Rigidity: Its Relation to Intelligence as Measured by Psychological Tests and School Performance

Denis Cabezon
Loyola University Chicago

Follow this and additional works at: https://ecommons.luc.edu/luc_theses

Part of the Psychology Commons

Recommended Citation

This Thesis is brought to you for free and open access by the Theses and Dissertations at Loyola eCommons. It has been accepted for inclusion in Master's Theses by an authorized administrator of Loyola eCommons. For more information, please contact ecommons@luc.edu. Copyright © 1965 Denis Cabezon
RIGIDITY: ITS RELATION TO INTELLIGENCE AS MEASURED BY PSYCHOLOGICAL TESTS AND SCHOOL PERFORMANCE

by

Denis Cabezon, O.P.

A Thesis Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Arts

January

1965
LIFE

Denis Cabezón was born in Oteros de Boedo, Palencia, Spain, December 26, 1930.

After attending High School and College, Santa María de Nieva, Segovia, Spain, he took three years of philosophy and three of Theology at St. Thomas Aquinas Institute, Ávila, Spain. He finished his last year of Theology in the "Angelicum", Rome, obtaining the degree of Th.L. In 1959 he obtained the M.A. degree in philosophy at the Catholic University, Washington, D.C.

In September, 1961, he entered the Graduate School of Psychology at Loyola University.
ACKNOWLEDGMENTS

The author wishes to express sincere thanks to Vincent Herr, S.J. for his constant interest and the generous giving of his time in directing this thesis.

Further thanks are expressed to the principal of St. Pius School for her help in providing the subjects for the experiment.
# TABLE OF CONTENTS

1. INTRODUCTION ................................................................. 1

2. REVIEW OF THE LITERATURE ON CONCEPTIONS OF RIGIDITY .... 7
   a) EARLY EXPERIMENTATION ON RIGIDITY .......................... 11
   b) RECENT EXPERIMENTATION ON RIGIDITY ......................... 13
   c) APPLICATION OF RIGIDITY CONCEPTS TO INTELLIGENCE ... 18
   d) METHODS OF MEASURING RIGIDITY ................................. 20
   e) APPLICATION OF RIGIDITY TO INTELLIGENCE:
      EXPERIMENTAL STUDIES ............................................. 28
   f) APPLICATION OF RIGIDITY TO OTHER PSYCHOLOGICAL
      ENTITIES: EXPERIMENTAL STUDIES ............................... 29
   g) RIGIDITY: GENERAL OR SPECIFIC FACTOR? ....................... 31
   h) RIGIDITY AND PROBLEM SOLVING .................................. 32

3. RELATION OF RIGIDITY OF SET TO INTELLIGENCE ............... 35

4. THE EXPERIMENT: METHOD, THE TESTS, PROCEDURE, SUBJECTS
   AND SCORING .............................................................. 44

5. RESULTS AND DISCUSSION .................................................. 54

6. SUMMARY AND CONCLUSIONS .............................................. 62

7. BIBLIOGRAPHY ............................................................... 69
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTELLIGENCE QUOTIENT AND GRADE POINT AVERAGE CORRESPONDING TO EACH SUBJECT</td>
<td>65</td>
</tr>
<tr>
<td>II. CLASSIFICATION OF SUBJECTS INTO GROUPS ACCORDING TO RIGIDITY</td>
<td>66</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION AND PURPOSE

The field of intelligence measurement appears to have reached a point where most workers in the field seem satisfied that what they have is about as good as can be expected. Current tests seem to measure what they are expected to measure. Persons that deviate from the average, generally appear as deviant. However, there are some areas where the tests are of questionable applicability, such as for adults; or again they possibly discriminate against a particular segment of the population such as low socio-economic groups; or finally they present the question as to whether or not a given I.Q., at a given time is actually representative of an individual's capacity for future achievement. These three objections against test theory, will be taken up here, as an introduction to an examination of the possible relation of intelligence, as measured by psychological tests, to rigidity of set, with the possibility that an interpretation of intelligence as rigidity of set would be a more adequate conception both in terms of the above areas and accepted test theory.

Until the construction of Wechsler-Bellevue Scales, there were few valid tests of adult intelligence according to R.B. Cattell(1). He listed several obstacles: (1) variability of education and specialization of interests; (2) difficulty of standardization based on an adequate sampling; (3) expression of scores in meaningful units; (4) decline with age in scores in certain content areas; (5) difficulty of finding criteria for validation. The Wechsler-Bellevue (70)
seems to remedy the middle three of the above objections. It was based on a reasonable good standardization sample (although only whites were used); the scores are I.Q. units based on variability at different age intervals, obviating the problem of a chronological age based on no further mental growth; and finally, decline of scores with age is corrected by reducing the raw scores needed to obtain a comparable I.Q. (based on variability). The fifth objection, lack of validation criteria, is not corrected much by the Wechsler, but has led to emphasis on separate aptitude tests for each area. The first objection, variability in education and interests has not been solved adequately by any adult tests, as yet. Thus, the Wechsler seems to have solved problems of tests construction, but the objections based on intelligence theory remain.

Eells, and others (23) have concentrated on supposed socio-economic bias in content of test questions. They hypothesize that at least a part of the usually obtained hierarchy of average intelligence levels according to socio-economic level is a result of such bias. This assumes that socio-economic factors are irrelevant to intelligence as they conceive it (problem solving ability); indeed, they list the factors entering into a test score as: hereditary ability, cultural phenomena (social environment, cultural training, cultural motivation), emotional status at time of testing, and speed. It is the first factor that the author wishes to make the differentiating factor in intelligence tests. An added difficulty with present tests is the criterion of educability; for Eells, the trouble
lies in that the education has a middle class bias. They suggest that education find new approaches in handling exceptional children, based on the elicitation of practical talent and techniques of learning; these approaches should be valid for all classes, not just the middle class. Thus Eells, and the other authors bring out possible differences in current intelligence testing in regard to item content and test validity.

The third difficulty, expression of scores in meaningful units, mentioned above related to apparent lack of I.Q. constancy at the early ages. Anastasi (1,pp.254 ff.) reports several factors related to tests themselves which may account, at least in part, for this phenomenon. Assuming a highly reliable test, these factors are:

- change in item content over several age levels (introduction of verbal material does accompany increased stability);
- lack of common experience for pre-school age children; inadequacy of samples of pre-school age children, difficulties in rapport with youngsters. The latter two are not directly related to intelligence theory, and it is doubtful if they have much effect due to the repeated confirmation of the phenomenon. The first two factors relate to the idea that intelligence may be measured indirectly by "informational learning" i.e., a more intelligent child will have more information than a less intelligent child. The concept of I.Q. constancy, with increasing age, as an added factor to changes in I.Q. due to overt environmental changes, is the result of many studies on the nature-nurture problem being longitudinal in character.
Anderson (2) brings in the concept of "overlap" of mental functions in comparison over different age levels (assuming no "forgetting"). The relation is well illustrated by Goodenough (52), where

initial test score = \( S_1 + E_1 \) \( (S_1 = \text{true mental status at time 1,} \ E_1 = \text{error in the test}) \), final test score = \( S_1 + I + E_2 \) \( (I = \text{true increment}) \). "Error" also includes differences in item content at the two age levels. Now, when \( S_1 \) is small, such as at a young age, \( E \) will be relatively large and a low correlation between the two tests will result. If \( S_1 \) is large, a large correlation will occur because of the large "overlap" in the tests. This assumes, as Anderson does, that intelligence is a composite of many functions with an "additive overtime" characteristic. Thus, the low correlation between intelligence status before two years and post-adolescence may be explained statistically. Anderson prefers the use of a criterion of terminal status for early tests rather than age progression.

The above point is important because of its role in interpretation of the low predictive value of early tests. Supporters of the hereditarian point of view (intelligence ranking is determined largely through heredity) wish to account for this low prediction in terms of such irrelevant factors as given above. The concept of constancy of the I.Q. is a major point in their theoretical viewpoint. Those who hold a point of view (intelligence ranking is determined largely through "environmental" influence) prefer to regard this lack of predictive ability by early tests as being due, at least in part, to changes in some environmental factors which in turn will change
the I.Q. level. It is thus not surprising that environmentalists like Stoddard, Wollman, etc., regard the I.Q. level as being the current "test I.Q." (a sort of best estimate), while hereditarians constantly point out the lack of validity of early tests because of their low predictive value.

In summary, there may be some deficiencies in current intelligence test theory relating to adult measurement, item content bias, and low predictive validity of early tests. However, it was stated at the beginning that current theory and tests appear to be on the whole, adequate. The reason for this apparent contradiction may lie in the ordinary use made of test scores. The individual is tested and given a score which may affect decisions as to educational and job opportunities. In other words, an individual is labelled. From that time on, it is up to the individual to make out as best he can; the tester has done his job.

Even if the tester has a real interest in the problems of the individual "applicant", he has no way of knowing whether or not the labelling was "fair" to the individual (indicative of future capacity); hence the emphasis on an a priori statement of lack of validity for early tests. However, a different use of testing, that of using tests as indicators of present level in a certain type of capacity (perhaps the "practical talents" emphasized by Eells and the other authors) could lead to an individual-centered approach where the mechanism of intelligence itself is studied in relation to the individual and the criterion together, that is, the process involved,
including possible change over time. This latter approach, if it were used, would be far more helpful to those individuals, who for some reasons, are inadequately "labelled" by the present system.

Another fact of the "labelling" problem is the largely unknown area of an individual's reaction to a label. It has been suggested by some studies (52,63) that persons may actively (though perhaps "unconsciously") behave in a manner that they perceive others expect them to behave—a sort of role-taking. This hypothesis as applied to I.Q. scores is certainly tentative, but it may well be worth further investigation.

The purpose of this study is to examine the nature of the rigidity of set, given an operational definition, and find its overt reaction to two measures of intelligence, namely, Wechsler Intelligence Scale for children (WISC) and school grade-point averages. Further, the interpretation of intelligence in terms of such rigidity will be discussed in order to possibly obtain a more adequate conception of intelligence.

The next chapter will be a summary of the different conceptions of rigidity and previous findings. The third chapter will consist in a theoretical exposition of the relation of rigidity of set to intelligence, with the formal hypotheses for this study. The remaining chapters describe the study and give the results with discussion. A summary and conclusions complete this thesis.
CHAPTER II
REVIEW OF THE LITERATURE ON CONCEPTIONS OF RIGIDITY

The concept of mental rigidity is vague, and there is disagreement in definition between serious workers in this area, and also seemingly "within" workers over a period of time. For example, R.B. Cattell (14,15,16) has presented several formulations of rigidity. He first presented a common formulation of rigidity, (or perseveration), which involves two parts: (1) "inertia of mental processes", where there is production of interference in a series of tasks performed in rapid succession, and (2) "disposition rigidity" defined as the difference in performance of a task done in an old, accustomed manner as opposed to a new way. For Cattell, the first does not exist conceptually; the second refers only to motor performance, independent of intelligence, and is largely hereditary.

