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A COMPARISON OF NORMAL AND SUBNORMAL BOYS ON TASKS REQUIRING THE USE OF SELECTED CATEGORIES

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CHAPTER I

INTRODUCTION

Workers in the field of mental subnormality have been faced with a growing number of immediate practical problems as society has become more complex. As a result, they have had little time for theorizing about the conceptual issues which subnormality involves. To a public which is disturbed by the presence of intellectively deviant persons in its midst, plans for social, educational, and custodial care of subnormal persons exceed in importance such theoretical considerations as the nature of subnormality, or the implications of subnormality for a general theory of behavior. Consequently, individuals who work with the subnormal have often been required by the pressures of a concerned society to look for solutions to specific problems, rather than being allowed to reflect on basic theoretical aspects of mental handicap.

This set of factors has produced two major results which are undesirable. First, lack of experimentally established knowledge has made it necessary for professional workers

in subnormality to rely heavily upon clinically derived information concerning subnormal persons. Over a period of years this practice has become accepted, as the passage of time has given credulity to a number of assumptions which have not been adequately tested. This has been accompanied by a second undesirable consequence, which is the propensity to defend these traditional assumptions as if they were known to be valid, rather than exerting the effort to test them experimentally.

Fortunately, recent literature reveals an increasing unwillingness to accept traditional ideas and practices which have not been evaluated critically.[1] Furthermore, there is an emerging recognition that two important goals of workers in the field of subnormality--the need for a theory of subnormality, and the need for solutions to problems posed by practical demands--can both be best achieved by greater emphasis on the experimental investigation of the problems associated with subnormality, rather than by continued attempts to justify beliefs based largely on tradition.[2] Inasmuch as information provided by clinical observation has not furnished sufficient authority for trusting a number of commonly accepted ideas, it becomes increasingly desirable to begin subjecting to experimental evaluation those principles which have long been accepted as

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[1]William C. Kvaraceus, "Research in Special Education: Its Status and Function," Journal of Exceptional Children, YXIV (1958), 249-254.

[2]Edward Zigler, "An Overview of Research in Learning, Motivation, and Perception," Journal of Exceptional Children, XXVIII (1962), 445-448.

facts.

One common assumption which merits further investigation is the claim that the patterns of thinking in subnormal persons are simpler than those of normal individuals.[3] This assumption is accepted widely as a fundamental tenet of the psychology of subnormality. Its service as a basis for educational planning is demonstrated in the instructional practices utilized with subnormal individuals, and in the objectives which guide these practices.[4] Further, this allegation underlies current social planning for subnormal persons, such as the practice of institutionalization, which hinges on the justification that intellective deficit in subnormals is of such a nature that these persons can never be expected to maintain themselves independently.[5] Ostensible simplicity of thinking seems to be one of the most widely accepted characterizations of subnormal individuals, both among lay persons and among workers in the field of subnormality.[6]

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[3]Marion White McPherson, "A Survey of Experimental Studies of Learning in Individuals Who Achieve Subnormal Ratings on Standardized Psychometric Measures," American Journal of Mental Deficiency, LII (1948), 232.

[4]For example, see: Malinda Dean Garton, Teaching the Educable Mentally Retarded (Springfield, Illinois: Charles C. Thomas, 1961), pp. 8-11.

[5]Edgar A. Doll, "The Essentials of an Inclusive Concept of Mental Deficiency," American Journal of Mental Deficiency, XLVI (1941), 214-219; _____, "Is Mental Deficiency Curable?," American Journal of Mental Deficiency, LI (1947), 420-428; _____, "Feeblemindedness versus Intellectual Retardation," American Journal of Mental Deficiency, LI (1947), 456-459.

[6]McPherson, loc. cit.

In current research a focus of interest is developing which will help to provide those interested in how subnormal persons think with a part of the information which they require. This focus is on the process of categorization--the process through which the individual is enabled to give structure, and thus meaning to his experiential world.[7] Here, in the investigation of the part played by categories in the intellective process, it may be possible to determine the acceptability of the assumption that patterns of thought in normal children are more complex than those found in subnormal children.

The professional literature of subnormality includes few studies which deal with categorization in subnormals although the basic importance of the process in intellective function has been discussed by Brown,[8] Church,[9] and Bruner.[10] There are no published studies which compare normal and subnormal children with respect to their ability to employ categories. Investigation of the current literature reveals a strong need for research which will provide additional information concerning some of the basic assumptions which have traditionally been made to explain the subnormal condition.

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[7]Jerome S. Bruner, Jacqueline J. Goodnow, and George A. Austin, A Study of Thinking (New York: John Wiley and Sons, Inc., 1956), pp. 1-24.

[8]Roger Brown, Words and Things (Glencoe, Illinois: Free Press, 1958), pp. 1-21.

[9]Joseph Church, Language and the Discovery of Reality (New York: Random House, 1961), pp. 147-159.

[10]Bruner et al, op. cit., pp. 2-24.

Among those basic assumptions requiring further investigation is the claim that in subnormal individuals, patterns of thinking are simpler than those found in normal persons. If research were to demonstrate that subnormal persons were deficient in their use of conceptual categories, this information would help explain the dimensions of this alleged simplicity.

The present study attempts to provide experimental data which will clarify some of the assumptions regarding patterns of thinking in normal and subnormal children. It proceeds from the basic postulate that a knowledge of how children employ conceptual categories in their intellective activity will yield increased understanding of the relative simplicity or complexity of these patterns of thinking.

The line of reasoning underlying the approach employed in this study is as follows:

1. It appears that one important aspect of everyday intellective activity is that of making discriminations among similar experiential data in order to determine their meaning. This is not a simple sensory task. To be able to accomplish this task, the individual must possess a variety of conceptual categories of meaning, which he uses as a framework for classification of his experiences.

2. The process of categorization is possible for the individual because he has accumulated a number of similar experiences into meaningful aggregates during the course of his development. He then employs these, in the form of categories,

as an interpretative framework. The meaning of new experience for the individual is derived from the manner in which he is able to relate that new experience to his previously established categories.

3. Further, it can be seen that normal intellective function requires that an individual be able to employ approximately the same categories as do his peers, and that the individual must attain roughly the same meaning from his experiences as do others in the same surroundings, or risk classification as a deviant.

4. Since subnormal individuals are observed to have actual difficulty in functioning successfully in numerous situations, it seems legitimate to suggest that this low level of function may be caused by the subnormal person's inability to incorporate adequately the set of categories which is predominant for his particular culture.

5. An inability to employ categorization as an intellective tool might take several forms in subnormal persons. They might possess relatively fewer categories, in which case they would likely be unable to find items representing as great a number of categories as would normal individuals. They might possess a stock of categories which were less well delineated or understood by them, in which case their verbal descriptions of their categories might not keep pace with their category use. Or their use of categories might require more time, which would cause them to use categories with more apparent difficulty.

In view of the need for further research in subnormality, and recognizing the importance of categorization in the intellective process, it is interesting to examine professional literature to determine the nature of information which is currently available.

Review of the Literature

General Literature

Several contemporary writers have exhibited interest in the categorization process and its importance in intellective function. Roger Brown, for example, proposed that categories are important because they provide ways of ". . . grouping an array of objects or events in terms of those characteristics that distinguish this array from other objects or events in the universe."[12] Church, in a book which outlined his theory of a developmental psychology of cognition, stated that ". . . the end effect of all learning--whether by insight or accretion or classical or operant conditioning--is schematization."[13] Schematization is accomplished by formation of ". . . implicit principle(s) by which we order experience."[14] These schemata, essentially similar to categories as discussed in the present study, are ". . . The most fundamental form of knowledge."[15] "Our more specific schemata," continued Church,

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[12]Brown, op. cit., p. 221.

[13]Church, op. cit., p. 37.

[14]Ibid., p. 36.

[15]Ibid.

"are of classes of objects--sometimes called concepts or categories."[16]

A third writer whose work has forcefully emphasized the importance of categories of thought in intellective function is Jerome Bruner. In A Study of Thinking, he stated: "The learning and utilization of categories is one of the most elementary and general forms of cognition by which man adjusts to his environment."[17] Bruner further related that the utility of categories lies in the following facts:

1. Categorization reduces the complexity of the environment.
2. Categorization is the means by which the objects of the world about us are identified.
3. Categorization reduces the necessity of constant learning.
4. Categorization permits the ordering and relating of classes of events.[18]

The foregoing information indicates a strong interest in the importance of categories as a foundation of intellective function. However, in spite of growing interest, research in this area is far from complete. Inspection of the experimental literature, conducted in the following section, points up this incompleteness.

Experimental Studies

While general writers such as those cited above attest to the importance of understanding the place of categories in

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[16] Ibid., p. 37.

[17] Bruner, op. cit., p. 2.

[18] Ibid., p. 13.

intellective activity, little research has been conducted which bears directly on categorization as it reflects patterns of thinking. No investigators have published research which compares normal and subnormal children with respect to their repertory and use of categories, and few studies have been published which yield even indirect information on this topic. Most of the work which does provide indirect information concerning categorization may be grouped under one of three headings:

1. Studies of concept formation.
2. Studies analyzing the results of standardized ability tests.
3. Psychological studies of normal and subnormal subjects.

These studies will be considered in the above sequence.

