Cognitive Processes in Emotionally Disturbed Boys: A Comparison of Problem Solving Processes Used by Matched Groups of Disturbed and Nondisturbed Boys

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COGNITIVE PROCESSES IN EMOTIONALLY DISTURBED BOYS:
A COMPARISON OF PROBLEM SOLVING PROCESSES USED BY
MATCHED GROUPS OF DISTURBED AND NONDISTURBED BOYS

by

Hugh Patrick Creedon

A Dissertation Submitted to the Faculty of the Graduate
School of Loyola University in Partial Fulfillment
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ABSTRACT

There has been a paucity of research performed in the field of cognition as it pertains to man's psychic development. Writers such as Arieti have deplored this neglect. The present study investigated certain aspects of cognitive functioning among emotionally disturbed and normal boys.

Both the Genevan and the Harvard schools have performed extensive studies of cognitive development. They offered different interpretations, however, of the mechanisms by which cognitive growth occurs. Piaget proposed two mechanisms by which this takes place, accommodation and assimilation. Bruner placed more emphasis on the role of language in development.

Both schools would expect that emotionally disturbed children would demonstrate deficiencies in their language abilities. Bruner would imply that it was this deficiency that was contributing to an individual's emotional disturbance. i.e., if the individual could not make use of language to organize his world, he would exhibit maladaptive behavior. His reasoning follows that of Vygotsky and Luria.

Piaget, on the other hand, would more easily maintain that the individual simply had not matured sufficiently to allow him proper command of language.

Rimoldi has also devoted considerable effort in investigating the relationships between language, thinking, and logical structure. His research has given strong indications that there are relationships between what structures can be handled and what languages are available. He has also contributed a unique methodology for studying cognitive functioning through problem solving. Rimoldi's method was employed in this research.

A sample of 32 boys between the ages of 9 and 12 years of age who had been presented to four institutions in the Chicago area as being too disturbed to cope with school and home without psychiatric help were tested by this method. Another sample of boys who were matched to the disturbed sample in age and I.Q. but were not known to have any psychiatric problems were also administered the same problems.

The presentation of these problems varied in terms of abstractness-concreteness. The internal structure also varied from less to more complex. The score for each boy was based on how he went about solving the problem although the correctness of his final answer was also recorded.

The analyses of the data revealed that the disturbed group performed significantly more poorly than the nondisturbed sample. Furthermore, it was observed that the disturbed sample exhibited an inability to deal with the structurally isomorphic problems when they were presented to them in verbal rather than picture form. That is, disturbed boys could cope with certain problems when presented to them in picture fashion, but not when the information was conveyed in verbal terms. Further inspection revealed that 11- and 12-year-old boys could solve the more simple verbal problems but not the
complex verbal problems.

The results were seen as indicating that the Rimoldi method was sensitive to differences in cognitive functioning among disturbed children while scores based on number of correct answers did not reveal differences between the group. More importantly, these results indicate that a preferable approach to teaching disturbed children may be a nonverbal one since this may be comprehensible to them while verbal communication containing the same information might not be.
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Vita

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>VITA</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>Chapter</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. REVIEW OF THE LITERATURE</td>
<td>5</td>
</tr>
<tr>
<td>III. METHOD.</td>
<td>18</td>
</tr>
<tr>
<td>IV. RESULTS</td>
<td>30</td>
</tr>
<tr>
<td>V. DISCUSSION</td>
<td>42</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>55</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>60</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>66</td>
</tr>
</tbody>
</table>
List of Tables

Table                                                                 Page
1. Mean, Standard Deviation and Range for Age and         20
   I.Q. in Disturbed and Normal Samples and Tests          
   for Significance of Differences                        
2. Mean Scores and Standard Deviations for Problems       31
   Administered to Both Samples                           
3. Analysis of Variance of Problem Solving Scores for     34
   Normal and Disturbed Samples                           
4. Significance of Differences Between Problems Within    35
   and Between Normal and Disturbed Samples               
5. Analysis of Variance of Problem Solving Scores for     38
   Younger and Older Disturbed Boys                       

vi
List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logical Structure of the &quot;31&quot; series problems.</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Logical Structure of the &quot;35&quot; series problems.</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>Mean problem solving scores for each problem for the disturbed and normal groups</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>Problems scored on the correctness of final answers</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>Mean problem solving scores for each problem for the older and younger disturbed subsamples</td>
<td>39</td>
</tr>
<tr>
<td>6</td>
<td>Mean problem solving scores for younger and older disturbed subsamples; problems arranged by structure</td>
<td>40</td>
</tr>
</tbody>
</table>
Chapter I

Introduction

The last century has seen a vast growth in man's knowledge about himself. Freud's tremendous contributions in the realm of man's unconscious has made his name a household word. Another name that has recently gained that stature is that of Jean Piaget. His voluminous writings on the development of cognition have been presented, in one form or another, to almost every section of society.

While there have been numerous other areas of development, these two men stand as landmarks in this vast field. It is worthy of note, then, that there has been so little intercommunication between psychiatry and cognition. As Arieti (1970) expresses it, "Cognition is or has been, up to now, the Cinderella of psychoanalysis and psychiatry. No other field of the psyche has been so consistently neglected [p. 91]."

What Arieti refers to here is not simply cognition itself. There has been a great deal of work devoted to cognition. What Arieti is complaining about is that the work on cognition has seldom been done with an eye to furthering understanding of what Arieti calls man's intrapsychic life. And, he goes on to say, "This situation is particularly unacceptable to people, like the present writer, who believe that cognition should receive
the place of honor in psychiatric studies [p. 91]."

Arieti's point is well taken and it is surprising to realize that there has been so little work in this combined area. Certain limited areas have been investigated, such as Goldstein's (1942) study of the results of injury to the brain, but by and large it is a neglected area.

The increased interest in cognitive development and child psychiatry are no doubt helping to bring these areas closer together. The present investigation, for example, is an attempt to study the combined areas of cognition and psychiatry.

It is to be expected that a child who, because of some emotional disturbance, has developed maladaptive behavior will manifest some cognitive anomalies or deficits. What these differences might be have received little attention. Much of the work so far has investigated such factors as the different patterns of intelligence scores produced by disturbed children. And yet, writers such as Vygotsky, Piaget, Bruner, and even Whorf have pointed out how an individual's cognitive framework structures his perceptions of the world around him. As will be seen in the following chapter, Vygotsky and Piaget view the relationship between cognitive structure and perceptual framework quite differently. Nevertheless both would agree that an individual's cognitive development is intimately linked with his emotional well being. It would seem natural and desirable, then, to investigate the cognitive functioning of emotionally disturbed children. Differences in the cognitive functioning could conceivably dictate different approaches to their education as well as their treatment.

An additional reason for studying the cognitive functioning of dis-
turbed children, is to learn more about cognition. Rimoldi (1967a), for instance, in his investigation of the relationships between thought and language, points out that certain features of the cognitive process may manifest themselves only "at the early stages of development or in the deterioration due to ageing or pathological conditions [p. 28]."

Arieti (1970) also points this out. "From the acquisition of language (naming things) to a logical organization of concepts various substages follow each other so rapidly and overlap in so many multiple ways that it is very difficult to retrace and individualize them. These intermediary stages are more pronounced and more easily recognizable in pathological conditions [p. 97]."

It is hoped, therefore, that a study of cognitive functioning in emotionally disturbed individuals will shed light on both cognitive functioning and on pathology.

As a further consideration, special attention will be paid to the role of language in cognition. As has been implied above, language, in its broadest sense, plays a key role in cognitive development. One of the aims of this study, therefore, was to study the role of language in cognitive functioning of disturbed boys to see how it differed from the way language was used by a normal group.

The experimental method of this investigation studied the cognitive processes of normal and emotionally disturbed boys, based on their performance on a series of problems developed by Rimoldi (1970). The cognitive tasks varied in terms of: (1) the complexity of the problem or its internal structure, and (2) the level of abstractness at which the problem was
presented to the subject. Complexity refers to the number of bits of information to be processed to find an answer and abstractness refers to the manner of presentation, varying from pictures to symbolic. Earlier work (Rimoldi et al. 1970) indicated that there were significant differences between these parameters in normal boys. Although literature in this area does not suggest any particular hypothesis, this investigation was performed with the aim of studying possible differences that might be found to exist both within and between group performances.

The work of Rimoldi (Rimoldi et al. 1970) also indicated that variations among the subjects in both intelligence and age also resulted in significant differences in the level of their performances. For this reason it was decided to control these variables by matching the emotionally disturbed sample with a normal or non-disturbed sample on the basis of age and intelligence.

