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**A THEORETICO-EXPERIMENTAL STUDY OF DIFFERENCES IN PROBLEM
SOLVING PROCESSES OF OPEN AND CLOSED MINDED INDIVIDUALS**

by

Reverend Paul Vincent Robb, S.J.

**A Dissertation Submitted to the Faculty of the Graduate
School of Loyola University in Partial Fulfillment
of the Requirements for the Degree of Doctor
of Philosophy**

May

1966

LIFE

Paul Vincent Robb was born in Toledo, Ohio, July 15, 1928.

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CHAPTER I

INTRODUCTION AND PURPOSE

Concern with personality and its manifestation in behavior has long been important in psychology. Cognitive functioning is one behavioral manifestation which has been studied and which highlights some of the difficulties in analyzing the relationship of personality and its expression in behavior. It has become increasingly clear that it is difficult, if not impossible, to separate the subject with his own personality from his cognitive activity, even though it is rather easy to distinguish these two.

Approaches to these distinct phenomena have been varied in the history of psychology, and, as G. W. Allport (1955, 1960) frequently pointed out, related to various philosophical presuppositions. Research emphases, also, show differences in approach. Else Frenkel-Brunswick (1951) has drawn attention to two main approaches in psychological research by pointing out the distinction between personality-centered and cognition-centered approaches.

Cognition-centered approaches have attempted to study cognition as a function in itself. Thus, emphasis has been on the process involved in this activity. The subject of the activity has been minimized, and, at times, completely excluded.

On the other hand, personality-centered approaches have attempted to study the knower himself as a distinct personality type. Thus, the emphasis has been on the variables and determinants of personality, or on a particular personality theory. Once the theory or the variables are determined, research is directed toward the differences in various personality types as expressed in cognitive behavior.

Whether these two approaches are so fundamentally different is questionable. The primary difference seems to center on the interpretation rather than the reality. If cognition-centered researchers speak of sets or cognitive styles, or if personality-centered researchers speak of rigidity or authoritarianism, is the reality of which they speak really different? Secondly, does rigidity or authoritarianism really say anything more than set or cognitive style? Perhaps there has been some heuristic value in the distinction between these two approaches, but they must converge (Blake, 1951), "For there cannot be one way of thinking about perception when one is interested in personality, and another way of thinking about it when one is interested in, say, size constancy" (Bruner, 1951, p. 122).

Such a convergence seems to be present in a phenomenological approach. Such an approach basically denies the heuristic value of the separation of the subject and his functioning. In practice it emphasizes the meaning of Bruner's statement and attempts, through a rigorous method, to distinguish these inseparable realities. Its approach is based on an observation of experience. Experience presents complex and related

realities. Though it provides a basis for distinction, it does not allow for the separation of these realities. As Bruner (1951) states, "where the perceived self terminates and the world of objects begins is, under extraordinary conditions, a matter of confusion; and there is also a shading off between those objects which have a self-relating characteristic and those which do not" (p. 142-143).

The present study, concerning personality and cognitive functioning, places itself in the context just presented. It could be classified as a personality-centered approach, but would rather be a phenomenological approach. This study would attempt what few others have. "Few studies have started out with a hypothesis which stated explicitly that, according to such and such a theory of personality, we would expect people of such and such a type to handle stimuli of such and such a kind in such and such a manner" (Bruner, 1951, p. 138).

In discussing the problem of adequate personality-oriented research in cognitive functioning Bruner (1951) maintains that "we must concentrate upon the investigation of those environmental cues which are appropriate to the confirmation of hypotheses which reflect basic personality patterns" (p. 140). He suggests two guides to the selection of personally relevant stimulus cues for investigation. One is theoretical in that the hypotheses are derived from a theory, e.g., the psychoanalytic theory provided the basic hypotheses for the study on authoritarianism by Adorno, Frenkel-Brunswick, et al. (Sanford, 1956). The second approach, and the one adopted here, is phenomenological, i.e., "we begin by inquiring

how the world appears to us" (Bruner, 1951, p. 142) and proceed by careful analysis to various structures that appear and which can be tested in various ways, depending on the kind of structures that do appear.

The present investigation seeks to explore one of the dimensions involved in the relationship of personality structure and cognitive functioning. The personality variable is open and closed mindedness and the cognitive function is the process of problem solving. In order to follow the suggestion of Bruner (1951) it is necessary to discuss: a) the concept of structure, b) open and closed mindedness, and c) the relationship of the two. Each of these must be discussed in turn.

THE CONCEPT OF STRUCTURE

The importance and necessity of accounting for individual differences in studying behavior has long been the concern of psychologists dealing with cognitive functioning. Whether one speaks of sets, expectancies, hypotheses, cognitive styles, Aufgabe, needs, rigidity, or belief, the implication is that the subject, the knower, in some way actively enters into his own cognitive functioning (Ausubel, 1963). His part in the process seems to concern structure. Through his previous cognitive and affective experiences he dynamically forms a structure of the world in which he lives and knows. Recent concern with this concept of structure is evident in psychological literature.

F. H. Allport (1955), while preferring a general theory of "the structuring of events," applies it, in the first instance, to the

perceptual act which

appears as a structure that is closely knit, yet not isolated from surrounding happenings, that is built up of the events of ongoing and interacting elements--events that have assembled, as it were, through space and time, a structure that can endure, that is flexible and yet ordered and resistant to disruption, that has both a non-quantitative and a quantitative aspect, that pools or averages its energies, that 'gears in' with some adjacent structures and opposes or reduces others, and that operates as self-closing or self-renewing cycles (p. 612-613).

In studies dealing with higher cognitive processes, the notion of structuring is involved in those of Bruner, Goodnow, and Austin (1956), Duncan (1959), Dunker (1945), and Wertheimer (1959). W. R. Garner (1962) stressed the necessity and universality of structuring, but applied it primarily to the notions of uncertainty and meaning. He designated structure as "the totality of the relations between events . . . an entire set of events" (p. 141). This structure is either external or internal. External structure seems to refer to the relationship between the representation of events, whereas internal structure seems to refer to the relationship between the events themselves.

Piaget (1960), also, viewed cognitive functioning as basically a structuring activity. "Intelligence," he says, "takes the form of a structuring which impresses certain patterns on the interaction between the subject or subjects and near or distant surrounding objects" (p. 167). With evolutionary overtones, he extends the notion of structuring to all cognitive functioning and, seemingly, to all behavior. However, the structuring is analogous, not univocal, and preserves the autonomy of different

kinds of structuring.

In Flavell's (1963) exposition of Piaget's theory, he points out the importance the concept of structure has. He states that structures, in Piaget's system, "are the organizational properties of intelligence, organizations created through functioning and inferable from the behavioral contents whose nature they determine. As such, Piaget speaks of them as mediators interposed between the invariant functions on the one hand and the variegated behavioral contents on the other (1928a)" (p. 17). Later Flavell says that they "form a kind of bridge between the nomothetic and the idiographic in cognitive development. Perhaps the most important thing to say about the concept of structure here is that, as we see it, one cannot really have a detailed theory of intellectual development without it" (p. 409). In distinguishing structure, function and content in Piaget's system, he writes, "function is concerned with the manner in which any organism makes cognitive progress; content refers to the external behavior which tells us that functioning has occurred; and structure refers to the inferred organizational properties which explain why this content rather than some other has emerged" (p. 18).

G. A. Kelly (1955) expands the notion of structuring from its strictly cognitive function and applies it to personality. The concept of structure is the focal point of his theory. For Kelly, personal constructs are patterns construed by the subject in order to bring unity and understanding into the multiplicity of experience. "The construct is a representation of the universe, a representation erected by a living

creature and then tested against the reality of the universe" (p. 12). Regarding the reality of constructs, Kelly says that the construct is real, "but its reality is not identical with the factual elements in its context. With respect to the factual elements it is representative, not identical. Its reality is not their reality. The construct has its own reality . . . a construct and its elements are both real, but distinguished from each other" (p. 136).

In a similar vein Milton Rokeach (1960) deals with the concept of structure in order to understand the relationship of personality and cognitive functioning. Here, however, structure is not so much related to cognitive activity as to the relationship of beliefs in a belief-disbelief system. These beliefs, formed and maintained by authoritarian relationships and influences, are the principle determinants around which structure is formed. The resulting structure is the means a subject has for dealing with the world and himself in the world.

In the nascent area of phenomenological psychology, concern with structure is of primary importance. This importance derives from the assumption that the structures of reality-as-it-is can only be discovered in the structures of reality-as-known resulting from human cognitive functioning. Edie (1964), writing of Merleau-Ponty, states that "the structures of what he calls 'perceptual consciousness' are our first route of access to being and truth, and these structures underlie and accompany all the structures of higher-level 'intellectual consciousness'" (p. xvi).

similarly, Strasser (1963) stresses the necessity of discovering the structures of experience which characterize man as human, conscious, free, and personal. "The primary aim of phenomenology," he writes, "is to lay bare the general and necessary structures of experience" (p. 275).

In these many and different viewpoints there is much communality and agreement. All of the authors, except F. H. Allport, stress the structuring activity of the subject. Allport (1955) seems to give structuring some kind of independent existence which precludes and denies a real subject. Implicit in all the authors is the notion that structuring is the natural and primary function of dynamic, vital activity. This is implied in F. H. Allport (1955) and made more explicit in the evolutionary language of Piaget (1960) and Merleau-Ponty (1964). Structuring is, however, an analogous concept and must, therefore, be applied in different ways to different kinds of structuring activity. The insight into this characteristic of vital functioning is provided by cognitive activity, especially higher cognitive processes involving meaning, in which structuring reaches its perfection and becomes the prime analogate for other kinds of structuring. The search for meaning, as discussed by Garner (1962), Piaget (1960), Kelly (1955), Strasser (1963), and Merleau-Ponty (1964), is the dynamic search for structure. This search is inherent in behavior and is the subject's own structuring and restructuring of the parts and wholes of primary cognitive experience. This is a search for the relationships between the various aspects of reality-as-known which will provide for an interaction with reality-as-it-is which is meaningful, i.e., the

subject acts successfully in the world-as-it-is according to the structure found in and derived from the world-as-it-is-known. Thus, structuring stands, as insisted on by the phenomenologists, as the door between the subject and the object, between inner and outer, between the "I" and the "not I", between personal structure and reality structure. Garner (1962) states well the relationship between personal structure and reality structure.

The search for structure will occur with respect to either internal or external structure, but preferably for both. Thus, we will try to perceive the relations that exist in the stimulus environment, but we will also relate our own behavior to the variations in the stimulus environment. In the first case we are attempting to perceive the internal structure which exists in the stimulus environment, and in the second case we are trying to provide external structure by relating our own behavior to the stimulus variations (p. 340).

Though structuring is viewed primarily as a cognitive activity, most of the authors recognize that it is the activity of a subject. Thus, the variability and differences in structuring encountered in experience suggest an added element--affectivity. While assuming the cognitive nature of structuring, Rokeach (1960), especially, is more concerned with the affective element which influences differences in structuring. Because of his interest in a kind of genetic or developmental approach, i.e., the formation of belief systems, the stress turned to affectivity. The particular form of affectivity dealt with was authoritarianism. This was a strong influence on, and perhaps the starting point of, Rokeach's analysis. However the failure to distinguish

clearly between the cognitive and affective elements involved in structuring is partially responsible for the confusion in his theory of belief systems.

With this analysis of the various aspects of structuring presented by various authors, in this study structuring will be considered to be the dynamic, personal, cognitive activity by which the multiplicity of reality-as-it-is-known is brought into an order or pattern so that man can deal with, understand, and find meaning in reality-as-it-is. More precisely, structuring is the forming of relationships or structures between the parts and wholes of reality-as-is-known. It is an integrating activity. The necessity for the individual to structure is inherent and is the fundamental function and purpose of cognitive activity. The responsibility of the individual is to remain open to the structure of reality-as-it-is so that it can aid the individual in his own personal structuring of reality-as-it-is-known. The structure which is resultant from this structuring must be meaningful, i.e., the construed structure must correspond to, by ever changing and approximating degrees, the structure of reality-as-it-is and lead to an interaction with reality-as-it-is which is adequate.

This study, which deals with the relationship of cognitive activity and personality variables, demands a consideration of these latter aspects. The necessity for the individual to structure seems to be clear. Here there is need to deal with the responsibility of the individual to remain open to the structure of reality-as-it-is. Since openness and

closedness are the personality variables involved in this study, they must now be clarified.

OPEN AND CLOSED MINDEDNESS

Milton Rokeach (1960) discusses openness and closedness in terms of belief-disbelief systems. Since this study was greatly influenced by Rokeach and yet presents a theory which differs from his, it seems necessary to attempt a summary of his ideas.

Rokeach (1960) centers his theory on belief-disbelief systems which, he suggests, are more inclusive, more basic, and more psychodynamic than other behavioral organizations in terms of personality or cognition. He concludes from his research that a person's belief system has pervasive effects on all spheres of activity--personal, ideological, perceptual, conceptual, and esthetic. These different spheres of activity seem to have something in common. Rokeach suggests that this is something structural which joins together an individual's personality, ideological, cognitive, and esthetic systems. It is, thus, the structure of the belief systems rather than its content which is important and indicative of general functioning.

Within this broad framework Rokeach addressed himself to the relation between thought and belief and "to the possibility that there is a basic unity between them" (p. 7). He asks,

If we know something about the way a person believes, is it possible to predict how he will go about solving problems that have nothing to do with his ideology?

. . . We will try to find out if belief and thought can be tied together because of certain structural properties they might have in common. If they can, then we should be able to predict, from a knowledge of a person's ideological orientation, his conceptual behavior when solving intellectual problems (p. 7).

Beliefs are basically expectancies or predispositions to action. The belief system represents all the expectancies or hypotheses, conscious or unconscious, that a person at a given time accepts as true of the world in which he lives. The disbelief system is not just the opposite of the belief system. It is composed of all the expectancies or hypotheses, conscious or unconscious, that a person at a given time rejects as false. As a system, the belief-disbelief system is conceived to be an organization of parts, with single beliefs and disbeliefs as a basis, that may or may not be logically interrelated. Thus, Rokeach assumes that "all people have belief-disbelief systems that can be described in terms of the structural arrangement of their parts" (p. 34). These systems "include each and every belief and disbelief of every sort the person may have built up about the physical and social universe he lives in. We mean it to represent each man's total framework for understanding his universe as best he can" (p. 35).

These systems are organized according to the principle of belief congruence. ". . . we organize the world of ideas, people, and authority basically along the lines of belief congruence. What is not congruent is further organized in terms of similarity to what is congruent" (p. 395). Among the determinants of congruency is the degree of isolation

and differentiation of individual beliefs. There is also a time perspective which refers to the person's beliefs about the past, present, and future and to the manner in which they are related to each other. A further important determinant deals with the centrality of a belief. Here Rokeach distinguishes three types of belief: a) primitive beliefs, which have a "specific" content, about the physical, social and personal realities of the subject's world; b) intermediate beliefs, which have a "formal" content, which a person has in and about the nature of authority and the people who line up with authority and on whom he depends to help him form a picture of the world he lives in; and c) peripheral beliefs which are those beliefs derived from authority and which fill out his picture of the world.

That which joins these determinants together is a more fundamental variable. "We are referring to the capacity to distinguish information from source of information and to evaluate each on its own merits. This variable, in the extreme, describes the essence of the open and closed mind and, with its diverse manifestations, is at the cornerstone of our attempts to understand whatever relationships may exist among personality, ideology, and cognitive functioning" (p. 396). Thus, openness and closedness and the function of authority are fundamental in Rokeach's theory.

The primary characteristic of the belief-disbelief system is openness and closedness. These are determined "by the extent to which

the person can receive, evaluate, and act on relevant information received from the outside on its own intrinsic merits, unencumbered by irrelevant factors in the situation arising from within the person or from the outside" (p. 57). That which is central in the structure of the belief-disbelief system and which determines the amount of openness or closedness is assumed to be a set absolute beliefs about positive and negative authority and other closely related beliefs representing attempts by such authority to reinforce and perpetuate itself.

