining probabilities from independent samples. Psychometrika, 1952, 17, 311-316.

10. Hays, W. L. Extension of the unfolding technique. Unpublished doctor's dissertation, Univer. of Michigan, 1954.

11. Hebb, D. O. The organization of behavior: a neuropsychological theory. New York: Wiley, 1949.

12. Heider, F. Attitudes and cognitive organization. J. Psychol., 1946, 21, 107-112.

13. Kardiner, A. The psychological frontiers of society. New York: Columbia Univer. Press, 1939.

14. Kendall, M. G. The advanced theory of statistics. London: Charles Griffin & Co. Ltd., 1943, 2 volumes.

15. Korzybski, A. Science and sanity. Lakeville, Conn.: International non-Aristotelian Library Pub. Co., 1948.

16. Krech, D. & Crutchfield, R. S. Theory and problems of social psychology. New York: McGraw-Hill, 1948.

17. Maier, N. R. F. Reasoning in humans. I. On direction. J. comp. Psychol, 1930, 10, 115-143.

18. Mead, G. H. Mind, self, and society. Chicago: Univer. of Chicago Press, 1934.

19. Merei, F. Group leadership and institutionalization. In Swanson, G. E., Newcomb, T. M. & Hartley, E. L. (Eds.) Readings in social psychology. New York: Henry Holt, 1952. Pp. 318-328.

20. Milholland, J. E. The dimensionality of response patterns for the method of single stimuli. Unpublished doctor's dissertation, Univer. of Michigan, 1953.

21. Newcomb, T. M. An approach to the study of communicative acts. Psychol. Rev., 1953, 60, 393-404.

22. Whorf, B. L. The relation of habitual thought and behavior to language. In _Language, culture, and personality: essays in memory of Edward Sapir._ Spier, L., Hallowell, A. I., & Newman, S. S. (Eds.) Menasha Wisconsin: Sapir memorial publ. fund., 1941. Pp. 75-93.

23. Wilder, R. L. _Introduction to the foundations of mathematics._ New York: Wiley, 1952.

24. Woodger, J. H. _The technique of theory construction._ Chicago: Univer. of Chicago Press, 1939. Vol. 2 No. 5 of Internat'l Encyc. of Unified Science.