Later, Cattell (15) dealt with "structural rigidity" which has three cases: (1) failure of new behavior to appear as new solutions related to "g", (2) internal dynamic conflict, a failure to make adaptations, and (3) rigidity as basic to all dispositions for the individual. The third case, an "inherent" disposition rigidity, and based on resistance to change in the physiological neural paths, is defined as a difficulty in turning from old to new responses when the new responses are clear to the individual's intelligence and he wills to make them. This latter case was apparently the major concept for Cattell in 1949. He regarded it as highly related to his personality
factors "character integration" and "emotional stability" and also associated with ethnocentric and concrete thinking. Still later (16) he divided the concept of rigidity into many categories, possibly overlapping but not yet shown to be so, such as "process" rigidity (resistance to alternatives), the opposite of which may be called flexibility; "goal path" rigidity (inability to learn), the opposite to which is capacity to learn, and "ergic rigidity" (motivation), the opposite to which may be called ergic plasticity or capacity to sublimate.

It must be recognized that there are two general situations in which the word rigidity has been applied to failure to adapt or learn: (1) failure to achieve even once the shortest path in a new situation, and (2) failure to acquire a habit of taking the shortest path in repeated presentations of the situation. Obviously, the second depends partly upon the first and brings in addition some effects in the realm of retention and extinction. The "goal path" rigidity holds for both new and repeated situations and includes concepts like defective perception of relation ("g") high disposition rigidity, inherent in the individual, and defective motivation. Thus "g" rigidity in Cattell's mind, i.e., disposition rigidity, is an independent factor of a more generalized rigidity.

Goldstein (26) also emphasized a physiological basis for rigidity. He differentiated between primary rigidity, a certain isolated mental area where effects last a long time, and secondary rigidity, which comes into force only when the individual is confronted with tasks he
can not perform (particularly in the abstract area). For Goldstein, feeblemindedness is not the "result" of rigidity, but the contrary; rigidity for feebleminded children is a consequence of that condition, especially rigidity in abstract attitude, and is only one of several typical reactions to difficult situations (another being distractibility).

Werner (71,72) defined rigidity as the lack of variability and adaptability. The lower the position on the ontogenetic and phylogenetic scales, the more uniform the relation between animal and its world, therefore the more stereotyped the behavior. Rigidity is also an inversely monotonic function with age for humans. Descending the ontogenetic scale, a similar increase of rigidity can be observed. Less variability exists in the immature than in the mature organism. Unlike Werner, Kounin (41,42) following the Lewinian system uses the term rigidity in a predominantly structural rather than functional sense. He thinks in terms of "regions" of personality and conceives rigidity as a dynamic property of a boundary, that which prevents communication between neighboring regions. He poses the hypothesis that "rigidity is a positive monotonous function of chronological age". This seems to be the opposite of Werner's view.

This and other contradictions do not stem from the facts, as Werner says. They can be traced back to the ambiguity of the concept of rigidity.

There seem to be mainly three reasons for the ambiguity. The first lies in the confusion between functional and structural con-
cepts; Werner preferred the functional. The second is a confusion of rigidity and stability; for Werner, the less the individual is able to differentiate the environment, the more rigid and less stable he is, because stability requires flexibility of response to preserve a functional equilibrium in different situations. The third factor is unitary versus multiform manifestations; the latter refers to the two types of feeblemindedness, familial and brain damage, each with a different type of rigid behavior. This latter point will be taken up later in this chapter, regarding intelligence.

Kounin's position illustrates that of the Lewinian system. Rigidity has the nature of a construct, being the property of a boundary between neighboring regions of the mind. Unlike Werner, Kounin prefers a structural concept of rigidity, and also regards it as directly directed to chronological age; this interpretation from his study (and theory) is not supported by other workers, including Goldstein and Werner. Again, his definition is "dynamic", as opposed to the phenotypic approach of Werner.

Two common operational type definitions are those given by Fisher (24) and Guetzkow (25). Fisher defined rigidity in terms of the "number of alternatives utilized". Also, it is independent of intelligence. Guetzkow recognized three factors: susceptibility to set, ability to surmount set, and ability to form new and original solution patterns. It is the second factor which has been the basis for most recent measuring devices and experimentation.
To summarize, conceptions of rigidity vary, but tend to revolve around the concept of ability to change from old to new responses. Some investigators take a functional point of view, others a structural, with emphasis on physiology; some regard it as inherently constituted, others don't commit themselves (a study pointing to a learned basis of rigidity will be reported later); again, some define rigidity to be independent of intelligence while others prefer to test the relationship according to their own definitions.

A. EARLY EXPERIMENTATION ON RIGIDITY

Interest in the phenomenon of perseveration as it was called in early work, has been greater among British than American psychologists. According to Spearman (67), the Dutch school, particularly G. Heymans and E. Wiersma, were among the first workers to devise the first definite and serviceable tests of perseveration. Wiersma devised three tests: light adaptation, color test and sensitivity to electric current. These tests were administered to patients in a mental hospital suffering from mania and melancholia, and to a group of normal subjects. The time required for light adaptation was greater for melancholics and least for manics. In the color test, melancholics saw gray sooner, although at a slower rate, than did manics. Wiersman's results led to the inference that perseveration, or secondary function, is increased by melancholia and diminished by mania.

A six-test battery prepared by Heymans and another collaborator
In 1913 took into consideration the motor as well as the sensory aspect of perseveration. In addition to the fusion of colors and light adaptation, there were tests to determine the threshold for flicker and for sound (after a loud noise). A fifth test was based upon the pronunciation of difficult words. The last test in the battery was a hand-writing test, in which the letter S was to be written normally and in reverse.

These early perseveration tests have been used by many investigators. They have been modified, and new tests have been added from time to time. L. W. Jones (39) made several studies in perseveration. He used tests of light adaptation and of color fusion which were similar in principle to those of Wiersma. However, he varied the procedure; his results did not corroborate those of Wiersma. He also developed several new motor tests; which involved a change in hand-writing and while writing changing the direction of movement.

Much of Jones's work was done with patients in mental hospitals. He became interested in the relationship of perseveration to fluency of ideas in certain types of psychoses. On the basis of his own and other investigations, Jones considered the motor tests the best measures of perseveration.

W. Lankes (44) used eight tests and a questionnaire in an investigation of perseveration. He found that various mental activities representing perseveration were positively inter-correlated. On the basis of his findings he posited the existence of a group factor of perseveration, which in normal subjects was very small.
Jasper (37) prepared a questionnaire which he hoped would measure perseveration alone. He concluded that his results failed to support the hypothesis of a broad group factor of motor perseveration participating in a number of processes which require a rapid shift from one pattern of response to another. He stressed the need for measures of perseveration specific enough to eliminate the masking of the perseverative tendency by other factors, and held that no definite conclusions regarding the nature of a perseveration factor in all behavioral processes could be arrived at until such measures were available.

The theory of mental inertia proposed by Spearman (67) seems to provide the best explanation thus far suggested for the fact, that a perseverative tendency is manifested in the realms of sensations, movements and ideas. Perseveration is one example of inertia.

B. RECENT EXPERIMENTATION ON RIGIDITY

Although psychologists have been concerned for sometime with inflexible or fixated behavior, systematic study of the concept of rigidity has been relatively recent. Freud with his concept of fixation and Adler with his concept of the style of life, have described behavior that appears to be consistently inappropriate to a present set of cues or at least is responsive only to a very limited set of cues in a variety of situations. These clinical approaches, however, fail to clearly describe the conditions under which this behavior will occur except perhaps at a high level of generality. For Lewin
rigidity was a central construct. Kounin has applied Lewin's rigidity construct to the feebleminded. Goldstein has approached the problem from the point of view of mental set, and Luchins has placed emphasis on the field conditions rather than in the individual. Recent experimental work on rigidity emphasizes the effects of practice, reinforcement schedules or stress on ability to overcome induced mental sets. The first of these experiments, that of Jersild (38), was devised from ideas put forth by H.S. Hollingworth and Poffenberger (35), who first formulated the problem of mental set, as such, and shift. They pointed out that shifting between sets, and also attitudes, was a relatively ineffective mode of work. The Jersild study, using relatively simple tasks, compared relative efficiency of a homogeneously constructed task versus a task whose parts involved an alternate shifting of the mental set (i.e., giving synonyms and antonyms alternately), in terms of the amount of practice for each type of task. Results were: (1) the greater the practice within a homogeneous task, the greater the loss in moving to a new task; (2) the greater the shifting within a "shift" task, the less the loss in moving to a new task; (3) one can practice on a "shift" task sufficiently to bring performance to a level comparable to that of the homogeneous tasks. These results emphasize the importance of practice, and how they may increase the rigidity or flexibility of the persons according to the task practiced.

Jersild also found fairly high correlations (+ .40 to .60) between ability of the homogeneous and "shift" tasks, and also fairly high
correlations (+ .40 to .65) between "shift" tasks and group tasks of intelligence. Jersild concluded that it was not high intelligence that caused high "shift" scores, but that both situations involved reactions that are "identical to a high degree".

Schroeder and Rotter (66) were dissatisfied with the lack of generality of existing conditions of rigidity, feeling that previous approaches have failed to describe the specific learning or training conditions which will account for individual differences in rigid behavior. Nor do they provide theories broad enough to account for the similarities of behavior seen in so-called feebleminded, neurotic, brain-injured and some normal individuals who appear to have in common a lack of flexibility, a resistance to change or a repetitiveness of the same behavior in what appear to be a variety of situations.

The study adopted a social learning framework developed by Rotter and his students. The problem of rigidity was approached not as a trait or entity but as a kind of behavior predictable from specific learning experiences. As applied to rigidity, with flexibility as the unit, it follows: flexibility is the expectancy that more than one route to the goal will lead to the reinforcement, i.e., looking for alternative solutions is a higher level of behavior, is reinforceable, and has varied strengths (individual differences) according to the training sequences. Rigidity is a failure to learn this; it consists of approaching a situation with the expectancy that a single pathway leads to reinforcement, and does not change. It is
restricted attention to a given set of cues. Once the solution is learned, rigidity may well do for efficiency, as flexibility brings in cues not necessary for solution. The study proper involved training subjects to look for a single solution to a problem versus looking for alternative solutions (i.e., similar designs leading to solutions in different ways, subjects being forced to adopt the different solutions). Results were in the expected direction; that is, the group trained for a single solution behaved rigidly on the test problems, and the group trained to seek alternative solutions were able to change solutions more quickly, depending on the degree of training.

Buss (10,11,12) defined rigidity in terms of resistance to shift from old to new discriminations. Degree of rigidity was measured in terms of the ability to reverse a discrimination.

In this study he relates rigidity to reinforcement schedules and the S-R theory in general. He found that shifting occurred more easily for partial reinforcement than for continuous reinforcement in the training series, a reversal of the usual extinction theory. He also found contradictory results. Shifting to a cue previously reinforced positively was more difficult in relation to a shift to a mental cue; a similar design resulted in opposite findings. In all, the results from the Buss experiments seem ambiguous.

Cowen's (17,18) definition of rigidity parallels those previously mentioned in recent experiments. Rigidity is defined as "a tendency to adhere to an induced method of problem solving behavior when the induced solution no longer represents the most direct
and economical path to the goal (24, p. 518). He found that induced stress prior to a problem-solving situation leads to rigidity in solutions of those problems. This rigidity was a linear function of the amount of stress.