From his research on the relationship of thought and belief, Rokeach found that many aspects of cognitive functioning could "be attributed to personality rather than to intelligence" (p. 398). He attributed the essential difference in the intellectual functioning of open and closed persons to the ability to synthesize. He found that closed minded individuals were poorer at synthesis. He concluded that "a person's cognitive functioning is not a thing apart from his affective or emotional functioning" (p. 399).

He begins his discussion of the relationship between cognitive and affective functioning with the assumption that every affective state has its representation as a cognitive state in the form of some belief or some structural relation among beliefs within a system. He states, "In all cases, enjoyment or its opposite is the affective counterpart of a belief organization and can be thought of as being in a one-to-one relation (isomorphic) with it. Thus, our cognitive approach is

as much concerned with affection as with cognition" (p. 399). Among the affective states, authoritarianism is the central one in Rokeach's theory. He concludes by saying that "the traditional distinction between what is cognitive and what is affective may be a convenient one but not a necessary one" (p. 400).

Finally, Rokeach sees the functional aspects of belief systems highlighted in this relationship between the cognitive and the affective. These systems are seen to serve two opposing sets of functions. "The beautiful thing about a belief system is that it seems to be constructed to serve both masters at once: to understand the world insofar as possible, and to defend against it insofar as necessary" (p. 400).

Hollander and Hunt (1963) classify Rokeach's theory as a fixed-trait, need-based model in which the immediate forces in the social environment are, more or less, subordinated to authoritarian influences of the past. They point out the deterministic implications derived from the psychoanalytic influence on Rokeach through Adorno, Frenkel-Brunswick, et al. Also, Rokeach claimed that belief congruence was a more important organizing principle than race or ethnic considerations in determining personal relationships. However, Triandis (1965) found that this theory was not as general or as central as proposed. In studying both race and belief as determinants of behavioral intention he found that race was more important in intimate behavior and belief more important in non-intimate behavior.

One source of difficulty with Rokeach's theory seems to be

involved with his concept of structure. Structure refers to the inter-relationships of single beliefs or disbeliefs in a three dimensional space having as determinant vectors three continua: isolation-differentiation, central-peripheral beliefs, and a time perspective. Thus, effectively structure would seem to be static rather than dynamic. Besides, structure must depend effectively upon the content of the beliefs since relationships are basically similarities and dissimilarities in content. Therefore, Rokeach's concept of structure does not seem to account for the dynamism described in the phenomena of the open and closed mind and ascribed to structure. As seen in the discussion on structuring at the beginning of this study, the dynamic element is the individual who actively structures. In Rokeach the individual seems to be more passive, determined, or held in by authority, and, thus, subordinated to past rather than present influences of the situation, as Hollander and Hunt (1963) indicated.

A second source of difficulty is related to the first. The dynamic element of Rokeach's theory seems to center in the beliefs, which are defined as expectancies and predispositions to action. Thus, they combine both affective and cognitive elements. These beliefs are similar to Kelly's (1955) personal constructs, as Rokeach indicates (1960, p. 400), as predictors of behavior. Yet, T. Mischel (1964) criticizes such a notion as too narrow. He distinguishes hypotheses or expectancies which lead to behavior from those which are more descriptive of things as they are. He makes this distinction on the basis that the first are

evaluative and the second are not. Thus, he points up a necessary distinction between two aspects of expectancies, one which is cognitive in terms of description and one which is affective in terms of evaluation.

Finally, a belief is not so much an expectancy as a judgment that such and such a reality is, or exists, in such and such a way. The expectancy is a result of this judgment for things are expected to act depending on what they are. Also, as Mischel (1964) indicates, such an expectancy may or may not lead to some personal behavior. Thus, despite Rokeach's claim that the distinction between cognitive and affective elements is not necessary, it does seem necessary to distinguish these elements. Piaget (1960), also, emphasizes the need to distinguish these two when speaking of affective theories.

if all behaviour, without exception, thus implies an energetics or an 'economy', forming its affective aspect, the interaction with the environment which it instigates likewise requires a form or structure to determine the various possible circuits between subject and object. It is this structuring of behaviour that constitutes its cognitive aspects. A perception, sensori-motor learning (habit, etc.), an act of insight, a judgment, etc., all amount, in one way or another, to a structuring of the relations between the environment and the organism. It is in this that they reveal a certain affinity among themselves which distinguishes them from affective phenomena . . . Affective life and cognitive life, then, are inseparable although distinct. They are inseparable because all interaction with the environment involves both a structuring and a valuation, but they are none the less distinct, since these two aspects of behaviour cannot be reduced to one another (p. 5-6).

The whole impact, too, of phenomenological method is to enable the individual to distinguish between these two, cognitive and affective,

aspects of behavior. Through this method an individual attempts to discover the structure in reality-as-it-is-known and, on the basis of this, to discover the structure of reality-as-it-is. In order to discover this structure, it is necessary to remain open and free of undue affective influences.

Thus, the failure to distinguish adequately between the affective and cognitive aspects of beliefs leads to many difficulties. To ascribe the dynamic element of structure primarily, if not solely, to the affective rather than the cognitive seems to be the fundamental difficulty with Rokeach's theoretical explanation. This implies that the individual is passive and subject to the influences of affectivity, which would be bound up with early experiences involved with authority figures. With such a psychoanalytic orientation, it is easy to understand why authoritarianism and belief systems are rather invariant and so pervasively determining of all behavior.

The phenomenological analysis used in this study, though agreeing with the phenomena of openness and closedness as described by Rokeach, presents a theory of the opened and closed mind that is somewhat different from that of Rokeach. Openness and closedness, as used here, deal with the interaction of and the relationship between the individual person and reality. They are characteristics of a person and not of beliefs or belief systems. Thus, open and closed mindedness refer to the openness and closedness of the individual to the evidence of reality presented in knowledge.

Open and closed mindedness are viewed as characterizations of personality types derived from and designated by the individual's approach to or structuring of reality. This approach to reality depends on the reality present in primary cognitive activity and the individual who is both a structurer and an evaluator.

OPEN AND CLOSED MINDEDNESS AND STRUCTURE

Physical, social, and personal reality, present to the individual in cognitive activity, place demands on the individual. Since structuring is an inherent and natural function, the individual must deal with these realities in some way. He must either accept and integrate the realities, which would be the approach of the open minded individual; or he must reject and exclude or distort the realities, which would be the approach of the closed minded individual. These three basic realities must be dealt with in a positive, active way. This active attitude seems to demand three steps: 1) an examination of the evidence of the reality as it is presented in cognitive activity, 2) a personal integration of the reality, a structuring, into the total "view of the world" of the individual, i.e., into his own personal Weltanschauung, and 3) a positive decision to accept, exclude, or to delay the acceptance or exclusion of this particular reality in the actual life of the individual. For example, a young man, aware of the particular expression of love which is marriage, must examine the reality of this expression of love for what it is in itself, then he must integrate this into his total view of reality, his

Weltanschauung, and, finally, he must decide to accept the reality into his actual life by marriage or exclude it by making another choice of an expression of love or he must actively delay his choice to another time. Such would be the general approach of the open minded individual. The closed minded person, on the other hand, would deal with reality in a negative way--either by failing to examine the evidence of the reality-as-it-is-known, or by refusing to integrate it as it is into his personal Weltanschauung, or, finally, by refusing to make a positive decision concerning this particular reality in his actual life. Though this example tends to emphasize these three steps as separate, the intention is to point out three inseparable, but distinct, aspects of personal structuring.

To understand openness and closedness it is necessary to consider its relationship to structuring as building one's view of the world, a personal Weltanschauung. An insight into this aspect of structuring comes from Kronfeld's (1922) comment on Wilhelm Dilthey's contribution to the notion of structure and personality. "Dilthey hat diese Grundbegriffe vor allem im Hinblick darauf ausgewertet, den Zusammenhang zwischen Weltbild und Wertrichtungen einer Persönlichkeitstypus darzulegen. Seine Typen der Weltanschauung sind zunächst nicht psychologische Typen, sondern bezeichnen typische Unterschiede der Weltanschauungen als objectiver geistiger Gebilde" (p. 158). Here Dilthey proposes that the Weltanschauung is contributed to by the Weltbild and the Wertrichtungen. The Weltbild would be the picture or representation of reality as present in reality-as-it-is-known. This is similar to the perceived-world of Merleau-Ponty (1964)

and the phenomenologists. It is this world, Merleau-Ponty claims, that contains the universe. The Wertrichtungen are the general value orientations which give a direction to a man's life. They are also the attitudes, communicated in experience, which are the basis for classifying individuals as open, closed, warm, etc. It was on the basis of these Wertrichtungen that Dilthey formed his typology which divided men into the earth-bound, heroic, and contemplative.

Since structuring is always done in a context--in the context of reality as present in "perceived reality", the Weltbild, and in the context of the individual's general value orientation, the Wertrichtungen--openness and closedness are related to the value orientations of the individual and expressed in his cognitive structuring. These are the influences which aid or interfere with the individual in his structuring of the elements of the Weltbild into his personal Weltanschauung. These value orientations are not directed toward, or involved with, specific objects, but toward the totality of the three realities: physical, social, and personal. These would be similar to Rekeach's (1960) primitive beliefs. These value orientations, which involve an evaluation about the nature of the reality encountered, would appear to be centered on the judgment of whether the particular kind of reality is amicable, therefore accepting and approachable, or hostile, therefore rejecting and to be avoided. Admittedly, the evaluation of and affect toward the amicability or hostility of reality is learned from attitudes provided by authority figures, especially parents. However, the center of the value orientation and that

which determines the amount of openness and closedness seems to be the judgment about reality rather than a set of absolute beliefs about positive and negative authority, which Rekeach posits as the center of the belief-disbelief system. In the present explanation, also, the individual is dynamically active in structuring and is, thus, able to restructure by making new judgments about the kind of reality present.

Thus, an individual seems to be judged opened or closed minded depending on the degree to which his value orientations aid or prevent him from structuring reality in a positive way according to the demands of reality itself. Such an inability to deal positively with the demands of reality necessitates that the individual form a structure of reality according to his own personal value orientations rather than those of reality. Since the individual in such a case fails to deal with reality-as-it-is, he rejects and distorts the demands of reality and, thus, lives in a world created by himself. As a result, his interaction with the world is not meaningful, since he is living in and dealing with a world not derived from the structure of reality as presented in knowledge, but structured according to his own orientations. The degree to which there is conflict between these two worlds would indicate the degree of open and closed mindedness, and, probably, would give rise to the anxiety which is the hallmark of psychological maladjustment.

Consequently, in the closed minded individual one would expect an effort to impose structure on reality rather than to derive it from

reality; one would expect prior experience to be less of a help since it would not have been integrated; one would expect memory to be more of a hindrance than a help because of its greater selectivity in the closed mind; one would also expect that imagination, in the sense of phantasy, would be more operative than memory since it is more related to personal structuring; one would expect the closed minded person to be generally less well motivated than the open minded individual because he has met with more failure than success in dealing with reality, however, there may be great motivation for the closed minded to maintain the structure imposed; finally, one would expect that new information would be more difficult to integrate because it would not fit easily into a rather closed system.

With these expectations concerning open and closed minded individuals and with the concepts of openness and closedness related to cognitive structuring, it would seem that problem solving tasks would provide the necessary cues for the "confirmation of hypotheses which reflect basic personality patterns" (Bruner, 1951, p. 140). In a problem solving task, the successful solution to the problem, not in terms of the answer but of the process, demands that the individual find the structure of the problem and let the structure of the problem aid him in the solution to the problem (Rimoldi, Fogliatto, Erdmann, Donnelly, 1964). Besides this crucial element which, also, distinguishes the open and closed minded person, problem solving tasks seem to involve most of the other areas that distinguish the two personality types: prior experience, motivation,

memory, and integration of new information.

There seem to be two ways of dealing with the problem of personal structuring versus reality structure. One approach attempts to analyze the structures as they appear in consciousness or in the performance of a particular task. The other approach concerns itself with defining reality structures in themselves so that individual differences will be more recognizable. This second is the approach employed here.

STRUCTURES IN PROBLEM SOLVING

Concern with the structure of a task has been one of the aims of individuals involved in studies of higher cognitive functioning. Wertheimer (1959) considered the problem situation as having a goal, obstacles to the goal, and no clear perception of the means to reach the goal. The productive thinker is active in seeking the goal in that he must restructure his own process in terms of the structure of the problem. To check on this restructuring he used the method of retrospection. Duncan (1959) has a related idea of the problem solving situation which he distinguishes from rote learning and conditioning. Bloom and Breder (1950) presented a study whose methods were similar to those of Wertheimer, but they used both introspection and retrospection. Among their findings was the special ability of the successful problem solver to understand the nature of the problem and to attack it in its own terms.

Dunker's (1945) well known studies of problem solving were important in this regard. He studied the process of problem solving with his method of "thinking aloud" by the subjects. This method directed

the subject's attention to the problem structure itself rather than to his own processes. This seemed to be a better method than retrospection since Dunker's technique did not depend on the subject's memory of his process.

Bruner's (1956, 1957) studies with strategies in concept attainment deal with the structure of the problem as well as the structuring of the individual. The difference between scanning and focusing indicates processes by which different individuals structure, or derive structure, from a situation. When the focusing method is used successfully, it is because the structure of the task has been understood.

Recent developments by Rimoldi and others (1955, 1960, 1961, 1962a, 1962b, 1963, 1964) in analyzing the problem solving processes of individuals seem to provide a unique opportunity for the study of differences in approach between open and closed minded individuals. These developments, though not primarily aimed at personality differences, have been concerned with means of gathering useful information about the processes followed by individuals when they solve problems. The critical contribution of Rimoldi's work centered on the notion of structure. By devising problems with a set structure it was possible to score individuals according to their understanding of the structure and it was possible to devise norms that would indicate individual processes rather than group processes. According to Rimoldi, Haley, Fogliatto, Erdmann (1962) ". . . By structure is meant the formal properties or schema of the problem expressed in terms of a basic set of relationships. These 'schemata' are the logical frames on which various types of content or objects may be superimposed"

This concept of the logical structure of a problem was a "major impetus in the evaluation of individual tactics" (Rimoldi et al., 1964, p. 143).

Given a set logical structure it was possible to direct attention to the processes of individual problem solvers. The results of the studies by Rimoldi et al., (1964) produced at least two scoring methods which "facilitate the analysis of the dynamic aspects of thinking which are ignored when the final answer is considered alone" (p. 143).

Thus, Rimoldi effectively involved himself in the study of personal structuring as evaluated against the structure of a given problem. Given a set structure which could be altered for different levels of complexity and on which different languages could be imposed, it was possible to evaluate personal structuring in a variety of situations. The scoring procedures were more objective than those used in previous studies since they did not call for introspection, retrospection, or 'thinking aloud'. The process of each individual is recorded directly as he takes each step in his structuring activity.

The background for Rimoldi's recent work is found in two articles published in Psychometrika in 1948 and 1951. The empirical results of this factor analytic study of intelligence are, also, quite pertinent to the theoretical formulation presented in this study. After deriving first-order factors, Rimoldi (1948) found the second-order factors which he suggests "refer to more fundamental psychological variables" (p. 38). At the conclusion of his analysis Rimoldi (1951) states:

If the second order refers to a more fundamental level of psychological dynamics, our results seem to indicate

that one relation--that of likeness--is a basic step in the solution of intellectual problems; that analysis and synthesis are the two main procedures at our disposal, one indicating the more abstract logical performance that is mainly involved in cognition of the "that" type, the other pointing to the combination of the different elements and their expression by means of appropriate symbols (p. 92).

The first factor--involving the relation of likeness and its opposite--is orthogonally related to the other two--involving synthesis and analysis, which are correlated. This factor seems to be related to the insight that one total object is like or unlike another total object. It transcends different kinds of materials: sensory or intellectual, abstract or concrete, perceptual or highly complex intelligible. Rimoldi (1951) who suggests "the relation of likeness makes possible the extension of conceptual thinking to levels of high complexity" also says that Spearman considers it "as furnishing 'the main resource of all mental tests, whether sensory or otherwise'" (p. 88). This insight includes the capacity of finding the relationship between objects and the eduction of correlates, as well as an adaptability on the part of the knower in gaining insight. This latter is called plasticity which is "the capacity of bringing together several conflicting Gestalts, 'the more plastic the subject, the more likely he is to be Gestalt free' (24), and it is probably related to some temperamental and personality concepts" (p. 91).