Studies of Concept Formation. Although there are numerous studies in the area of concept formation, as a whole they yield limited information regarding the nature of categories possessed by children. According to Vinacke, two main reasons account for the general shortcomings of research in concept formation:

> First, the evolution of psychology has not gone far enough to free the treatment of concept formation from its past associations with epistemology and formal logic. Thus, terms like "abstraction" and "generalization" are still utilized--and still influence the nature of experiments--without sufficient analysis of the behavioral and genetic processes involved. Second, the data utilized in discussions of the subject are much too narrow, since they are usually drawn from limited experimental situations...[19]

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[19]W. Edgar Vinacke, "The Investigation of Concept Formation," Psychological Bulletin, XL (1951), 1.

Vinacke also suggested that one fault evident in previous studies of concept formation is the fact that investigators have unwittingly included three related but somewhat different fundamental problems in their studies. These problems which have been dealt with are; (1) Ability to Conceptualize, which is concerned with a general effort to ". . . trace, with age, the unfolding and elaboration of a general function in the behavior of the individual together with conditions which influence that development."[20] (2) Repertory of concepts, which is more concerned with ". . . the particular concepts which the child possesses, and with the way he utilizes them."[21] (3) Achieving specific concepts, in which the question is posed: "How does the individual go about attaining a particular concept?"[22]

It is evident that the second of these problems is the most closely related to the present study; it is unfortunate that attempts to investigate all three of these areas at the same time have resulted in relatively inadequate information in all of them. Of the studies which have been conducted in these areas, the following are most pertinent to the present study.

Reichard, Schneider, and Rapaport administered the Color-Form and Sorting tests described by Goldstein and Scheerer

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[20] Ibid., 7-8.

[21] Ibid.

[22] Ibid.

to 234 normal children who ranged in age from 4 through 14 years.[23] Their results demonstrated a steady increase with age in the ability of children to group together objects which belong together, and in ability to give conceptual explanations of the groupings. On the basis of their findings, they postulated that development of conceptual abilities progresses from a concretistic level through a functional level to a conceptual level. This development appears to take place throughout the whole age range studied by these investigators.[24]

Welch attempted to measure the gradual development of finer concepts of large, small, middlesize, wide, and narrow, in a group of 24 children from 12 to 40 months in age.[25] The gradual development of these concepts was noted as he observed these subjects over a period of several months. A series of studies conducted by Welch, and his collaborator Long, in general indicated that the development of conceptual abilities in children proceeds from simple to complex. Their studies also

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[23]Suzanne Reichard, Marion Schneider, and David Rapaport, "The Development of Concept Formation in Children," American Journal of Orthopsychiatry, XIV (1944), 156-162.

[24]Ibid., 156-160.

[25]Livingston Welch, "The Development of Size Discrimination Between the Ages of 12 and 40 Months," Journal of Genetic Psychology, LV (1939), 243-268; _____, "The Span of Generalization Below the Two Year Level," Journal of Genetic Psychology, LV (1939), 269-297; _____, "The Development of Discrimination of Form and Area," Journal of Psychology, VII (1939), 37-54; _____ and Louis Long, "A Further Investigation of the Higher Structural Phases of Concept Formation," Journal of Psychology, X (1940), 211-220.

indicate that at this childhood level of conceptual development, chronological age is as important a determinant of conceptual ability as is mental age.[26]

A few other studies have sought to establish the typical age at which specific concepts occur in children. For example, Friedman studied 697 children who ranged in school placement from kindergarten through the sixth grade, and who possessed average intelligence.[27] He found that conventional concepts of time are usually established by the time the children reach grade six, and that younger children tended to have less comprehension of time unless the time period is important to them. To Friedman, the progression of concept development appeared to be characterized by long and continuous progress, during which the child first developed gross discriminations which were followed by increasingly fine discriminations.

Concepts of magnitude have been studied by Thrum, who investigated the concept of middlesizeness in children from two to five years in age.[28] She found that many of her subjects had great difficulty in employing this concept. There appeared to be a high correlation between the ability to discriminate

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[26]Louis Long and Livingston Welch, "Influence of Levels of Abstraction on Reasoning Ability," Journal of Psychology, XIII (1942), 41-59.

[27]Kopple C. Friedman, "Time Concepts of Elementary School Children," Elementary School Journal, XLIV (1944), 337-342.

[28]Martha E. Thrum, "The Development of Concepts of Magnitude," Child Development, VI (1935), 120-140.

middlesizeness and general intelligence. Hicks and Stewart also investigated the concept of middlesizeness in two to five year old children, and reported findings which supported those of Thrum.[29] Both these studies reported results to indicate that gross discriminations of size are followed by increasingly finer ones as the child develops.

Concepts of form have also been of interest to investigators. Gellerman studied two children and two chimpanzees to determine their relative rate of development of concepts of form.[30] As a result of his investigations, he concluded that two year old children could discriminate forms, and that symbolic behavior is definitely exhibited in connection with form discrimination. Colby and Robertson also studied form and shape discrimination, and the results of their investigations led them to the conclusion that form, as a concept, is established as early as age three, and is dominant over color as a concept at that stage.[31]

Two main types of investigation of concept formation have been pursued in addition to the studies cited. However, these two approaches are not directly pertinent to the problem

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[29]Allen Hicks and Florence D. Stewart, "The Learning of Abstract Concepts of Size," Child Development, I (1930), 195-203.

[30]Louis W. Gellerman, "Form Discrimination in Chimpanzees and Two-year Old Children. I. Form (Triangularity) Per. Se. Journal of Genetic Psychology, XLII (1933), 23-50.

[31]Manual G. Colby and Janis G. Robertson, "Genetic Studies in Abstraction," Journal of Comparative Psychology, XXXIII (1942), 385-401.

addressed in the present study. One of these is the line of investigation undertaken by Piaget and his colleagues which, while classic in conception, is oriented toward a nonexperimental treatment of metaphysical and philosophical questions.[32] The other area not dealt with in this review concerns studies utilizing a number of tests of concept formation, which are not discussed because they either are directed primarily toward adult concept formation processes or do not test the subject's repertory of concepts or categories.[33]

In summary, experimental studies of concept formation, as a group, yield only minimal information concerning the range of categories which children possess, describing how well they employ these categories, or comparing different groups of children with respect to their efficiency in the use of a range of categories. This lack appears to be caused largely by an inadvertent confusion by investigators of several basic issues. Also, previous studies have either emphasized concepts related to primarily perceptual abilities, such as form, shape, and size, or at the other extreme, have studied more philosophical concepts, such as causation. As a result, little experimental information is available relating to those categories which children are likely to use in everyday intellective function.

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[32]Jean Piaget, The Child's Conception of the World (New York: Harcourt, Brace, and Co., 1959).

[33]Kurt Goldstein and Martin Scheerer, "Abstract and Concrete Behavior: An Experimental Study with Special Tests," Psychological Monographs (1941), No. 239.

Studies Analyzing the Results of General Ability Tests. Additional efforts have been made to investigate the intellective characteristics of children by analyzing the results of different tests of general mental ability. Among the instruments whose results have been subjected to such analysis are the Stanford-Binet Intelligence Test[34] and the different Wechsler scales.[35]

The Stanford Binet was originally designed to measure general intelligence and consequently includes items which show high correlation with general ability.[36] However, some investigators have attempted to determine whether or not certain patterns of responses to the test are characteristic of certain modes of thinking. Myers and Gifford, for example, pursued this line of investigation, and reported that schizophrenics were superior in vocabulary, abstract words, and dissected sentences, when compared as a group with normals of the same mental age.[37] Another investigator, Feifel, found that

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[34]Revised Stanford-Binet Scale (New York: Houghton Mifflin Company, 1937).

[35]David Wechsler, The Measurement of Adult Intelligence (3rd Edition; Baltimore: Williams and Wilkins, 1944); _____, The Wechsler-Bellevue Intelligence Scale (New York: Psychological Corporation, 1946); _____, Wechsler Intelligence Scales for Children (New York: Psychological Corporation, 1949).

[36]Lewis M. Terman and Maud A. Merrill, Stanford-Binet Intelligence Scale, Manual for the Third Revision Form L-M, (Boston: Houghton Mifflin Company, 1960), 1-3.

[37]C. R. Myers and Elizabeth Gifford, "Rescoring the Stanford-Binet," Bulletin of the Canadian Psychological Association, I (April, 1941, Number 29).

mental patients and normal subjects responded to vocabulary items in different ways, in that normals tended to use synonyms, while mental patients defined by description, illustration, and explanation.[38]

An important study was conducted by Thomson and Magaret, who compared the Binet performance of normal and subnormal subjects with similar mental ages. In this study, 73 of the Binet items were subjected to statistical analysis, and of these 73, 43 failed to differentiate between the normal and subnormal subjects.[39] These results seem explainable on the basis of the statistical analysis of the Binet carried out by McNemar, who reported that performance on Stanford-Binet items can be largely explained in terms of a single common factor, which for lack of a better name has subsequently been called "brightness."[40] In the Thomson and Magaret study, subnormal subjects proved to be more deficient in items which were more heavily saturated with the general factor described in the McNemar analysis.[41]

As the foregoing studies indicate, analysis of Stanford-Binet scores has done little to further the understanding of

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[38]Harold Feifel, "Qualitative Differences in the Vocabulary Responses of Normals and Abnormals," Genetic Psychology Monographs, XXXIX (1949), 151-204.

[39]Claire W. Thomson and Ann Magaret, "Differential Test Responses of Normals and Mental Defectives," Journal of Abnormal and Social Psychology, XLII (1947), 285-293.