Rokeach (59) defines rigidity as the "inability to change one's set when the objective conditions demand it, or the inability to restructure a field in which there are alternative solutions to a problem in order to solve that problem more effectively". He found that rigidity is a direct function of the amount of time available to the subject between presentation of the problem and chance to write an answer. Different groups were given delays of 10, 20, 30 and 60 seconds. The 10 second delay group gave the greatest frequency of rigid solutions and utilized concrete aids more frequently than the other groups. The 20 second delay group gave somewhat fewer rigid solutions and utilized concrete aids less often. No differences appear between the 30 and the 60 second group with respect to the rigidity and the concrete thinking measures used. The results indicate that rigidity and concreteness as a function of time availability, at least with the particular problem used, levels off at about 30 seconds. This factor of availability of time may be created by both external and internal elements; the latter is more relevant to our problem, and probably deserves further study. Krech and Calvin (43), working along similar lines, found a biserial correlation of +.91 (N=28) between Wechsler vocabulary and speed with which college subjects reproduced differentiated material (as opposed to simple designs)
presented by tachistoscope. They suggested that this perception of differentiated material (a higher level than perception for simpler material) goes through stages related to levels of organization within persons, and is thus related to intelligence.

In summary, the concept of rigidity for later experiments seems to involve a lack of ability to shift solutions when what was correct is no longer correct. Also it appears, especially from the Jersild and Schroeder and Rotter studies that this rigidity may have a learned basis, and is not necessarily hereditary.

C. APPLICATION OF RIGIDITY CONCEPTS TO INTELLIGENCE

Some of the above mentioned theoretical formulations of rigidity, especially those which considered rigidity as a behavior trait caused by various organismic conditions, have adapted some of that material to problems of intelligence. Werner (73,74), as reported above, differentiated the two kinds of feeblemindedness, endogenous (familial) and exogenous (brain-injured), as to a type of rigid behavior displayed. First, he classified rigidity into three types: (1) simple, that which may be defined as a single repetition of an immediately preceding pattern; (2) repetitive, the repetition of a pattern occurring more than once during the series; (3) iterative or delayed, a suddenly appearing repetition of a pattern which has been presented with two or more trials earlier in the series. In a study with matched groups, Werner (73) found that the brain-injured children, in all experiments, produced significantly more perseverations than
did the endogenous children. The rigidity of the brain-injured and that of the endogenous appear to differ not only in amount but also in kind. The outcome of the first two experiments suggests that "interactive" and "repetitive" forms of perseveration are typical for brain-injured children. Werner concluded that with familial feeblemindedness, the individual has integration, but has difficulty in differentiating between responses. He retains wholes. The brain-injured has the above along with possible lack of integration; the whole breaks into unrelated parts, with isolation of certain elements.

Schroeder and Rotter (66) tried to explain the similarity of behavior in such groups as maladjusted, feebleminded, brain-injured and institutionalized children on the basis of their rigidity theory based on expectancy and learning principles. The familial feebleminded individual is both restricted in learning alternative solutions and has frequent failures which lead him to seize upon any positive reinforcement solution and maintain it; he has low expectancy of reinforcement from any other path. The brain-injured, likewise operates under physical handicaps which limit the kinds of solutions he can learn, and also has frequent experiences of failure and inadequacy. The neurotic individual has avoidance behavior regularly reinforced by preventing the occurrence of some expected trauma. The authors even say that individuals who spend much time in institutions where there are relatively inflexible rules, precedents, schedules, etc., to determine behavior, are in a situation that may be characterized by its emphasis upon single pathway learning.
D. METHODS OF MEASURING RIGIDITY

Representatives of early tests of perseveration are those described by Pinard (55). He used four tests. The first was the "inverted S" test, where subjects wrote "S" for 30 seconds, then a reversed "S" (ɔ) for 30 seconds, then repeated the procedure, giving a total of two minutes. Subjects then wrote 52 52 for two minutes. Total score is the number correct for the first four standard trials (two minutes) minus the number correct for the last "shifting" trial (two minutes). The procedure was the same for the "triangular test", the triangles having their apexes up or down, and similar for the "alphabet and number test", where the alphabet was written for one minute, then the number series for one minute, and finally a shifting between the two, for two minutes. The fourth test consisted of writing a given set of five capital letters in the standard way for two minutes, then writing their "mirror image" (as they would look in the mirror) for two minutes. Pinard's method called for a continuous emphasis to subjects for speed, a practice series beforehand, so there would not be any break between tests. With this set of problems, Pinard found a steady increase in the mark for perseveration among children of increasing age, but little difference between boys and girls. Adults show a higher mark than do children, and men a somewhat higher mark than women. But differences in speed of work need to be taken into consideration. Tests of perseveration may be constructed on one of two principles. In those which are constructed on the creative principle, perseveration is shown by a relative in-
ability to reassemble the elements of an old habit in a new way. In those which are constructed on the principle of alternation, perseveration is indicated by a slowing down, when habits which have been well established are made to alternate rapidly. In this four-test battery both principles of construction are represented.

Luchins (46,47,48,49,50) has developed various methods for measuring rigidity, among them are: arithmetical problems, hidden word tasks, mazes, series of drawings, tapping rhythm and a set for color. The procedures described above by no means exhaust the list of simple techniques which can be employed to study rigidity. A number of other methods discussed by Woodworth in his section on habit-interference (75) can be used as tests of rigidity. It is hoped that systematic and extensive experimentation with the methods outlined herein and with other methods may be able to shed some light on whether there are differences in degrees of rigidity of behavior between normal and abnormal individuals, or among individuals suffering from various types of mental disorders, and on the causes of the differences.

The most commonly used test for rigidity, particularly to measure the overcoming of set, is the Einstellung water-jar test adapted and standardized by Luchins. In this test the subject is asked to solve, one at a time, a series of six numerical problems, each involving the measurement of a certain volume of water by means of three given jars. Every problem is solvable by the same rather complicated procedure. These are followed by four tasks (test problems),
similar in appearance to those of the preceding series, which are solvable not only in this complicated way but also in a simple manner. The next task is four extinction problems solvable only by the simple procedure. They are intended to break the Einstellung or set; it's influence is tested by two subsequent test problems. If the subject solves the last two test problems in the complicated manner, two more extinction tasks are presented, followed by two other test tasks. If the set is still not broken, a series of three, four or more extinction problems are given with test problems intervening. The strength of rigidity is determined by the number of extinction tasks required before the individual employs the simple procedure in the test problems. When this does occur, a new problem is presented, solvable both in the simple manner and in still a simpler fashion, in order to determine whether one set has merely been substituted for another.

For retest purposes various sets of such problems are available. In retesting, the number of tasks in the first series should be varied so that the subject will not learn to expect the test problems at any particular point.

Luchins' theory is stated as follows: "Einstellung--habituation creates a mechanized state of mind, a blind attitude toward problems; one does not look at the problem on its own merits, but is led by a mechanical application of a used "method" (46).

Certain problems arise with this method. One is absence of a good reliability measure, where Luchins' suggestion (47) is to use different sets of values in the same procedure. Interpretation for
different ages is uncertain, as there may be differences in attitudes toward and interpretations of the tasks and instructions. Luchins (50) tried different techniques of instruction, but the effect remained. He recognized the possibility that the Einstellung solution may actually be more efficient, since subjects are just continuing a set. However, many subjects showed annoyance at "how foolish and blind they had been"; also in a situation where the Einstellung solution was not possible, the set was a great hindrance (46). However, some subjects see both solutions, yet use the Einstellung solution because they think it is expected of them.

With regard to the theoretical explanations of the Einstellung behavior, Luchins' experiments did not lead to a clear, positive formulation, but they did show what the Einstellung effect may not be. The Einstellung behavior can not be adequately understood as long as it is centered on the individual qua individual; that is, as long as we assume it is due to something in the respondent's nature. Field conditions seem to influence the Einstellung behavior. Various experimental situations in Luchins' preliminary experiments showed whether or not Einstellung effects resulted from a dependence on features in the situation and on the subject's attitudes; there were cases in which, in spite of the number of Einstellung problems, no Einstellung effects were found, and, on the other hand, cases in which the use of only one Einstellung task resulted in positive Einstellung effects. Besides, making a speed test out of the experiment vitiated the possible effects of factors introduced to prevent
Einstellung effects or to produce recovery from them. Not speed of response, in and of itself, but rather the manner in which the subject reacted to the pressure of timing brought about the blinding effects. Luchins criticizes Rokeach, Else Frenkel and Brunswik for assuming that every Einstellung solution to a test problem is brought about by the same psychological process which brings about the Einstellung solution of the criticals. They concentrate on the end product of the process, the overt response, and label it according to their interpretation of the process: rigidity. Not what the subject did, but the investigator's assumptions as to what he did, is the basis of evaluation of a response.

Others see different parts of the personality structure as being characterized by different degrees of rigidity. In most of this work the answer to rigidity of behavior is sought for in the respondent; it is considered as relatively independent of the field conditions under which the individual is operating. This approach ignores the chief finding of experimentation with the test, that is, that the Einstellung behavior is influenced by field conditions and cannot be understood merely as a characteristic of the individual's mental makeup.

Luchins points out that the tests in his manual may test and measure rigidity of behavior but it is not purported that they test or measure rigidity inherent in the personality. Moreover, while the tests may have some predictive value in the clinic, the manual does not make any pretenses of explaining the phenomena underlying
Levit and Zelan (45) criticized the Einstellung test on the ground that with any experimental design the distribution of Einstellung test scores tends to be skewed, with about 40 per cent of the usable protocols showing no critical solution at all. There is usually a loss of 20 to 30 per cent of the original subjects because of criteria for accepting a result as experimental data.

One of the most recent tests devised for measuring rigidity or the ease with which a subject can shift from reinforced responses to non-reinforced responses is the so-called Wisconsin Card Sorting Test (WCST), prepared at the University of Wisconsin by Grant and Berg (6, 28, 29, 30, 31, 62). This test combined many of the features of the Weigle, Goldstein, Scheerer and Vigotsky tests; it uses card sorting and can test ability to react selectively to one of several qualities along with ability to shift from one quality to another. It is more flexible in possibilities for qualifying the scores.

The test materials consist of a pack of four stimulus cards and 64 response cards which were devised so that each card contains from one to four identical figures of a single color. Four kinds of figures are used: stars, crosses, triangles and circles. Four different colors are used: red, yellow, green and blue. A single card might have four red stars or two green circles or any of the 64 possible combinations of colors, numbers and forms. Each card could then be sorted or categorized according to the color, number or form of the figure. The four stimulus cards are: one red triangle, two
green stars, three yellow crosses and four blue circles.

The initial correct sorting category was arbitrarily determined in advance to be color. As the subject sorted the response cards he was informed whether he was "right" or "wrong". As soon as the subject made a certain number of consecutive correct responses (reinforcing or confirming triangles), the experimenter shifted the problem with no explanation to the subject and began to call the number classifications "right" and all others, including color, "wrong". In this way the "correct" classification or category was later shifted from number to form, then back to number, then to color and finally to form. The subject's only cue to the shift was in the experimenter's "right" or "wrong".