The two correlated factors--analysis and synthesis--are the mechanisms through which the knower clarifies and fills out this insight. The analytic factor refers to the logical process underlying psychological activity and would seem to involve the finding of relationships and eduction

of correlates between parts of one object or between parts of different objects. It would, therefore, be distinct from the previous factor in that the factor involving likeness deals with totalities rather than parts. The synthetic factor refers to what might be called the psychological process of psychological activity, i.e., it involves subjective elements more than the logical process does. This factor involves the ability of bringing different parts together into a unity which promotes solution.

These two factors are always related and work hand in hand. Though they are distinct, it is difficult to separate them in actual cognitive activity. As related they are best described by "the factors described by Mieli (6) as "complexité" and "globalization," which the author defines as : 'capacité de réaliser clairement et avec précision des structures complexes' and '... la facilité avec laquelle des données relativement séparées s'unissent pour former un tout.'" (Rimoldi, 1948, p. 39).

As related to the discussion given above, the first factor--the relation of likeness--would seem to be related to the individual's structuring in his search for meaning. The analytic process serves this structuring by enabling the derivation of structures from the Weltbild. The synthetic process, also, serves this structuring by unifying the parts of the derived structures as the individual seeks to form a meaningful Weltanschauung. Therefore, it can be seen that Rimoldi's work involves both ^{the} structuring activity of the individual and the structures of the logical problem solving activities.

With the development of the concept of structuring related to open and closed mindedness and to problem solving completed, it is necessary to mention one study that is, more or less, directly related to this research. This was a study reported by Rokeach (1960) who used the same personality types as investigated in this study. The purpose of Rokeach's particular research was to distinguish between the processes of dogmatic (closed minded) individuals and rigid individuals. In solving a problem, called the Doodlebug Problem, Rokeach distinguished two phases: the analytic and the synthetic. In the analytic phase, three beliefs that individuals ordinarily have had to be overcome; in the synthetic phase, three new beliefs had to be integrated into a solution. The measurement of analysis and synthesis was in terms of time, i.e., the time taken to overcome each of the beliefs and the time taken to formulate a new solution. There was, necessarily, an overlap of time which made scoring difficult since the time between overcoming the first and third belief coincided with part of the time for measuring synthesis. Thus, in terms of measurement there was ambiguity. It is questionable, also, whether analytic and synthetic phases can be separated as Rokeach attempted to separate them for purposes of measurement. The results of the experiment were not clearly significant. In the analytic phase, there was no significant difference between the open and closed group, though there was between the rigid and non-rigid groups, as predicted. In the synthetic phase, which was crucial for Rokeach in distinguishing between open and closed minded individuals, in only one of three measures was there a

significant difference between the two groups. Thus, as Rekeach (1960) observed, "these data are not conclusive" (p. 192). However, he states as a general theoretical conclusion from the total research on open and closed mindedness related to cognitive activity that "the findings suggest that information about personality organization can reliably predict the outcome of different phases of thinking in problem solving" (p. 193).

HYPOTHESES OF THE PRESENT STUDY

It seems, therefore, that both elements of Bruner's challenging formulation are adequately accounted for in this analysis of a personality type and in the problem solving work done by Rimoldi, et. al. In summary, the purpose of this investigation is to explore the differences between open and closed minded persons in a problem solving task with reference to differences in processes in solving problems which have factorially different contents and structures. In a paraphrase of Bruner's formulation, the expectation of this study is that closed minded individuals would proceed in this particular structured problem solving task in a closed way, i.e., they would find the structure of the problem less accurately than the open minded individuals, they would reduce uncertainty to a lesser degree, they would find specific concrete content easier to deal with than abstract, and they would find it more difficult to integrate the information presented into the proper solution than would the open minded individual.

The specific hypotheses of this study are the following:

1. There will be a significant difference between the scores of the open and closed minded groups on all of the problems, the verbal problems as well as the geometrical problems. This significant difference will be found in the higher scores of the open minded group when the pulling out method, which is sensitive to structure, is employed.
2. There will be a significant difference between the two groups on all the problems using the method of uncertainty reduction. The open minded group will reduce uncertainty on all the problems to a significantly greater degree than the closed minded group.
3. Using scores derived from information values there will be a significant difference between the two groups on the geometrical problems. The open minded group will obtain lower scores than the closed minded group.
4. There will be a difference in group performance on concrete and abstract material in the closed minded group but not in the open minded group. The difference will be that the closed minded group will perform significantly better on concrete material than on abstract.

CHAPTER II

PROCEDURE

A. SUBJECTS: A total of 60 male subjects were used in this research. The s's were all freshmen at Loyola University's College of Arts and Science and enrolled in a course in General Psychology. These 60 s's were divided into two groups of 30 on the basis of Rokeach's Dogmatism Scale, Form E.¹ Table 1 presents the mean scores and differences of these two groups on this Scale.

In order to control for the influence of intelligence or quantitative ability on problem solving, the two groups were also equated for quantitative ability by means of quantitative scores on the usual college entrance examinations, the CEEB and the SCAT. Table 2 presents the means and differences of these groups on this variable.

¹The Rokeach Dogmatism Scale, Form E, has a reliability ranging from .68 to .93 for different groups using the test-retest method. Form E is the final form of a number of revised Scales. It is the result of refined thinking and a number of item analyses. The validity of the Scale was established in a number of ways. Perhaps the most significant for the purposes here was conducted by having graduate students in psychology contact subjects who were judged to be open or closed minded according to the various characteristics which have been mentioned above as the phenomena of the open and closed mind. When the Dogmatism Scale was administered to these groups, it distinguished the two beyond the .01 level of confidence. Subsequent studies, also, have used this Scale to distinguish these two personality types (Rokeach, 1960). (See Appendix I for the content of the Dogmatism Scale).

Relative to the relationship between open and closed mindedness and intelligence, Rokeach (1960) found no correlation between the scores on his Dogmatism Scale and I. Q.

Another methodological issue that we have already considered many times is whether the differences obtained between high and low scorers on the Dogmatism Scale, particularly with respect to cognitive functioning, can be explained away as being due to intelligence. As we have shown, however, the correlation between scores on the Dogmatism Scale and intelligence is typically close to zero, when intelligence is measured by such tests as the American Council on Education Test, the Ohio State Psychological Examination Test, and the Wonderlic Test. Similarly, extreme scorers on the Dogmatism Scale typically do not differ from each other in intelligence. It would therefore be hard to account for our findings on this basis (p. 407).

A more indirect indication of this phenomena, which perhaps provides another basis for this study, is the division of groups in the research of Rimoldi, et. al (1964). He found there were good and poor problem solvers in students with both high and low academic grades. Table 3 provides the correlation coefficients between scores on the Rokeach and those on the CEEB and the SCAT.

A methodological difficulty, which does not seem serious in light of the discussion above, stems from the fact that the available college records do not have both SCAT and CEEB scores for all of the S's. This necessitated the somewhat uneven comparisons found in Table 2. However, since both of the differences are non-significant, and, especially, the difference using the CEEB Quantitative scores, which account for almost all the open minded group and over half of the closed minded,



TABLE 1

t-TEST FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS
ON THE ROKEACH DOGMATISM SCALE, FORM E.

OPEN MINDED			CLOSED MINDED				
M	SD	N	M	SD	N	<u>t</u> -score	prob.
72.77	11.23	30	135.53	9.54	30	7.4837	.0001

TABLE 2

t-TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS
OF QUANTITATIVE SCORES ON THE CEEB AND SCAT
AND ON THE TOTAL I.Q. OF SCAT.

	OPEN MINDED			CLOSED MINDED			
	M	SD	N	M	SD	N	<u>t</u> -score
CEE B Q	72.42	18.94	24	71.06	22.865	16	.1994
SCAT Q	82.25	16.93	12	70.25	23.62	20	1.49
SCAT IQ	76.33	20.04	12	70.5	17.5	20	.835

TABLE 3

CORRELATION COEFFICIENTS BETWEEN ROKEACH DOGMATISM SCALE,
FORM E, AND QUANTITATIVE SCORES ON CEEB AND SCAT.

1. Rokeach, Form E, and SCAT Q	$r = -.287$	N 32
2. Rokeach, Form E, and CEEB Q	$r = -.123$	N 40

it seems possible to generalize that the groups are equal in quantitative ability. A further justification for this generalization is presented in Table 4. In this table, the means and differences for 12 S's, who had scores on both the CEEB and the SCAT, are given. There are 6 open and 6 closed minded individuals in this group.

TABLE 4

t-TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS
ON QUANTITATIVE SCORES ON THE SCAT AND CEEB
FOR 12 S's, 6 OPEN AND 6 CLOSED MINDED: AND
CORRELATION COEFFICIENTS FOR THE
TOTAL GROUP BETWEEN THE CEEB AND
THE SCAT QUANTITATIVE SCORES.²

	OPEN MINDED		CLOSED MINDED		
	M	SD	M	SD	<u>t</u> -VALUE
CEEB Q	88.2	12.56	74.3	25.01	1.112
SCAT Q	67.8	17.19	55.5	20.28	1.034
<u>r</u> _{scat,ceeb} = .882					

B. MATERIALS: The kinds of problems used in the problem solving task in this study are described in full in publications by Rimoldi, et. al.

²The large difference between the standard deviations in this small sample does not necessarily indicate that the two populations have different variances. The F score for the difference between variances, 3.96, is not significant. Therefore, the null hypothesis cannot be rejected. Besides, McNemar (1962) suggests that "if we suspect the variances may be unequal, we should make the two sample sizes equal or nearly so" (p. 106). Here the sample sizes are the same.

(1962, 1964). The problems used in the study will be of two types: verbal and geometrical. The verbal problems are divided into two kinds, each of which has two variations. Therefore, there will be a total of four verbal problems: 31A, 31 B, 35 A, 35 B. All four of the problems are of the type that presents a verbal definition of a problem situation together with a series of questions printed on separate cards. Each card contains a question on one side and the question and answer on the reverse side. The questions and answers contain information relevant to the problem situation, some of which is necessary for the solution of the problem. The subject, in pursuing a solution, selects the cards he feels will give him the information needed for a solution and also records the order in which he chose to have the various questions answered. This establishes a sequence for each individual which describes his process, and, also, supplies sufficient information for the experimenter to score the answers.

In identifying the problems, the number refers to a particular type of schema, or framework or set of logical relationships or structures, upon which is superimposed various contents which are identified by letters. (See Appendices II and III for the logical structures of the 31 and 35 problems). The numbers, 31 and 35, refer to two different types of problem structure. The two structures represent a rather simple, #31, and a somewhat more complex, #35, type of problem. The letter "A" presents the problem in concrete, everyday terms. The letter "B" presents the problem in abstract language, or by means of letters that represent, symbolically, non-specified concrete objects. In both of these forms of

the problem, the answers are given in numbers.

Three geometrical problems, 40, 42, and 46, have been included in order to provide a variation of the verbal problems. These problems are of the type that presents a geometrical figure with various enclosed areas one of which is the correct solution of the problem. The procedure for the solution is the same as with the verbal problems. (Appendices IV through X contain all of the problems in detail.)

An additional reason for the selection of these six problems is that it was found, in an unpublished study of the Loyola Psychometric Laboratory, that problems 31 A, 35 A, and 46 contain a perceptual factor, and problems 31 B, 35 B, and 40 contain an abstract factor. These two contents were found to be factorially different.

C. SCORING PROCEDURES: Since the unique contribution of Rimoldi et. al. (1964) centers on the notion of process, the scoring techniques devised are of great importance. A process is experimentally characterized by the sequence of questions asked by the subject, according to Rimoldi and Haley (1962). Thus, the characterization of the process and the scoring techniques must include the number of questions asked, the specific questions asked in terms of the information they provide, and the order in which the questions are asked. Among the scoring procedures devised by Rimoldi et. al. (1964), three will be used in this research: a) group performances, b) pulling out method, and c) information values. Each of these will be discussed in turn.

a) Group Performances

This approach estimates for each problem and for each group of subjects the frequency with which each question was asked in each possible order.

These frequencies correspond to the values observed in two-way entry tables where columns represent questions, and rows, order in the sequence. If the subjects in a group follow exactly the same tactic, then all the cells in the table will present zero entries, with the exception of one cell per row and per column with a frequency equal to the total number of subjects in the group. In fact, the highest possible dependency between questions and order is at the basis of this type of performance; knowing a question, the order of choice is also known, and vice versa, the uncertainty being minimal.

If the subjects in a group perform in such a way that no relationship whatsoever exists between questions and order of choice, then the cell frequencies will be identical throughout the table. No information can be gained in terms of associating a given question with a given order, the uncertainty being maximal.

Seldom, if ever, will all actual performances follow any of the two previously described patterns. In practice, the performance of a group may approach either of the uncertainty levels just defined. This will depend on two major variables that can be experimentally controlled: a) characteristics of the group, b) characteristics of the problems.

Considering the logical structure of the problem, the language used, the number and wording of the questions and of the corresponding answers, etc., it is possible to state for each problem the sequence or sequences of questions that as a result will represent the maximum empirical association between question and order of choice. This set of sequences corresponds to the schemata norms. In this sense, schemata norms represent the lower empirical limit of uncertainty based on a logical analysis of the problems. This shall be considered to be the criterion of minimal uncertainty for a group performance. It is theoretically conceivable that an observed group performance may yield an uncertainty value smaller than that indicated by the schemata, but in such cases, this may be due to guessing, incomplete performance, poorly constructed problems, etc.

The definition of a criterion for maximum uncertainty is more complex. Several hypotheses can be defended of which only one, designated H, will be discussed.

In this hypothesis, the assumption of no association between questions and order is maintained, but the following conditions are added: a) that subjects may choose sequences of varying lengths, b) that these sequences of different lengths have the same chances of appearing. For a discussion of the derivation of the values for this hypothesis, confer Rimoldi, et. al. (1964).

Any observed performance can be then located along a continuum varying from minimum uncertainty, as defined by the schemata, to maximum uncertainty as defined by H. For each problem, these limits can be assigned without any references to group performance. They will be considered to be inherent properties of the problems and thus help to define the instruments employed in the experiment. This attempt at characterizing instruments without resort to group indexes is a feature which deserves special emphasis.

The uncertainty value $H(x,y)^*$ was computed for H and for the schemata in each problem. Further, this value was also calculated for the observed group performances in all the problems. These uncertainty values should not be interpreted strictly in terms of information theory. As stated before, they serve to characterize the patterns present in the tables. The discussion will be limited to define trends in these patterns. (Rimoldi, et al., 1964, pp. 104-107.)

* $H(xy) = \log_2 n - \frac{1}{n} \sum n_i \cdot \log_2 n_i$, where n equals total number of entries in the table and n_i frequencies in each cell.

b. Pulling Out Method

The decision to use the pulling out method for scoring subjects' performances was based on previous experimentation and on the results obtained by Erdmann, 1964, where this approach was shown to be consistently better than other methods of scoring performance in the type of problems used in this research.

In essence, the pulling out method is used as follows: After determining by a logical analysis of the structure of the problem, the best tactic or tactics by means of which a problem can be solved, these are tabulated considering each question in each order in which it occurs in the various tactics, Rimoldi, Haley, Fogliatto and Erdmann, (1963). This table of frequencies is converted into a table of proportions. Each question will have a weight according to the frequency with which it occurs in a particular order. The next step is the application of this table of weights to an observed sequence. A previous method had merely summed the weights corresponding to the questions and the order of these questions in the observed sequence. This was called the schema method. The pulling

out method uses the same norms as the schema method and differs from it only in the application of the norms to the individual observed sequence. This method attempts to account for any restructuring or "late" understanding of the nature of the problem by the performer. In other words the benefit of the doubt is given to the subject in the evaluation of his performance.

The procedure involves a kind of matching of the observed sequence with one of the ideal sequences. That is, the scorer determines the ideal sequence which best approximates the observed sequence and will therefore maximize the evaluation of the performer. Obviously, there are certain rules according to which this is done.

The first step is to remove all the irrelevant (as far as the ideal sequence is concerned) questions from the observed sequence. It is important to maintain the order of the questions as selected by the subject.