To achieve this purpose the design employed was a 2 X 3 X 2 factorial with repeated measures on the last two factors. The two groups, disturbed and normal, constituted one factor, the three levels of abstractness constituted the three levels of the second factor, and the two levels of difficulty the third factor.
Chapter II

Review of the Literature

Rutter (1966) wrote that the characteristic feature of the psychotic child's cognitive functioning was not its level but its pattern. Appelbaum (1969) showed that long term psychotherapy served to raise a child's intelligence quotient. Sarason (1966) pointed out that "the impacts on cognitive processes of environmental experiences and idiosyncratic motivations are ultimately related to the individual's actual problem-solving behavior [p. 464]."

The above are but a brief sample of opinions that psychologists hold concerning the relationship between cognitive processes and emotional functioning. It is probably safe to say that all clinicians would subscribe to the statement that cognitive processes and emotional functioning are intimately associated, but that there are subtle differences in how they view the relationship.

Rapaport (1944) perhaps best summarized an earlier, psychoanalytically oriented approach to this question of the association between cognition and emotion. For many of the psychoanalytic school the aspect of the relationship which they preferred to view as primary was the affect. Thus, an individual must first develop proper affect. Only then could he develop and/or use cognitive functions. Knowledge is seen as a threat to
some people. For these persons their cognitive abilities become inhibited and acquisition of further knowledge becomes almost impossible. As Watson (1965) sums this up "children may be affectively rather than intellectually stupid [p. 498]."

Rabin and Winder (1969) developed this notion in regard to schizophrenics. "Persons who prefer psychodynamic and other psychosocial explanations of schizophrenia expect to find that stimulus content influences performance. In general, the expectation is that human content and, more specifically, conflict related content, will tend to disrupt cognitive processes [p. 216]."

Brody (1969), in her approach to therapy with disturbed children, explicitly aims at fostering affect. Her assertion is that cognitive development will follow automatically once proper affect is established.

Theoreticians primarily interested in cognition have also been concerned with emotional functioning and, as might be expected, have proposed different views of the relationship.

Although Piaget has apparently never addressed himself to the question of how cognitive development affects mental illness, his extensive work in the area of cognitive development has made a great impact on the field and he has exerted wide influence on those working in it.

A significant aspect of Piaget's contribution is his theory that human knowledge is an activity on the part of the individual. Furth (1969) stated that Piaget holds that behavior at all levels demonstrates aspects of structuring and that Piaget identifies structuring with knowing. That is, the individual structures all that is known to him; he does not merely
receive the world around him, he constructs it. How the individual goes about this structuring of his world presents yet another problem. Luria (1961), developing the work of Vygotsky, maintains that the principal instrument by which the child goes about structuring his world is the verbal process, represented in language.

Piaget (1963), on the other hand, doubted that language has such an important role to play. "If it is legitimate to consider language as playing a central role in the formation of thought, it is insofar as it constitutes one of the manifestations of the symbolic function while the development of this symbolic function is itself dominated by the intelligence in all its aspects [p. 57]." The processes for structuring the world that Piaget offers as alternatives to verbal processes are assimilation and accommodation. Piaget sees these processes as basic and underlying even such processes as language.

Assimilation is the term for the psychological relation of a stimulus to a reacting organism and expresses an inner correspondence or sameness between an environmental phenomenon and the structure within the organism. Furth (1969) defined Piaget's principle of accommodation as "the outgoing process of an operative action oriented toward some particular reality state. Accommodation applies a general structure to a particular situation; as such, it always contains some element of newness [p. 259]."

According to Piaget, both assimilation and accommodation are carried out in a series of stages through which each individual must pass on his way to maturity. Within each stage are particular schemes or operations; organized, universal forms of specific knowing activities. Thus,
in the first stage, the sensory-motor stage, there are various schemes which both constitute and characterize the stage. Some of these schemes are grasping, sucking, handling, and the like. The child is thus limited to what it can assimilate by what can be grasped, sucked, etc. Therefore, during this first sensory-motor stage which lasts about two years the child can organize very little. The next question to be answered in this context is what relationship, if any, does Piaget see between the development of cognitive processes and emotional functioning. Piaget and Inhelder (1969), in addressing themselves to this point, noted: "Studying the infant's affectivity is much more difficult than studying his cognitive functions. . . for the risk of 'adultomophism' is much greater in this area [p. 21]." Although they have not experimented in this area themselves they have reported a number of studies by others which presumably support their own thinking.

Their contention is that there are stages of affectivity which develop in a manner corresponding to the stages of cognitive development. These affective stages are, in one sense, independent from cognitive growth.

It remains to be noted that, insofar as such correlations are verified [correlations between stages of affectivity and the stages at which the individual can 'construct' various objects], that is, insofar as affectivity is inseparable from the whole of behavior without constituting either a cause or an effect of the cognitive structurations, the essential factor in object relations is the relation itself between the subject and the affective object. . . . [p. 27].

Another individual who has made significant contributions to this area is J. S. Bruner. Similar to Piaget, Bruner is primarily interested in investigating the course of cognitive growth. It is only secondarily that he adverts to the question of the interrelatedness of cognition and emotional states.
His epistemological point of origin is rather close to Piaget's, namely, a constructivistic theory of cognition. However, the manner in which he sees the individual as constructing his world is slightly different than Piaget's. Bruner relies upon the analogy of information processing and talks in terms of various systems that individuals use, that is, "systems of processing information by which human beings construct models of their world [1964, p. 1]." He distinguished three of these systems and stated that individuals process their information: (1) through action, (2) through imagery, and (3) through language.

A second area of concern to Bruner is integration, "the means whereby acts are organized into higher-order ensembles, making possible the use of larger and larger units of information for the solution of particular problems [1964, p. 1]." Extrapolating from anthropological findings, Bruner stated that man has changed himself by his use of three "implementation systems": (1) amplifiers of human motor control (tools, etc.); (2) amplifiers of sensory capacities (smoke signals, radar, etc.); and (3) amplifiers of human ratiocinative capacities. This last constitutes the most important as well as the most diverse, ranging from language systems to myth and theory and explanation.

It is these language systems that are most useful, according to Bruner, since they constitute a higher form of representation, symbolic representation. He noted: "if we are to benefit from contact with recurrent regularities in the environment, we must represent them in some manner [p. 2]." He believed this cannot be explained in terms of simple memory. These systems of representation are not merely storage systems; they are
systems of coding, processing, and selective recalling.

Bruner's position is much closer to the position of Luria and Vygotsky than is Piaget's. Although Luria does not speak of symbolic representation but of speech, he and Bruner sound very much alike. Luria (1960) referred to Vygotsky's contribution that the verbal relationship with the mother plays a decisive role in the further development of the child. Gradually the child is able to internalize the controls established by his mother. He accomplishes this by acquiring speech. Luria (1961) summarized this line of thinking when he stated: "Thus he [the child] becomes capable of actively modifying the environment that influences him; by using speech for himself, he alters the relative strength of the stimuli acting upon him, and adapts his behavior to the influences thus modified [p. 20]."

Bem (1967) investigated Luria's ideas and found evidence that supported the hypothesis that verbal self-control aids the child to structure his environment. Bem established verbal self-control in 3-year-olds and thus enabled them to perform at a 4-year-old level -- a level at which they were unable to perform prior to the establishment of verbal controls.

Obviously, following this line of thinking leads one to suppose that a failure to develop this symbolic mode of representation properly, an inability to make use of this great tool of language, would result in mal-adaptive behavior on the part of the child.

An interesting experiment by Mehler and Bever (1967), however, may cause both sides of the Harvard-Geneva debate to reinterpret their findings. In a verbal test for conservation of number, Piaget's findings were supported
when younger children selected the longer row of pellets when asked to point to the row with "more" pellets, even though that row had fewer pellets than the shorter row. When the pellets were replaced by candy M & Ms, however, and the children were told that they could have the row with more M & Ms, they chose the correct row, even though it was the shorter of the two. In other words, even though the children could not demonstrate conservation in the usual manner, they could do so in a matter of personal importance to them.

The question still remains concerning the relationship between cognitive development and emotional functioning. It may well be that Arieti presents what could best stand as the Luria-Bruner answer to this question.

Arieti (1967) has examined many of the "higher level" emotions in man. These include love, hate, depression, and so forth. His position is that it is man's cognitive functions that constitute the basis of man's emotions. In a later article he stated:

Concepts and organized clusters of concepts become depositories of emotions and also originators of new emotions. They have a great deal to do with the conflicts of man, his achievements and his frustrations, his states of happiness or despair, of anxiety or of security. They become the repositories of intangible feelings and values. Not only every concept has an emotional counterpart, but concepts are necessary for high emotions [1970, pp. 102-103].