The WCST may be scored on number of cards correct, perseverative errors (sorting to a category just after it was correct, but is no longer so), non-perseverative errors and unique errors (sorts not according to any of the three categories i.e., position of objects on the card), or combination of these. A study of Berg (6) among college students showed large differences in perseveration. A separate group of older persons (averaged 66 years old) had a great deal of perseveration. Grant and Berg (29) found that the greater the number of reinforcing trials (correct trials per category) in a series of three to ten, the fewer the errors. Basescu (4) repeated this procedure but found no differences. Results from other studies show that the number category was easiest to sort, then form and lastly color (28,30).
Ross, Rupel and Grant (62) studied the differential effects on abstract behavior produced by administering the WCST under eight combinations of personal, impersonal and physical stress. They found that the electric shock, the physical threat, alone or in combination with other factors was the only variable which degraded performance on the WCST to a statistically significant extent as revealed by the analysis of variance; the effect on the test performance was general and certainly not confined to perseverative tendencies; and finally, the effect on card sorting behavior was transient as indicated by the lack of significant differences after the second stage.

The reliability of the WCST is similar to that of the Einstellung test, and also some subjects are lost due to not meeting the sorting criterion of ten correct sorts, particularly at the beginning.

Blum (8) studied the patterns of rigidity--flexibility of children and that of their parents to find out the correlation between them. He hypothesized a positive relationship of rigidity--flexibility between parents and children. The techniques used to measure it were: Child Transition Test, and the Adult Transition Test, based on the concept of "tolerance of ambiguity". Both tests consisted of a series of drawings wherein one figure (dog) is successively altered until it appears in the last drawing as a completely new figure (cat). The Adult Transition Test correlated positively (2 per cent level of significance) with the WCST.

His findings confirmed the hypothesis advanced, the rigidity--
flexibility of the child was found to correlate positively but not significantly with either the rigidity--flexibility of either the father or mother.

Several other tests, like Gottschald figures, and some described in Cattell (44), are also used, but their mechanisms are either similar to those described by Pinard or have too complex a content to be certain what they measure.

E. APPLICATION OF RIGIDITY CONCEPTS TO INTELLIGENCE

The majority of the studies relating measures of rigidity to intelligence show some relationship. Using the Einstellung test both Guetzkow (32) and McNemar (54) found the rigidity test to differentiate groups high and low in reasoning ability for "overcoming set". Guetzkow found males less rigid than females.

McMurray (53) used a modified version of the WCST test to study rigidity in conceptual thinking in exogenous and endogenous mentally retarded children. It was demonstrated that the brain-injured are significantly more rigid in conceptual thinking as shown by their greater tendency to perseverate in the card sorting task. The exogenous child is indeed less able to shift his mental set from a sorting principle such as color to another such as form or number. Such findings warrant the conclusion, that the relatively poor drawing performance of the exogenous defectives on such memory for design tests as that found at year IX on the Binet are not due to faulty memory but to such factors as perseveration and rigidity in conceptual thinking.
With the regular WCST, Basescu (4) differentiated among college students on the intelligence level; he also manipulated the number of reinforcement trials, and found that with more such trials, high I.Q. persons became less rigid, low I.Q. persons became more rigid. He hypothesized that reinforcement acts to differentiate relevant from irrelevant features of stimuli for high I.Q. persons, but acts to accustom low I.Q. persons to a particular pattern without any selective differentiation. Finally, Huler (36) using some perseveration tests described by Cattell, found moderate correlation between perseveration and intelligence; however, holding I.Q. constant, there was no relation between perseveration and concrete thinking.

F. APPLICATION OF RIGIDITY TO OTHER PSYCHOLOGICAL ENTITIES: EXPERIMENTAL STUDIES

Among those who have studied rigidity relating it to other psychological factors is Rokeach (60), who stimulated research on the relation of rigidity of thought to personality variables with his study on ethnocentrism. He interpreted his findings, using the Einstellung test among others as showing a significant relation between rigidity and ethnocentrism. Brown (9) found the same result only when stress was a part of the situation. Rokeach (61) later changed emphasis from "rigidity" of thought to "concreteness" of thought (the latter was a criterion of the former), as measured by simplification of thinking in writing things down, etc. He then found a relation between ethnocentrism and concreteness of thought.

Cowen and Thompson (19) found that the Einstellung problems
failed to differentiate subjects on adjustment as shown by questionnaire personality tests, but did differentiate judges' ratings of personality from Rorschach protocols. Schmidt (65) and others found a significant correlation between the Einstellung test and the Wesley Rigidity Scale.

Goodstein (27), also using the Einstellung test, among others, found few significant correlations between the rigidity measures and several of the Thurstone Social Attitude Scales. He concluded that "rigidity" may not be a useful concept. Drevdahl (22) explored some of the relationships between creativity and various intellectual and personality characteristics. He obtained a group of creative college students by means of judges' ranking, and several tests designed to measure a variety of intellectual and personality characteristics. These tests were several of Guilford's creativity factor tests, Thurstone's Primary Mental Ability Test and Cattell's sixteen Personality Factor Questionnaires. He found that creative persons appear to be significantly superior to non-creative persons in their verbal fluency, flexibility and originality. Creative persons appear to be somewhat more withdrawn and quiescent as well as more sophisticated, radical in their social views and self-sufficient, than non-creative persons.

Barron (3) studying complexity-simplicity as a personality factor noticed the influence of these two bipolar factors in perceptual preferences. The artists liked figures which were highly complex, asymmetrical, free-hand rather than ruled and rather restless and
moving in their general effect. The figures which were liked by people in general were relatively simple, often bilaterally symmetrical and regularly predictable. These figures were described by artists as "static", "dull" and "uninteresting". He compared this factor with ratings and scales, and found that high complex persons were higher on things like verbal fluency, originality depression and independence of judgement; while low-ranking persons in complexity were higher on things like good adjustment, lack of deceitfulness, ethnocentrism and rigidity.

In summary the majority of studies show some relation between rigidity and intelligence; however, the relation to personality variables is ambiguous, only some of the studies showing positive results. There are some methodological problems in these studies. First, most of them use college students, which may cause restriction in one or more of the variables tested. Secondly, many of the measuring instruments are not clear as to what they measure, possibly bringing in irrelevant factors which cloud the results. Finally, few of the results, even when positive, are really clear-cut and not subject to an ambiguous interpretation.

G. IS RIGIDITY A GENERAL OR SPECIFIC FACTOR?

Several studies have proposed the question of whether rigidity is a general trait or is specific to content of tests. Rokeach (60) interpreted his ethnocentrism findings as indicative of generality, as did Pinard (55) with his set of four tests as mentioned above.
Schmidt and others (65) interpreted the correlation with the Wesley Scale as indicative of trait consistency, as did Cowen and others (20) who set up a rigidity task ("alphabet maze") for a different cognitive area from that of the Einstellung test, and obtained a moderately high correlation between the two.

Cynamon (21), Huler (34), Belmont (5) and Pitcher and Stancey (56), all using either their own special tests of rigidity or specialized tests like those described by Cattell, found rigidity to be specific to certain areas. Scheier and Ferguson (64) and Kleemeier and Dudek (40) constructed batteries of simple tasks "in hope that factors would be more easily identified", consisting of different areas, but a test of rigidity for each area. Factor analysis in both studies failed to show a factor of rigidity.

Again, problems of college samples and lack of homogenous tests content give these findings ambiguous interpretation. At best, we can say that the question is still undecided.

H. RIGIDITY AND PROBLEM SOLVING

Birch (7,8) in his studies with chimpanzees concluded that a necessity for insightful problem solving was ability to shift from one "conceptual organization" to others. The best condition (more flexibility in response) for this was that of a moderate degree of moderation, inasmuch as subjects under high motivation became rigid in response as they approached the goal. McGeoch and Irion (52, PP.299-347), summarizing several studies dealing with this "set
transfer" by use of current learning, concluded that such transfer tends to be temporary; however, this finding may be due to the types of learning studied and lack of chance for "adequate" reinforcement. They stated that transfer by "modes of attack" is a subtle vehicle of transfer. This "mode of attack" principle has been specifically studied by Harlow (33). He called it "learning how to learn", in which subjects get a learning set from solving a block of problems of similar content and transferring the principle of solution to new problems. The relatively quick solution of the new problems is then often called "insight". The principle of solution itself becomes a set, hence the term "learning set". Such a concept of a learning set may well have a learning basis, aside from the evidence by Harlow. Riopelle (58) in an analysis of interproblem transfer relations, showed that partial perseveration of stimuli from one problem to the following, elicits positive transfer if the stimulus plays the same role in both problems, but elicits negative transfer if its role is reversed. These results were interpreted to indicate the significance of interproblem transfer for the formation of learning sets.

Rees and Israel (57) studied properties of sets, and found that sets derived from training and experience are equal in strength to those from verbal instruction. Furthermore, sets may operate quite effectively without an individual's awareness of its presence. It is an hypothesis of this study that such a set is indeed formed, becomes strong through continued and partial reinforcement, and has the nature of ability to shift particular sets in order to solve
problems.

In summary, the theory concerning mental rigidity tends to be vague, but recent experimenters seem to regard it in terms of ability to overcome an established set, especially if the set no longer represents the most efficient route to the goal. Several theorists have linked rigidity to intelligence, particularly the feebleminded end of the continuum. Studies linking rigidity with personality variables show ambiguous and conflicting results and there is disagreement on whether rigidity is a general trait or is specific to task content. Finally, several experiments suggest the possibility that rigidity has a learned basis.
CHAPTER III

RELATION OF RIGIDITY OF SET TO INTELLIGENCE

As indicated in the previous chapter, the definition of rigidity of set combines the concept of rigidity as used by Schroeder and Rotter and the development of learning sets as formulated by Harlow. The Schroeder and Rotter definition is given again here: "Flexibility is the expectancy that more than one route to the goal will lead to reinforcement". Rigidity is a failure to learn this; it consists of approaching a situation with the expectancy that a single pathway leads to reinforcement, and does not change, it is restricted attention to a given set of cues. The Harlow "learning set" concept as indicated in the previous chapter, consists of the transfer of a principle of learning from one block of problems to other blocks of problems. In other words, the application of a single principle of learning to different types of problems. Thus combined, the concept of rigidity of set is: a problem-solving a pattern established containing the expectancy that more than one method may lead to solution (rigidity), (of course, there is a continuum between the extremes of flexibility and rigidity). Translating this into practice it would mean that the more flexible individual would find it easier to shift his method of attack when the current method is not succeeding, while the more rigid individual will tend to continue with the same method even though it is not succeeding.
It is our hypothesis, that this rigidity of set is learned. Studies using "short term" learning which tend to confirm this are those of Jersild and Schroeder and Rotter for rigidity, and Harlow and Rees and Israel for learning sets, all these studies have been reported in the previous chapter.