What results may be a complete or partial ideal sequence. In order to be complete, the order of the relevant observed questions must duplicate the ideal sequence. If this occurs, then one finds the value of the ideal sequence which would maximize the score for the observed sequence. This completes the second step in the determination of a final score for the pulling out method. The third and final step is to divide the value, found at the completion of the second step, by the number of questions of the original observed sequence, i.e., before any pulling out of irrelevant questions.

The sequence resulting from the pulling out of irrelevant questions, however, may only partially duplicate an ideal sequence. In this case credit is given for the partial sequence. This value is again divided by the number of questions of the original observed sequence to determine the final score.

An example of the technique is in order to clarify the application. Suppose the observed sequence 1,6,3,8,2,10. Assume that the ideal sequences of the problem are 6,3,10 and 10,3,6. Pulling out the irrelevant questions leaves 6,3,10 for the observed sequence. This exactly duplicates the ideal sequence 6,3,10 so the final score is the value of the 6,3,10 sequence in the schema norms divided by 6 (the number of questions from the original observed sequence). Had the original sequence been 1,10,8,3,2,6 then the ideal sequence 10,3,6 would have been duplicated with results exactly as above.

In some instances, the ideal sequence will not be duplicated. Assuming the observed sequence 1,6,7,8,2,3,5, the ideal sequence approximating it best is 6,3,10. However, there is only partial approximation here, namely 6,3. The final score is, therefore, the

value of 6,3 in the schema norms, divided by 7 (in this case). The remnants of the observed sequence following the pulling out of irrelevant questions must follow the order of one of the ideal sequences so that an observed sequence without 3 and 6 in it would obtain no value at all. If either occurred at the end of the sequence only that question would contribute any value. For instance, the observed sequence 1,3,8,4, would have zero as a final score. The sequence 1,3,6,5,7, would have the value of 6 in the first position in the schema norms divided by 5.

This technique, in summary, works to the advantage of the subject by giving him the benefit of the doubt as far as the occurrence of restructuring or reshaping the problem is concerned. It also incorporates the advantages of the schema method and adds the feature of differentially penalizing the subject for the prodigal selection of cards! (Erdmann, 1964, Loyola Psychometric Lab, Pub. No. 40.) (Rimoldi et al., 1964, pp. 114-116).

c) Information Values

In this part of the study, we shall present a method of scoring individual performances in terms of the processes followed by a subject in solving a problem. This method is independent of group performances and attempts to analyze at each step in the process the amount of uncertainty reduction with respect to the total uncertainty of the problem. This was accomplished for those problems in which figures are presented.

We are assuming that at the outset of the problem, all the alternatives are equally likely. On this basis the total uncertainty value for each problem can be calculated according to the total number of these equally likely alternatives. Then in order to solve the problem in a logical fashion or at least in a fashion eliminating guessing or hunches it becomes necessary for a subject to reduce the uncertainty of a problem to zero. This he can do by asking questions and obtaining the corresponding answers. Each of these questions and answers will reduce the total uncertainty according to the information contained in them and the order in which they were asked. It thus becomes a matter of determining for each question and answer that part of the total uncertainty of the problem that is eliminated according to the order in which it was asked. The next step is to consider an individual sequence of questions and to establish the amount of uncertainty reduction accomplished by each in the particular order it was asked. These values can be accumulated for individual questions of an observed sequence in the order in which they were asked so that at any point in the process, the amount of uncertainty reduced can be indicated. Obviously, certain

questions asked in a definite order can maximize this process of uncertainty reduction, and this can be seen more clearly by plotting the cumulative values for successive questions. Tactics following the "best" sequence(s) as determined by the schema should be those that maximize the reduction of uncertainty with each successive question.

According to the nature of the problems, the solution to be obtained will be achieved through a process of either rejecting or retaining certain alternatives. This binary characteristic of the process suggests the use of a system of evaluation which embodies these properties, such as the transformations implied in "information theory". (Rimoldi et al., 1964, pp. 134-135.) For an illustration of this method, confer Rimoldi et al., (1964).

D. DESIGN OF EXPERIMENT: All of the S's were given the Rokeach Dogmatism Scale, Form E, as part of a battery of tests, including the Rigidity Scale and the California F Scale, given during a class period in General Psychology. On the basis of the scores on the Dogmatism Scale the two groups were selected and found to be equated in quantitative ability.

The problems were administered in two sessions to groups of S's ranging from 7 to 10. Two sessions were used because there is no time limit imposed for the solution of a problem and because one session, lasting approximately 50 minutes, was insufficient for the solution of all the problems. The S's were selected randomly, according to their individual free periods, to be included in any particular group. Thus, there were both open and closed minded individuals in every group.

The problems were administered to each group in the following order: 1st session, problems 31 A, 31 B, 40, and 42; 2nd session, problems 35 A, 35 B, and 46. There were two reasons for administering all of the problems in the same order. The first was based on the rationale that

learning would be constant for all over the trials. The second reason was based on the authority of past research in which the problems were presented in the same order to each subject (Rimoldi et al., 1964).

The following instructions were given to the S's for the problem solving sessions. Each subject was given a mimeographed copy of the instructions. The sections in parentheses were added verbally and demonstrated by the experimenter as he read over the instructions with the S's.

You will be given a packet of cards on which are typed a particular problem situation and a set of questions and answers relevant to the problem. (The question is on one side of the card and the question with its answer is on the other side.)

READ OVER THE PROBLEM SITUATION CAREFULLY, noting especially the specific problem to be solved.

NEXT, READ OVER ALL THE QUESTIONS, which are typed on one side of the cards. At this time, do not turn the cards over.

Decide the first question you would like to have answered. Then, WRITE THE NUMBER OF THE QUESTION ON THE SHEET PROVIDED. If it is the first question you ask, its number goes next to no. 1, etc.

TURN THE CARD OVER AND READ THE ANSWER ON THE CARD.

After having read the answer, decide on the next question you would like to have answered. Write its number on the page provided, then turn it over to read the answer. (So, decide the first question you want to ask, then write its number after number 1 on the sheet provided. With the information you have when you find the answer on the reverse side of the card decide which question you want to ask second. Proceed in this way.)

When you are satisfied that you have arrived at the answer, stop asking questions, and write down your answer. Do not ask more questions than you think you need to solve the problem, but do not hesitate to ask those questions that appear to be necessary. A previously selected question may be referred to as often as one wishes in the process of solving the problem. (There is no time limit for the solution of any of the problems. When you are finished, I will give you the packet of cards for the next problem. When you finish all the problems you may go.)

CHAPTER III

RESULTS

A. GROUP PERFORMANCE METHOD

Uncertainty values, according to the discussion presented above, were computed for each group on each of the problems. These values were determined, according to a method described by Attneave (1959), from the frequencies in a scatter diagram which has, as the abscissa, the numbers of all the questions which may be asked, and, as the ordinate, the order in which the questions were actually asked. (Confer Appendices XI through XVII for these diagrams.) Table 5 presents the uncertainty values for each group for each problem along with the minimum uncertainty value for each problem, as determined by schema or "X" norms, and with the maximum uncertainty value, as determined by the H norms. The minimum uncertainty value can be determined by either schema or "X" norms. The uncertainty values listed in column "X" depend exclusively on the minimum number of questions needed to solve the problem, whereas the schema norms depend on the total set of sequences which represent the maximum empirical association between the questions and order of choice. Thus, when there is more than one sequence which will solve the problem, as in the verbal problems in this study, the schema and the "X" norms will differ. These

TABLE 5

UNCERTAINTY VALUES, $H_{(x,y)}$, FOR THE OPEN AND CLOSED MINDED GROUPS TOGETHER WITH THE SCHEMA, X, AND H NORMS

PROBLEMS	OPEN	CLOSED	SCHEMA	X	H	SCHEMA/X
31 A	3.35144	3.80079	2.252	1.585	6.426	1.421
31 B	4.04206	4.97603	2.252	1.585	6.426	1.421
35 A	4.18995	4.80435	3.922	2.322	7.934	1.689
35 B	3.98415	5.38893	3.933	2.322	7.934	1.689
40	4.43870	4.94901	1.000	1.000	6.426	1.000
42	4.94901	5.70350	2.000	2.000	6.426	1.000
46	5.33463	5.34909	2.000	2.000	6.426	1.000

norms will be the same, on the other hand, when there is one and only one sequence. The ratio between the schema and "X" values will be 1.00 when these two are identical. The higher the value of the ratio, the greater is the uncertainty of the schema in relation to the uncertainty of one of the ideal sequences.

It can be seen by inspecting the scatter diagrams that the open minded group, as a whole, used more efficient tactics than the closed minded group. The only case in which this is not so clear is in problem 46. However, it has been found, here and in other research, that this problem is ambiguous. Therefore, the results from this problem should always be considered in this context.

The uncertainty values, $H(x,y)$, also, show that the open minded group has, in each case, lower values than the closed minded group. This is especially true in problem 35 B in which the uncertainty value for the open minded group is almost equal to the minimum uncertainty value of the problem schema itself.

Because of the method used to derive the uncertainty values, it was impossible to compare the differences by ordinary tests for significance. It was possible, however, to compare the groups on the basis of the number of problems for which the open minded group presented high^{er} uncertainty values than the closed minded group. The test used was a one-tailed Sign Test, as described by Siegel (1956). The probability of the open minded group having a lower value on each problem than the closed minded group is .008. Such a probability is indicative of the significance of the difference between the groups using this measure of uncertainty values.

B. PULLING OUT METHOD

The pulling out method attempts to score individuals according to their structuring of the solution in terms of the structure built into the problem. Thus, the score represents the S's recognition and use of the structure present in the problem. Each subject was scored on each problem in terms of the pulling out method. Then, the average pulling out scores were computed for each group and for each problem. Table 6 presents these average scores and the t-values for determining the significance of the difference between means. In analyzing this data t-tests for uncorrelated means were used. The values for significance were determined according to

TABLE 6

t-VALUES FOR THE DIFFERENCES BETWEEN THE TWO
GROUPS BASED ON THE PULLING OUT METHOD

	OPEN MINDED		CLOSED MINDED		
	MEAN	SD	MEAN	SD	<u>t</u> -value
31 A	.05695	.0147	.04803	.0184	2.035*
31 B	.04836	.0178	.04022	.0166	1.56
35 A	.02252	.0026	.02005	.0061	2.035*
35 B	.02152	.0035	.01824	.0056	3.508**
40	.06717	.0363	.05291	.0334	1.558
42	.05857	.0351	.03930	.0323	2.176*
46	.03794	.0182	.03465	.0200	.655

* .025 > p > .01

** p < .005

the norms for one-tailed tests because of the definite prediction in a specific direction made in the hypotheses.

Using the pulling out method, a higher score indicates that the S structured his solution according to the demands of the structure of the problem. By inspection it can be seen that the open minded group, as a whole, has higher scores than the closed minded group. In all cases except one the differences are significant. This exception, again, is problem 46 which was discussed above. The group differences for problems 31 B and 40

are not quite at the .05 level of confidence, yet they do show the same directional tendency as the other problems which are significant. Using a table of areas of the normal curve, the significance of these two differences would seem to be .06. Thus, in all of the problems which have been shown to be discriminatory, the differences between the average scores of the two groups are significant.

C. INFORMATION VALUES

In using information values, an S is scored according to the average amount of information he acquires in his pursuit of the solution of the problem. Each question asked results in information, some of which may be relevant and some of which may be irrelevant. If the information is relevant, some of it may be new or some of it may be repeated from previous questions. The information value is the average resulting from the division of the numerical calculation of the total, new, relevant information, by the number of questions asked. The numerical calculation is derived from a method described by Attneave (1959).

With the use of these scores, the information value of the questions is maximized and the structural properties of the problem are minimized. Thus, a high score can be reached if the necessary questions are asked no matter in what order they are asked. When the pulling out method is used, on the other hand, the order is of prime importance.

Information values of the three geometrical problems were evaluated for each subject and then the group averages were computed. Only the

TABLE 7

t-VALUES FOR THE DIFFERENCES BETWEEN THE TWO
GROUPS BASED ON INFORMATION VALUES

	OPEN MINDED		CLOSED MINDED		
	MEAN	SD	MEAN	SD	<u>t</u> -VALUE
40	1.16062	.394	.99818	.388	1.582
42	.89921	.221	.69152	.278	3.145*
46	.72062	.282	.61008	.234	1.626

* $p < .005$

geometrical problems were used because there is only one correct sequence of questions leading to the solution of the problem. Table 7 presents the group averages and the t-values of significance between these averages.

Again, it can be seen by inspection that, in every case, the means of the open minded group are higher than those of the closed minded group. For problem 42, the difference between the means for the two groups is significant below the .005 level of confidence. For problems 40 and 46 the differences almost reach the .05 level. Such differences indicate that the open minded group used the information of the problem to a more significant degree than the closed minded group.

D. SCORING IN TERMS OF PROCESS RATHER THAN CORRECT ANSWERS

One of the ideas that was partially responsible for the kind of research Rimoldi devised was the contention that correct answers are not

the best indicators of individual differences. Correct answers do not indicate the process of coming to the solution, which could be due to logical reasoning, chance, elimination, or guessing. Also, incorrect answers are not equally incorrect, e.g., an incorrect answer in a mathematical problem may be due to a computation error or it may be due to a complete lack of understanding of the nature of the problem. Because of these considerations, Rimoldi devised the scoring procedures used in this research to evaluate the process of solution rather than the solution itself. His own research (Rimoldi, et al., 1964) has shown the reliability

TABLE 8

χ^2 TEST ON THE NUMBER OF CORRECT AND INCORRECT ANSWERS
BETWEEN THE OPEN AND CLOSED MINDED GROUPS

PROBLEM	DF	χ^2	SIGNIFICANCE
31 A	1	8.437	.01 > p > .001
31 B	1	2.33	None
35 A	1	.12	None
35 B	1	.085	None
40	1	.000	None
42	1	4.176	.05 > p > .025
46	1	.60	None

and validity of these scoring procedures. However, it is of value to see whether the same applies in the present research. Table 8 presents the significance of differences between the groups in terms of correct and incorrect answers only. The χ^2 test for independent samples, described by Siegel (1956), was used with significance values for two-tailed tests since the hypothesis was that there would be no difference between the groups in terms of correct and incorrect answers.

It can be seen by inspection of Table 8 that only two of the differences are significant. (See Appendix XVIII for the χ^2 diagrams.) Both of these problems, 31 A and 42, were administered in the first testing session. The difference in correct and incorrect answers for the groups in problem 31 A is significant between the .01 and .001 level of confidence; for problem 42 the significance is between the .05 and .025 level of confidence.

The results of this study, also, confirm the usefulness and validity of Rimoldi's scoring techniques. Group comparisons in terms of correct answers are not sensitive to differences in process.

E. DIFFERENCES IN CONCRETE AND ABSTRACT CONTENT

One of the advantages of the development of problems which have a set structure or schema is that different languages or materials can be superimposed upon this structure. Thus, the same logical problem may be given to different groups having different age levels, e.g., the problem can be given to young children using different colored and shaped

blocks or to adults using languages of different degrees of abstractness. In the present study, two problems having different levels of complexity in structure were given in concrete and in abstract language. The "A" problems were presented in a concrete, everyday language, and the "B" problems in an abstract language. Table 9 presents the t-values and their probabilities for the open and closed minded groups for differences in content. The pulling out method was used to derive the scores used in this t-test.

TABLE 9

t-VALUES FOR GROUP DIFFERENCES IN CONTENT
BASED ON THE PULLING OUT METHOD

PROBLEMS	OPEN MINDED	CLOSED MINDED
31 A vs. 31 B	1.644	2.23*
35 A vs. 35 B	1.37	2.63**

* .025 > p > .01
 ** .01 > p > .005

Since the same groups were used for comparison in this analysis, t-values for correlated means were used. In establishing the significance of the differences, a one-tailed test was used for the closed minded group because of the specific hypothesis that this group would perform significantly better on concrete material. A two-tailed test, implying no difference, was used for the open minded group. It can be seen that

the differences in performance for the closed minded group on concrete and abstract content are significant. Those of the open minded group are not.