[40]Quinn McNemar, The Revision of the Stanford-Binet Scale (Boston: Houghton Mifflin Company, 1942), Ch. IX.

[41]Thomson and Magaret, loc. cit.

specific aspects of the thinking process. Regarding these efforts, Anastasi wrote: "Attempts have repeatedly been made to determine whether the extent and nature of scatter bore any relation to the individual's intellectual . . . characteristics. The results of such investigations have generally been negative or inconclusive."[42]

A number of other studies have been interpreted to indicate that patterning of responses on the subtests of the different Wechsler scales reflects variations in patterns of thinking. Studies by Wechsler[43] and Rapaport[44] have been prominent in this area of investigation. Both these writers have suggested that patterning of scores on subtests of the Wechsler scales can reflect pathological thought processes on the part of the subject. Rapaport's lengthy study of the Bellevue scale presented his findings concerning the relation of scatter and patterning of test results to disturbed thought processes.[45] However, Anastasi has pointed out several criticims of scatter analysis.[46] Among these was the fact that the sub-tests are factorially complex, which makes it impossible to draw inferences

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[42]Anne Anastasi, Psychological Testing (New York: The MacMillan Company, 1954), p. 189.

[43]David Wechsler, The Measurement of Adult Intelligence, (3rd Edition; Baltimore: Williams and Wilkins, 1944), Ch. X.

[44]David Rapaport, et. al., Diagnostic Psychological Testing, I (Chicago: Year Book Publishers, 1945), pp. 37-379.

[45]Ibid.

[46]Anastasi, op. cit., pp. 333-334.

about any particular mental ability on the basis of information provided by specific sub-tests.[47] On these grounds, she submitted that the Wechsler scales can do little to provide systematic information concerning differential patterns of normal, abnormal, or subnormal thought.

In summary, both the Stanford-Binet test and the Wechsler scales have had wide acceptance since their introduction, and both are considered outstanding estimators of general ability. However, repeated studies have failed to find any patterning of responses to either test which provides reliable information concerning specific aspects of thinking, or which gives information concerning the stock of categories which a subject possesses.

Psychological Studies Comparing Normal and Subnormal Subjects. A portion of the indirect information which bears upon the importance of conceptual categories has been provided by psychological studies of normal and subnormal persons. Most of these studies are in one of two main areas: (1) studies comparing endogenous and exogenous types, and (2) studies of abstract versus concrete behavior.

Werner, Strauss, Lehtinen, and their colleagues conducted a number of studies designed to reveal differences between so-called garden variety subnormals and brain injured subnormals. While these studies accomplished their goal with only limited success, they provided some incidental information

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[47] Ibid., p. 334.

concerning thought processes in subnormal children.

Werner and Strauss found, for example, that a garden variety group approached a marble patterning task "globally," with uni-directional line arrangements, while the exogenous or brain injured group was characterized by incoherent, unrelated lines of arrangement.[48] The same investigators, in an experiment which required children to sing back melodic patterns played on a piano, found that endogenous children's responses were similar to those of normal children in that they both tended to simplify patterns which were too difficult for them. The exogenous group, however, tended to respond with bizarre, unrelated patterns. This same study provided indications that exogenous children were more confused by distracting backgrounds in trying to reproduce figures presented in complicated backgrounds.[49]

Another area of interest has been that of concrete versus abstract behavior and thought processes. Goldstein and his colleagues conducted a series of studies utilizing sorting tests they had devised with the purpose of evaluating behavior patterns as they reflected disturbance of thought. Most of these studies are not directly relevant to the present study, first of all, because the majority of the subjects studied were

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[48]Heinz Werner and Alfred A. Strauss, "Pathology of Figure-ground Relation in the Child," Journal of Abnormal and Social Psychology, XXXVI (1941), 236-248.

[49]Heinz Werner and Alfred A. Strauss, "Causal Factors in Low Performance," American Journal of Mental Deficiency, XLV (1940-1941), 213-218.

adults, and second, because the investigators conceived and constructed the testing instruments as estimators of thinking pathology or maladjustment, rather than as instruments to assess the subjects' stock and use of categories.[50] Rapaport, epitomizing their viewpoint, has stated that the aim of testing of concept formation is "to discover and diagnose in statu nascendi the encroachment of maladjustment upon conscious thinking."[51] If this is true, such a limitation curtails the usefulness of instruments of the type devised by Goldstein.

One investigator, Bolles, has specifically studied the ". . . qualitative differences in certain of the thinking processes of aments, dements, and normal children."[52] Only the results concerning normal and subnormal subjects are pertinent to this review. Ten subjects in each of these two classifications were administered the Holmgren Wools Test, Weigl Object Sorting Test, and the Goldstein Revision of the Kohs Block Test.[53] Bolles reported that her subjects classified the test items in four different ways:

1. Identity. The subject brings together only those objects which are exact sensory equivalents. If there are any discrepancies between them, the objects are not brought together.

2. Partial Identity. The subject brings objects together that are similar in some ways. The

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[50]Goldstein and Scheerer, loc. cit.

[51]David Rapaport et. al., op. cit., p. 389.

[52]Mary M. Bolles, "The Basis of Pertinence," Archives of Psychology, XII (1937).

[53]Goldstein and Scheerer, loc. cit.

similarity seems still to be on a sensory level. The objects seem to be equivalent in terms of some one sensory attribute.

3. Co-functionality. The subject brings the objects together because they seem to belong together in a concrete situation. The relationship between them seems to depend upon their being used together in a specific set of circumstances.

4. Categorical Similarity. The subject brings together objects that belong to the same general category. The objects are taken as a representative of a class and not in terms of some specific attribute or function each possesses.[54]

According to Bolles, these groupings form a progression from concrete to abstract, and she reports that "aments" tended to respond concretely, and were less able to shift voluntarily from one aspect of the situation to another. While these findings contribute to our knowledge of thinking processes, they are somewhat limited as a consequence of being interpreted on the basis of the abstract-concrete continuum,[55] because of the small number of subjects studied, and because the subnormal subjects studied were adults.[56]

Summary

The professional literature in the field of subnormality provides little systematic comparison of mental processes in subnormal and normal children. Specifically, there is a lack of information concerning the important idea of conceptual categories and the part they play in the thinking process.

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[54]Bolles, op. cit., p. 46.

[55]Brown, op. cit., Chapter 8.

[56]Bolles, op. cit., p. 48.

Various writers attest to the importance of categories in intellective function. Furthermore, the results of clinical observation and of certain studies provide tentative information about these processes. But in general, this information is sparse and difficult to evaluate.

A point of view which seems valuable, but which appears to have had little investigation, is one which holds that the basic ability underlying a large part of intellective function is the ability of the individual to utilize conceptual categories to give meaning to his experiences. Conversely, according to this point of view, an inability to classify experiences would cause the individual to perceive his experiential world as undifferentiated, and largely incomprehensible.

All these facts, when taken together, suggest the value of a study which describes the relative abilities of normal and subnormal children in using a variety of categories which have been observed to be an important part of everyday intellective function. Such a study should investigate the comparative number of categories used by normal and subnormal subjects, the ability of normal and subnormal subjects to use these categories independently, their ability to specify a name for the category they have used for their grouping, their ability to find examples of a category when they are given the name of the category, and the relative speed with which they can carry out all of these tasks.

Additional experimental data concerning these questions should increase the understanding of mental processes

and intellective characteristics of children. Furthermore, it will provide educators with an experimental basis on which to base instructional practices and theory, and it should serve as a spur to further research.

CHAPTER II

STATEMENT OF THE PROBLEM

Introduction

It was the purpose of this study to determine whether or not normal and subnormal children possess a similar stock of conceptual categories, and to determine how they differ in their ability to use categories in test situations. Specifically, it was desired to determine whether or not normal subjects could independently employ relatively more of a series of test categories than subnormal subjects; to determine whether or not normal subjects were able to correctly specify the name of relatively more of the categories which they employed than were subnormal subjects; to determine whether or not normal subjects were superior in their ability to correctly identify members of categories the names of which the examiner had specified; and to determine whether or not normal subjects attained correct responses in all these tasks more rapidly than did subnormal subjects.

Hypotheses to be Tested

To determine whether or not normal subjects were able to employ independently a relatively greater number of categories than were subnormal subjects when each group was presented

with unstructured categorization tasks, the following null hypothesis was formulated:

1. The number of correct responses obtained by the normal group is not significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 unstructured categorization tasks are compared.

To determine whether or not normal subjects were superior to subnormal subjects in their ability to specify the name of relatively more of the categories which they utilized correctly in the unstructured situation, the following null hypothesis was formulated:

2. The number of correct category names specified by the normal group is not significantly greater than the number of correct category names specified by the subnormal group when members of each group are required to name the categories they have employed in the unstructured categorization tasks.

To determine whether or not normal subjects were superior to subnormal subjects in their ability to point out members of categories the names of which the examiner had specified in advance of each item presented during the structured administration of the test, the following null hypothesis was formulated:

3. The number of correct responses attained by the normal group is not significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 structured categorization

tasks are compared.

The hypotheses related to differences in time are:

4. The mean time for correct responses attained by the subnormal group is not significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 unstructured categorization tasks are compared.

5. The mean time for correct responses attained by the subnormal group is not significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 category naming tasks are compared.

6. The mean time for correct responses attained by the subnormal group is not significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 structured categorization tasks are compared.