Of course, Arieti would not deny that man's emotions play a large role in his cognitive functioning as well. On this question he stated the following:

Emotions and cognitive processes form a circular process. The emotional accompaniment of a cognitive process becomes the propelling drive not only toward action but also toward further
cognitive processes. Only emotions can stimulate man to overcome the hardship of some cognitive processes and lead to complicated symbolic, interpersonal and abstract processes. On the other hand, only cognitive processes can extend indefinitely the realm of emotions [1970, p. 103].

As is obvious, Arieti lays great stress on the role that cognition plays in man's intrapsychic life. He furthermore emphasizes the position that language occupies. According to him the "high level" emotions presuppose the existence of verbal symbols. While Luria and Bruner might not agree with all that Arieti says, it is probable that they would accept his emphasis on cognition and, even more so, his emphasis on the role of language.

Erikson, for instance, has formulated several notions about children between the ages of seven and eleven. It is during this period that the child, having realized that he cannot immediately do the things an adult does, begins to develop a sense of industry in order to fend off a sense of inferiority. As Erikson (in Maier, 1965) sees it, the child delves diligently into all opportunities to learn by doing and experiments with the rudimentary skills required by his culture. As he learns to wield his culture's tools and symbols, the child seems to understand that this sort of learning will help him to become more himself. It seems to follow from this line of reasoning that failure of such learning might result in some sort of maladjustment.

White (1963) develops the idea that a child is motivated to master his environment--at least to the point of being able to influence it. A significant part of his environment is the social setting in which he grows up and his most effective method would be language. Success in such
endeavors leads to what White terms a "feeling of efficacy."

Several studies have suggested that motivational factors may be associated with impairment in cognitive development. Freibergs and Douglas (1969) studied concept learning in normal and hyperactive children. They found that the hyperactive children did more poorly than the normal children during certain schedules of reinforcement. They suggested that the hyperactive children's performance decrements are more attributable to attentional and motivational variables than to global, cognitive-conceptual impairments. Reger (1964) also addressed himself to this problem and attempted to assess the relationship between emotional disturbance and abstract thinking level in children. He used as subjects emotionally disturbed and/or mentally retarded boys. By using the Goldstein-Scheerer Object Sorting Test and ratings of the children's adjustment, he found that there was a negative relationship indicating that lower levels of abstract thinking were associated with higher degrees of emotional disturbance. While his design leaves much to be desired, his findings did support the hypothesis that impaired language ability and emotional dysfunction are associated.

Rimoldi and his collaborators have done extensive research in children's thinking, and the method he developed lends itself very well to the questions at hand. Moreover, one of his recent concerns has been thinking and language and their relationship (1967a, 1967b). He has adapted concepts from the algebra of transformations to formulate and express his thinking on this subject. What he suggested is that "the type of correspondence that exists between a given language and logical structures is of interest in defining the precision and completeness of a language.
While Piaget and Bruner seem to be more concerned about developmental psychology and the role that language may or may not play with regard to a child's cognitive development, Rimoldi's appears to be more interested in the effects of language on thinking in general. Thus, Rimoldi proposed that if one language component corresponds to several logical components, uncertainty is at a maximum. He added the interesting note that "This may occur with ordinary language at the early stages of development or in the deterioration due to ageing or pathological conditions [1967a, p. 28]."

Rimoldi further stated that a greater degree of precision is to be had when each language component corresponds to one and only one logical component. Even with this, the same logical component may be expressed by several different language components. This, Rimoldi feels, may represent ordinary everyday verbal language. The most precise languages are the "one-one" languages. With these there is an exact correspondence between each language component and each logical component. This is similar to knowing an exact function in algebra that can be used to find either x or y when the other is known. The transformation that obtains in ordinary language is a "many-one" type of transformation. That is, many language components may correspond to a single logical component.

Rimoldi's formulation suggests that what exists in primitive or pathological cases is a "one-many" type of transformation. While this may at first glance appear to be the opposite of what was being said concerning abstraction and the emotionally disturbed, it actually is not. What is being implied here is that the pathological individual, in contrast to the normal
individual, cannot make a true categorization on an abstract level. In other words, normal individuals can form concepts that allow them to organize their world. What happens with the pathological cases is that organization is attempted, but due to something, such as a lack of abstracting ability, the transformation results in a one-many type. That is, uncertainty and ambiguity are at their highest level.

In addition to conceptualization at a highly theoretical level, Rimoldi has also contributed a unique methodology for investigating cognitive processes. While it is apparent that various differences in the cognitive functioning of normal and maladjusted persons might be anticipated, there is a paucity of research which throws light on the hypothesized differences between the cognitive process of the two groups.

Much of the research in the area of cognition has evolved from the S-R (stimulus-response) school of psychology. As such, it concentrated on what could be termed the end product of an individual's cognitive process—the final answer. This approach chooses to ignore what goes on in the mediating process, the "black box," as it is termed.

Rimoldi (1955, 1961), however, has pointed out repeatedly that the same response may be reached through different processes and therefore the study of the response itself does not bring out the variety of individual differences that no doubt exist. What is more important for Rimoldi is to investigate this process, to monitor what goes on when a person engages in intellectual activity.

As a final note to the question of S-R "product" approach versus the "Process" approach Levitt (1968), in examining them both, declared the
"process" approach superior in that it focuses on the individual's organization of incoming information and in his transactions with the environment.

A question that must be answered, of course, is just what is this mental activity. Rimoldi (1967b) offers a brief description of thinking. "In a restricted sense, thinking could be understood as an attempt to make explicit and communicable (to one's self or to others) the formal properties of a problem [p. 15]."

Luria (1966) gave a more complete description of the process:

As has been repeatedly mentioned, intellectual activity is a particularly complex form of mental activity, taking place only when the problem demands preliminary analysis and synthesis of the situation and special auxiliary operations by means of which it can be solved. Any investigation of the intellectual processes must therefore create a situation in which the subject has no ready-made, previously established means of attaining the desired goal and in which he must analyze this situation, picking out its essential components and correlating them with each other, formulate hypotheses, develop a "strategy," and select definite operations or tactical methods for its realization [p. 448].

It is surprising how closely Luria's description of intellectual activity mirrors Rimoldi's method of studying problem solving. Luria (1966) also spoke of problem solving:

Intellectual activity assumes its most distinct and highly developed form in other operations—in discursive intellectual activity and in the solutions of problems. It is in these activities that the basic structure of the intellectual processes is seen especially clearly. The person solving a problem must analyze its requirements, select the essential relationships, and discover the intermediate aims and the operations by which these aims may be secured. Only by carrying through intermediate operations of this nature can he reach a final solution to the problem [p. 463].

This review has sought to investigate some of the different opinions that exist concerning the relationship between cognition and emotionality. We have seen that both aspects of an individual appear to be intimately
linked and interdependent. A further question arose in the shape of what part language plays, especially in cognitive development. While the Genevan school feels that language is a secondary step in the child's development, Bruner, following Luria and Vygotsky, insist that language is essential as a major tool for development. Rimoldi's work has demonstrated that certain languages or levels of language are necessary before one can solve certain problems and that the methodology of choice is one that concentrates on the process rather than the product of cognition.
Chapter III

Method

Subjects

The original sample of emotionally disturbed boys consisted of 32 boys between the ages of 9 and 12 years of age who had been presented to four various institutions in the Chicago area because of their maladaptive behavior at home and at school. All of these subjects were either being screened for acceptance for psychotherapy or were in the early stages of treatment.

The criteria for their selection, aside from age, were as follows:
(1) their primary diagnosis did not involve organic brain damage. A few of the subjects carried diagnoses of visual-perceptual handicaps, but these were secondary diagnoses and considered to be minimal. None of the subjects was observed to experience any difficulty in perceiving the test materials. (2) Their functioning intelligence must be such as to allow them to grasp the nature of the tasks set them and to attempt to formulate an answer. This criterion was judged to be met if a subject received an intelligence quotient of 80 or more on the Peabody Picture Vocabulary Test. (3) Their behavior must not be such as to make it impossible for them to attend to the tasks given them in the testing situation.

Of the 32 boys tested, 5 failed to meet the second criterion and 3 failed to meet the third. It was possible to eliminate boys who failed
to meet the first requirement prior to actually testing them. As a result only 24 boys were actually used in this study.

The nondisturbed sample was gathered from primary schools in the Chicago area. These were 24 boys between the ages of 9 and 12 years with no known psychiatric disorder who volunteered to solve the problems. The two groups were matched for age and intelligence. Descriptive data characterizing the two samples are presented in Table 1. Significance tests indicated there was no difference between the samples.

Measures

The Peabody Picture Vocabulary Test (PPVT) was used to ascertain the I.Q. for each boy in the disturbed sample. The I.Q. scores for the normal sample were obtained from Otis group intelligence tests that had been administered within the year.