F. DIFFERENCES IN COMPLEXITY OF LOGICAL STRUCTURES

The final results to be reported concern differences in performance using different logical structures. Appendices II and III present graphic representations of these different structures, and Appendices IV through VII show these structures disguised in concrete and abstract language. These different logical structures provide an added opportunity for the study of the effect of structures on the individual, and, also, the differences in individual structuring in terms of different structures. Table 10 presents the results of these differences for the open and closed minded groups. Scores derived from the pulling out method were used in this comparison of the groups.

TABLE 10

t-VALUES FOR GROUP DIFFERENCES ON PROBLEMS DIFFERING
IN STRUCTURE WITH CONSTANT CONTENT BASED
ON THE PULLING OUT METHOD

PROBLEMS	OPEN MINDED	CLOSED MINDED
31 A vs. 35 A	4.946*	(8.490)*
31 B vs. 35 B	6.813*	7.14*
* $p < .001$		

Again, t-values were computed for the groups using correlated means. The large values obtained, all significant beyond the .001 level of confidence, makes a discussion of one- or two-tailed tests irrelevant. Each group performed significantly better on the more complex schema with both concrete and abstract content. Since these problems were presented in the second testing session, it would seem that the S's had grasped the nature of these problems and used the logical structure better than in the first testing session.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The results of the present study seem to present definite evidence that personality variables, designated open and closed mindedness, are directly related to good and poor problem solving. The findings in this study substantiated all of the hypotheses in the predicted direction.

Using the pulling out method, it was found that the open minded group performed significantly better on every problem except one. This last was a function of the ambiguity of the problem. The pulling out method emphasizes the subject's recognition and use of the structure of the problem in his own structuring and restructuring of the solution to the problem. Thus, it can be concluded that the open minded individuals were significantly better at recognizing and using the structure of the problem in their own structuring, or formulation, of the solution to the problem than were the closed minded individuals.

The efficiency and validity of this particular scoring procedure was not in question in this study. However, an analysis was made in terms of correct and incorrect answers. It was found that such a criterion distinguished the two groups in only two instances, problems 31 A and 42. Both of these problems were presented in the first testing session which might indicate that the open minded group were quicker at grasping the nature of the problems than the closed minded group. In the other

five problems, there is no difference in terms of correct and incorrect answers. Therefore, the sensitivity of the pulling out method would seem to be evident for it clearly distinguishes these groups where correct and incorrect answers show no difference.

Using the group performance method, the hypothesis that the open minded group would perform significantly better was also substantiated. Inspection showed each uncertainty value of the open minded group to be lower than that of the closed minded group. Such an occurrence has a probability of .008 when a one-tailed Sign Test is used.

The group performance method considers the performance of the total group in terms of both uncertainty and structure. The best performance, in an evaluation of process, would present a scatter diagram in which the minimum number of questions were asked in the proper order. For example, in problem 31 A the proper sequences of questions are 6,3,10 or 6,5,9. Thus, there would be maximum certainty and recognition of structure if all the frequencies for the first question, which is marked along the ordinate, are in the 6th cell, if the frequencies for the second question are in the 3rd or 5th cell, and if the frequencies for the third question are in the 10th or 9th cell. There should be no other cells filled and there should be as many frequencies in the 3rd as in the 10th and as many in the 5th as in the 9th. Appendices XI through XVII present the diagrams obtained. This method of uncertainty values for group performance, therefore, estimates the uncertainty of the group in terms of the structure of the problem. Thus, it can be concluded that the open minded group not

only recognized and used structure to a more significant degree than the closed minded group, but also reduced uncertainty to a greater degree.

The method using information values, also, supported the hypothesis that the open minded group would reduce uncertainty to a significantly greater degree than the closed minded group. In this method each individual was scored in terms of the reduction of uncertainty and then group averages were calculated.

This method considers the performance of individuals in terms of uncertainty alone without any reference to the structure involved. For example, the ideal sequence for problem 42 is questions 3, 1, 5, 8. In the pulling out method only an individual who would ask the questions in this particular order would receive the maximum value. In the present method any individual who asked these four questions in any order would receive the maximum score. However, if information curves were plotted both the informational and structural characteristics of the individual processes would be evident.

The results of the present study show, therefore, that the open minded group performs significantly better, when process is evaluated, both in terms of recognizing and using the structure of the problem and in terms of reducing uncertainty. It should also be noted that the differences involving uncertainty are greater than those involving structure alone. The t values of the differences between the groups are 1.558, 2.176, and .655 for problems 40, 42, and 46 respectively, based on the pulling out method. Using the method for information values, the t values

1.582, 3.145, and 1.626 respectively. In problem 40, the values are practically the same which would seem to indicate that the acquiring of structure and the gathering of information was about the same. In problems 42 and 46, the t values are higher for the information value method and the significance of the differences are increased over those found with the pulling out method.

When the groups were compared in terms of the logical structures of the problems and of the materials, concrete and abstract, used, differences were also found. The only hypothesis regarding these two aspects of the problems was, also, substantiated. This hypothesis was that the closed minded individuals would perform significantly better on concrete than on abstract material and that there would be no difference in the open minded group's use of these materials. There is, therefore, an added dimension to consider in comparing open and closed minded individuals. Open minded individuals show themselves as more efficient at the recognition and use of structure, as able to reduce uncertainty to a greater degree, and as not hindered in these activities by the kind of material in which the problem is phrased. The closed minded individuals, on the other hand, show themselves as less efficient in the recognition and use of structure, as less able to reduce uncertainty, and as hindered by the kind of material used in the problems.

A final result of this study reveals that both groups performed better, to quite significant degrees, on complex structures than on simple structures. This result should be interpreted, it would seem, not in terms

of complexity-simplicity, but in terms of learning. Both of the problems with a more complex structure were administered in the second testing session. It would seem, therefore, that both groups learned something about the nature of the problems, i.e., that the problems involved a set structure and that a structural approach should be used. Such an interpretation could be substantiated by Rimoldi's (Rimoldi, et al., 1964) findings that subjects who had training performed better than those who had no training. "The individual performance curves show that the process followed by the experimental subjects in order to solve a problem is 'better' than the one followed by the control subjects. This means that the experimental subjects always approach the problems in a more 'logical' way. The greatest differences were found in the problems similar to those used in the training session" (p. 94).

In the results presented, there appears to be a relationship between uncertainty reduction and structure. Before attempting to specify and interpret this relationship in light of the results obtained, it is necessary to clarify the concepts involved.

Uncertainty reduction is a correlative notion implying information. W. R. Garner (1962) indicates this relationship. "Any communicative act provides information only insofar as it reduces a condition of ignorance or uncertainty about the state of things under consideration. . . thus information occurs only if there exists some a priori uncertainty, and the amount of information is determined by the amount of uncertainty--or, more exactly, it is determined by the amount by which the uncertainty has

been reduced" (p. 3). Therefore, the amount of uncertainty which is reduced is indicative of the amount of information gained.

In the present study the scoring procedures were designed to evaluate individual differences in problem solving processes. The scores obtained, therefore, in terms of structure or of information are estimates of the subject's use of the structure of the problem or of his use of the information presented. However, the problems were so designed that they would have an objective information, or uncertainty, and structural value. It is possible, therefore, to understand the problems and the subjects' performance in terms of these objective criteria.

The problems, as presented, consist of a problem situation and a series of questions and answers. The problem situation presents an objective, logical structure, or schema, which is distinct from the different languages in which the problem situation is phrased. Appendices II and III present figures of these structures. The answers to the questions in the problem are designed to provide 'bits' of information, or data, when a particular question is selected. Some of the data is relevant to the problem and some is not. Among the relevant data, some is unique, i.e., it is provided in only one question and answer, and other data is not unique, i.e., it is provided in more than one question and answer. Thus, the total information value of a problem includes both the information about the structure presented in the problem situation and the potential information, or data, to be received on the asking of a question.

This distinction is also made by Garner (1962) in his treatment

of uncertainty and structure. "Structure is an entire set of relations between variables and its amount and form can be specified without statement of the particular significations which operate because of the structure" (p. 343). By signification, he intends "the particular specifying or indicating relation for any single event or symbol. . . Signification is any or all of the relations which are unique to a particular word" (p. 141). Signification in this sense would be similar to the notion of specific data or information about a single part of a total structure. Thus, Garner not only distinguishes structure and information, or data, but he also says that "structure can be perceived even without the ability to verbalize the significations" (p. 343).

Garner (p. 342) proceeds to show the similarity of this distinction to the more general psychological theory of Gestalt. Gestalt theory distinguishes an experience into its 'whole' and 'part' aspects. Though the 'whole' and the 'part' are inseparable in any experience, they are distinct elements of an experience. The structure discussed here is similar to the 'whole' aspect of an experience, whereas the particular data or information is similar to the 'part' aspect. In a particular situation, an awareness of the 'whole' aspect may be of help in selecting the parts to fill it out. Likewise, by joining different 'parts' together it is possible to grasp a new 'whole'.

It is possible, therefore, in this study, to distinguish structure and information, or data, in a problem and to assign different functions to each. The structure provides the framework within which the solution

to the problem is sought and directs the problem solver in the selection of questions which will provide the necessary data for the solution. The data provide the specifications of the structure or the 'bits' which, when related by the structural properties of the problem, produce the unique answer to the particular problem.

In solving a problem both structure and data are important. Though they are inseparable, they are distinct and work together toward the solution to the problem. Ideally, the recognition of the structure of the problem leads to the selection of questions in the proper sequence which will provide maximum information, or data, for the solution. However, if the structure is not immediately or totally clear, the selection of questions which have a certain information value will provide the opportunity to find or to clarify the structural relationships of the problem. In such cases there is a structuring or restructuring according to the added information received.

These distinctions between the structure and data of a problem, and between the objective structure and data of the problem and the subjects' use of these seem to be valuable in interpreting the results of the present study. These results, which deal with the subjects' use of information and structure, indicate definite group differences. However, there are indications that the subjects in both groups received the structure and information equally well even though they did not make equally good use of these.

The results found in Table 10 suggest that both groups learned

the structural nature of the problems and used this structure to great advantage in the second testing session, even though the group differences remained. Rimoldi (Rimoldi, et al., 1964), too, has found that training improved performance, and especially in those problems that had a similar structure. Such findings are quite consistent with a conclusion of Garner (1962) in which he states: "the existence of structure itself can, and must, affect the rate of learning, and, insofar as it does, we must then consider structure as a meaningful variable in its own right--not simply the sum of its significations" (p. 343). The experimental results, therefore, suggest that the groups did receive the structure of the various kinds of problems.

Because of the inseparability of structure and information, it would seem that the groups received the necessary information for the solution to the problem also. This inseparability is indicated by the fact that the same 'bits' of data are used for scoring the individual's performance. The different scores are derived from the different ways of scoring the same data. Also, the fact that the groups did not differ in the number of correct and incorrect answers would suggest that the groups received both structure and information equally well, even though they did not use the information equally well in the process of solving the problems.

These results of the study suggest a further hypothesis which would be important in the total interpretation of the results. This hypothesis is that both open and closed minded groups received information

and recognized structure equally well even though the use of this structure and information is quite different for the two groups as is indicated by the previous results of the study.

The reception of information and recognition of structure can, it seems, be measured by the selection of the necessary questions involved in the ideal sequences of the problems, regardless of the order in which they are selected. When these questions are selected the individual has maximum information. It is presumed, for three reasons, that he also recognizes the structure. First, the results recorded in Table 10 and discussed above suggest this presumption. Second, the relationship of inseparability between information and structure that was discussed above makes this presumption reasonable. Third, even though an individual may not select the questions in the proper sequence which represents the structure, his selection of the necessary questions indicates restructuring or late structuring. The recognition of this late structuring by Rimoldi (Rimoldi, et al., 1964) prompted the change from schemata norms for scoring a performance to the use of the pulling out method. This method is precisely described as an attempt "to account for any restructuring or late understanding of the nature of the problem by the performer" (p. 115).

The method used to evaluate the information and structure, in terms of all the necessary questions or maximum information, received by the groups is the χ^2 method for independent groups. This method was used because it preserves the contributions of the individuals in the group to the total group performance better than a method using averages does.

Taking problems 31 A and 31 B together, 55 of the open minded group and 50 of the closed minded group received maximum information, i.e., they selected the necessary questions for solution of the problem. The difference between these groups has a χ^2 of 1.219 which is not significant. Taking problems 40 and 42 together, 54 individuals of the open minded group and 46 of the closed minded group received maximum information. This difference is 2.94 which is also not significant. A level of .05 was used for significance. (See Appendix XIX for the χ^2 tables.)

Therefore, these results, added to those of the whole study, would seem to indicate that open and closed minded individuals receive both structure and information equally well, but their use of these materials in reaching a solution are markedly different. This difference centers on the use each individual makes of the information he has received.

The fact that differences between the groups in uncertainty reduction measures were found to have a higher degree of significance than those using structural measures suggests that the uncertainty of the subject is important in understanding the results of the study. In the light of the results above, this uncertainty would not seem to be related to the problem structure or information, but more to a generalized, personal uncertainty.¹

¹Without having strict experimental controls or measures, it was observed that more closed minded individuals approached the experimenter after a testing session than open minded. The typical comment or question of the open minded concerned the problems and how they were formed. The typical question of the closed minded concerned himself and was frequently phrased, "How did I do?". This would seem to indicate a problem centered approach in the open minded and a self centered approach in the closed minded.

To pursue this notion of subjective, or personal, uncertainty further, the following comparison was suggested in reviewing the results. One of the closed minded subjects, in the four problems dealt with in the previous analysis, always asked the necessary questions first and in the correct order, i.e., he had ideal structure and maximum information, then he would ask an equal number of irrelevant questions. Thus, the question arose whether there were group differences in the asking of extra questions once the maximum information had been received.

Again the χ^2 method for independent groups was used for measurement. Taking problems 31 A and 31 B together, of the 55 instances in which open minded individuals received maximum information in only 2 cases were extra questions asked. In the closed minded group, in 14 out of 50 instances where maximum information was received were extra questions asked. The measurement of this difference by χ^2 is 10.224 which is significant below the .01 level of confidence. In problems 40 and 42, in 7 of 34 instances were extra questions asked by the open minded group and in 14 of 46 instances were extra questions asked by the closed minded group. This difference is 3.58, which is almost significant at the .05 level of confidence. (See Appendix XX for the χ^2 tables of this data.)

In conclusion, the experimental results of the present study indicate that there are significant differences between open and closed minded individuals in their problem solving processes when structural and/or information measures are used. However, there would seem to be no difference between the groups in the reception of the information or struc-

ture of the problem. The relevant variable is the subject's own use of the information and structure received. That which seems to be involved with this poor use of the information and structure is personal uncertainty rather than lack of information and structure.

Such a conclusion is consistent with the theoretical analysis in the Introduction to this study on the relationship of structuring and personality variables, especially open and closed mindedness. The hypotheses for this study were derived from this analysis and the results of the experimental study seem to substantiate the hypotheses and to verify, to some degree, the feasibility of the theoretical analysis.

In the theoretical analysis structuring was seen as a dynamic, personal, cognitive activity in which the individual structures, i.e., forms relationships or integrates, the wholes and parts of reality-as-it-is-known, or received, into a personally meaningful structure. These wholes and parts are similar to the structure and the data, or information, discussed above. Thus, four different, but related, notions of structure were concerned: 1) the structure of reality-as-it-is independently of the individual and against which the individual's personal structure must be tested by meaningful interaction, 2) the structure of reality-as-it-is-known or received in the perceptual act, 3) the dynamic structuring activity of the knower, and 4) the personal structure of the knower, similar to the Weltanschauung, which results from the knower's structuring of the parts and wholes of the structure of reality-as-it-is-known. The experimental results of this study indicate the usefulness of these distinctions, es-

pecially the last three, in understanding and explaining individual differences in cognitive activity.