CHAPTER III

PROCEDURE OF THE STUDY

Introduction

The purpose of this study was to compare normal and subnormal children with respect to their ability to utilize a variety of conceptual categories under different conditions. It was of particular interest to determine whether or not normal subjects were superior to subnormal subjects in several aspects of category use. Questions were posed concerning whether or not subnormal subjects possessed a smaller stock of categories, whether or not they might have a relatively inadequate understanding of some of their categories, and whether or not they might require more time or apparent effort to utilize their categories appropriately.

The Instrument

In order to answer these questions, it was first necessary to locate a testing instrument suitable for determining the presence or absence of a range of categories in children, and capable of assessing their use of these categories in different situations. Initially, several published tests were considered; the two main ones were the Goldstein tests[1] and the

[1]Goldstein and Scheerer, loc. cit.

Columbia Mental Maturity Scale.[2] None of the Goldstein tests were judged suitable. Some of these tests deal only with one or at most a few categories, and thus would have lacked the scope necessary for this study. The other tests cover a broader range of categories, but are made up of relatively unwieldy materials, and lack a clear cut basis for judging passes and fails. A further undesirable aspect of the Goldstein tests is that they all are designed so that their results must be interpreted on the basis of the abstract-concrete continuum.

The Columbia Mental Maturity Scale also was considered. However, as Canter has pointed out, the items of this test are factorially complex, and although ability to categorize is required of the subject for successful completion of each item, the factorial complexity obscures the nature of the category used by the subject.[3] In addition, the Columbia Test has a high chance score (20%-25%, depending upon the item), which contaminates the obtained results.

As a result of these findings, a test of categorization was constructed by the investigator, specifically for the present study. It consists of a series of 27 cards, each eight inches by 18 inches. There is one test card for each of the

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[2]Bessie B. Buregemeister, Lucille H. Blum, and Irving Lorge, Columbia Mental Maturity Scale (New York: World Book Company), 1954-1959.

[3]Arthur Canter, "The Use of the Columbia Mental Maturity Scale with Cerebral Palsied Children," American Journal of Mental Deficiency, LX (April, 1956), 843-851.

following 27 categories:

Sample: Size
Sample: Form
1. Color
2. Number
3. Detail
4. Orientation in space
5. Heat
6. Clothing
7. Fruits versus vegetables
8. Flying versus non-flying objects
9. Containers versus non-containers
10. Tools versus non-tools
11. Cutting versus non-cutting equipment
12. Sex differences in children
13. Age differences in men
14. Sex differences in adults
15. Happy versus sad children
16. Ugly versus pretty women
17. Land vehicles versus airborne or amphibious vehicles
18. Land animals versus airborne or amphibious animals
19. Young boys versus other living things
20. Clothing made from animal products versus other wearing apparel
21. Footwear versus other clothing
22. Furniture versus other household objects
23. Cooking equipment versus other household objects
24. Male versus female wearing apparel
25. Even numbers of dots versus odd numbers of dots

On each test card there are seven randomly ordered figures or pictures, four of which represent the category, and three of which are incorrect responses in terms of the category which is being tested. In the present study, the subject was required to perform three types of tasks employing these materials. First, he was required to independently decide upon the appropriate category for each card. Second, he was required to provide a name for each of the categories he had used as a basis for arriving at his responses. Third, he was required

to find the items on each card which represented the correct category, after the name of that category had been specified by the examiner.

Several delimitations must be noted concerning these categories. First, they are not intended to include the whole range of intellective experience, but rather are believed to be representative of classification tasks necessary for adequate everyday intellective function on the part of children. Their importance has been verified by observation of children in their life situations.

A second delimitation has to do with the relative difficulty of the categories. It appears impossible to establish the absolute difficulty of any given category. However, on the basis of logic, it may be suggested that the difficulty of a category is dependent upon the number and type of cues which the individual must consider before the decision of inclusion or exclusion is made. This idea has some experimental support.[4] A test of the sort required for the present study must proceed from the basic assumption that it is important to estimate the individual's ability to deal with the category in a simple form. It is granted that the particular categories may differ in their relative difficulty. While there is no way of establishing conclusively that a test item for a particular category is the simplest form possible, a recognition of the necessity for simplicity at least serves to draw the attention

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[4]Bruner, Goodnow, and Austin, op. cit., pp. 45-49.

of the test constructor toward this problem.

A third delimitation was the recognition that a one item test is not considered desirable for many purposes. It was also necessary, however, to consider the following factors. First, it was not desired to create a test for popular usage, but rather to devise an experimental instrument. This meant that the value of the test depended not upon its resemblance to existing tests, but upon whether or not it differentiated normal from subnormal subjects along the dimension of behavior being studied.[5] Administration to eight normal and eight subnormal subjects prior to the pilot study showed that subnormal and normal children differed widely in their number of correct responses to test items. This evidence indicated that the experimental instrument would be adequate for the present study.

The Pilot Study

The main purposes of the pilot study were (1) to gain further information concerning the ability of the test items to discriminate between normal and subnormal children, and (2) to reveal any mechanical problems which might be associated with administration procedure, recording of scores, and with timing the items.

Two groups were tested in the pilot study. One was composed of 10 normal boys from regular classrooms, while the other was made up of 10 subnormal boys in the "educable" range,

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[5]Seymour B. Sarason, Psychological Problems in Mental Deficiency (New York: Harper and Brothers, 1959), 646-647.

who were enrolled in special classes. All children were from the same school, and each of the normal subjects was matched for chronological age to a subnormal subject, allowing a range of ± three months.

The procedure for testing was as follows:

1. Subjects were seated facing the examiner across a small table. The examiner then placed four pennies, heads up, in a row before the subject, and said: "You've probably noticed how different things can be like each other. See, these pennies are all alike. They look alike."

   The pennies were then removed, and a row composed of one penny, one dime, one nickel and one quarter was made before the subject. The examiner then asked: "Are these alike? They don't look alike, but they do something alike, don't they? We could buy something with any of them. They are alike because they do something alike."

   "So, things can be alike for different reasons. They can be alike because they look alike, like the pennies, or they can be alike because they do something alike, like the others."

   The pennies were replaced before the subject, and the examiner said:

   "Now, I have some pictures on these cards of lots of things. On each card some of the things go together because they are most alike. We're going to look at each card and put the pennies on the things which are most alike. I'll show you what I mean with the first two cards."

2. The examiner presented each sample card, and aided the subject, when necessary, in the correct solution, each time verbalizing the correct category following correct placement of the pennies.

3. The examiner then presented the first test card, saying: "Let's do this one. Which of these are most alike?" The subject's response and the time required to reach it were recorded. Then the examiner asked: "How or why are those most alike?"

4. The same instructions as presented in item 3 were

presented for each of the subsequent items through item 25.

5. After completion of the unstructured administration, each card was presented again in the structured condition, wherein the examiner structured the situation by specifying the category which the subject should employ. The examiner placed each card before the subject and asked: "Which ones are the same color?", etc., naming the category for each card, until all cards had been attempted by the subject.

All responses made by each subject, and the number of seconds required for him to make the response, were recorded on a specially constructed form (Appendix 1).

Inspection of the results obtained in the pilot study indicated substantial raw score differences between groups, and in favor of the normal subjects. These differences demonstrated that many of the items discriminated between normal and subnormal children. In addition the mechanical procedure of administration was satisfactory.

The Sample

Subjects included in the present study were 60 boys from two public schools in an urban area in central Oklahoma. Thirty were enrolled in regular classrooms and 30 were from classes for the educable mentally retarded. They represented families of lower-middle or middle-middle socio-economic level. Each subject was screened for evidence of gross physical handicap, difficulty in hearing, visual acuity problems, or emotional disturbance, and no subject was included who evidenced any of these characteristics.

The examiner determined the presence or absence of gross

physical handicap and of hearing difficulty by observation of the child in the classroom followed by a brief conversation with the child. Adequacy of visual acuity was estimated by requiring each subject to name several items pictured on a special test card. These items were as small as or smaller than the items presented on the regular test cards. If the child could name the depicted objects, his visual acuity was judged adequate for his participation in the present study. Color vision was tested in a similar manner, by requiring the subject to name the color of red, green, and blue objects presented pictorially on a second special card. Success at this task was accepted as evidence that color vision was adequate for the present study.

All boys who served as subjects were in the 7 years 6 months to 10 years 6 months chronological age range. There were 10 normal and 10 subnormal boys in each of three age brackets: 7 years 6 months to 8 years 6 months, 8 years 6 months to 9 years 6 months, and 9 years 6 months to 10 years 6 months.

The intellective characteristics of the subjects were as follows: Each of the 30 boys included in the subnormal group possessed an intelligence quotient in the 47 to 72 I. Q. range as measured by the Goodenough Test.[6] Normal subjects included in this study had earned Goodenough Intelligence

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[6]Florence L. Goodenough, Measurement of Intelligence by Drawings (Yonkers-on-Hudson, New York: World Book Company, 1926).

quotients in the 90 to 110 I. Q. range. Results of the Good-enough test were also examined for evidence of severe emotional disturbance,[7] and no subject whose drawing revealed evidence of such disturbance was included in the present study.

In summary, the sample tested in the present study had the following characteristics:

1. All subjects were boys attending public schools in an urban area in central Oklahoma. The 30 normal subjects were attending regular classes, and the 30 subnormal subjects were enrolled in special classes for the educable mentally handicapped.

2. All subjects represented lower-middle or middle-middle socio-economic level families.

3. No subjects had an observable gross physical handicap, difficulty in hearing, visual handicap, nor severe emotional disturbance.