The PPVT was used with the disturbed group because it was possible to ascertain the individual's "use" vocabulary by it (Anastasi, 1968). Solving the Rimoldi problems depends in good part on a sufficient level of receptive language ability and since this is one of the factors the PPVT tests best, this constituted another reason why this instrument was chosen. Furthermore, the PPVT has been used previously with emotionally disturbed children and has also been found to correlate rather well with group intelligence tests, especially ones high in verbal loadings (Anastasi). Moss and Edmonds (1960) found that with a sample of British children the PPVT and the Otis correlated at .68.

The problems used in this study are presented in Appendix A. These problems were developed by the Loyola Psychometric Laboratory in connection
Table 1

Mean, Standard Deviation
And Range For Age and I.Q.
In Disturbed And Normal Samples
And Tests for Significance of Differences

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>t</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbed</td>
<td>24</td>
<td>9.71</td>
<td>0.96</td>
<td>9 - 12</td>
<td>93.92</td>
<td>11.76</td>
<td>82-118</td>
<td>0.18</td>
<td>0.64</td>
</tr>
<tr>
<td>Normal</td>
<td>24</td>
<td>9.78</td>
<td>1.08</td>
<td>9 - 12</td>
<td>91.53</td>
<td>5.09</td>
<td>85-103</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

_t values nonsignificant_
with a government sponsored project investigating problem solving in elementary school boys. They are modifications of problems which Rimoldi and his collaborators have been investigating for a number of years under various conditions (1955, 1961) and for different age groups (1962, 1967a, 1967b).

Aside from the sample problems there were six problems administered to each subject. These problems varied along two dimensions, internal complexity and the abstractness of the language in which they were presented.

Internal complexity of the problem refers to the structure of the different problems used. In this study only two different structures were employed. These structures are designated by numbers, 31 referring to a more simple structure and 35 to a more complex one. The structure of problems in the 31 series is represented graphically in Figure 1 and the structure of the 35 series is pictured in Figure 2.

The structure of the problems and their corresponding complexities may be best thought of in terms of information theory. Problems in the 31 series have fewer alternatives than those of the 35 series to be investigated prior to arriving at an answer and thus these problems may be said to demand fewer bits of information for their solution. It is for this reason that the 31 series is said to be less complex than the 35 series and it is assumed that the 31 series is therefore easier to solve.

The language of the problems refers to the level of concreteness-abstractness used in the presentation of the problem. There were three levels of language abstractness used in this investigation: Picture language, designated P; concrete verbal language, designated A; and abstract verbal language, designated B. Thus, a problem designated 31B would indicate the
Figure 1. Logical structure of the "31" series problems.
Figure 2. Logical structure of the "35" series problems.
logical structure of the 31 series and the verbal abstract presentation.

In the picture series the problems were presented with actual pictures representing the various alternative to be used in arriving at a solution. In the concrete verbal series the language used was what might be termed an everyday language. The problems were presented, for example, in terms of horses, black horses and white horses, and the like. In the verbal abstract series the concrete language is replaced by rather abstract symbols such as the letters of the alphabet.

An assumption, supported by the results of problem solving processes of elementary school boys (Rimoldi et al., 1970), is that the problems are most difficult when presented in the verbal abstract language. Thus, by using six problems it was possible to present both structures in each of the three "languages." The problems in the 31 series, then, were isomorphic with regards to their structure and varied only in the language used to present them. The same is true of the 35 series.

At least two sample problems were also used, one for the picture presentation and one for the verbal presentation. Their logical structure, however, was even more simple than the 31 series.

As the subject worked each problems the experimenter recorded which questions he used and the order in which he used them. This sequence of questions formed the individual's tactic for that particular problem. Although the answer that the subject finally gave was also recorded it was the tactic and not the subject's answer that was scored. Through this method it was possible to attend to the process rather than merely to the final product of the process.
The questions that the subject had available to him could be categorized into three classes: relevant and pertinent, relevant but non-pertinent, and irrelevant. The first category of questions imparted useful information to the subject about the problem he was trying to solve. The second class, relevant but non-pertinent, contained information which pertained to the actual problem at hand but which did not really aid in solving it. Sometimes the information contained in these questions was redundant and sometimes it was simply unnecessary. The final category, irrelevant questions, were simply that. Questions which had no relevance to the problem and which therefore imparted no usable information toward its solution.

The scoring method used in this study is the same as used by Rimoldi (Rimoldi et al., 1970). As stated therein, this particular method is a refinement and a redefinition that resulted from the comparison of twenty different scoring methods by one of his assistants. The technical details of this scoring method are given in Appendix B.

The method considers how each tactic approximates the logical structure of the problem. This implies, in terms of information theory, eliminating the greatest number of alternatives or maximally reducing the uncertainty at each opportunity. Therefore, the first question asked should remove the greatest uncertainty while the later questions should deal with more specific alternatives. As a result, the ideal tactic fulfills these requirements: "Maximum correspondence between the generality of the question and its position in the tactic with the minimum number of questions that exhaust the information necessary to solve the problem [Rimoldi et al., 1970, p. 34]."
In the scoring system used, these ideal tactics obtain the maximum score. Scores are lower to the degree that they vary from the ideal tactic (i.e., if there are reversals in order, irrelevancy, failure to choose the meaningful questions, etc.). Scores may vary from +1.00 to -1.00, with +1.00 representing the maximum score for the ideal tactic.

Procedure

Previous research (Rimoldi, Aghi, & Burger, 1968) indicated that the length of testing for normal subjects should not exceed 1 1/2 hours. On the basis of this it was decided that the more realistic limit for emotionally disturbed children would be approximately 1 hour. This limitation was kept in mind in designing the research and it was felt that for the most part the subjects were able to work for that period. Occasionally rest periods, trips to the water fountain and the like, were taken. Two of the subjects in the disturbed sample could not finish because they felt they were too tired and one boy failed to finish when he began to hallucinate in the midst of the testing session. As noted previously, the data from these subjects were not included in the results.

Each disturbed subject was tested individually in an office of the institution with which he was familiar. In practically all instances a staff member of the institution introduced the subject to the experimenter and explained that he had some puzzles for the boy to work on.

Each disturbed subject was first given the Peabody Picture Vocabulary Test. In addition to providing an I.Q. score for each boy this test was found to be nonthreatening and therefore facilitated the establishment of rapport between the subject and the tester.
Each subject was then given a sample of the picture type problem. The task was explained to him and he was helped, if necessary, to work his way through this sample problem. If he failed to grasp the nature of the task or was unable to do the problem, the sample problem was worked for him and the procedure explained to him. He was then given a second sample problem to attempt on his own. If he failed this, testing was discontinued at this point. If the subject demonstrated that he comprehended what the test was and an ability to perform it, the first picture language problem, problem 31P, was then administered. This was followed by problem 35P. This completed the picture language series of problems.

The mode of presentation for the picture problems was as follows. The subject was informed by the examiner, in some fictionalized story fashion, that he must attempt to decide what the correct alternative was, given all the various choices. For instance, the subject might be told that "Johnie has round blocks and square blocks; he has white blocks and he has blue blocks. What kind of blocks does Johnie like best?" The various alternatives were always listed several times as well as all the combinations such as white round blocks, blue round blocks.

The subject was then shown pictures of various combinations of blocks. He could then ask the examiner if the object in question was one of the things pictured on a particular card. The subject was informed that he should ask only those questions that he actually needed. The examiner would answer the subject, set the card apart so the subject could tell he had asked about it, and mark down which card the subject had asked about. The "correct" alternative was never pictured on any of the cards, so that
it was necessary for the subject to first rule out all the other alternatives and then form the conclusion that it must be the only one left. It was occasionally necessary to verbalize this for some of the subjects who were obviously aware that they had eliminated all the alternatives except one and yet were somewhat upset by the fact that that alternative was not pictured anywhere.

In a previously cited study (Rimoldi et al., 1970) involving several hundred boys, a subject occasionally caught on that the answer was simply the missing alternative. This phenomenon did not seem to occur in this study. In fact, even when it did occur in the larger study it was simple enough to ask the subject which cards he would have to pick to make sure that his hunch was really the right answer.

When he had finished the picture series of problems the subject was then given a sample verbal problem. These sample problems were similar in design to the actual problem except that they had fewer bits of information to work with. Most subjects seemed to experience less difficulty in grasping what was expected of them when the verbal problems were presented.

In the verbal series the boy was first given a 3 X 5 index card with the problem printed on it. The experimenter read through this problem with the subject, trying to make sure that the subject understood what he was expected to answer. Then 10 more 3 X 5 cards were shown the subject. On the front of each of these cards there was a question. The answer to some of these questions contained bits of information useful in solving the problem. The answers to the questions were on the back side of the
cards. These cards were explained as clues or questions that the subject might wish to ask to help solve the puzzle. The experimenter read each of the cards with the subject and then read the problem again.