In the theoretical analysis of open and closed mindedness as general personality variables, it was suggested that these concepts were derived from and characterizations of the individual's approach to reality. Reality-as-it-is-known places the demand on the individual to analyze its parts and wholes for what they are so that he may use these as framework and content in his own structuring, which is an inherent demand of the knower, of his own personal structure. The open minded individual is one who meets and accepts these demands of reality-as-it-is-known. The closed minded individual does not. Instead of deriving structure from the structure of reality-as-it-is-known, the closed minded individual attempts to impose structure or to force the evidence of reality-as-known into a structure of his own making. This difference in approach was attributed to an affect variable, i.e., a value orientation similar to Dilthey's Wertrichtungen, rather than a cognitive one. The affect suggested resulted from the judgment of whether different kinds of reality are amicable, therefore approachable, or hostile, therefore to be avoided.

The experimental results of this study show the usefulness of this analysis. The differences in cognitive approaches of the two groups, predicted in the hypotheses, were substantiated. The results also seem to provide for a clarification of the affective element. They indicated that personal uncertainty was important in understanding the different uses made by the two groups of the information and structure received.

This personal uncertainty did not seem to concern the structure and information of the problem since these seemed to be received equally well by both groups. Therefore, it is suggested that the personal uncertainty was about the affect, i.e., about the amicability or hostility, of different kinds of reality. It would seem, furthermore, that uncertainty and hostility are related.

Uncertainty and hostility are both related to fear. Fear occurs, it seems, in three situations: 1) when something unknown is present and the imagination, working on the individual's uncertainty of the object, supplies a fearful or threatening object, 2) when something is present which the individual knows but he is uncertain whether he can cope with the object, and 3) when something is present which the individual knows and he knows he cannot cope with the object. In these situations the object, whether real or imaginary, is hostile. In the first two situations, in which the fear is unreasonable if not resolved, there is uncertainty--either uncertainty of the object-as-it-is or uncertainty of the individual's own capabilities for handling the object.

Therefore, the experimental evidence concerning personal uncertainty would seem to give credence to the theoretical explanation that the affective judgment of the amicability or hostility of the kinds of reality is important in distinguishing the two types: open and closed minded. The results, also, support the author's criticism of Rokeach's explanation that a set of absolute beliefs about authority is the distinguishing mark.

If concrete material is considered to be specific and particular,

therefore certain, and abstract material is considered to be more general and more unspecified, therefore more uncertain, the results found in using different materials would substantiate the explanation above. It was found that closed minded individuals performed significantly better with concrete materials than with abstract, whereas there was no difference for the open minded.

The results of this study also find meaning in the context of the explanations which influenced the author's theoretical analysis. In Dilthey's terminology, the Weltbild, or informational structure, is present to the individual, but because of the Verrichtungen, in this case subjective or personal uncertainty, the Weltanschauung, the process and/or outcome of solution, is distorted and changed, thus providing for the differences observed. So, too, is the phenomenological observation supported that the structure of the world is presented to the individual in the "perceptual act", and only by a rigorous method, which attempts to overcome or account for subjective nuances, will the individual be able to discover the structure as it is.

The results of this study of the cognitive processes of open and closed minded individuals would seem to suggest that the concepts of openness and closedness are valuable in designating general personality types. It would seem that these should be considered as general and underlying characteristics of personality upon which is superimposed particular behavioral activities, e.g., cognitive, through which the person expresses and reveals his personality structure or orientation. Klein (1934) and

Rokeach (1960) suggest this same relationship between personality and behavioral expression.

In conclusion, it seems that this study has accomplished, in some degree, its purpose to present "a hypothesis which stated explicitly that, according to such and such a theory of personality, we would expect people of such and such a type to handle stimuli of such and such a kind in such and such a manner" (Bruner, 1951, p. 138). In pursuing this purpose, it appears that the problems and methods employed concentrated "upon the investigation of those environmental cues which are appropriate to the confirmation of hypotheses which reflect basic personality patterns" Bruner, 1951, p. 140).

CHAPTER V

SUMMARY

This study investigated differences in problem solving processes of open and closed minded individuals. The specific hypotheses were derived from a theoretical analysis of the structuring aspect of cognitive activity and its relationship to the characteristics of open and closed minded individuals. The theoretical analysis was derived from various psychological sources: F. W. Allport, Garner, Piaget, Kelly, Merleau-Ponty, Dilthey, and Rokeach.

60 Freshmen in college were divided into two groups of 30 each and designated open or closed minded by means of Rokeach's Dogmatism Scale, Form E. The groups were equated for intellectual and quantitative ability. The S's were administered problems with a set logical structure, which could be varied in terms of complexity and/or content, devised by Rimoldi. Various scoring procedures, emphasizing structural and informational aspects of problem solving, devised by Rimoldi for this kind of data were employed.

The results substantiated the hypotheses which predicted that the open minded group would use the structure and the information of the problems more efficiently than the closed minded group, and that the closed

minded group would perform better with concrete rather than abstract material whereas there would be no difference in the performance of the open minded group.

Further analysis of the data received suggested that the two groups receive both information and structure equally well and that the differences found in the use of these is attributable to a generalized, personal uncertainty.

These results were related to the theoretical analysis which seemed to be consistent with the findings. Therefore, it was concluded that openness and closedness are valuable concepts for the designation of personality types and important for predicting differences in behavioral activity.

BIBLIOGRAPHY

- Aderne, T. W., Frenkel-Brunswick, Else, Levinson, D. J., & Sanford, R. N. The authoritarian personality. New York: Harper & Bros., 1950.
- Allport, F. W. Theories of perception and the concept of structure. New York: John Wiley & Sons, 1955.
- Allport, G. W. Becoming: basic considerations for a psychology of personality. New Haven: Yale University Press, 1955.
- _____. The open system in personality theory. J. abnorm. sec. Psychol., 1960, 61, 301-311.
- _____. Pattern and growth in personality. New York: Holt, Rinehart & Winston, 1961.
- Attneave, F. Applications of information theory to psychology. New York: Holt, Rinehart, and Winston, 1959.
- Ausubel, D. T. The psychology of meaningful verbal learning. New York: Grune & Stratton, 1963.
- Blake, R. R., Ramsey, G. V., & Moran, L. J. Perceptual processes as basic to an understanding of complex behavior. In R. R. Blake & G. V. Ramsey (Eds.), Perception: an approach to personality. New York: The Ronald Press, 1951. pp. 3-24.
- Bloom, B. S., & Broder, L. J. Problem Solving Processes of Students. Chicago: University of Chicago Press, 1950.
- Bruner, J. S., & Goodman, C. C. Value and need as organizing factors in perception. J. abnorm. sec. Psychol., 1947, 42, 33-44.
- Bruner, J. S. Personality dynamics and the process of perceiving. In R. R. Blake & G. V. Ramsey (Eds.), Perception: an approach to personality. New York: The Ronald Press, 1951. pp. 121-147.
- Bruner, J. S., Goodnow, J. J., & Austin, G. A. A study of thinking. New York: John Wiley & Sons, Inc., 1956.

Bruner, J. S. Going beyond the information given. In H. E. Gruber, R. R. Hammond, & R. Jessor (Eds.), Contemporary approaches to cognition. Cambridge: Harvard University Press, 1957. pp. 41-70.

Christie, R., & Jahoda, M. Studies in the scope and method of "the authoritarian personality". Glencoe: The Free Press, 1954.

Christie, R., & Cook, M. A guide to published literature relating to "the authoritarian personality". J. Psychol., 1958, 45, 171-199.

Duncan, C. P. Recent research on human problem solving. Psychol. Bull., 1959, 56, 397-429.

Dunker, K. "On problem-solving." Psychol. Monogr., 1945, 58, 5.

Edie, J. M. Introduction. In J. M. Edie (Ed.), The primacy of perception and other essays. Evanston: Northwestern University Press, 1964.

Fillenbaum, S., & Jackman, A. Dogmatism and anxiety in relation to problem solving. J. abnorm. soc. Psychol., 1961, 63, 212-214.

Flavell, J. H. The developmental psychology of Jean Piaget. Princeton: D. Van Nostrand Co., 1963.

Fogliatto, H. M. Individual differences in thought processes. Chicago: Loyola University, Loyola Psychometric Laboratory, 1963, (pub. N. 35).

Frenkel-Brunswick, Else. Personality theory and perception. In R. R. Blake & G. V. Ramsey, (Ed.), Perception: an approach to personality. New York: The Ronald Press, 1951. pp. 336-420.

Gardner, R. W., Helman, P. S., Klein, G. S., Linton, H. B., & Spence, D. P. Cognitive control: a study of individual consistencies in cognitive behavior. Psychol. Issues, 1959, 1, 1-186.

Gardner, R. W., Jackson, D. N., & Messick, S. H. Personality organization in cognitive controls and abilities. Psychol. Issues, 1960, 2, 1-150.

Garner, W. R. Uncertainty and structure as psychological concepts. New York: John Wiley & Sons, Inc., 1962.

Harvey, O. J. Authoritarianism and conceptual functioning in varied conditions. J. Personality, 1963, 31, 462-470.

Heidbreder, E. F. Reasons used in solving problems. J. exper. Psychol., 1927, 10, 397-414.

- Heidbreder, E. F. Toward a dynamic theory of cognition. Psychol. Rev., 1945, 52, 1-22.
- Heider, Fritz. Trends in cognitive theory. In H. E. Gruber, K. R. Hammond, & R. Jessor (Eds.), Contemporary approaches to cognition. Cambridge: Harvard University Press, 1957. pp. 201-210.
- Hollander, E. P., & Hunt, R. G. Personality and society. In E. P. Hollander & R. G. Hunt (Eds.), Current perspectives in social psychology. New York: Oxford University Press, 1963. pp. 145-150.
- Kelly, G. A. The psychology of personal constructs. New York: Nerton, 1955, 2 vols.
- _____. Man's construction of his alternatives. In G. Lindzey (Ed.), Assessment of human motives. New York: Rinehart, 1958. pp. 33-64.
- Klein, G. S. The personal world through perception. In R. R. Blake & G. V. Ramsey (Eds.), Perception: an approach to personality. New York: The Ronald Press, 1951. pp. 328-355.
- _____. Need and regulation. In M. R. Jones (Ed.), Nebraska Symposium on motivation: 1954. Lincoln: University of Nebraska Press, 1954. pp. 224-274.
- Kronfeld, A. Lehrbuch der charakterkunde. Berlin: Verlag von Julius Springer, 1932.
- McNemar, Quinn Psychological Statistics, New York: John Wiley & Sons, 1962.
- Merleau-Ponty, M. The primacy of perception and other essays. J. M. Edie (Ed.). Evanston: Northwestern University Press, 1964.
- Mischel, T. Personal constructs, rules, and the logic of clinical activity. Psychol. Rev., 1964, 71, 180-192.
- Piaget, J. Psychology of Intelligence. Paterson: Littlefield, Adams & Co., 1960.
- Rapaport, D. Cognitive structures. In H. E. Gruber, K. R. Hammond, & R. Jessor (Eds.), Contemporary approaches to cognition. Cambridge: Harvard University Press, 1957. pp. 157-200.
- Restle, F., Andrews, M., & Rekeach, M. Differences between open- and closed-minded subjects on learning-set and oddity problems. J. abnorm. soc. Psychol., 1964, 68, 648-654.

Restle, F. Toward a quantitative description of learning set data. Psychol. Rev., 1958, 65, 77-91.

Rimoldi, H. J. A. Study of some factors related to intelligence. Psychometrika, 1948, XIII, 27-46.

_____. The central intellectual factor. Psychometrika, 1951, XVI, 75-101.

_____. A technique for the study of problem solving. Educ. and Psychol. Meas., 1955, 15, 4.

Rimoldi, H. J. A., Devane, J. V., & Haley, J. V. Characterization of processes. Educ. and psychol. meas., 1961, 21, 383.

Rimoldi, H. J. A., Fogliatto, H. M., Haley, J. V., Reyes, I. O., Erdmann, J. B., & Zacharia, R. M. Training in problem solving. Chicago: Loyola University, Loyola Psychometric Laboratory, 1962a, (pub. No. 25).

Rimoldi, H. J. A., Haley, J. V., & Fogliatto, H. M. The test of diagnostic skills. Chicago: Loyola University, Loyola Psychometric Laboratory, 1962b, (pub. No. 25).

Rimoldi, H. J. A., Haley, J. V., Fogliatto, H. M., & Erdmann, J. B. Program for the study of thinking. Bulletin of International Association of Applied Psychology, France, 1964.

Rimoldi, H. J. A., Fogliatto, H. M., Erdmann, J. B., & Donnelly, M. B. Problem solving in high school and college students. Chicago: Loyola University, Loyola Psychometric Laboratory, 1964, (pub. No. 42).

Rokeach, M. Generalized mental rigidity as a factor in ethnocentrism. J. abnorm. soc. Psychol., 1948, 42, 259-278.

_____. A method for studying individual differences in "narrow-mindedness." J. Personality, 1951a, 20, 219-233.

_____. "Narrow-mindedness" and personality. J. Personality, 1951b, 20, 234-251.

_____. Prejudice, concreteness of thinking, and reification of thinking. J. abnorm. soc. Psychol., 1951c, 46, 83-91.

_____. Attitude as a determinant of distortions in recall. J. abnorm. soc. Psychol., 1952, 47, 482-488.

- Rokeach, M. The nature and meaning of dogmatism. Psychol. Rev., 1954, 61, 194-204.
- Rokeach, M., McGovney, W. C., & Denny, M. R. A distinction between dogmatic and rigid thinking. J. abnorm. soc. Psychol., 1955, 51, 87-93.
- Rokeach, M. On the unity of thought and belief. J. Personality, 1956a, 25, 224-230.
- Rokeach, M., & Eglash, S. A scale for measuring intellectual conviction. J. soc. Psychol., 1956b, 44, 135-141.
- Rokeach, M., & Fruchter, B. A factorial study of dogmatism and related concepts. J. abnorm. soc. Psychol., 1956c, 53, 356-360.
- Rokeach, M., & Hanley, C. Eysenck's tender-mindedness dimension: a critique. Psychol. Bull., 1956d, 53, 169-176.
- Rokeach, M., Oram, A., & Marr, J. The effects of meprobamate on analysis and synthesis in thinking. J. Psychol., 1959, 48, 359-366.
- Rokeach, M. The open and closed mind. New York: Basic Books, Inc., 1960.
- Rokeach, M. Belief versus race as determinants of social distance: comment on Triandis' paper. J. abnorm. soc. Psychol., 1961, 62, 187-188.
- Rokeach, M. & Rothman, G. The principle of belief congruence and the congruity principle as models of cognitive interaction. Psychol. Rev., 1965, 72, 128-142.
- Sanford, N. The approach of "the authoritarian personality". In J. L. McCary (Ed.), Psychology of personality. New York: Grove Press, 1956, pp. 253-319.
- Siegel, S. Non parametric statistics for the behavioral sciences. New York: McGraw-Hill Book Co., 1956.
- Strasser, S. Phenomenology and the human sciences. Pittsburgh: Duquesne University Press, 1963.
- Thistlethwaite, D. Attitude and structure as factors in the distortion of reasoning. J. abnorm. soc. Psychol., 1950, 45, 442-458.
- Thurstone, L. L. The nature of intelligence. Patterson: Littlefield, Adams & Co., 1960.

Vinacke, W. E. Motivation as a complex problem. In M. R. Jones (Ed.), Nebraska Symposium on motivation: 1962. Lincoln: University of Nebraska Press, 1962. pp. 1-46.

Wertheimer, M. Productive thinking. New York: Harper & Bros., 1959.

APPENDIX I

Rokeach Dogmatism Scale, Form E

Instructions:

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement below is your personal opinion. We have tried to cover many different and opposing points of view; you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others; whether you agree or disagree with any statement, you can be sure that many people feel the same as you do.

Mark each statement in the left margin according to how much you agree or disagree with it. Please mark every one. Write +1, +2, +3, or -1, -2, -3, depending on how you feel in each case.