4. All subjects were between 7 years 6 months and 10 years 6 months in chronological age. There were 10 normal and 10 subnormal subjects at each age level 7 years 6 months to 8 years 6 months, 8 years 6 months to 9 years 6 months, and 9 years 6 months to 10 years 6 months.

5. Thirty of the boys, the subnormal group, possessed I. Q. scores ranging from 47 to 72, with a mean I. Q. of 60 and a standard deviation of 7.4.

6. The normal group of thirty boys had I. Q. scores ranging from 96 to 108, with a mean I. Q. of 101.1, and a standard deviation of 3.0.

Administration of the Test

Each subject accompanied the examiner to a quiet, well lit testing room, and was seated opposite the examiner across

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[7]Karen Machover, Personality Projection in the Drawing of the Human Figure: A Method of Personality Investigation (Springfield, Illinois: Charles C. Thomas and Sons, 1949).

a small table. The subject was then required to complete the Goodenough Draw-a-Man Test.

After the subject completed the Goodenough Test, the examiner removed the sheet of paper he had used, and carried out the following procedure:

1. Subjects were seated facing the examiner across a small table. The examiner then placed four pennies, heads up, in a row before the subject, and said: "You've probably noticed how different things can be like each other. See, these pennies are all alike. They look alike."

   The pennies were then removed, and a row composed of one penny, one dime, one nickel and one quarter was made before the subject. The examiner then asked: "Are these alike? They don't look alike, but they do something alike, don't they? We could buy something with any of them. They are alike because they do something alike."

   "So, things can be alike for different reasons. They can be alike because they look alike, like the pennies, or they can be alike because they do something alike, like the others."

   The pennies were replaced before the subject, and the examiner said:

   "Now, I have some pictures on these cards of lots of things. On each card some of the things go together because they are most alike. We're going to look at each card, and put the pennies on the things which are most alike. I'll show you what I mean with the first two cards."

2. The examiner presented each sample card, and aided the subject, when necessary, in the correct solution, each time verbalizing the correct category following correct placement of the pennies.

3. The examiner then presented the first test card, saying: "Let's do this one. Which of these are most alike?" The subject's response and the time required to reach it were recorded. Then the examiner asked: "How or why are those most alike?" The subject's responses and the time he required to reach them were recorded.

4. The same instructions as presented in item 3 were presented for each of the subsequent items through 25.

5. After completion of the unstructured administration, each card was presented again in the structured condition, wherein the examiner structured the situation by specifying the category which the subject should employ. The examiner placed each card before the subject and asked: "Which ones are the same color?", etc., naming the category for each card, until all cards had been attempted by the subject.

Following completion of the unstructured tasks, the naming tasks, and the structured tasks in that order, the child was complimented on his effort and allowed to return to his classroom.

Obtained Data

In addition to data used for screening, information was obtained concerning each of the 60 subjects in two categories: (1) preliminary data, and (2) test data. The preliminary data included the subjects name, sex, age, birth date, school, teacher, previous mental ability test scores, and information concerning the adequacy of his vision and hearing. The test data included the subject's responses to the unstructured tasks, which were his independent, self-organized responses to each of the 25 categories tested; his naming responses, which were the names each child gave for each of his completed efforts whether correct or incorrect; and the child's responses to the structured tasks, which were his responses to the same 25 test cards but with the examiner specifying in advance of each successive category the subject was to use in selecting the correct

pictures or objects.

Using the methods which have been described in this chapter, the normal and subnormal samples were tested in order to determine their performance on tasks requiring the use of conceptual categories. The results of this evaluation are presented in the following chapter.

CHAPTER IV

THE RESULTS

The broad purpose of the present study was to provide experimental data concerning certain intellective characteristics of normal and subnormal children. In particular, it was desired to gain information regarding the alleged simplicity of thinking in subnormal children. Therefore, a test was devised to measure several aspects of performance of children on tasks requiring the use of conceptual categories which had been observed to be important in everyday intellective activity. Specifically, information was gathered to enable comparisons of normal and subnormal subjects with respect to how successfully each group could perform three main types of tasks, all of which were dependent upon the subject's ability to employ conceptual categories. In these three tasks the subjects were required: (1) to determine the appropriate category for organizing pictures of items without help from the examiner; (2) to give correct names for categories which the subject had just employed appropriately in the unstructured situation; and (3) to find pictures which represented the category being tested after the examiner had specified the category name in advance of each task. These tasks were respectively called: (1) the

unstructured tasks, (2) the naming tasks, and (3) the structured tasks. The time in seconds required by each subject to complete each task was also recorded.

It was proposed that knowledge of how subjects performed on these categorization tasks would help explain the relative simplicity or complexity of thinking patterns in normal and subnormal children. A further assumption was that a subject whose repertory of conceptual categories was relatively limited, poorly understood by him, or difficult for him to use, would be at a disadvantage in most intellective tasks when compared with subjects in whom these abilities was relatively intact. In connection with this assumption, it was proposed that lowered performance on structured tasks would indicate a limited repertory of conceptual categories, that lowered performance on the naming tasks would indicate lack of category development and delineation, and that low scores on unstructured tasks would point to a general difficulty in independent application of conceptual categories to experiential material.

Two groups of subjects were included in the present study. Each group was composed of 30 boys between the ages of 7 years 6 months and 10 years 6 months, who represented families of middle-middle and lower-middle socio-economic levels. One group was composed of boys whose mean intelligence quotient, as measured by the Goodenough Intelligence Test, was 60.0 with a standard deviation of 7.4. The normal group had a mean intelligence quotient of 101.1 with a standard deviation of 3.0. These two groups, similar except for measured intellective

level, were compared to determine their relative levels of performance on (1) twenty-five unstructured categorization tasks on which each subject attempted to find the depicted items which belonged together with no help from the examiner, (2) twenty-five naming tasks wherein each subject attempted to give a correct name to the grouping he had just made on the unstructured task, and (3) twenty-five structured categorization tasks in which the subject attempted to find items which represented each a category after the name had been specified in advance of the tasks by the examiner.

The normal and subnormal groups were also compared with respect to the mean number of seconds required by each group to successfully complete the tasks described. Furthermore, they were compared to determine the types of errors which were characteristic of each group in the naming tasks.

Statistical Treatment

The test results for the normal and subnormal groups were compared by converting them to percentages and applying the formula for the significance of the differences between proportions, which is described by Garrett.[1] This formula provides a standardized deviate score based upon the following operations:

$$Z = \frac{P_1 - P_2}{\sqrt{P\,Q\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

[1]Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1960), pp. 235-241.

In this formula, P_1 equals the proportion of the first group attaining correct responses and P_2 equals the proportion of the second group whose responses were correct. In the denominator, P equals the total proportion of both groups achieving the correct response, while Q equals 1 - P. The total denominator provides an estimate of the standard error of the difference between scores, and when the percentage difference between the two groups is divided by this standard error value, the result is a standard deviate score for which the position on the baseline of a distribution indicates the probability of such a difference occurring by chance alone. For the present study the level of significance was set at the 0.05 level.

In this investigation the hypotheses were accepted or rejected by reference to a statistical consideration reported by Wilkinson.[2] Through the use of a table provided by Wilkinson (Appendix 3), it is possible to determine the number of differences which may be significant in a given number of comparisons without exceeding certain levels of expectation. In this study, it was desired to test the null hypotheses that normal subjects do not exhibit performance which is significantly superior to that of subnormals on a series of 25 potential comparisons in four different areas. For each of these areas it was possible to determine the number of comparisons which were required to produce significant differences before the null

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[2]Bryan Wilkinson, "A Statistical Consideration in Psychological Research," Psychological Bulletin, XLVIII (1951), 156-158.

hypothesis (stating that no differences exist) could be rejected.

The data obtained by statistical analysis of the test results are presented in the following sections.

Differences in Number of Correct Responses to the Unstructured Tasks

Each subject in the present study was tested to determine the number of the 25 test categories which he could complete successfully through a process of inspecting each test card and then independently applying the appropriate category for selecting the items on that card which were most alike. As far as could be determined, only one logical solution was possible for the subject in each category. The test was constructed to minimize the number of reasonable groupings which a subject could employ. The correct responses of the subnormal subjects were compared as a group with those of the normal group. The comparisons for the unstructured tasks are presented in Table 1.

The data presented in Table 1 reveal that in 21 of the 25 unstructured categorization tasks a greater number of normal than subnormal subjects attained correct responses. These differences were significant at or beyond the 0.05 level. A significantly greater number of subjects in the normal group achieved correct responses on the following items: (1) Color, (2) Number, (3) Detail, (4) Orientation in space, (5) Heat, (6) Clothing, (7) Fruits, (8) Flying objects, (9) Containers, (10) Tools, (11) Cutting equipment, (12) Sex differences in children, (13)

Age differences in men, (14) Sex differences in adults, (15) Sad children, (17) Land vehicles, (18) Land animals, (19) Young boys, (21) Footwear, (22) Furniture, and (23) Cooking equipment. In all these categories, a significantly greater number of normal subjects attained correct responses.