To solve the problem the subject would then have to decide which cards he would have to use. Once he had decided on a particular card or question he could obtain the answer for it by simply turning the card over. On the back of each card the question was repeated and its answer was given.
Chapter IV

Results

Each subject in this study was administered six problems in addition to the sample problems. These problems varied in internal complexity and in the mode of presentation or "language." Internal complexity refers to the number of bits of information that the individual must process before arriving at an answer. There were two structures presented in this dimension, a simple type of problem referred to as the "31" series, and a more complex one referred to as the "35" series.

The mode of presentation or language refers to the degree of abstractness in which the problem was presented. This continuum varied from presenting the problems in picture form to presenting them in concrete verbal form and, finally, to presenting them in abstract terms in which objects are designated by such symbols as letters of the alphabet. The letter "P" represents the picture mode of presentation, the letter "A" the concrete verbal language, and the letter "B" symbolizes the abstract language. Thus, problem 31A indicates a type of problem in the more simple series and one that was presented in concrete, everyday language.

The mean score and standard deviation for each problem obtained by each group of boys, normal and disturbed, is presented in Table 2. These mean scores are plotted in Figure 3. The mean scores of the disturbed
Table 2

Mean Scores and Standard Deviations for Problems Administered to Both Samples

<table>
<thead>
<tr>
<th>Problem</th>
<th>Sample</th>
<th>Normal</th>
<th>Disturbed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure</td>
<td>Mode of Presentation</td>
<td>Code</td>
</tr>
<tr>
<td>Simple</td>
<td>Picture</td>
<td>31P</td>
<td>0.484</td>
</tr>
<tr>
<td>Complex</td>
<td>Picture</td>
<td>35P</td>
<td>0.565</td>
</tr>
<tr>
<td>Simple</td>
<td>Concrete</td>
<td>31A</td>
<td>0.317</td>
</tr>
<tr>
<td>Complex</td>
<td>Concrete</td>
<td>35A</td>
<td>0.227</td>
</tr>
<tr>
<td>Simple</td>
<td>Abstract</td>
<td>31B</td>
<td>0.206</td>
</tr>
<tr>
<td>Complex</td>
<td>Abstract</td>
<td>35B</td>
<td>0.084</td>
</tr>
</tbody>
</table>
Figure 3. Mean problem solving scores for each problem for the disturbed and normal groups.
and the matched normal groups, were analyzed statistically by a $2 \times 3 \times 2$
analysis of variance with repeated measures on the last two variables
(Winer, 1962). The results of this analysis (Table 3) confirm what is
indicated by Figure 3. The performances of the two groups are different at
a statistically significant level. Furthermore, the differences of the
various language scores were significant at less than the .01 level while
the difference between the two structures was significant at the .05
level.

To further investigate these differences between and within the two
groups, Scheffe intervals were calculated. Since the original analysis of
variance indicated that there was no significant interaction effect between
the complexity and language ($B \times C$ interaction), the results were collapsed
on the complexity variable prior to calculating the intervals. These
intervals are presented in Table 3. Inspection of the Scheffe intervals
shows that within the groups the major difference is between the perfor-
mance on the picture problems and the performance on the verbal problems.
However, the difference between the two groups in terms of their perfor-
mances on the picture problems was not significant.

Finally, the scores for the two types of verbal problems, concrete
and abstract, differed significantly between the two groups but not within
either group. That is, the subjects within each group performed as well
on the abstract language as they did on the concrete language, but the
overall performance level of the normal group was higher than that of the
disturbed group.
Table 3

Analysis of Variance
of Problem Solving Scores
For Normal and Disturbed Samples

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups (A)</td>
<td>1</td>
<td>2.512</td>
<td>6.376*</td>
</tr>
<tr>
<td>Ss Within Groups</td>
<td>46</td>
<td>0.394</td>
<td></td>
</tr>
<tr>
<td>Within Languages (B)</td>
<td>2</td>
<td>8.927</td>
<td>89.270**</td>
</tr>
<tr>
<td>A x B</td>
<td>2</td>
<td>1.394</td>
<td>13.940**</td>
</tr>
<tr>
<td>B x Ss</td>
<td>92</td>
<td>0.100</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure (C)</td>
<td>1</td>
<td>0.514</td>
<td>9.018**</td>
</tr>
<tr>
<td>A x C</td>
<td>1</td>
<td>0.120</td>
<td>2.105</td>
</tr>
<tr>
<td>C x Ss</td>
<td>1</td>
<td>0.057</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>46</td>
<td>0.057</td>
<td></td>
</tr>
<tr>
<td>B x C</td>
<td>2</td>
<td>0.043</td>
<td>0.597</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2</td>
<td>0.239</td>
<td>3.319*</td>
</tr>
<tr>
<td>BC x Ss</td>
<td>92</td>
<td>0.072</td>
<td></td>
</tr>
</tbody>
</table>

* P < .05
** P < .01
Table 4

Significance of Differences Between Problems
Within and Between Normal and Disturbed Samples

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Scheffé Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbed  Picture vs. Disturbed Concrete</td>
<td>+0.941 -- +1.789*</td>
</tr>
<tr>
<td>Disturbed  Picture vs. Disturbed Abstract</td>
<td>+1.115 -- +1.973*</td>
</tr>
<tr>
<td>Disturbed  Picture vs. Normal Picture</td>
<td>-0.255 -- +0.603</td>
</tr>
<tr>
<td>Disturbed  Picture vs. Normal Concrete</td>
<td>+0.264 -- +1.112*</td>
</tr>
<tr>
<td>Disturbed  Picture vs. Normal Abstract</td>
<td>+0.503 -- +1.361*</td>
</tr>
<tr>
<td>Disturbed  Concrete vs. Disturbed Abstract</td>
<td>-0.245 -- +0.613</td>
</tr>
<tr>
<td>Disturbed  Concrete vs. Normal Picture</td>
<td>+0.757 -- +1.615</td>
</tr>
<tr>
<td>Disturbed  Concrete vs. Normal Concrete</td>
<td>+0.254 -- +1.112*</td>
</tr>
<tr>
<td>Disturbed  Concrete vs. Normal Abstract</td>
<td>-0.001 -- +0.857</td>
</tr>
<tr>
<td>Disturbed  Abstract vs. Normal Picture</td>
<td>+0.941 -- +1.799*</td>
</tr>
<tr>
<td>Disturbed  Abstract vs. Normal Concrete</td>
<td>+0.438 -- +1.295*</td>
</tr>
<tr>
<td>Disturbed  Abstract vs. Normal Abstract</td>
<td>+0.183 -- +1.041*</td>
</tr>
<tr>
<td>Normal Picture vs. Normal Concrete</td>
<td>+0.074 -- +0.932*</td>
</tr>
<tr>
<td>Normal Picture vs. Normal Abstract</td>
<td>+0.329 -- +1.187*</td>
</tr>
<tr>
<td>Normal Concrete vs. Normal Abstract</td>
<td>-0.174 -- +0.684</td>
</tr>
<tr>
<td>Both Picture vs. Both Concrete &amp; Abstract</td>
<td>+0.768 -- +1.312*</td>
</tr>
</tbody>
</table>

* p .01
The performance of the two groups scored simply on the correctness of their final answers is plotted in Figure 4. Tests of significance indicated that the two samples cannot be differentiated on the basis of the final answers alone.

Previous research (Rimoldi et al., 1970) indicated that further analysis of the data for the disturbed group might be relevant in terms of age differences. As a result of their study of a large group of nondisturbed boys, they concluded: "In summary all the comparisons performed seem to indicate that at about 10 to 11 years of age there is definite improvement in performance in the VA [verbal concrete] problems so that two relatively homogeneous subsamples could be defined below and above this age level [p. 47]."

In order to investigate these two subsamples, the present disturbed group was subdivided into two groups according to age. Nine and 10-year-old boys in one group, 11 and 12-year-old boys in the other. The results for these two groups were treated statistically by an analysis of variance, again a 2 X 3 X 2 with repeated measures. The results are presented in Table 4. The mean scores of these two subsamples are also plotted in Figure 5.