- | | |
|--------------------------|-----------------------------|
| +1: I AGREE A LITTLE | -1: I DISAGREE A LITTLE |
| +2: I AGREE ON THE WHOLE | -2: I DISAGREE ON THE WHOLE |
| +3: I AGREE VERY MUCH | -3: I DISAGREE VERY MUCH |

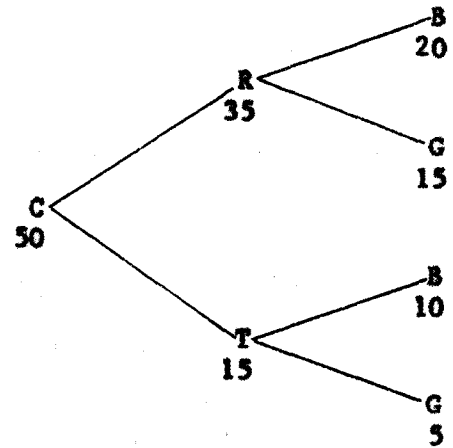
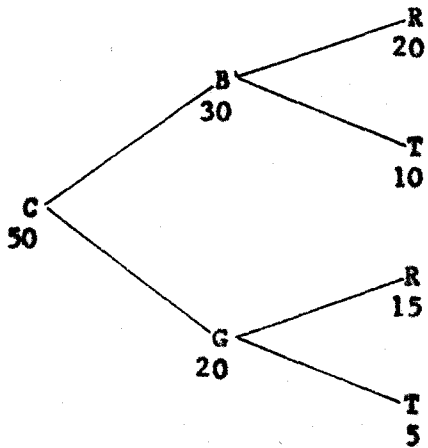
Test:

1. The United States and Russia have just about nothing in common.
2. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.
3. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.
4. It is only natural that a person would have a much better acquaintance with ideas he believes in than with ideas he opposes.

5. Man on his own is a helpless and miserable creature.
6. Fundamentally, the world we live in is a pretty lonesome place.
7. Most people just don't give a "damn" for others.
8. I'd like it if I could find someone who would tell me how to solve my personal problems.
9. It is only natural for a person to be rather fearful of the future.
10. There is so much to be done and so little time to do it in.
11. Once I get wound up in a heated discussion I just can't stop.
12. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
13. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.
14. It is better to be a dead hero than to be a live coward.
15. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.
16. The main thing in life is for a person to want to do something important.
17. If given the chance I would do something of great benefit to the world.
18. In the history of mankind there have probably been just a handful of really great thinkers.
19. There are a number of people I have come to hate because of the things they stand for.
20. A man who does not believe in some great cause has not really lived.
21. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.
22. Of all the different philosophies which exist in this world there is probably only one which is correct.
23. A person who gets enthusiastic about too many causes is likely to be a pretty "wishy-washy" sort of person.

24. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.
25. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.
26. In times like these, a person must be pretty selfish if he considers primarily his own happiness.
27. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.
28. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp than by those in the opposing camp.
29. A group which tolerates too much differences of opinion among its own members cannot exist for long.
30. There are two kinds of people in this world: those who are for the truth and those who are against the truth.
31. My blood boils whenever a person stubbornly refuses to admit he's wrong.
32. A person who thinks primarily of his own happiness is beneath contempt.
33. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.
34. In this complicated world of ours the only way we can know what's going on is to rely on leaders or experts who can be trusted.
35. It is often desirable to reserve judgment about what's going on until one has had a chance to hear the opinions of those one respects.
36. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.
37. The present is all too often full of unhappiness. It is only the future that counts.
38. If a man is to accomplish his mission in life it is sometimes necessary to gamble "all or nothing at all."
39. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.
40. Most people just don't know what's good for them.

APPENDIX II

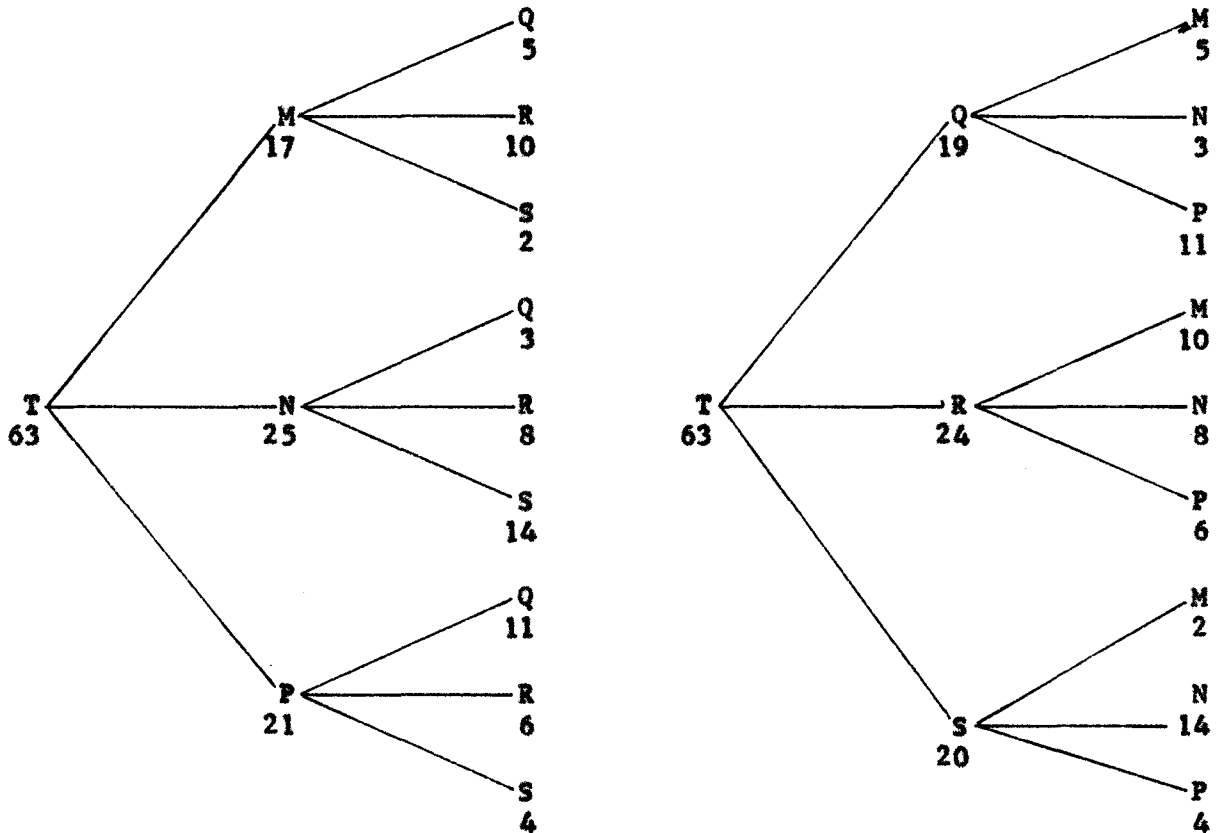


The Structure and Content of Problem 31 B

	B	G	
R	20	15	35
T	10	5	15
	30	20	50C

A Two by Two Matrix of the Structure and Content of Problem 31 B

APPENDIX III



The Structure and Content of Problem 35 B

	M	N	P	
Q	5	3	11	19
R	10	8	6	24
S	2	14	4	20
	17	25	21	63T

A Three by Three Matrix of the Structure and Content of Problem 35 B

APPENDIX IV

Problem 31 A

Instructions and Corresponding Questions and Answers

At Spencer High School the annual fall dance is about to be held. A dance committee has been selected to make the necessary arrangements. Both boys and girls are on the committee. A part of the committee is to take care of the refreshments for the evening and another part will look after the sale of the tickets for the dance. The list of the girls on the dance committee involved in the sale of tickets has been lost. From the other information available, which you will find in the questions, your object is to discover the number of girls involved in the sale of tickets.

Questions	Answers
1. Is Spencer High School the only co-educational school in the city?	1. No.
2. How many boys attend Spencer High?	2. 240 boys attend Spencer High.
3. How many boys are on the dance committee?	3. 10.
4. Are there more girls than boys at this school?	4. Yes.
5. How many students on the dance committee are assigned to supplying the refreshments?	5. 14.

- | | |
|---|---------------|
| 6. What is the total number of students on the fall dance committee? | 6. 25. |
| 7. How much time would the committee as a whole spend in preparation for the dance? | 7. 275 hours. |
| 8. How much time would the average committee member contribute? | 8. 11 hours. |
| 9. How many boys on the committee are involved in the sale of tickets? | 9. 6 boys. |
| 10. How many girls are on the refreshment part of the dance committee? | 10. 10 girls. |

solution: 5 girls

APPENDIX V

Problem 31 B

Instructions and Corresponding Questions and Answers

We have a certain number of objects, M , a part of which, for lack of a better name, will be called C 's. The C 's are composed of B 's and G 's. No B is a G and vice versa. Some of the C 's also are R 's and some others are T 's. No R is a T and vice versa. How many G 's are also T 's?

Questions	Answers
1. Are there C 's that are not B 's and G 's?	1. No.
2. How many B 's are C 's?	2. 30.
3. How many B 's are M 's?	3. 120.
4. How many C 's are R 's?	4. 35.
5. Are there more G 's than B 's among the M 's?	5. Yes.
6. What is the value of k times the C 's?	6. 550.
7. What is the total number of C 's?	7. 50.
8. How many B 's that are C 's are also T 's?	8. 10.
9. How many G 's that are C 's are also R 's?	9. 15.
10. What is the value of k ?	10. 11.

Solution: 5 G 's.

APPENDIX VI

Problem 35 A

Instructions and Corresponding Questions and Answers

A college choral group is composed of freshmen, sophomores and juniors. The chorus has three voices or parts which are high, medium, and low. The questions and answers below give vital information concerning the group. From these facts you are to find the number of juniors singing the middle or medium part.

Questions	Answers
1. How many Juniors are in this college?	1. 1567.
2. How many Freshmen are in the chorus?	2. 23.
3. How many Sophomores are in the middle voice?	3. 10.
4. How many chorus members are there?	4. 76.
5. How many girls are in the chorus?	5. 45.
6. How many sophomores are in the chorus?	6. 28.
7. How many juniors sing the high voice?	7. 7.
8. How many freshmen are in this college?	8. 1848.
9. How many freshmen sing the high voice?	9. 8.
10. How many low voice members are there?	10. 28.
11. How many sophomores sing the high part?	11. 9.

- | | |
|--|---------|
| 12. How many pianos does the chorus have? | 12. 3. |
| 13. How many freshmen sing the low voice? | 13. 9. |
| 14. How many chorus members sing the high voice? | 14. 24. |
| 15. How many juniors are in the low voice section? | 15. 10. |
| 16. How many freshmen sing the middle voice? | 16. 6. |
| 17. How many sophomores sing the low part? | 17. 9. |

Solution: 8 juniors.

APPENDIX VII

Problem 35 B

Instructions and Corresponding Questions and Answers

T objects are composed of M, N, and P types. Each of these latter three types may or may not also be Q's, R's and S's. From the questions and answers you can discover the various relationships of these objects. Make use of this available information to determine how many T objects are N's and also S's.

Questions	Answers
1. How many S's are A's?	1. 350.
2. How many Q's are there among the T's?	2. 19.
3. How many G's are there among the T's?	3. 43.
4. How many R's are also N's?	4. 8.
5. What is the total number of T objects?	5. 63.
6. How many P's are there among the T's?	6. 21.
7. How many R's are there among the T's?	7. 24.
8. How many Q's are also M's?	8. 5.
9. How many R's are also M's?	9. 10.
10. How many S's are also M's?	10. 2.
11. How many Q's are A's?	11. 400.

- | | |
|-------------------------------------|---------|
| 12. How many R's are also P's? | 12. 6. |
| 13. How many Q's are also N's? | 13. 3. |
| 14. How many S's are also P's? | 14. 4. |
| 15. How many M's are among the T's? | 15. 17. |
| 16. How many Q's are also P's? | 16. 11. |
| 17. How many H's among the A's? | 17. 2. |

Solution: 14 T objects are N's and also S's.

APPENDIX VIII

Problem 40

Instructions and Corresponding Questions and Answers

This figure is composed of 20 areas. One of the areas has been selected. Your task is to discover the selected area. You may discover this area by using any of the questions you like to arrive at the answer.

Proceed by reading over all the questions. Decide the first question you would like to have answered and write its number on the page provided. Then, read the answer on the back of the card. After having read the answer, decide on the next question you would like to have answered. Write down its number and read the answer. When you are satisfied that you have arrived at the answer, stop asking questions, and write down your answer. Remember, you may ask as many questions as you need to find the correct area, but do not ask more questions than you need.

Questions	Answers
1. Is the value of the area divisible by 10?	1. No.
2. Is the value of the area divisible by 2?	2. No.
3. Is the value of the area divisible by both 2 and 3?	3. No.
4. Is the value of the area divisible by 4?	4. No.
5. Is the value of the area divisible by 9?	5. No.

- | | |
|--|---------|
| 6. Is the value of the area divisible by both 2 and 4? | 6. No. |
| 7. Is the value of the area divisible by 3? | 7. No. |
| 8. Is the value of the area divisible by 6? | 8. No. |
| 9. Is the value of the area divisible by 5? | 9. No. |
| 10. Is the value of the area divisible by 7? | 10. No. |

Solution: 11

PROBLEM 40

20	9	4	35
25	2	55	6
8	21	10	39
33	11	27	12
16	14	18	5

APPENDIX IX

Problem 42

Instructions and Corresponding Questions and Answers

This figure is composed of 24 areas. The numbers in the areas are merely for the purpose of identifying a particular area and have no bearing on the solutions of the problem whatsoever.

One of the areas has been selected. Your task is to discover the selected area. You may discover this area by using any of the questions you like to arrive at the answer.

Proceed by reading over all the questions. Decide the first question you would like to have answered and write its number on the page provided. Then, read the answer on the back of the card. After having read the answer, decide on the next questions you would like to have answered. Write down its number and read the answer. When you are satisfied that you have arrived at the answer, stop asking questions, and write down your answer. Remember, you may ask as many questions as you need to find the correct area, but do not ask more questions than you need.

Questions	Answers
1. Is it above the unbroken curve line?	1. No.
2. Does it have 2 curved lines as borders?	2. No.

- | | |
|--|---------|
| 3. Is it to the right of the vertical curve line? | 3. Yes. |
| 4. Does it have 2 continuous straight lines and 2 broken lines as borders? | 4. No. |
| 5. Does it have 2 broken straight line borders? | 5. No. |
| 6. Does it have any combinations of 2 broken and 2 curved sides? | 6. No. |
| 7. Is it below the dotted curve line? | 7. No. |
| 8. Does it have 3 continuous straight lines and 1 broken straight line as borders? | 8. No. |
| 9. Does it have a broken curved line as a border? | 9. No. |
| 10. Does it have at least 1 continuous straight line and 2 continuous curved lines as borders? | 10. No. |

solution: 23

PROBLEM 42

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24

APPENDIX X

Problem 46

Instructions and Corresponding Questions and Answers

The figure here is composed of overlapping geometric figures and lines, forming twenty areas. You will notice that an area is any enclosed part of the figure that does not have a line through it. One of the areas has been selected. Your task is to find out which one it was. To find the particular area, you must discover enough facts about it so that it can be distinguished from other areas. You may discover these facts by using any of the questions you like.

Proceed by reading over all the questions. Then, decide on the first question you would like to have answered, and write its number on the page provided. Then, take the card and read the answer on the back of the card. After having read the answer, decide on the next question you would like to have answered. Write down its number, and take the card. When you are satisfied that you have arrived at the answer, stop drawing cards, and write down your answer. Remember, you may use as many of the cards as you need to find the correct area, but don't choose any more than you need.