TABLE 1

NUMBER AND PERCENTAGE OF SUBJECTS ATTAINING CORRECT RESPONSES IN UNSTRUCTURED TASKS

Category	Normals (n=30) Number	Normals (n=30) Percentage	Subnormals (n=30) Number	Subnormals (n=30) Percentage	Percentage Difference (N>SN)	Z Value
1.	30	100.0%	23	76.7%	23.3%	2.81*
2.	29	96.7	20	66.7	30.0	3.00*
3.	29	96.7	24	80.0	16.7	2.01*
4.	26	86.7	18	60.0	26.7	2.34*
5.	28	93.3	18	60.0	33.3	3.05*
6.	14	46.7	7	23.3	23.4	1.90*
7.	12	40.0	1	3.3	36.7	3.45*
8.	10	33.3	4	13.3	20.0	1.83*
9.	15	50.0	5	16.7	33.3	2.74*
10.	39	93.3	11	36.7	56.3	4.60*
11.	12	40.0	3	10.0	30.0	2.68*
12.	27	90.0	16	53.3	36.7	3.16*
13.	23	76.7	13	43.3	33.4	2.64*
14.	30	100.0	14	46.7	53.3	4.67*
15.	20	66.7	7	23.3	43.4	3.38*
16.	12	40.0	7	23.3	16.7	1.39
17.	26	86.7	5	16.7	70.0	5.43*
18.	12	40.0	2	6.7	33.3	3.05*
19.	14	46.7	1	3.3	43.4	3.88*
20.	1	3.3	2	6.7	-3.4	0.60
21.	27	90.0	12	40.0	50.0	4.06*
22.	24	80.0	4	13.3	66.7	5.18*
23.	22	73.3	9	30.0	43.4	3.36*
24.	4	13.3	5	16.7	-3.4	0.37
25.	2	6.7%	0	0.0%	6.7%	1.45

Positive percentage differences in favor of normals; minus differences in favor of subnormals.

* Significant at or beyond the 0.05 level.

The number of subnormal subjects making correct responses was similar to the number of normal subjects in the following categories: (16) Pretty women, (20) Clothing made from animal products, (24) Male wearing apparel, and (25) Even numbers of dots. Examination of Table 1 reveals that for each of the categories (6) Clothing, and (16) Pretty women, a total of no more than 21 subjects in both normal and subnormal groups combined made correct responses. In (8) Flying objects, only a total of 14 subjects, and in (20) Clothing made from animal products, and (24) Male wearing apparel, a total of fewer than 10 subjects in the normal and subnormal groups combined made correct responses. In (25) Even numbers of dots, comparison was not possible because no subnormal subjects attained correct responses. These findings may have indicated that the difficulty of these items was too great for them to be a fair test of the subjects' categorization ability at the age levels represented in this group.

With respect to the significance of the total findings concerning the unstructured tasks, 25 comparisons were possible. In a set of 25 comparisons the probability is less than one in one thousand that as many as 7 significant differences would occur by chance alone.[3] Twenty-one of the 25 comparisons yielded differences which were statistically significant beyond the 0.05 level and in favor of the normal subjects. Evidence is thus provided which indicates that as a group the

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[3]Wilkinson, loc. cit.

subnormal subjects in the present study were substantially less able to determine independently the proper category to employ when the responses both groups made to a series of unstructured categorization tasks were compared.

On the basis of the data presented above, the first null hypothesis was rejected. The number of correct responses attained by the normal group was significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 unstructured categorization tasks were compared.

Differences in Number of Correct Responses to the Naming Tasks

The normal and subnormal subjects in the present study were also compared on the basis of their performance on the naming tasks. The main interest in this comparison was the relative efficiency with which subjects in each group could specify the correct names for categories which they had been able to employ correctly in the unstructured tasks. Comparisons of the responses of each group for the total number of tasks would not have yielded meaningful data, because the subnormal group had already scored a significant number of lower scores in the unstructured tasks; thus it was not reasonable to expect them to be able to provide the correct names for categories which they had been unable to utilize. Therefore, comparisons of the groups in the naming tasks dealt only with those of the test categories for which subjects in both groups had scored correct response on the unstructured tasks. (It

should be noted that the subjects had not been informed whether or not their responses on the unstructured tasks were correct.) The responses of each subject to the naming tasks were recorded, as was the number of seconds required to state the responses. Table 2 presents a summary of the responses of each group to this second set of tasks.

The data presented in Table 2 reveal that the normal and subnormal groups differed significantly in their correct responses to the naming tasks in 11 of the 24 categories for which comparisons were possible. These differences were significant at or beyond the 0.05 level, and all were in favor of the normal group. Differences were revealed in the following categories: (2) Number, (4) Orientation in space, (5) Heat, (6) Clothing, (8) Flying objects, (10) Tools, (13) Age differences in men, (15) Sad children, (17) Land vehicles, (21) Footwear, and (24) Male wearing apparel.

Those categories in which no significant differences in naming performance existed were: (1) Color, (3) Detail, (7) Fruits, (9) Containers, (11) Cutting equipment, (12) Sex differences in children, (14) Sex differences in adults, (16) Pretty women, (18) Land animals, (19) Young boys, (20) Clothing made from animal products, (22) Furniture, and (23) Cooking equipment. No comparison was possible for (25) Even numbers of dots.

In a set of 24 comparisons the probability of 11 significant differences occurring by chance is less than one in

TABLE 2

NUMBER AND PERCENTAGE OF SUBJECTS ATTAINING CORRECT RESPONSES IN TASKS OF NAMING CORRECTLY COMPLETED UNSTRUCTURED TASKS

Category	Normals (n=30) Number Correct: Unstructured Tasks	Normals (n=30) Number Correct: Naming Tasks	Normals: Percentage Naming Correctly	Subnormals (n=30) Number Correct: Unstructured Tasks	Subnormals (n=30) Number Correct: Naming Tasks	Subnormals: Percentage Naming Correctly	Percentage Difference (N > SN)	Z Value
1.	30	30	100.0%	23	22	95.6%	4.4%	1.53
2.	29	26	89.6	20	13	65.0	24.6	2.10*
3.	29	28	96.6	24	23	95.8	0.8	0.15
4.	26	23	88.5	18	9	50.0	38.5	2.46*
5.	28	28	100.0	18	16	88.9	11.1	1.80*
6.	14	12	85.7	7	3	42.8	42.9	2.05*
7.	12	11	91.7	1	1	100.0	8.3	0.09
8.	10	7	70.0	4	1	25.0	50.0	1.71*
9.	15	10	66.7	5	1	20.0	46.7	1.04
10.	28	23	82.14	11	4	36.4	45.7	2.78*
11.	12	10	83.3	3	3	100.0	-16.7	1.14
12.	27	23	85.2	16	16	100.0	-14.8	1.61
13.	23	23	100.0	13	9	69.2	30.8	2.83*
14.	30	23	76.7	14	11	78.6	-1.9	0.14
15.	20	15	75.0	7	3	42.8	33.2	1.83*
16.	12	2	16.7	7	0	0.0	16.7	1.14
17.	26	17	65.4	5	1	20.0	45.4	1.88*
18.	12	4	33.3	2	1	50.0	-16.7	0.46
19.	14	12	85.7	1	1	100.0	-14.3	0.41
20.	1	1	100.0	2	2	100.0	0.0	0.00
21.	27	27	100.0	12	9	75.0	25.0	2.71*
22.	24	10	41.7	4	1	25.0	16.7	0.63

TABLE 2--Continued

Category	Normals (n=30) Number Correct: Unstructured Tasks	Normals (n=30) Number Correct: Naming Tasks	Normals: Percentage Naming Correctly	Subnormals (n=30) Number Correct: Unstructured Tasks	Subnormals (n=30) Number Correct: Naming Tasks	Subnormals: Percentage Naming Correctly	Percentage Difference (N > SN)	Z Value
23.	22	17	77.3	9	7	77.8	-0.5	0.03*
24.	4	4	100.0	5	1	20.0	80.0	2.40*
25.	2	0	0.0	0	0	0.0	0.0	0.00
			$\bar{X}$ = 80.0			$\bar{X}$ = 68.4	$\bar{X}$ = 11.6	3.40*

Positive percentage differences in favor of normals; minus differences in favor of subnormals.

* Significant at or beyond the 0.05 level.

one thousand.[4] The fact that on the naming tasks, 11 of the 25 comparisons differed significantly in favor of the normal subjects gives an indication that this group of normal subjects were better able to specify the correct category names for categories which they had previously been able to utilize successfully. While it is important that the normal subjects' performance was superior on 11 of the 25 categories tested, it also is of interest to consider that subnormal subjects compared favorably with the normal subjects on 11 of the categories tested. Although on each of the categories tested, relatively fewer of the total group of subnormal subjects were able to perform successfully, apparently those who did succeed on the unstructured tasks had some degree of efficiency in naming those categories on which they had performed satisfactorily.

It also should be noted that while normal subjects exceeded subnormal subjects in their ability to specify correct category names for their performances on the unstructured tasks, their performance responses were not perfect. In fact, only an average of 80.0% of the subjects in the normal group were able to equal the correct responses they made on the unstructured tasks. In the subnormal group, 68.4% of the subjects who had achieved correct responses in the unstructured task were able to successfully complete the naming tasks for those same categories. The difference between these proportions is significant at the 0.05 level, and in favor of the normal group.

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[4]Wilkinson, op. cit., p. 158.

However, these data also point up the fact that the normal subjects did not have perfect scores on tasks requiring them to specify the names of categories they had employed successfully.

On the basis of the data presented above, the second null hypothesis was rejected. The number of correct category names specified by the normal group was significantly greater than the number of category names specified by the subnormal group when members of each group were required to name the categories which they had correctly employed in the unstructured categorization tasks.