As was previously indicated, there is a significant difference between the two age groups. Not only was the overall performance of the older group superior, but its pattern was different from the younger group. The difference in this pattern can be seen more easily if the mean scores of the two groups are plotted according to the problem structure rather than language. This is done in Figure 6 and it can be observed that the
Figure 4. Problems scored on the correctness of final answers.
## Table 5

### Analysis of Variance of Problem Solving Scores

For Younger and Older Disturbed Boys

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups (A)</td>
<td>1</td>
<td>3.000</td>
<td>8.721**</td>
</tr>
<tr>
<td>Ss within Groups</td>
<td>22</td>
<td>0.344</td>
<td></td>
</tr>
<tr>
<td>Within Languages (B)</td>
<td>2</td>
<td>8.497</td>
<td>61.129**</td>
</tr>
<tr>
<td>A x B</td>
<td>2</td>
<td>0.155</td>
<td>1.115</td>
</tr>
<tr>
<td>B x Ss</td>
<td>44</td>
<td>0.139</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure (C)</td>
<td>1</td>
<td>0.495</td>
<td>12.073**</td>
</tr>
<tr>
<td>A x C</td>
<td>1</td>
<td>0.153</td>
<td>3.732</td>
</tr>
<tr>
<td>C x Ss</td>
<td>22</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B x C</td>
<td>2</td>
<td>0.174</td>
<td>2.597</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2</td>
<td>0.320</td>
<td>4.776*</td>
</tr>
<tr>
<td>BC x Ss</td>
<td>44</td>
<td>0.067</td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$  ** $p < .01$
Figure 5. Mean problem solving scores for each problem for
the older and younger disturbed subsamples.
Figure 6. Mean problem solving scores for younger and older disturbed subsamples: problems arranged by structure.
older group coped with the more simple structure (31) far more easily than the younger group. Furthermore, while it can be seen that the younger group could not handle the verbal language no matter which structure was presented, the older group could deal with the verbal presentation as long as the structure was simple (31).
Chapter V

Discussion

The obtained results give rise to some interesting questions. Very briefly, these results indicated that a sample of emotionally disturbed boys can solve problems as well as a nondisturbed sample as long as the problems are presented to them in picture fashion. When the same type of problems are presented in verbal terms, however, the performance level of the disturbed sample falls far below that of the normal sample.

The question that comes most immediately to mind is why should the performance level of the disturbed sample drop so drastically when the problems are presented verbally? It is hoped that a discussion of these results in the light of the theories reviewed previously will offer an answer to this and other questions.

Bruner, in formulating his theories about cognition in children, has been impressed by the findings of anthropologists that the principal changes in man have been alloplastic rather than autoplastic. For instance, man's complex brain evolved due to new selection after bipedalism and consequent upon the use of tools. Bruner argues that man did not simply evolve a larger brain than his predecessor and then begin to walk upright and use tools. From this he further argues that man has effected his changes through the use of various systems, of which one of the most important
and complex is language. Following this line of thought led him to the conclusion that language is a tool of major importance in the development of an individual. It is not merely a means of communicating with his fellow man, it is far more important than that. It is through language that an individual is able to organize and master his environment. Bruner (1964) stated: "In effect, language provides a means, not only for representing experience, but also for transforming it. . . . Once the child has succeeded in internalizing language as a cognitive instrument, it becomes possible for him to represent and systematically transform the regularities of experience with far greater flexibility and power than before [p. 4]."

Some of the implications of this contention bear looking into. One could speculate, for instance, what would be the results if, for some reason, a child failed to master language adequately. I am not referring to a deaf child, for whom there are special problems in communicating, but to a child who hears but fails to comprehend; who misunderstands and is unable to make himself understood; who is confused and in turn confuses. He would either fail to generate a set of laws whereby he could organize his environment and thus be faced with a chaotic world, or he would quite likely formulate his own unique set of laws. In either event, his behavior would surely be viewed as maladaptive and disturbed by the rest of society.

On the other side of the coin, of course, is the individual who is presumed to be disturbed for some reason other than failing to master language. If this individual would be hyperactive and distractible or somewhat alienated from those around him it is more than likely that he would find it difficult or undesirable to make the effort to master language.
It is quite possible, of course, that these two cycles foster each other, and as the disturbed individual falters in his development of language, his information becomes increasingly meaningless and inadequate. This in turn may bring about a more maladaptive adjustment on his part. Although it is nearly impossible to decide at present which process might be responsible for starting such a cycle, some current research will shortly be discussed that may provide some clues.

The point to be stressed is that the results of this investigation are quite compatible with what Bruner is thinking. That is, disturbed children manifest an inability to work with verbal symbols.

In Chapter II it was seen that Piaget and Bruner hold different views of the role of language. While the results give some support to the Harvard school they cannot be interpreted as disproving the Genevan school. For although Piaget postulates different mechanisms of cognitive development he does not fail to appreciate the importance of language. Sinclair (in Furth, 1969) perhaps expressed the Genevan position on the role of language as well as anyone else. Language can direct attention to pertinent factors of a problem, just as it can control perceptual activities, as Luria and his collaborators have shown. In this way, language can prepare an operation but it is neither sufficient nor necessary to the formation of concrete operations [p. 130]."

In an attempt to resolve their differences Piaget and his collaborators have performed a number of experiments aimed at investigating Bruner's contention that language does far more than simply direct attention or control perceptual activities. One of these studies (Inhelder, Bovet,
Sinclair, and Smock, 1966) sought to teach children who did not have the concept of conservation to use language expressions found to be characteristic of children with conservation. They did this with concepts of increasing complexity in terms of number, quantities, and dimensions. One of the aims of this experiment was to see whether performance on conservation tasks could be improved through systematic teaching of the language of description appropriate to that particular concept.

Their conclusion from this experiment was, in part, as follows:

Our evidence offers little, if any, support for the contention that language learning per se contributes to the integration and coordination of "informational units" necessary for the achievement of the conservation concepts. . . . Language learning does not provide, in our opinion, a ready-made "lattice" or lens which organizes the child's perceptual world [p. 163].

Something to be noted about this investigation is that at its inception the children lacked certain verbal proficiencies. It is conceivable, then, that the attempt to teach them certain verbal concepts through other verbal means may have amounted to attempting to teach one unknown by another unknown. Although the analogy limps, it is possible that what they were doing was similar to trying to teach the color green to a blind person by telling him it is made up of blue and yellow. What might have been more apropos would have been to allow the child to learn the concept himself while working with some medium other than words. Fortunately such an experiment has been performed.

Gelman (in Trabasso, 1968) worked with normal children who did not have the concept of conservation. Gelman's hypothesis was that perhaps these children fail to conserve as a result of some perceptual fixation, not because, as Piaget would say, they have not yet achieved the proper
cognitive structure and were therefore unable to perform the logical operations needed for conservation. Her approach was to train the child to ignore irrelevant changes and to pay attention to factors that do not change. This was done, for example, by presenting stimuli that differed in many ways, such as rods of different color, size, shape, and length, and asking the child to pick the two rods that were different from the third. The results of two days of such training were that 94 percent of the children responded correctly to tests of conservation. Interestingly, a control group that received similar training, except that they did not receive any feedback as to the correctness of their choices during training, responded correctly only 25 percent of the time. Gelman interpreted these findings as supportive of her hypothesis.

It is possible that one of the reasons Gelman was successful in teaching conservation was that she had made use of nonverbal media. Dykman, Walls, Suzuki, Ackerman, and Peters (1970) provide a clue as to the importance of not relying too heavily on verbal input alone. Their investigation of children with learning disabilities suggested to them that these children take almost 1/10 of a second longer than average to process a single bit of information. As they pointed out, normal conversation contains approximately 9 bits of information per second. At this rate children with learning disabilities could be completely lost in a matter of seconds. While their study indicated that speed of input was a crucial factor, the present study seems to indicate that a large number of verbal bits of information is too much even if the task at hand is not a timed one. A point to be noted is that when many of the bits of
information are presented in picture fashion the subjects did much better. We have seen the importance Bruner places on language and can easily surmise the explanation he might offer. But what might Piaget say?

The article cited above (Dykman et al., 1970) pointed out that Piaget long ago noted that young children tend to speak to themselves not only when alone but while with others. Piaget (1924) distinguished between egocentric speech and socialized speech. The former is usually replaced by the latter during the early school years. Dykman and his co-workers assume that as egocentric speech disappears the individual's inner speech progressively condenses into single words or even fragments of words. They feel that these units accomplish in thought what sentences and phrases accomplished earlier. "Condensation helps the child to think rapidly and a child whose inner speech is well developed should be able to process information more rapidly and react more quickly than a child who is slow in this development [Dykman et al. 1970, p. 779]."

Vygotsky (1962) has explicated the notion that egocentric speech does not merely cease but that it becomes the inner speech referred to above. He further pointed out that during problem-solving tasks the egocentric speech of children increased in occurrence.

While Gelman did not report anything along these lines, it is possible that her success in teaching conservation was due, in part, to allowing children to proceed at a rate and with a medium (other than verbal) which allowed them to not only process the information but to formulate in their own way their inner speech necessary for the problem.