Piaget, it will be remembered, interpreted intelligence as a building up of perceptual habits, using experience. Baldwin (2) conducted research based upon the observations of preschool children to measure, with the Fels Rating Scales, certain aspects of children's personalities and also the type of home living atmosphere (degree of democracy or parental control) and found differences, depending on the type of home atmosphere, in such traits as aggressiveness, competitiveness, quarrelsomeness and resistance, plus curiosity on the one side, and on the other emotional excitability, intensity of emotional response and impatience. Cruelty too is almost significantly greater. The implication is that degrees of such traits are a function of what is learned in home atmosphere. McClelland in his book on Personality (51, pp. 216-217) has defined traits as learned: "A trait is the learned tendency of an individual to react as he has reacted more or less successfully in the past in similar situations". A further indication for this possibility is the apparent applicability of "laws" of reinforcement to this behavior. It may be expected that such behavior (rigid or flexible) would be partially reinforced, considering all situations. Jenkins and Stanley reviewing and criticizing available literature on partial reinforcement with
main emphasis on the effects of partial reinforcement on acquisition, maintenance of behavior and resistance to extinction, found that with "partial reinforcement" the response habit: a) strengthens somewhat less rapidly, b) the behavior in post-acquisition performance is more stable though maintained usually at a lower level, and c) is much more resistant to extinction than are response habits after 100 per cent reinforcement. From this, we might hypothesize that rigidity of set is a learned behavior, relatively low in establishment, but becoming stable and resistant to extinction with time.

In the previous chapter the nature of rigidity was considered in its double aspect, namely, general and specific. Several studies concluded that it was specific to content, while others concluded that it is a general trait. It does not appear that any of these studies have shown sufficient clear-cut results in order to take a definite stand. However, from the definition of rigidity of set as stated above, it should be expected that this type of behavior is general in problem-solving situations, but specific as relating to personality variables. Therefore, one may consider different aspects of a general rigidity factor which will manifest themselves in personality variables (such as ethnocentrism, tolerance of ambiguity, etc.) and in solving any problem, social or non-social in nature. A possibility for investigation relative to content was suggested by Baseaescu (4), where tasks are categorized as consisting of integrating or differentiating mental functions; it is the differentiating function that is related to rigidity (poor integration is
manifested in distractibility). (See also Werner's differentiation between feebleminded groups on a basis of ability to integrate and differentiate, as included in the previous chapter.) This latter dichotomy relating to content of material, if valid, may account for apparent specificity within levels, if such be the case.

CRITERIA OF INTELLIGENCE AND RIGIDITY OF SET

In this study two criteria of intelligence have been taken. The first, with grade school students, is the Wechsler Intelligence Scale for Children. The second, using the same sample is grade point average. The grade point average is used, even though it is probably further removed from intelligence than an intelligence test score. The expected homogeneity on I.Q. scores would make interpretation and generalization more difficult.

These two criteria should not be confused with intelligence (as defined in this paper) as such. As stated in the introduction, there may be difficulties in current intelligence test theory which make it inadequate to some extent as a measure of intelligence. Intelligence is here conceived as being made up of natural ability plus cultural and informational training plus motivational aspects. The cultural and informational training relate to learned cultural values and goals, along with the informational material to which the individual is exposed. The motivational aspects refer to immediate motivation, including test rapport, and a long range, personal motivation (e.g., desire to make good grades).
Therefore, a measure of "intelligence" should be a function of measures of intellectual ability and "cultural training", plus in the case of school course grade, a special measure of motivation and study habits. In a similar vein Thorndike (69,p.203), considers the maturity level of the problem solver as a major factor influencing the ability to form hypotheses. Of course, intellectual maturity and richness of informational background, he says, go together, so that usually the more mature individual also has the greater store of information and experience to draw upon. But, apart from the accompanying experience, one of the marks of intellectual development is the readiness with which he produces concepts. General intelligence has been defined as the ability to educe relationships and correlates. As with most theories of intelligence, personality factors as such are excluded from the system presented here.

Intelligence could also be considered as "an approach to problem solving" in terms of flexibility rigidity. Basascu found (as mentioned in the previous chapter) that with more reinforcements in the WCST situation, high I.Q. persons scored better, and low I.Q. persons scored worse, and this may be related to rigidity of set theory in that more reinforcement gives more chance for flexible behavior (concerning high I.Q. persons), but acts to accustom more rigid persons (low I.Q.) to the single solution expectancy.

However, there may well be other factors involved in intelligence. One may consist of an "ability to perceive cues"; that is, more intelligent persons may perceive more cues that are relevant to
the situation than do less intelligent persons (again, this may be part of the definition of rigidity by Schroeder and Rotter--restricted attention to a given set of cues). It seems quite possible that this, too, is learned (allowing for biological structural characteristics related to sensation), as seeking of new cues may be reinforced (avoidance of new cues may also be reinforced). This factor may be similar to the second component in Thorndike's intellectual factor of "intellectual maturity level", which is a combination of "fluency of ideas" and "readiness of apprehending relationships". Again, this factor may have a relation to ability to learn, under a definition of learning as "perception of relations".

A third factor may be a sort of role-taking, as indicated in the first chapter. This consists in the individual assuming a position that he feels others expect of him; this has motivational components, and if present at all, is probably at a low level of consciousness. Two of the above mentioned factors are quite tenable, however, for the purpose of this study, the first--rigidity of set--could be considered like perseveration as it is interpreted in more recent investigations.

Spearman (67) seems to provide the best explanation thus far proposed for the fact that a perseverative tendency is manifested in the realms of sensations, movements and ideas.

Spearman names five principles which govern cognition, "not in respect of quality, but only in that of quantity" (67). One of these is the principle of retentivity, according to which every cognitive
event has a tendency to recur... This principle, he states, manifests itself in two ways: facilitation and inertia. Inertia refers to the fact that "cognitive events always both begin and cease more gradually than their (apparent) causes" (67). Rigidity as perseveration are examples of inertia.

According to the theory of inertia, the well-known 'g'-factor and the factor of rigidity and perseveration are both concerned with mental energy. Stephenson (68) interprets this theory to signify that the 'g'-factor may be regarded as an individual's available mental energy and the 'P'-factor as the amount of inertia of that energy. Thus, the 'P'-factor is regarded as characteristic of an individual, just as is his 'g'.

Stephenson says, "we may picture general mental energy 'switching' with extreme sluggishness from a group of neurons subserving a particular mental activity to another subserving a different activity, as when a mental activity begins or ends in an individual who is sleepy or narcotically drugged; antithetically, the energy may "switch" with great facility, instantaneously, from one operation to another, as, perhaps occurs in the maniacal patient. Degrees of this sluggishness, instantaneous antithesis, it seems, is what is measured by 'P'-factor. The sluggishness is high 'P', high inertia; the instantaneity is low 'P' (68). In concluding that, for the present we have to employ the theory of mental inertia as that best-fitted to explain the 'P' scores (68).

The pertinency of Spearman's theories to the present investiga-
tion is rather doubtful. We do not presume with Earle that 'g' is taken to be roughly equivalent to the "general intelligence". Neither can we assume from Stephenson's apparent use of 'g' and "intelligence" interchangeably that 'g' is synonymous with intelligence as measured in the I.Q. test examinations.

Cattell (14), following the paradigm of general and specific factors set up by Spearman, hypothesized two types of mental capacities: (1) general, or ability to discriminate and perceive relations between fundamentals; that is, responsible for the intercorrelations which produced 'g' variance; (2) specific, or discriminatory habits in a particular field, but no longer requiring insightful perception for their successful operation. Cattell stated that a combination of the two factors is present in all intelligence tests, but the general predominates in childhood, the specific in adulthood.

Since, however, there are no definite available data pertaining to the relationships between rigidity or perseveration score and intelligence quotient it seems well to mention here the meager facts, which are given regarding the relationship of the (P'-factor to 'g'). These are somewhat contradictory.

The results of one of Cattell's (16) earlier investigations indicated that high perseveration tended to be associated with low 'g' especially with feebleminded persons. Stephenson also found a negative, though small correlation, between perseveration tests and 'g' in one of his studies (68).

In a later publication Cattell says that: "Perseveration, as
measured in tests, is a short-time effect. It is a kind of inertia in nervous processes as they are made to respond to the will. It is the persistence of old, habitual responses in face of new ones which the will seeks to set up. 'P'-factor has no relation to intelligence, or fluency, or introversion." (16)

The latter statement of Cattell agrees with Spearman's view that 'P' and 'g' vary independently of each other. Both seem to deal with mental energy: 'g' measures quantity, 'P' may express degree of inertia (67). It is also in substantial agreement with Stephenson's statement that "...normality, 'P' and 'g' have no correlations". (68)

HYPOTHESIS

A negative correlation is predicted between intelligence as measured by the Wechsler Intelligence Scale for Children, and Grade Point Average and a combination of rigidity of set as measured by the Einstellung test. The hypotheses of this study are:

1. The more rigid the individual, the less will be his school achievement.

2. The more intelligent the person, the less rigid he will be.

A real difference is predicted in favor of the hypotheses, namely, the more rigidity the less achievement, and the more intelligence the less rigidity.
CHAPTER IV

THE EXPERIMENT: METHOD, THE TESTS, PROCEDURE, SUBJECTS AND SCORING

In order to study behavioral rigidity, we employed the Einstellung test which has been described above. The test was given to a group of 120 subjects. Their task was to figure out how they can obtain a stipulated value of water in each of the series of numerical problems. The problems are as follows:

1. Given: an empty 29 quart jar, an empty 3 quart jar; measure 20 quarts of water.
2. Given: an empty 21 quart jar, an empty 127 quart jar and an empty 3 quart jar; measure 100 quarts of water.
3. Given: an empty 14 quart jar, an empty 163 quart jar and an empty 25 quart jar; measure 99 quarts of water.
4. Given: an empty 18 quart jar, an empty 43 quart jar and an empty 10 quart jar; measure 5 quarts of water.
5. Given: an empty 9 quart jar, an empty 42 quart jar and an empty 6 quart jar; measure 21 quarts of water.
6. Given: an empty 20 quart jar, an empty 59 quart jar and an empty 4 quart jar; measure 31 quarts of water.
7. Given: an empty 23 quart jar, an empty 49 quart jar and an empty 3 quart jar; measure 20 quarts of water.
8. Given: an empty 15 quart jar, an empty 39 quart jar and an empty 3 quart jar; measure 18 quarts of water.
9. Given: an empty 34 quart jar, an empty 85 quart jar and an empty
17 quart jar; measure 17 quarts of water.

10. Given: an empty 26 quart jar, an empty 65 quart jar and an empty 13 quart jar; measure 13 quarts of water.
11. Given: an empty 28 quart jar, an empty 76 quart jar and an empty 3 quart jar; measure 25 quarts of water.
12. Given: an empty 14 quart jar, an empty 21 quart jar and an empty 4 quart jar; measure 10 quarts of water.
13. Given: an empty 15 quart jar, an empty 32 quart jar and an empty 6 quart jar; measure 9 quarts of water.
14. Given: an empty 35 quart jar, an empty 69 quart jar, and an empty 5 quart jar; measure 30 quarts of water.