Differences in Number of Correct Responses to the Structured Tasks

Both groups investigated in the present study were also administered 25 structured categorization tasks. The tasks were structured in that the examiner specified the name of the category for each of the 25 test cards, and the subject was required to locate on each card the items which represented that category. It was expected that the structured tasks would be relatively less difficult for the subjects because the category was specified; presumably, a person who possessed that category at any functional level could find objects which represented it if asked specifically to do so.

The total number of subjects in each group who attained correct responses was compared for each of the 25 categories. The results of these comparisons are summarized in Table 3.

The data presented in Table 3 indicate that the number of normal subjects attaining correct responses was significantly greater than the number of subnormal subjects doing so, in 14 of the 25 categories tested. These differences were significant

TABLE 3

NUMBER AND PERCENTAGE OF SUBJECTS ATTAINING CORRECT RESPONSES IN STRUCTURED TASKS

Category	Normals (n=30) Number	Normals (n=30) Percentage	Subnormals (n=30) Number	Subnormals (n=30) Percentage	Percentage Difference (N > SN)	Z Value
1.	29	96.7%	29	96.7%	0.0%	0.00
2.	30	100.0	25	83.3	16.7	2.35*
3.	30	100.0	30	100.0	0.0	0.00
4.	28	93.3	23	76.7	16.6	1.80*
5.	30	100.0	30	100.0	0.0	0.00
6.	28	93.3	22	73.3	20.0	2.08*
7.	21	70.0	8	26.7	43.3	3.36*
8.	29	96.7	28	93.3	3.4	0.60
9.	28	93.3	26	86.7	6.6	0.85
10.	30	100.0	19	63.3	36.7	3.68*
11.	30	100.0	20	66.7	33.3	3.46*
12.	30	100.0	30	100.0	0.0	0.00
13.	26	86.7	15	50.0	36.7	3.06*
14.	30	100.0	30	100.0	0.0	0.00
15.	30	100.0	25	83.3	16.7	2.35*
16.	21	70.0	10	33.3	36.7	2.84*
17.	30	100.0	22	73.3	16.7	1.96*
18.	22	73.3	10	33.3	40.0	3.11*
19.	28	93.3	14	46.7	46.6	3.95*
20.	3	10.0	2	6.7	3.3	0.46
21.	28	93.3	28	93.3	0.0	0.00
22.	28	93.3	17	56.7	36.6	3.27*
23.	27	90.0	23	76.7	13.3	1.38
24.	24	80.0	26	86.7	6.7	0.69
25.	10	33.3	0	0.0	33.3	3.44*

Positive percentage differences in favor of normals.

* Significant at or beyond the 0.05 level.

at or beyond the 0.05 level of confidence. The following categories are those in which significant differences in favor of the normal subjects were found: (2) Number, (4) Orientation in space, (6) Clothing, (7) Fruit, (10) Tools, (11) Cutting equipment, (13) Age differences in men, (15) Sad children, (16) Pretty women, (17) Land vehicles, (18) Land animals, (19) Young boys, (22) Furniture, and (25) Even numbers of dots. When all of these categories were presented as structured tasks, a significantly greater number of normal subjects than subnormal subjects attained correct responses.

There were 11 of the 25 test categories in which no significant differences existed between normal and subnormal subjects with respect to the number of correct responses each group achieved. There were: (1) Color, (3) Detail, (5) Heat, (8) Flying objects, (9) Containers, (12) Sex differences in children, (14) Sex differences in adults, (20) Clothing made from animal products, (21) Footwear, (23) Cooking equipment, and (24) Male wearing apparel. Percentage scores for both normal and subnormal groups were most often high for the 11 test categories in which no significant differences were observed. In 10 of these 11 categories, more than 75% of each group attained correct responses. For the remaining category, both groups had a low percentage score on the order of 10%.

To summarize these data, when the subjects included in the present study were required to find items which represented examples of categories named by the examiner subnormal

subjects had performance levels significantly lower then those evidenced by the normal subjects in 14 of the 25 categories tested. In a set of 25 comparisons the probability is less than one in one thousand that as many as 7 significant differences would occur on the basis of chance alone.[5] Therefore, the occurrence of 14 significant differences indicates that factors other than chance are operating.

Thus, on the basis of the above data, the third null hypothesis was rejected. The number of correct responses attained by the normal group was significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 structured categorization tasks were compared.

Time Comparisons

The data gathered concerning the normal and subnormal subjects in the present study also permitted comparisons of the mean number of seconds required by each group of subjects to complete their responses to the unstructured tasks, the naming tasks, and the structured tasks. It should be noted that only correct responses of the subjects were dealt with throughout the evaluation of time differences.

These data were analyzed in the following manner. First, for each of the two groups of subjects, the mean number of seconds required for a correct response to each category was computed. Then the variance for each mean was found. It was

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[5] Ibid.

then necessary to compare the variances of the normal group with those of the subnormal group for each of the 25 categories tested, for the unstructured tasks, the naming tasks, and for the structured tasks (Appendix 2). This was accomplished with the F test, in which the larger variance is divided by the smaller variance to yield a value which indicates the likelihood of the two variances being significantly different.[6] In comparing means with variances which are not significantly different, the following formula yields the most accurate results.

$$t = \frac{X_1 - X_2}{\sqrt{s^2_p\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

However, comparisons of means where variances differ significantly require a different formula:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{s2_1}{n_1} + \frac{s2_2}{n_2}}}$$

and for degrees of freedom,

$$\frac{1}{d.f.} = \frac{c^2}{d.f._1} + \frac{(1 - c)^2}{d.f._2}$$

where $c = \dfrac{\frac{s^2_1}{n_1}}{\frac{s^2_1}{n_1} + \frac{s^2_2}{n_2}}$

Following the determination of means, variances, and the

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[6] Ibid.

significance of the differences between the variances, the one of the above statistics which was appropriate was computed for each of the desired comparisons. The results of these comparisons are reported in the following sections of the study.

Differences in Mean Number of Seconds Required for Correct Responses in Unstructured Tasks

In order to gain information concerning the relative speed with which normal and subnormal subjects can correctly accomplish unstructured categorization tasks, the length of time required by subnormal subjects in the present study was compared with that of the normal subjects for each of the 25 categories. These data are presented in Table 4.

The data in Table 4 reveal that normal subjects attained correct responses in significantly less time on seven of the 25 categories tested. These differences were significant at or beyond the 0.05 level of confidence. Categories in which significant time differences in favor of the normal subjects were observed are: (1) Color, (2) Number, (4) Orientation in space, (5) Heat, (14) Sex differences in adults, (15) Sad children, and (21) Footwear. In all these preceeding categories, normal subjects attained correct responses in significantly less time than did subnormal subjects.

In 18 of the categories, normal subjects were not found to be significantly faster in achieving correct responses. However, it is important to note that in eight of these 18 categories it was not possible to compare the two groups because of

the exceedingly small number of subnormal subjects who had attained correct responses. It was decided arbitrarily before analysis of data concerning time differences that means and variances would not be computed when fewer than five subjects in a group responded correctly. Of the 18 categories where no

TABLE 4

COMPARISON OF MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN UNSTRUCTURED TASKS

Category	Normals (n=30)	Subnormals (n=30)	Difference (SN > N)	*t* value
1.	12.5	21.4	8.91	3.09*
2.	12.7	24.2	11.44	3.98*
3.	14.8	16.5	1.70	0.10
4.	12.8	19.9	7.12	2.39*
5.	14.5	30.9	16.41	3.40*
6.	17.1	17.9	0.80	0.04
7.	14.0	....	....	....
8.	19.7	....	....	....
9.	27.3	....	....	....
10.	12.5	19.5	6.95	1.57
11.	19.5	....	....	....
12.	12.2	14.9	2.7	0.96
13.	15.4	17.6	2.25	0.92
14.	12.6	18.5	5.86	2.12*
15.	13.8	31.7	17.85	2.37*
16.	19.2	20.5	0.75	0.10
17.	11.9	13.0	1.08	0.35
18.	26.2	....	....	....
19.	16.2	....	....	....
20.	....	....	....	....
21.	8.9	14.0	5.1	3.58*
22.	23.6	....	....	....
23.	16.2	16.1	0.1	0.02
24.	17.3	....	....	....
25.	....	....	....	....

* Significant at or beyond the 0.05 level.

significant differences were observed, the eight in which comparisons were not possible were: (7) Fruit, (8) Flying objects, (9) Containers, (11) Cutting equipment, (18) Land animals, (19) Young boys, (20) Clothing made from animal products, and (24) Male wearing apparel. In two of these eight categories, normal subjects also were insufficient in number to enable comparisons.

In seven of the 18 comparisons which yielded no significant differences the mean times for each group were found to be similar. These were: (3) Detail, (6) Clothing, (10) Tools, (12) Sex differences in children, (13) Age differences in men, (17) Land vehicles, and (23) Cooking equipment. For these seven categories the subnormal subjects did not require significantly more time to attain correct responses when they were able to attain them.

To summarize the data concerning time differences for correct responses to the unstructured tasks, 15 comparisons were possible, and in seven of the 25 categories tested, subnormal subjects had mean time responses which were significantly greater than those of normal subjects. There is only one chance in one thousand that seven significant differences in 15 comparisons would occur by chance alone.[7]

Thus, on the basis of the above data, the fourth null hypothesis was rejected. The mean time for correct responses attained by the subnormal group was significantly greater than

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[7] Ibid.

the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 unstructured categorization tasks were compared.