Questions

Answers

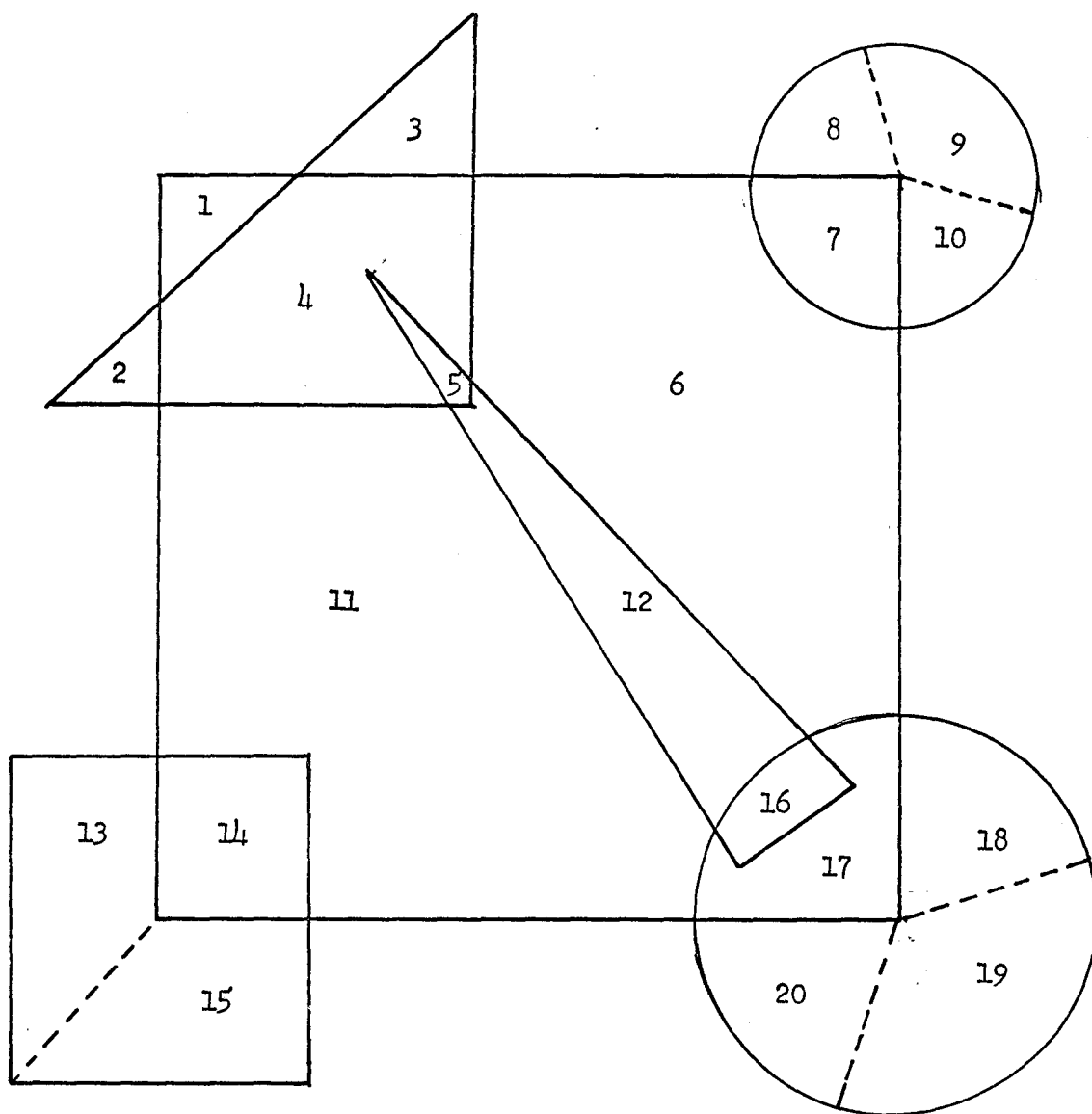
1. Is it a three-sided area with 3 straight sides?

1. No.

- | | |
|--|---------|
| 2. Is it inside the large square? | 2. Yes. |
| 3. Does it have 2 broken lines as borders? | 3. No. |
| 4. Does it have a broken line as a border? | 4. No. |
| 5. Is it in the small circle? | 5. No. |
| 6. Is it in the small square? | 6. No. |
| 7. Is it in only 2 figures? | 7. No. |
| 8. Is it in only 1 figure? | 8. No. |
| 9. Does it have only 4 straight lines as borders? | 9. No. |
| 10. Is it a three-sided area with 2 straight sides and 1 curve side? | 10. No. |

Solution: 16

PROBLEM 46



APPENDIX XI

SCATTER DIAGRAMS FOR PROBLEM 31 A FOR BOTH GROUPS

OPEN MINDED

ORDER
ASKED

QUESTIONS

	1	2	3	4	5	6	7	8	9	10
1			2		2	25				1
2			12		12	3			2	1
3			2		1	1			13	13
4			1		1	1			2	2
5										
6										
7										
8										
9										
10										

CLOSED MINDED

	1	2	3	4	5	6	7	8	9	10
1		1				25			2	2
2			14		11				3	2
3			1	1	5	2			13	6
4	1		2		2	1			5	1
5			1			1			1	4
6										1
7										
8										
9										
10										

APPENDIX XII

SCATTER DIAGRAMS FOR PROBLEM 31 B FOR BOTH GROUPS

OPEN MINDED

ORDER
ASKED

QUESTIONS

	1	2	3	4	5	6	7	8	9	10
1		1				1	22	2	4	
2	2	16	1	4			3	2	1	1
3		5		5	1		1	1	16	
4		1		1	1			3	4	1
5	1	1				1		1	1	
6						1		1		
7										
8										
9										
10										

CLOSED MINDED

	1	2	3	4	5	6	7	8	9	10
1	2	1		2			19	1	4	1
2	3	11	1	2	2		5	3	3	
3	3	5	1	2	2		2	5	10	
4		4		3	1		3	4	6	
5	1	4	1	1			1	3	2	1
6	1		1	1	1			1	1	1
7		1				1				1
8										
9										
10										

APPENDIX XIII

SCATTER DIAGRAMS FOR PROBLEM 35 A FOR BOTH GROUPS

OPEN MINDED

QUESTIONS

ORDER
ASKED

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1			28			1								1		
2	11				6	1			8				3	1		
3	7		1		10				3				9			
4		4			1	6			1					9	9	
5		9	1			9							1	5	4	
6		1														
7															1	
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																

CLOSED MINDED

ORDER
ASKED

QUESTIONS

SCATTER DIAGRAMS FOR PROBLEM 35 A FOR BOTH GROUPS

APPENDIX XIII CONT'D.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1			29													
2		7	2	1		8	4			6				2			
3		5	1			8			1	3	1		1	6	4		
4		1	5			2	9				1			1	5	6	
5		2	4			1	6		2						9	6	
6		1	1				1			1			1				
7														2	1	1	
8		1								1						1	
9									1								
10													1				
11																	
12																	
13																	
14																	
15																	
16																	
17																	

APPENDIX XIV

SCATTER DIAGRAMS FOR PROBLEM 35 B FOR BOTH GROUPS

OPEN MINDED

ORDER ASKED	QUESTIONS																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1					28										2		
2		1			15	1				1					12		
3		1			2	12	1							1	13		
4		1		11			1			4			11	1	1		
5		1		12		1							12	3			
6				2									2				
7				1									1				
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

CLOSED MINDED

ORDER
ASKED

QUESTIONS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

1				2	24			1		2					1		
2	1	2		1	2	12	1		2	1			3	1	4		
3		1		1	1	4	4			4		1	1		12		
4		1	1	9	1	6	1			3			3	3	1		
5		2	1	5	2	3	1						10	3	1		
6		2		2		1	1			2			1	1	1	1	
7							3		1	1			3	1			
8		1								1		1					
9								1						1	1		
10				1					1			1					
11																1	
12									1								
13								1									
14																	
15																	
16																	
17																	

SCATTER DIAGRAMS FOR PROBLEM 35 B FOR BOTH GROUPS

APPENDIX XIV CONT'D

APPENDIX XV

SCATTER DIAGRAMS FOR PROBLEM 40 FOR BOTH GROUPS

OPEN MINDED

ORDER
ASKED

QUESTIONS

	1	2	3	4	5	6	7	8	9	10
1	1	20	1	1		1	2		2	2
2		3	2		1		17		7	
3	1	2		1	4		3	1	17	1
4		2			1		1	1	1	4
5	1		1				5			2
6	1				1			1		
7				1	1			1		
8		1		1				1		
9						1				
10									1	

CLOSED MINDED

	1	2	3	4	5	6	7	8	9	10
1	1	15	5			4	1		2	2
2	2	4	1		1	1	12		8	1
3		4	1		2		6	1	12	2
4	1	1			1	1	6		4	3
5	1	1					1	2	2	2
6	1	1	1	1	2					
7	1			1	1		1			
8					1		1			
9		1	1							
10										1

APPENDIX XVI

SCATTER DIAGRAMS FOR PROBLEM 42 FOR BOTH GROUPS

OPEN MINDED

ORDER
ASKED

QUESTIONS

	1	2	3	4	5	6	7	8	9	10
1	5	3	16		1		2	2	1	
2	16		5	1			6	1		1
3	7	2	3	2	13	1			1	1
4	2		1	3	8			15		1
5		1	3	2	3	1		7	1	
6		2	1	2	2			3		
7				1	2	1			1	
8		1			1					1
9									1	
10										1

CLOSED MINDED

	1	2	3	4	5	6	7	8	9	10
1	5	5	12		1	1	2	2	1	1
2	10	2	7	2		2	4	1	2	
3	1	6	5	1	10	1	1	1	3	1
4	4	1	2	2	5		3	13		
5	1	1	2	5	1	2		6	3	2
6	1	1	1	3	4	1	1	1	2	1
7	1		1	1	2	4	1	1		1
8	1				1	2			2	2
9	1				1		2	1		1
10	1						1		1	1

APPENDIX XVII

SCATTER DIAGRAMS FOR PROBLEM 46 FOR BOTH GROUPS

OPEN MINDED

ORDER
ASKED

QUESTIONS

	1	2	3	4	5	6	7	8	9	10
1	1	25	1		1	1		1		
2	1			1	2	2	5	9	5	5
3	6	3	1		1		8	4	2	5
4	5	1			4	4	1	1	9	3
5	2		1		2	1	3	5	3	3
6	1			1	1		6	3	4	1
7	2		1			1	2	3	2	
8			1	1	1		2		1	1
9				1		1			1	
10						1				

CLOSED MINDED

	1	2	3	4	5	6	7	8	9	10
1	2	21	1	2		2		2		
2	7	4		1	3		7	2	3	3
3	5	2			3	1	1	4	5	9
4	7		1	1		1	1	3	9	6
5	3				6		5	5	4	3
6	1	1	1	2	1	1	5	4	3	3
7	1				1	2	5	1		
8					1	1	2	2		
9				1						
10			1							

APPENDIX XVIII

χ^2 TEST FOR INDEPENDENT SAMPLES FOR NUMBER OF CORRECT AND INCORRECT ANSWERS FOR BOTH GROUPS

PROBLEM	FIGURE	DF	χ^2	SIGNIFICANCE																
31 A	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>29</td><td>1</td><td>30</td></tr><tr><td>C</td><td>19</td><td>11</td><td>30</td></tr><tr><td></td><td>48</td><td>12</td><td>60</td></tr></table>		COR	INC		O	29	1	30	C	19	11	30		48	12	60	1	8.437	.01 > p > .001
	COR	INC																		
O	29	1	30																	
C	19	11	30																	
	48	12	60																	
31 B	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>26</td><td>4</td><td>30</td></tr><tr><td>C</td><td>20</td><td>10</td><td>30</td></tr><tr><td></td><td>46</td><td>14</td><td>60</td></tr></table>		COR	INC		O	26	4	30	C	20	10	30		46	14	60	1	2.33	NONE
	COR	INC																		
O	26	4	30																	
C	20	10	30																	
	46	14	60																	
35 A	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>25</td><td>5</td><td>30</td></tr><tr><td>C</td><td>25</td><td>5</td><td>30</td></tr><tr><td></td><td>50</td><td>10</td><td>60</td></tr></table>		COR	INC		O	25	5	30	C	25	5	30		50	10	60	1	.12	NONE
	COR	INC																		
O	25	5	30																	
C	25	5	30																	
	50	10	60																	
35 B	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>23</td><td>7</td><td>30</td></tr><tr><td>C</td><td>21</td><td>9</td><td>30</td></tr><tr><td></td><td>44</td><td>16</td><td>60</td></tr></table>		COR	INC		O	23	7	30	C	21	9	30		44	16	60	1	.085	NONE
	COR	INC																		
O	23	7	30																	
C	21	9	30																	
	44	16	60																	

APPENDIX XVIII CONT'D.

PROBLEM	FIGURE	DF	χ^2	SIGNIFICANCE																
40	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>28</td><td>2</td><td>30</td></tr><tr><td>C</td><td>27</td><td>3</td><td>30</td></tr><tr><td></td><td>55</td><td>5</td><td>60</td></tr></table>		COR	INC		O	28	2	30	C	27	3	30		55	5	60	1	*	p = .4999
	COR	INC																		
O	28	2	30																	
C	27	3	30																	
	55	5	60																	
42	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>26</td><td>4</td><td>30</td></tr><tr><td>C</td><td>18</td><td>12</td><td>30</td></tr><tr><td></td><td>44</td><td>16</td><td>60</td></tr></table>		COR	INC		O	26	4	30	C	18	12	30		44	16	60	1	4.176	.05 > p > .02
	COR	INC																		
O	26	4	30																	
C	18	12	30																	
	44	16	60																	
46	<table><tr><td></td><td>COR</td><td>INC</td><td></td></tr><tr><td>O</td><td>17</td><td>13</td><td>30</td></tr><tr><td>C</td><td>13</td><td>17</td><td>30</td></tr><tr><td></td><td>30</td><td>30</td><td>60</td></tr></table>		COR	INC		O	17	13	30	C	13	17	30		30	30	60	1	.60	NONE
	COR	INC																		
O	17	13	30																	
C	13	17	30																	
	30	30	60																	

* Because of the low entries in both Incorrect cells, it was necessary to use The Fisher Exact Probability Test.

APPENDIX XIX

χ^2 TEST FOR INDEPENDENT SAMPLES FOR MAXIMUM AND LESS INFORMATION FOR BOTH GROUPS

PROBLEMS	FIGURE	DF	χ^2	SIGNIFICANCE																
31 A & 31 B	<table><tr><td></td><td>MAX</td><td>MAX-</td><td></td></tr><tr><td>O</td><td>55</td><td>5</td><td>60</td></tr><tr><td>C</td><td>50</td><td>10</td><td>60</td></tr><tr><td></td><td>105</td><td>15</td><td>120</td></tr></table>		MAX	MAX-		O	55	5	60	C	50	10	60		105	15	120	1	1.219	NONE
	MAX	MAX-																		
O	55	5	60																	
C	50	10	60																	
	105	15	120																	
40 & 41	<table><tr><td></td><td>MAX</td><td>MAX-</td><td></td></tr><tr><td>O</td><td>54</td><td>6</td><td>60</td></tr><tr><td>C</td><td>46</td><td>14</td><td>60</td></tr><tr><td></td><td>100</td><td>20</td><td>120</td></tr></table>		MAX	MAX-		O	54	6	60	C	46	14	60		100	20	120	1	2.94	NONE
	MAX	MAX-																		
O	54	6	60																	
C	46	14	60																	
	100	20	120																	

APPENDIX XX

χ^2 TEST FOR INDEPENDENT SAMPLES FOR NECESSARY AND SURPLUS INFORMATION FOR BOTH GROUPS

PROBLEMS	FIGURE	DF	χ^2	SIGNIFICANCE																
31 A & 31 B	<table><tr><td></td><td>NEC</td><td>SUR</td><td></td></tr><tr><td>O</td><td>53</td><td>2</td><td>55</td></tr><tr><td>C</td><td>36</td><td>14</td><td>50</td></tr><tr><td></td><td>89</td><td>16</td><td>105</td></tr></table>		NEC	SUR		O	53	2	55	C	36	14	50		89	16	105	1	10.224	$p < .01$
	NEC	SUR																		
O	53	2	55																	
C	36	14	50																	
	89	16	105																	
40 & 41	<table><tr><td></td><td>NEC</td><td>SUR</td><td></td></tr><tr><td>O</td><td>47</td><td>7</td><td>54</td></tr><tr><td>C</td><td>32</td><td>14</td><td>46</td></tr><tr><td></td><td>79</td><td>21</td><td>100</td></tr></table>		NEC	SUR		O	47	7	54	C	32	14	46		79	21	100	1	3.58	$.06 > p > .05$
	NEC	SUR																		
O	47	7	54																	
C	32	14	46																	
	79	21	100																	

APPROVAL SHEET

The dissertation submitted by Reverend Paul Vincent Rebb, S.J. has been read and approved by five members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form, and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

May 25/1966

Date



Signature of Adviser