The first task is for illustrative purposes. Problems 2 through 6 are the Einstellung or "set" problems, each of which can be solved by one relatively complex procedure. If the three jars in the order listed are designated as A, B, C respectively, then the solution to each of these problems may be represented by the formula B-A-2C; e.g., 127 - 21 - 2 x 3 = 100 gives the solution to problem 2.

These Einstellung or "set" problems are followed by four critical problems, each of which is solvable by the B - A - 2C method as well as by one or two direct procedures. In problem 7 the direct method may be represented by the formula A-C (23-3 = 20). In problem 8 the direct method is A + C (15 + 3 = 18). In problems 9 and 10 the direct methods are A-C and the filling of the C jar, e.g., the ninth problem is solvable by any of these methods; 85 - 34 - 2 x 17 = 17 (B - A - 2C), 34 - 17 = 17 (A - C), 17 (C). The criticals are followed by four
extinction tasks solvable by the complex procedure, B - A - 2C.

Six children, three from the seventh grade and three from the eighth grade, served as subjects in the preliminary work of simplifying and standardizing the procedure to be used in the test of rigidity. The scores of these children are not included in the findings given here. Observation of the responses and the test-behavior of these children furnished the basis for the necessary simplification of instructions, and for changing the technique used in the test. The Einstellung test was administered to this group giving them two and a half minutes to solve the problems and seeing that most of the subjects could not answer the problems in that period of time, then, a period of five minutes was established, which was sufficient for all the subjects to finish their tasks without too much hesitation.

The test was administered in a large classroom in two different groups, taking 60 subjects in each group. Precautions were taken to avoid any communication among subjects.

The children were assured that this was an experiment, not a school test, that their teachers and principal would not see the papers, and that it would in no way affect their scholastic standing. While they were solving the problems, it was pointed out that they might not approximate and that they might not use jars other than those given in each problem, and that it might not be necessary to use all of the jars given in the statement of the problem in their solutions.

The problems are written on the blackboard one at a time. Each
problem is allowed to remain five minutes and then erased. Each subject is given a booklet and they are told to write their responses to each problem on a new sheet of the examination booklet which has been given to them, and not to turn back to any previous page to check any of the previous solutions.

After these instructions, the first problem is written on the blackboard. After the subjects attempt a solution to the first problem (illustrative problem), for five minutes, the Experimenter illustrates how it can be solved by filling the 29 quart jar and from it pouring off three times into the 3 quart container. This is also written on the blackboard in the form $29 - 3 \times 3 = 20$. After subjects have been allowed five minutes for the second problem, Experimenter gives again the solution verbally and by writing it on the blackboard this way; $127 - 21 - 3 - 3 = 100$. He also illustrates another method of solving this problem; $127 - 9 \times 3 = 100$. No further help is given. We are interested in whether the subject employs the $B - A - 2C$ method or one of the direct methods ($A - C$, $A + C$, $C$) in the criticals and whether he fails to solve the extinction tasks which are solvable by an $A - C$ procedure but not by the complex procedure. Solutions of the criticals in the $B - A - 2C$ method are usually regarded as indicative of the development of a mental set or Einstellung, and failures of the extinction tasks are usually interpreted as evidence of difficulty in surmounting the set. We will use failures of the extinction tasks as the criterion of the behavioral rigidity.
The Einstellung test of rigidity can be scored by using the failure to solve the extinction tasks as an operational index of behavioral rigidity or by using the B - A - 2C solutions of the criticals as the criterion of behavioral rigidity.

Using the failure to solve the extinction tasks as the index of rigidity we divide the subjects into four groups.

**Group I.** Consists of all the subjects who solved all the critical problems and all four extinction tasks by direct methods, i.e., who did not show any B - A - 2C solutions or failures to these problems.

**Group II.** Is made up of those subjects who used the B - A - 2C method in the first or second critical problem, or both, but who solved all subsequent problems by direct method.

**Group III.** Contains those subjects who used the B - A - 2C procedure in the first three critical problems or in all four critical problems but who solved all the extinction tasks.

**Group IV.** Contains those subjects who used the B - A - 2C method in all four critical problems and who failed to solve any of the four extinction tasks.

Following this scoring method, we eliminated from further consideration the papers of 24 subjects who have failed to solve any of the "set problems" from 2 to 6, or who had solved them in a manner other than the B - A - 2C practice prior to the presentation of the criticals. There then remained 96 subjects whom we tried to classify into the four above mentioned groups. This was done in order to simplify the comparison of responses in the Einstellung test with
the other two measures employed in the experiment. This resulted in the elimination of another 35 subjects, so that there remained 61 subjects who fell into one of the four groupings.

Interpreting these groupings in the terminology of Einstellung, we may say that subjects in Group I showed no overt signs of having developed an Einstellung or "set" for the use of the 8 - A - 2C method, that subjects in Group II showed signs of having developed an Einstellung from which they readily recovered, that subjects in Group III did not recover so rapidly from their Einstellung, and that subjects in Group IV apparently manifested no recovery from their Einstellung, which was so strong that it blinded them to the solution of the four extinction tasks.

Following failures to solve the extinction tasks as evidence of behavioral rigidity, then it may be said that the least and the most rigidity would be manifested by subjects in groups I and IV, respectively.

Solution of the critical problem in the 8 - A - 2C manner may or may not be followed by failures of the extinction tasks; failures of the extinction problems are almost invariably preceded by 8 - A - 2C solutions (or occasional failures) of the critical problems. Thus, the criterion of behavioral rigidity based on the extinction problems actually entails the criterion based on the critical problems, while the reverse is not necessarily the case. Hence the most rigidity, based on the former criterion, would involve failures of all extinction problems as well as no direct solutions of the critical problems.
(Group IV), while the least rigidity would involve no failures of the extinction tasks as well as direct solution of every critical problem (Group I). Because of this we decided to compare Group IV with Group I, rather than with the combined data of Groups I, II and III, none of whose subjects failed the extinction tasks.

As measures of intelligence were administered, the Wechsler Intelligence Scale for Children (WISC), and the School Grade-Point Average (GPA). The WISC was developed as a downward extension of the Wechsler-Bellevue Intelligence Scale, and most of the items contained in the WISC are from form II of the adult scales (Wechsler 1949), easier items have been added to the low end of the subtests to make it suitable for use with young children.

The WISC consist of twelve subtests grouped into a Verbal Scale (Information, Comprehension, Arithmetic, Similarities, Vocabulary and Digit Span), and a Performance scale (Picture completion, Picture Arrangement, Block Design, Object Assembly, Coding and Mazes). Only ten were used to establish the I.Q. tables. Digit Span and Mazes were omitted primarily (because of their low correlation with the other subtests of the scale and also, in the case of Mazes, because of the time factor involved.

Wechsler suggests that all twelve subtests be given whenever possible "because of the qualitative and diagnostic data they add", but since in this project it was used mainly as a measurement instrument rather than a diagnostic one, the Digit Span and the Mazes were omitted.
The WISC I.Q.'s (Verbal, Performance, and Full Scale) are deviation scores based on norms from other children of the same age.

To assess the content validity of the WISC, a universe of items must be defined which is relevant to Wechsler's concept of children's intelligence. Unfortunately, beyond a few general remarks, no theoretical discussion of the concept of intelligence as it applies to children exists in print. To proceed, the assumption must be made that, at least in the more general aspects, the discussion of adult intelligence is applicable to children.

Wechsler's definition of intelligence is very broad. As far as the trait "general intelligence" is concerned, any item which is judged to tap a child's "aggregate or global capacity to act purposefully, to think rationally and to deal effectively with his environment", might be included as a potential test item. Defined at this rather gross level, it is difficult to conceive of any measure of directed behavior which would be definitely excluded.

Wechsler assumes that specific subtests tap not only general intelligence, but specific factors as well. The exact nature of the factors, however, is far from clear. Some hints are given by Wechsler as to what he considers these factors to be for the adults scales; no help is given in interpreting the meaning of the subtests of the WISC when applied to children, however, beyond the statement that the subtests seem to measure different factors in children than in adults.

The WISC does not have an adequate rationale. Much more thought
and effort need to be devoted to put the WISC on a firm theoretical foundation. At present, both the assessment of the test's content validity and the long process of constructed validation are severely handicapped by this lack of an explicit rationale.

Littell (45) says that much more systematic attention should be given to investigations of the many practical problems involved in the use of the WISC as a measuring device.

There appears to be a strong reason to suspect that the WISC scores are affected systematically by many variables other than intelligence, but little information about the exact nature of these variables and the relationships involved is available. Especially in need of systematic investigation is the effect on WISC scores of (a) variables in the relationship between examiner and examinee, (b) the circumstances of the examination and (c) repeated administrations of the WISC.

On the other hand, the WISC appears to be a relatively well-standardized test with many virtues. It correlates consistently well with other measures of intelligence, and appears to be widely accepted and used. Since the age of the subjects was between 13 and 15 years, the WISC was used as one of the measures of intelligence.

The WISC was administered individually to the 61 subjects who answered the Einstellung test in the way required by the pre-established manner of scoring the test. The subjects came to the school by appointment to take the test, this way communication about the test among the subjects was avoided. Whenever two brothers had to
take the test, they were tested successively. The Grade Point Averages (GPA) for the same 61 subjects were obtained from the school records.
CHAPTER V
RESULTS AND DISCUSSION

The subjects have been classified in four groups on the basis of their responses to the test of rigidity. In order to compare these four groups of rigidity with the WISC, I.Q.'s and the grade point average (GPA), the mean average of I.Q.'s and GPA's has been found for each group respectively.

When responses to the extinction tasks are used as a criterion of behavioral rigidity, as in our study, then the least and the most rigidity were manifested by subjects in Groups I and IV respectively, subjects in Group II appear to be less rigid than those in Group III.

An examination of the individual I.Q.'s of each group shows that the highest I.Q., 142, was obtained by a subject of Group II, the second highest I.Q. of 138 was made by a member of Group IV, while the highest I.Q. in Group I and III were 134 and 133 respectively. The trend is a little different when we look at the lowest I.Q.'s obtained in each group. The lowest was obtained by a subject of Group IV, an I.Q. of 90; the second lowest is found in Group II of 92; the lowest I.Q. of Group III is 96 and finally, Group I with the lowest I.Q. of 108.

If we take a look at the highest and lowest individual GPA obtained by the subjects of the four groups, we find very much the same trend as indicated in the I.Q.'s. The highest GPA is obtained by a member of Group II with a GPA of 98, while the highest score
in GPA obtained by the other three groups is of 95. The distribution of the lowest scores in GPA is as follows; Group I 80.28, Group II 74.86, Group III 75.00 and Group IV 67.00. The highest of the lowest scores is found in Group I, while the lowest is obtained by a subject of Group IV.

This brief survey of the extreme scores of the I.Q.'s and GPAs of the four groups of rigidity indicate that there is not an individual relationship between I.Q., GPA and rigidity, since individuals are found in the most rigid groups with as high or higher I.Q.'s and GPAs as those in less rigid groups.

Even though no individual relationship as found between I.Q., GPA and rigidity, a further analysis of the scores of each group manifest a difference in compactness or homogeneity among the distribution of scores as the groups increase in rigidity. This gradation in homogeneity is clearer in the GPA than in the I.Q. scores; in both I.Q.'s and GPA's, Group II shows greater variability of scores than Group III and in the I.Q. scores, Group II has even greater variability than Group IV.