The results of these studies lead to some interesting implications
for dealing with children, especially with those that might be called disturbed or maladaptive. One such implication would be that it may be far better to attempt to communicate with such a child in a medium that he can process and understand rather than to insist upon his immediately learning our way of communicating. This attempt to communicate with such a child might take on many approaches. It would not only use nonverbal as well as verbal means, but it would also transmit information at a rate at which he could assimilate it. One such approach appears to be in use already in the form of behavior modification therapy. In this approach a good deal of communication to the child is done in nonverbal fashion, such as presenting him with rewards like M & Ms. Furthermore, even the verbal communication in this approach is quite likely to be rather simple and easily comprehended. The messages are often consciously broken down into smaller units that may be more easily grasped.

Another desirable factor that behavior modification therapy can readily incorporate is encouraging these children to use verbal media for communication even if they should fail in many of their attempts. What can be seen in such children is an overdependence on nonverbal means and a fear of attempting such complex and difficult modes of communication as language can offer. In behavior modification approaches this encouraging of the use of language can be dealt with in the form of shaping an individual's behavior and having him gradually approximate a desired behavior such as using language.

Perhaps an even further refinement on this approach is to couple it, in dealing with certain children, with the use of sign language. This
would serve two purposes. For one thing, it would most probably slow down the one who is doing the communicating and this in itself, according to the study cited above (Dykman et al., 1970) would have a very beneficial effect. The child would be given information at a slower rate and presumably would be able to process it and keep up with it more easily.

Another aspect of sign language is that it appears to be almost an intermediate step between verbal and nonverbal communications. Thus, if the goal is to aid an individual to make the transition from nonverbal to verbal communication the choice of an apt intermediate step is essential. With sign language the child can easily visualize what is being done and yet is forced to gradually incorporate verbal symbolizations. Presumably, gaining facility in doing this in a manner and at a speed which they can comprehend will allow them the confidence to attempt more and more actual verbal communication.

There is one final factor to be discussed. Although it has been mentioned before that the relationship between maladaptive behavior and verbal ability is circular, there is still the question of which process begins the cycle. That is, does a child develop maladaptive behavior patterns because of an inability to master language, or does some personality disturbance bring about this inability?

At present it is impossible to state definitively which process initiates the cycle and it may be that this question can never be solved. In fact, it may not even be a legitimate question. It is possible that for some individuals it is one process and for others it is the reverse.

Nonetheless there are some interesting studies currently being
conducted that may shed some light on this. Dykman and his coworkers (Dykman et al., 1970), for example, have concluded that children who are classified as having learning disabilities do not have trouble because of motivational or other similar difficulties. They hypothesize that the critical variable in such children is the nervous system which is less efficient in at least one kind of arousal, i.e. that which is necessary for the assimilation of symbolic information. On the basis of neurophysiology they contend that the reticular formation is the structure most likely to hold the answers to these questions. To date they have no hard evidence that the reticular formation in such children is indeed dysfunctioning although they have reported that children with learning disabilities are more reactive physiologically.

Interestingly enough, other researchers (Ornitz & Ritvo, 1968; Ritvo, Ornitz, Evitar, Markham, & Brown, 1969; Ornitz, 1970) have established some evidence for neurophysiological dysfunction, at least in autistic children. Although they located the dysfunction in the vestibular system rather than the reticular formation, this in no way disproves Dykman's contentions and in fact supports them.

Of course, even demonstrating that these children have neurological dysfunction that inhibits the acquisition of language would not in and of itself prove that this is what causes their emotional disturbance. In other words, it could still be argued that the emotional disturbance was primary and produced neurological dysfunction secondarily. Nevertheless, the presence of neurological dysfunction certainly adds much weight to the arguments of Vygotsky, Luria, Bruner and others like them who claim that
language is of major importance. While their theories are plausible, it is precisely this kind of evidence that must be had to support those theories. It will be interesting to see what the advances in theory and technique produce in this area in the near future.
Chapter VI

Summary

There has been a paucity of research performed in the field of cognition as it pertains to man's psychic development. Writers such as Arieti (1970) have deplored this neglect. The present study investigated certain aspects of cognitive functioning among emotionally disturbed and normal boys.

Both the Genevan and the Harvard schools have performed extensive studies of cognitive development. They offered different interpretations, however, of the mechanisms by which cognitive growth occurs. Piaget (1969) proposed two mechanisms by which this takes place, accommodation and assimilation. Bruner (1966) placed more emphasis on the role of language in development.

Both schools would expect that emotionally disturbed children would demonstrate deficiencies in their language abilities. Bruner would imply that it was this deficiency that was contributing to an individual's emotional disturbance, i.e., if the individual could not make use of language to organize his world, he would exhibit maladaptive behavior. His reasoning follows that of Luria (1961).

Piaget, on the other hand, would more easily maintain that the
individual simply had not matured sufficiently to allow him proper command of language.

Rimoldi (1967a) has also devoted considerable effort in investigating the relationships between language, thinking, and logical structure. His research has given strong indications that there are relationships between what structures can be handled and what languages are available. He has also contributed a unique methodology for studying cognitive functioning through problem solving. Rimoldi's method was employed in this research.

A sample of 32 boys between the ages of 9 and 12 years of age who had been presented to four institutions in the Chicago area as being too disturbed to cope with school and home without psychiatric help were tested by this method. Another sample of boys who were matched to the disturbed sample in age and I.Q. but were not known to have any psychiatric problem were also administered the same problems.

The presentation of these problems varied in terms of abstractness-concreteness. The internal structure also varied from less to more complex. The score for each boy was based on how he went about solving the problem although the correctness of his final answer was also considered.

The analyses of the data revealed that the disturbed group performed significantly more poorly than the nondisturbed sample. Furthermore, it was observed that the disturbed sample exhibited an inability to deal with the structurally isomorphic problems when they were presented in verbal rather than picture form. That is, disturbed boys could cope with
certain problems when presented to them in picture fashion, but not when the information was conveyed in verbal terms. Further inspection revealed that the 11- and 12-year-old boys could solve the more simple verbal problems but not the complex verbal problems.

The results were seen as indicating that the Rimoldi method was sensitive to differences in cognitive functioning among disturbed children while scores based on number correct did not reveal differences between the groups. More importantly, these results indicate that a preferable approach to teaching disturbed children may be a nonverbal one since this may be comprehensible to them while verbal communication containing the same information might not be.
References


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Rimoldi, H. J. A. The study of psychological processes. Chicago: Loyola University, Loyola Psychometric Laboratory, 1961 (publication No. 19).

Rimoldi, H. J. A. Analysis of the interrelationships between logical structure, language, and thinking. Chicago: Loyola University, Loyola Psychometric Laboratory, 1967a, (publication No. 51).


APPENDIX A

Problems used in this investigation

Jimmy's grandfather gave Jimmy some big and small balls. They were of two colors, blue and gray. Jimmy misplaced one kind. Which one did he misplace -- the big or the small, the blue or the gray?

<table>
<thead>
<tr>
<th>Questions*</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Airplane</td>
<td>No</td>
</tr>
<tr>
<td>2. Big gray balls</td>
<td>No</td>
</tr>
<tr>
<td>3. Black balls</td>
<td>No</td>
</tr>
<tr>
<td>4. Big and small gray balls</td>
<td>No</td>
</tr>
<tr>
<td>5. Wagons</td>
<td>No</td>
</tr>
<tr>
<td>6. Boat</td>
<td>No</td>
</tr>
<tr>
<td>7. Yellow balls</td>
<td>No</td>
</tr>
<tr>
<td>8. Small gray balls</td>
<td>No</td>
</tr>
<tr>
<td>9. Ponies</td>
<td>No</td>
</tr>
<tr>
<td>10. Big blue balls</td>
<td>No</td>
</tr>
</tbody>
</table>

*In all the P problems the "questions" are drawings presented on cards. The description of the corresponding drawing is given next to the number of the card.
Mark had saved enough money to buy a new toy, so he went to the toy store. He saw boats, cars and trucks. They were either white or gray or black. He wanted to buy only one. Which one did he buy?

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. White, gray, black boats</td>
<td>No</td>
</tr>
<tr>
<td>2. A chair</td>
<td>No</td>
</tr>
<tr>
<td>3. A white car</td>
<td>No</td>
</tr>
<tr>
<td>4. White, gray, black cars</td>
<td>No</td>
</tr>
<tr>
<td>5. Horses</td>
<td>No</td>
</tr>
<tr>
<td>6. Wagons</td>
<td>No</td>
</tr>
<tr>
<td>7. White and black trucks</td>
<td>No</td>
</tr>
<tr>
<td>8. A yellow boat</td>
<td>No</td>
</tr>
<tr>
<td>9. A white boat and white car</td>
<td>No</td>
</tr>
<tr>
<td>10. A gray boat</td>
<td>No</td>
</tr>
</tbody>
</table>
Instructions and Corresponding Questions and Answers

John has 20 horses. There are black race horses and white race horses. There are black farm horses and white farm horses. I want you to figure out how many black farm horses there are?