The range index and the standard deviation of means for I.Q.'s and GPA's are as follows:

<table>
<thead>
<tr>
<th>I.Q.'s</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest score</td>
<td>134</td>
<td>142</td>
<td>133</td>
<td>138</td>
</tr>
<tr>
<td>Lowest score</td>
<td>108</td>
<td>92</td>
<td>96</td>
<td>90</td>
</tr>
</tbody>
</table>
The standard deviation of means for I.Q.'s and GPA's indicates the amount of spread or dispersion of the distribution of I.Q.'s and GPA's within each group. Thus, of the four groups, the one with the greater spread should yield the higher standard deviation. The standard deviation of means for I.Q.'s indicates that the greatest variability in I.Q. is found among subjects of Group II, followed by Groups IV and III, while Group I the less rigid group, contains the more compact group of I.Q.'s.

The standard deviation of means for the GPA shows a little different arrangement, where the greater variability of GPA is found in group IV, followed by Group II with a slight difference, with the more compact scores being found in Groups I and III respectively.

When the mean average of intelligence quotients and the mean average of grade point averages for the four groups of rigidity are compared, we discover that the highest average in I.Q.'s and GPA's is that of the least rigid group; and the lowest average corresponds to the most rigid one. The difference between the average scores
of the intelligence quotients and the school grade point average follows a gradual descending in the means as the groups gradually increase in rigidity.

The mean averages for the I.Q.'s and the GPA's for the four groups are as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean intelligence quotient</th>
<th>Mean grade point average</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>123.57</td>
<td>91.84</td>
</tr>
<tr>
<td>II</td>
<td>115.87</td>
<td>87.07</td>
</tr>
<tr>
<td>III</td>
<td>111.00</td>
<td>84.26</td>
</tr>
<tr>
<td>IV</td>
<td>107.35</td>
<td>79.85</td>
</tr>
</tbody>
</table>

The difference between the average I.Q. scores does not follow the same trend as the difference between the average GPA scores for the four groups. The difference between means in GPA is more, even between consecutive groups than that of I.Q. groups. The differences between means in GPA are 4.77 between groups I and II, 2.81 between II and III and 4.41 between the last two groups. The difference in I.Q. mean averages within consecutive groups is more, even for the last three groups than between the first two. The greatest difference of 7.70 is registered between groups I and II, with a difference of 4.87 between II and III and 3.65 between groups III and IV.

The correlation between I.Q. and GPA scores for each of the four established rigidity groups has been found and translated into product-moment coefficients. They are:

For Group I  \( r = .88 \)
For Group II \( r = .93 \)
For Group III \( r = .57 \)
For Group IV \( r = .53 \)

As we look at the coefficients of correlations we notice a great
difference between the coefficients of the first two groups when compared with the last two groups. A descending trend is observed in the product-moment coefficients as the groups increase in rigidity, except between the first two groups where the second group has a higher correlation than the first being more rigid.

Finally, the t-test for uncorrelated samples was calculated in order to determine the significance of a difference in means. A one-tailed test has been used in the experiment because the hypothesis being tested demands that we be concerned with chance deviations in just one direction. Besides, the outcome of the experiment has been predicted on the basis of theory and in these cases a one-tailed test is appropriate since some benefit should accrue to the researcher who has predicted the direction of the results as opposed to the investigator who, though obtaining similar results, has not predicted the direction. The benefit consists in that the difference, to be significant, does not have to be as large for a one-tailed as for a two-tailed test.

The t-test was obtained for the following groups: I-II, I-III, I-IV, II-III, II-IV and III-IV. The same number of t's and the same arrangement of groups was followed for the GPA.

<table>
<thead>
<tr>
<th>Groups</th>
<th>T-test</th>
<th>df</th>
<th>Significant at .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>I - II</td>
<td>1.06</td>
<td>13</td>
<td>2.16</td>
</tr>
<tr>
<td>I - III</td>
<td>2.56</td>
<td>23</td>
<td>2.07</td>
</tr>
<tr>
<td>I - IV</td>
<td>3.41</td>
<td>33</td>
<td>2.04</td>
</tr>
<tr>
<td>II - III</td>
<td>.731</td>
<td>24</td>
<td>2.06</td>
</tr>
<tr>
<td>II - IV</td>
<td>1.302</td>
<td>34</td>
<td>2.04</td>
</tr>
<tr>
<td>III - IV</td>
<td>1.49</td>
<td>44</td>
<td>2.02</td>
</tr>
</tbody>
</table>
### GPA Groups

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I-II</td>
<td>1.29</td>
<td>13</td>
<td>2.16</td>
</tr>
<tr>
<td>I - III</td>
<td>3.28</td>
<td>23</td>
<td>2.07</td>
</tr>
<tr>
<td>I - IV</td>
<td>4.82</td>
<td>33</td>
<td>2.04</td>
</tr>
<tr>
<td>II - III</td>
<td>0.83</td>
<td>24</td>
<td>2.06</td>
</tr>
<tr>
<td>II - IV</td>
<td>2.12</td>
<td>34</td>
<td>2.04</td>
</tr>
<tr>
<td>III - IV</td>
<td>2.24</td>
<td>44</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Looking at the t's of the I.Q. groups and entering the t-table with the corresponding degrees of freedom it is found that only the t's corresponding to I-III and I-IV groupings are significant at the .05 level. The obtained t's of 2.56 and 3.41 are larger than those required, so the difference is significant at the .05 level. For these two groups the null hypothesis is rejected and the difference in means is accepted as a significant difference. Accepting the difference as significant in these two groups (at the 5 per cent level) is equivalent to stating that a difference as large as that obtained would occur, due solely to sampling error in less than 5 out of 100 times. These odds of better than 95 to 5 are sufficient to allow the Experimenter to conclude that chance was not the cause of the difference between the two means. The cause of the difference, is taken to be the independent variable.

In the I.Q. groups only the alternative groups except Group II-IV give a significant t at the .05 level, and the more distance there is among the groups the more significant the t becomes. If we take a look at the t-test results for the GPA, we find that all the alternative groups and one consecutive group, namely III-IV, give significant t's at the .05 level. Since the obtained values of t in all the I.Q. alternative groups except group II-IV, and all the alternative
and one consecutive groups of the GPA are larger than those required, (as shown in the Table), so the difference is significant at the 5 per cent level. The null hypothesis is rejected and the difference in means of 12.75 in I-III and 16.22 in I-IV of I.Q. groups, and the differences of 7.58 in I-III and 12.26 in I-IV and 7.49 in II-IV and 4.68 in III-IV groups of the GPA are accepted as significant differences, that is, the cause of the differences between the means is not due to mere chance, but to the independent variable. This significant difference is in the direction predicted in the hypotheses.

Even though there is not an individual relationship between I.Q., GPA and rigidity, our hypotheses still stand. A real difference has been shown in favor of the hypotheses, namely, to more rigidity less school achievement, and to more intelligence less rigidity. School achievement has proven to be a more constant and sensitive indicator in relationship to rigidity since all the alternative groups and one consecutive group show a significant difference.

Even though not all the consecutive groups are significant at the .05 level, they indicate a difference both in degree and direction of relationship between I.Q., GPA and rigidity.

There was another distinction between subjects of the different groups which is not revealed by these figures. This was the difference in the subjects test behavior.

If the subjects were rated in cooperation, there would be little difference between individuals or groups. Each child seemed to give careful attention to the instructions. Nevertheless, it was noticed
that while almost all the subjects took the same amount of time to solve the first six problems or the Einstellung set, when the criticals and the extinction problems started to come in, there was a difference in the amount of time the subjects employed to solve the problems. Those less rigid subjects of Groups I and II who were able to shift from the complex method to the more direct method finished their tasks earlier, while those in Group III took the whole, or almost the whole period, to find out the solution. Those of Group IV took the whole period and some of them not being through found it hard to give up at the end of the period.

There was also a significant difference in the interest shown by the various subjects after the completion of the test. The large majority of the subjects in Groups I and II asked questions regarding the purpose of the test. Many children of these two groups were interested in getting the results and knowing about their performance in the test. Several subjects of Group IV on the other hand, complained of not having enough time to complete their tasks.

To summarize, rigidity of set was found to be moderately related to I.Q. and GPA. As hypothesized, there is a relationship between intelligence and rigidity, and school achievement and rigidity.

Some of the more overt limitations in these studies which should be considered in interpretation are the relativecrudeness of the measuring instruments, especially that of rigidity.
For the purpose of this study intelligence is defined as the degree of flexibility-rigidity in the approach to problem solving ("rigidity of set"), although possible additional factors are discussed. Measures of intelligence are then hypothesized as being made up of intellectual ability plus factors of cultural and informational training. Viewed in another way, this rigidity of set intelligence may be regarded as a "general" factor in intellectual ability, while the cultural and informational training components make up "specific" factors in a Spearman general specific scheme. One purpose of this study was to determine the relation of this rigidity of set to various measures of intelligence—WISC, I.Q., and school grade point average (GPA) of a group of seventh and eighth grade school children.

Definition of intelligence in terms of a behavioral process may be more profitable for further experimentation and prediction, concerning intelligence, than are the current definitions which largely involved descriptive statements with little understanding of causality beyond "heredity". The latter approach results in problems which some workers feel are rather serious deficiencies in applications of intelligence testing, such as lack of criteria for adult testing, cultural bias in items and lack of predictive ability with tests at the very young ages. A "behavioral process" approach would be more
helpful to individuals who are inadequately "labeled" due to the above and possibly other factors. Finally, rigidity of set is hypothesized as being learned and a number of studies tending to confirm this were cited. Results of studies on the heredity versus environment problems are interpreted as being ambiguous in their interpretations, largely due to the poor identification of the relevant factor involved, aside from statistical difficulties.

The relation of rigidity of set to WISC, I.Q. and GPA was measured by using four groups divided according to the solutions to the extinction problems of the Einstellung Test of Rigidity.

Several conclusions may be drawn from the results of this experiment.
1. A negative correlation is found in all the groups between rigidity measures and I.Q. and GPA. The coefficients of correlation are lower as the groups increase in rigidity, except in Group II which has, though not significantly, higher correlation with a difference of .05 than Group I, being considered more rigid.
2. When each of the groups is considered separately, we find that the homogeneity or compactness of the I.Q. scores and GPA scores decrease as the groups become more rigid.
3. When the mean Intelligence Quotient and the mean Grade Point Average for each group are considered, a constant and rather gradual decrease is observed as the groups increase in rigidity.
4. The t-test for uncorrelated samples has been calculated for all the I.Q. and GPA groups, the t-scores obtained (applying one tail test)
indicate a significant difference at the .05 level for all the alternative groups.