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. How many white horses does John have?</td>
<td>2. 7.</td>
</tr>
<tr>
<td>3. How many brown horses does John have?</td>
<td>3. 0.</td>
</tr>
<tr>
<td>4. How many white racing horses does John have?</td>
<td>4. 5.</td>
</tr>
<tr>
<td>5. How many black racing horses does John have?</td>
<td>5. 5.</td>
</tr>
<tr>
<td>6. How many brown racing horses does John have?</td>
<td>6. 0.</td>
</tr>
<tr>
<td>7. How many white farm horses does John have?</td>
<td>7. 2.</td>
</tr>
<tr>
<td>8. How many brown farm horses does John have?</td>
<td>8. 0.</td>
</tr>
<tr>
<td>10. How many ponies does John have?</td>
<td>10. 0.</td>
</tr>
</tbody>
</table>
Instructions and Corresponding Questions and Answers

Joe and his two friends Peter and Mark went to the store to buy some marbles. Each one of them bought some green ones, some red ones, and some blue ones. Altogether they bought 45 marbles. How many blue marbles did Mark buy?

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many green marbles did the three of them buy?</td>
<td>1. 15.</td>
</tr>
<tr>
<td>2. How many red marbles and green marbles did Peter buy?</td>
<td>2. 10.</td>
</tr>
<tr>
<td>3. Did they use the marbles right away?</td>
<td>3. Yes.</td>
</tr>
<tr>
<td>5. How many red marbles did Peter buy?</td>
<td>5. 5.</td>
</tr>
<tr>
<td>7. Are the red marbles larger than the green ones?</td>
<td>7. No.</td>
</tr>
<tr>
<td>10. How many red marbles did the three of them buy?</td>
<td>10. 15.</td>
</tr>
</tbody>
</table>
Instructions and Corresponding Questions and Answers

We have 50 objects called C. There are two kinds of C's, one kind is called B, the other kind is called G. Any B can be either an R or a T, and any G can be either an R or a T. No B can be a G and no R can be a T. Will you find out how many of the G objects are also called T?

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many K's are there?</td>
<td>1. 11.</td>
</tr>
<tr>
<td>2. How many R objects are also called G?</td>
<td>2. 15.</td>
</tr>
<tr>
<td>3. How many T objects are also called B?</td>
<td>3. 10.</td>
</tr>
<tr>
<td>4. How many N objects are there?</td>
<td>4. 10.</td>
</tr>
<tr>
<td>5. How much is K times C?</td>
<td>5. 550</td>
</tr>
<tr>
<td>7. How many R objects are there?</td>
<td>7. 35.</td>
</tr>
<tr>
<td>8. Are there more R objects than T objects?</td>
<td>8. Yes.</td>
</tr>
<tr>
<td>10. How many R objects are also called B?</td>
<td>10. 20.</td>
</tr>
</tbody>
</table>
Instructions and Corresponding Questions and Answers

We have three kinds of T.objects. One kind is called M, another kind is called N, and another kind is called P. Further, each M, N, or P can also be called either a Q, a R, or an S. Altogether there are fifty objects. How many of the N objects are also called S?

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many Q objects and R objects are called P?</td>
<td>1. 15.</td>
</tr>
<tr>
<td>2. How many M objects and P objects are also called S?</td>
<td>2. 5</td>
</tr>
<tr>
<td>3. Are there more Q objects than S objects?</td>
<td>3. Yes.</td>
</tr>
<tr>
<td>4. How many N objects are called Q?</td>
<td>4. 5</td>
</tr>
<tr>
<td>5. How many objects are called Q?</td>
<td>5. 25</td>
</tr>
<tr>
<td>6. How many M objects are called A?</td>
<td>6. 0</td>
</tr>
<tr>
<td>7. How many objects are called R?</td>
<td>7. 15</td>
</tr>
<tr>
<td>8. Are there more P objects than R objects?</td>
<td>8. Yes.</td>
</tr>
<tr>
<td>9. How many objects are called K?</td>
<td>9. 0</td>
</tr>
<tr>
<td>10. How many P objects are also called R?</td>
<td>10. 5</td>
</tr>
</tbody>
</table>
APPENDIX B

Procedure for Scoring Problems

Assigning a score to an observed tactic involves several stages:

1) All irrelevant and redundant questions are set aside from the observed tactic. This procedure reduces an observed tactic to one of the possible basic tactics.

2) The elements remaining in the basic tactic are then analyzed for order reversals. For instance, reference to Figure 2 indicates that problems built around structure 35 have two types of questions: B, C, and D of maximum generality and E, F, and G of less generality or greater specificity.

In the scoring system reversals of questions within each order of generality are not considered. Thus, for the case of Figure 2, the sequences B, C, D, and D, B, C, are identical. But F, B, C implies reversals since the order of their occurrence in terms of the specifications set forth previously should be B, C, F or C, B, F. The number of more general questions that appear in the tactic determines the number of positions in which the less general questions may occur. That is, questions B and C determine three possible positions for any specific question: either before, in between, or following them. If a specific question follows a general question, it is arbitrarily assigned a positional number of 1.
Other positions are assigned values related to the number of steps that they are removed from the "logical" order. So question F has the following values: 1 if in sequences C, B, F or B, C, F, 2/3 if in sequences B, F, C, or C, F, B, and 1/3 if in sequences F, B, C, or F, C, B.

The general formula to determine these positional numbers is:

\[ a_{pj} = 1 - \frac{j}{k} \]

where \( a_{pj} \) is positional number for a question \( p \) in position \( j \), \( j \) corresponds to the number of steps that the question \( p \) is removed from its "logical" order, and \( k \) is number of possible steps. This formulation can be extended to problems with any values of \( k \), where \( 0 < j < (k-1) \).

3) With the positional numbers as defined in 2) above, a matrix \( L \) is built in which the rows correspond to all the questions presented with a problem and the columns to the basic tactics as specified in 1) above. In the cells of matrix \( L \), the corresponding positional numbers are entered, the values for the irrelevant and redundant questions being zero. An example of such matrix is given in Rimoldi, Chlapecka & Aghi (1970).

4) Each question in the problem is assigned a value in terms of the information it provides. Two conditions determine the information values \( I \) assigned to each question. First, assigning a score of 1.00 to the ideal tactic limits the information values of the 9 relevant questions. The more relevant questions in a problem, the smaller will be the information weight of each. The second condition relates the information weight of a general question to those of its equivalent class. The information weight of a question at level \( t \) is defined as:

\[ I_t = \left( 1 + \frac{r-1}{r} \right) I(t + 1) \]
where \( r \) is the number of elements in the equivalent class (sub-branches).

A \((1 \times n)\) row vector \( W (W_1, W_2, \ldots, W_n) \) may be used to represent these information values for a given logical structure. A sample follows.

Notice the information value of a given general question is greater than the sum of information values of its sub-branches by an amount directly related to the number of branches \( r \). This process allows a weighting for parsimony or economy of a tactic.

5) The score of basic tactic \((x_i)\), where \( i = 1, \ldots, m \), can be represented as a linear function of the information weights and of the positional numbers so that, \( x_i = w_1 a_{1i} + w_2 a_{2i} + \ldots + w_n a_{ni} \). Similarly, for all the other basic tactics.

In the \((n \times m)\) matrix \( L \), all the basic tactics corresponding to a given structure may be represented by the \((m)\) columns, while the \((n)\) rows correspond to all the questions in the problem. The \((1 \times n)\) row vector \( X \), gives the score for all the basic tactics and is obtained by the matrix multiplication:

\[
X = WL.
\]

6) The final step analyzes the tactics for the use of redundant and/or irrelevant questions. The total amount of irrelevancy is set equal to \(-1.00\) to be divided among the irrelevant questions of the problem.

If a problem has three irrelevant questions, each one of them has a value \( I_r = -0.33 \).

A relevant question is redundant when it appears in a tactic with a more general question covering the same information. Instead of receiving a positive information value, all the redundant possibilities
share a total weight of -0.25. If there are two possibilities as in Figure 2a for example, either c₂ or d₂ with a₁, then c₂ or d₂ with a₁ would receive a weight of Rd = -0.125 instead of a positive information weight as would occur if the a₁ question were not in the tactic.

The score for the observed tactic i is defined then as $S_i = x_i + I_{r_i} + R_{d_i}$, where $-1.00 \leq I_{r_i} \leq 0$, and $-0.25 \leq R_{d_i} \leq 0$ and $x_i$ is the score of the basic tactic.

Further technicalities and rationale for this scoring system can be found in the work by Rimoldi cited earlier (Rimoldi et al., 1970).
APPROVAL SHEET

The Dissertation submitted by Hugh Patrick Creedon has been read and approved by members of the Department of Psychology.

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

The Dissertation is, therefore, accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

1-15-71
Date

Signature of Advisor