Finally, on the basis of these facts, we may conclude that a moderate relationship is found between rigidity of set and WISC, I.Q. and GPA in a group of seventh and eighth grade students.
### TABLE I
INTELLIGENCE QUOTIENT AND GRADE POINT AVERAGE CORRESPONDING TO EACH SUBJECT

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123</td>
<td>91:43</td>
<td>31</td>
<td>120</td>
<td>82:14</td>
</tr>
<tr>
<td>2</td>
<td>128</td>
<td>95:00</td>
<td>32</td>
<td>101</td>
<td>75:14</td>
</tr>
<tr>
<td>3</td>
<td>129</td>
<td>94:57</td>
<td>33</td>
<td>98</td>
<td>80:00</td>
</tr>
<tr>
<td>4</td>
<td>134</td>
<td>95:00</td>
<td>34</td>
<td>90</td>
<td>68:86</td>
</tr>
<tr>
<td>5</td>
<td>133</td>
<td>95:00</td>
<td>35</td>
<td>92</td>
<td>73:00</td>
</tr>
<tr>
<td>6</td>
<td>110</td>
<td>80:28</td>
<td>36</td>
<td>110</td>
<td>91:43</td>
</tr>
<tr>
<td>7</td>
<td>108</td>
<td>91:57</td>
<td>37</td>
<td>108</td>
<td>78:71</td>
</tr>
<tr>
<td>8</td>
<td>92</td>
<td>74:86</td>
<td>38</td>
<td>105</td>
<td>82:14</td>
</tr>
<tr>
<td>9</td>
<td>100</td>
<td>76:00</td>
<td>39</td>
<td>97</td>
<td>79:43</td>
</tr>
<tr>
<td>10</td>
<td>107</td>
<td>87:86</td>
<td>40</td>
<td>109</td>
<td>89:43</td>
</tr>
<tr>
<td>11</td>
<td>107</td>
<td>79:71</td>
<td>41</td>
<td>100</td>
<td>92:71</td>
</tr>
<tr>
<td>12</td>
<td>125</td>
<td>95:00</td>
<td>42</td>
<td>133</td>
<td>95:00</td>
</tr>
<tr>
<td>13</td>
<td>142</td>
<td>98:00</td>
<td>43</td>
<td>109</td>
<td>81:00</td>
</tr>
<tr>
<td>14</td>
<td>133</td>
<td>92:43</td>
<td>44</td>
<td>122</td>
<td>92:86</td>
</tr>
<tr>
<td>15</td>
<td>121</td>
<td>90:71</td>
<td>45</td>
<td>103</td>
<td>74:86</td>
</tr>
<tr>
<td>16</td>
<td>101</td>
<td>82:00</td>
<td>46</td>
<td>123</td>
<td>84:43</td>
</tr>
<tr>
<td>17</td>
<td>99</td>
<td>89:14</td>
<td>47</td>
<td>124</td>
<td>90:57</td>
</tr>
<tr>
<td>18</td>
<td>117</td>
<td>85:00</td>
<td>48</td>
<td>107</td>
<td>89:28</td>
</tr>
<tr>
<td>19</td>
<td>109</td>
<td>82:86</td>
<td>49</td>
<td>111</td>
<td>84:43</td>
</tr>
<tr>
<td>20</td>
<td>107</td>
<td>80:28</td>
<td>50</td>
<td>138</td>
<td>80:57</td>
</tr>
<tr>
<td>21</td>
<td>109</td>
<td>78:86</td>
<td>51</td>
<td>101</td>
<td>80:00</td>
</tr>
<tr>
<td>22</td>
<td>133</td>
<td>90:85</td>
<td>52</td>
<td>109</td>
<td>78:57</td>
</tr>
<tr>
<td>23</td>
<td>96</td>
<td>80:28</td>
<td>53</td>
<td>92</td>
<td>67:00</td>
</tr>
<tr>
<td>24</td>
<td>108</td>
<td>83:43</td>
<td>54</td>
<td>92</td>
<td>75:28</td>
</tr>
<tr>
<td>25</td>
<td>113</td>
<td>90:00</td>
<td>55</td>
<td>115</td>
<td>88:13</td>
</tr>
<tr>
<td>26</td>
<td>117</td>
<td>79:00</td>
<td>56</td>
<td>108</td>
<td>94:57</td>
</tr>
<tr>
<td>27</td>
<td>115</td>
<td>95:00</td>
<td>57</td>
<td>130</td>
<td>86:57</td>
</tr>
<tr>
<td>28</td>
<td>125</td>
<td>90:57</td>
<td>58</td>
<td>87</td>
<td>87:28</td>
</tr>
<tr>
<td>29</td>
<td>133</td>
<td>90:14</td>
<td>59</td>
<td>91</td>
<td>73:28</td>
</tr>
<tr>
<td>30</td>
<td>97</td>
<td>81:57</td>
<td>60</td>
<td>110</td>
<td>92:14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>61</td>
<td>90</td>
<td>77:86</td>
</tr>
</tbody>
</table>
### TABLE II

CLASSIFICATION OF SUBJECTS INTO GROUPS ACCORDING TO RIGIDITY

**Group I.** Consists of those subjects who solved all four critical problems and all four extinction tasks by direct methods, i.e., who did not show any 8 - A - 2C solutions or failures of these problems.

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>134</td>
<td>95:00</td>
</tr>
<tr>
<td>2</td>
<td>133</td>
<td>95:00</td>
</tr>
<tr>
<td>3</td>
<td>129</td>
<td>94:57</td>
</tr>
<tr>
<td>4</td>
<td>128</td>
<td>95:00</td>
</tr>
<tr>
<td>5</td>
<td>123</td>
<td>91:43</td>
</tr>
<tr>
<td>6</td>
<td>110</td>
<td>80:28</td>
</tr>
<tr>
<td>7</td>
<td>108</td>
<td>91:57</td>
</tr>
</tbody>
</table>

**Group II.** Consists of those who used the 8 - A - 2C method in the first or second critical problems or both, but who solved all subsequent problems by direct method.

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>142</td>
<td>98:00</td>
</tr>
<tr>
<td>2</td>
<td>133</td>
<td>92:43</td>
</tr>
<tr>
<td>3</td>
<td>125</td>
<td>95:00</td>
</tr>
<tr>
<td>4</td>
<td>121</td>
<td>90:71</td>
</tr>
<tr>
<td>5</td>
<td>107</td>
<td>79:71</td>
</tr>
<tr>
<td>6</td>
<td>107</td>
<td>87:86</td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>76:00</td>
</tr>
<tr>
<td>8</td>
<td>92</td>
<td>74:86</td>
</tr>
</tbody>
</table>
**Group III.** Consists of those who used the B - A - 2C procedure in the first three critical problems or in all four critical problems but who solved all four extinction tasks.

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>133</td>
<td>90:85</td>
</tr>
<tr>
<td>2</td>
<td>133</td>
<td>90:14</td>
</tr>
<tr>
<td>3</td>
<td>125</td>
<td>90:57</td>
</tr>
<tr>
<td>4</td>
<td>120</td>
<td>82:71</td>
</tr>
<tr>
<td>5</td>
<td>117</td>
<td>85:00</td>
</tr>
<tr>
<td>6</td>
<td>117</td>
<td>79:00</td>
</tr>
<tr>
<td>7</td>
<td>115</td>
<td>95:00</td>
</tr>
<tr>
<td>8</td>
<td>113</td>
<td>90:00</td>
</tr>
<tr>
<td>9</td>
<td>109</td>
<td>82:86</td>
</tr>
<tr>
<td>10</td>
<td>109</td>
<td>78:86</td>
</tr>
<tr>
<td>11</td>
<td>108</td>
<td>83:43</td>
</tr>
<tr>
<td>12</td>
<td>107</td>
<td>80:28</td>
</tr>
<tr>
<td>13</td>
<td>101</td>
<td>82:00</td>
</tr>
<tr>
<td>14</td>
<td>101</td>
<td>75:14</td>
</tr>
<tr>
<td>15</td>
<td>99</td>
<td>89:14</td>
</tr>
<tr>
<td>16</td>
<td>98</td>
<td>80:00</td>
</tr>
<tr>
<td>17</td>
<td>97</td>
<td>81:57</td>
</tr>
<tr>
<td>18</td>
<td>96</td>
<td>80:28</td>
</tr>
</tbody>
</table>
Group IV. Consists of those who used B - A - 2C method in all four critical problems and who failed to solve any of the four extinction tasks.

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Intelligence Quotient</th>
<th>School Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>138</td>
<td>80.57</td>
</tr>
<tr>
<td>2</td>
<td>133</td>
<td>95.00</td>
</tr>
<tr>
<td>3</td>
<td>130</td>
<td>86.57</td>
</tr>
<tr>
<td>4</td>
<td>124</td>
<td>90.57</td>
</tr>
<tr>
<td>5</td>
<td>123</td>
<td>84.43</td>
</tr>
<tr>
<td>6</td>
<td>122</td>
<td>92.86</td>
</tr>
<tr>
<td>7</td>
<td>115</td>
<td>88.14</td>
</tr>
<tr>
<td>8</td>
<td>111</td>
<td>84.43</td>
</tr>
<tr>
<td>9</td>
<td>110</td>
<td>91.43</td>
</tr>
<tr>
<td>10</td>
<td>110</td>
<td>92.14</td>
</tr>
<tr>
<td>11</td>
<td>109</td>
<td>89.43</td>
</tr>
<tr>
<td>12</td>
<td>109</td>
<td>81.00</td>
</tr>
<tr>
<td>13</td>
<td>109</td>
<td>78.57</td>
</tr>
<tr>
<td>14</td>
<td>108</td>
<td>78.71</td>
</tr>
<tr>
<td>15</td>
<td>108</td>
<td>94.57</td>
</tr>
<tr>
<td>16</td>
<td>107</td>
<td>89.28</td>
</tr>
<tr>
<td>17</td>
<td>105</td>
<td>82.14</td>
</tr>
<tr>
<td>18</td>
<td>103</td>
<td>74.86</td>
</tr>
<tr>
<td>19</td>
<td>101</td>
<td>80.00</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>92.71</td>
</tr>
<tr>
<td>21</td>
<td>97</td>
<td>79.43</td>
</tr>
<tr>
<td>22</td>
<td>92</td>
<td>73.00</td>
</tr>
<tr>
<td>23</td>
<td>92</td>
<td>67.00</td>
</tr>
<tr>
<td>24</td>
<td>92</td>
<td>75.28</td>
</tr>
<tr>
<td>25</td>
<td>91</td>
<td>73.28</td>
</tr>
<tr>
<td>26</td>
<td>90</td>
<td>68.86</td>
</tr>
<tr>
<td>27</td>
<td>90</td>
<td>77.86</td>
</tr>
<tr>
<td>28</td>
<td>87</td>
<td>87.28</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


23a. Eells, K., Davis, A., Havighurst, R. J., Herrick, V. E. and Tyler, R. Intelligence and Cultural Differences, Chicago Univ. Chicago Press, 1951


38. Jersild, A. T. "Mental Set and Shift." Arch of Psychol., 1927
47. Luchins, A. S. "Mechanization in Problem Solving." Psychol. Monogr. 1942, 54, No. 6 (whole No. 248).


The thesis submitted by Reverend Denis Cabezon, O.P. has been read and approved by three members of the Department of Psychology.

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

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

March 18, 1965

Signature of Adviser