Differences in Mean Number of Seconds Required for Correct Responses in the Naming Tasks

The data yielded by the present study were also arranged to indicate whether or not normal subjects required significantly less time to successfully complete the naming tasks. These data are presented in Table 5.

Table 5 reveals that the differences in mean number of seconds required to make correct responses to the naming tasks reached statistical significance (at the 0.05 level) in three of the 13 categories where comparisons were possible between the normal and subnormal groups. The three categories in which subnormal subjects required significantly more time to attain correct responses were: (5) Heat, (12) Sex differences in children, and (21) Footwear.

Within the remaining 22 categories, comparisons were not possible in 13 because of the small number of subjects attaining correct responses. It was arbitrarily decided prior to the analysis of data that comparisons would not be attempted when fewer than five subjects in either or both groups of subjects failed to attain correct responses in the category being considered. In four of the 13 categories for which comparisons were impossible neither the normal group nor the subnormal group had enough subjects attaining correct responses to justify

analysis. These were: (16) Pretty women, (18) Land animals, (20) Clothing made from animal products, and (25) Even numbers of dots. In the remaining nine of the 13, only the subnormal group had too few subjects who had attained correct responses. These were (7) Fruit, (8) Flying objects, (9) Containers, (11) Cutting equipment, (15) Sad children, (17) Land vehicles, (19)

TABLE 5

COMPARISON OF MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN TASKS OF NAMING CORRECTLY COMPLETED UNSTRUCTURED TASKS

Category	Normals (n=30)	Subnormals (n=30)	Difference (SN > N)	*t* value
1.	6.2	8.6	2.4	1.51
2.	9.6	11.7	2.1	0.70
3.	8.9	12.1	3.2	1.31
4.	8.9	9.7	0.8	0.46
5.	8.7	16.6	7.9	1.73*
6.	6.6	7.2	0.6	0.31
7.	6.5	....	....	....
8.	4.4	....	....	....
9.	8.2	....	....	....
10.	6.7	8.2	1.5	1.33
11.	11.5	....	....	....
12.	4.6	7.2	2.6	2.56*
13.	6.4	7.5	1.1	0.60
14.	5.5	8.5	3.0	1.62
15.	5.0	....	....	....
16.	....	....	....	....
17.	8.4	....	....	....
18.	....	....	....	....
19.	4.9	....	....	....
20.	....	....	....	....
21.	4.9	8.5	3.6	2.92*
22.	5.5	....	....	0.40
23.	7.6	7.0	-0.6	0.30
24.	4.2	....	....	....
25.	....	....	....	....

* Significant at or beyond the 0.05 level.

Young boys, (22) Furniture, and (24) Male wearing apparel.

In nine of the 22 categories where no statistically significant differences were observed, the mean times reported for both groups were similar. These were: (1) Color, (2) Number, (3) Detail, (4) Orientation in space, (6) Clothing, (10) Tools, (14) Sex differences in adults, and (23) Cooking equipment. In these categories, when subnormal subjects were able to attain correct responses they appeared to require no more time to do so than did the normal subjects.

In summary, subnormal subjects required significantly longer to correctly accomplish the naming tasks in three of 12 tasks where comparisons were possible. The probability of three differences in 12 comparisons is less than three in 100, and therefore could not be expected on the basis of chance alone at the 0.05 level.[8]

Thus, on the basis of the data presented above, the fifth null hypothesis was rejected. The mean time for correct responses attained by the subnormal group was significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 category naming tasks were compared.

Differences in Mean Number of Seconds Required for Correct Responses in the Sturctured Tasks

It was also of interest to determine whether or not subnormal subjects required a significantly longer period of

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[8] Ibid.

time to successfully complete the structured tasks. The data relating to this question are presented in Table 6.

The data presented in Table 6 reveal that subnormal subjects, as a group, required a significantly greater length of time for their correct responses to the structured tasks in 19 of the 25 tasks. Differences existed in the following

TABLE 6

COMPARISON OF MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN STRUCTURED TASKS

Category	Normals (n=30)	Subnormals (n=30)	Difference (SN > N)	*t* value
1.	5.0	8.5	3.5	2.83*
2.	5.4	9.6	4.2	4.88*
3.	5.1	9.0	3.9	3.57*
4.	5.1	11.8	6.1	5.88*
5.	5.0	11.0	6.0	5.51*
6.	5.3	12.4	7.1	7.52*
7.	7.1	12.9	5.8	4.04*
8.	7.2	12.4	5.2	3.84*
9.	8.8	12.0	3.2	1.32
10.	5.2	11.6	6.4	6.16*
11.	7.3	11.9	4.6	2.91*
12.	5.6	8.9	3.3	3.30*
13.	7.1	8.9	1.8	1.50
14.	5.9	8.9	3.0	2.91*
15.	7.1	12.0	4.9	2.96*
16.	8.2	8.8	0.6	0.46
17.	5.9	13.3	7.4	4.03*
18.	9.7	17.3	7.6	2.05
19.	6.7	11.3	4.6	3.51*
20.	....	....	....	....
21.	5.9	8.7	2.8	2.82*
22.	6.8	10.9	4.1	2.59*
23.	6.0	11.4	5.4	4.33*
24.	9.8	14.8	5.0	3.07*
25.	22.1	....	....	....

* Significant at or beyond the 0.05 level.

categories: (1) Color, (2) Number, (3) Detail, (4) Orientation in space, (5) Heat, (6) Clothing, (7) Fruit, (8) Flying objects, (10) Tools, (11) Cutting equipment, (12) Sex differences in children, (14) Sex differences in adults, (15) Sad children, (17) Land vehicles, (19) Young boys, (21) Footwear, (22) Furniture, (23) Cooking equipment, and (24) Male wearing apparel.

In the remaining six categories, where no differences were observed, comparisons were not possible in two because of the small number of subjects attaining correct responses. These two categories were: (20) Clothing made from animal products, and (25) Even numbers of dots. In the remaining four categories, mean response times were similar. These categories were: (9) Containers, (13) Age differences in men, (16) Pretty women, and (18) Land animals.

A total of 23 comparisons was made of normal and subnormal subjects relating to the number of seconds required by subjects in each group to successfully complete a series of structured categorization tasks. In 19 of these 23 comparisons, subnormal subjects as a group required a significantly greater length of time for their correct responses. The probability of this number of significant differences occurring because of chance alone is less than one in one thousand.[9]

Thus, on the basis of the data reported above, the sixth null hypothesis was rejected. The mean time for correct responses attained by the subnormal group was significantly

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[9] Ibid.

greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 structured categorization tasks were compared.

Types of Errors Committed in the Naming Tasks

Information was also gathered in the present study concerning the types of errors committed by each of the groups being investigated. It was necessary to take several factors into consideration before deciding which errors to analyze. The final decision was that the most profitable and clearcut information could be derived from an analysis of the performance of the two groups of subjects on the naming tasks. The reasoning underlying this decision was that the responses to the naming tasks were relatively unambiguous in that the subject was giving his own verbal description of the categories he had used. On the other hand, determining types of errors for unstructured and structured tasks would have involved a degree of inference by the examiner. It seemed preferable to accept the subjects category as he specified it on the naming task, rather than attempting to judge what he had intended on either the unstructured or the structured tasks. Therefore, the responses to the naming tasks were chosen to provide further data concerning the types of errors found in the performance of the normal and subnormal subjects.

Examination of the verbal responses of the subjects in the naming tasks demonstrated that their errors could be organized into seven major categories. These were: (1) Overgeneral-

ization errors, in which subjects erroneously reported as the category name a spurious characteristic shared by all items on the card, rather than limiting their generalization to the appropriate items. A typical response of this type was: "They're all metal." (2) Under-generalization errors, in which the subjects reported a category name which applied to a smaller number of the depicted items. A typical response of this type was: "They're all little," (referring to two cars). (3) Incorrect generalization errors, in which the subject chose four objects as required, but applied a title which indicated the relationship the subject saw was spurious or unrealistic. For example, some subjects said: "Those are all good," (not referring to food), or "They're all electric." (4) Enumeration of names errors in which the child simply stated the names of the objects he had chosen. (5) Enumeration of functions errors, wherein the subject told the use of the objects he had chosen, such as by saying: "This one cuts, that one opens," and so forth. (6) No knowledge errors, in which the child was not able to state a category name. Usually, the response was "I don't know." (7) Similarity statement errors, in which the child merely reiterated resemblance. Examples of these statements are: "They're alike," and "They look alike."

Total Error Responses for Naming Tasks

In order to gain some idea of the relative proportion of errors in the total responses of the subnormal and normal groups, the data were arranged to reveal this relationship.

Table 7 presents these data. As indicated in Table 7, a total of 30 subjects in each group had a potential of 750 errors if all subjects failed all the naming tasks for each of the 25 categories. Table 7 reveals that for the subnormal group there

TABLE 7

NUMBER AND PERCENTAGE OF ERRORS AS A PROPORTION OF TOTAL RESPONSES IN NAMING TASKS

	Number of Errors Possible	Number of Errors Made	Percentage of Errors
Normals (n=30)	750	347	46.25%
Subnormals (n=30)	750	565	75.33%
	Difference in favor of normals		29.08%*

* Significant at the 0.05 level.

were 565 errors committed, while for the normal group, 347 errors occurred. When these figures were converted to proportions and compared for the significance of their difference, it was determined that a significantly greater proportion of errors was found in the subnormal group's responses than was found in the responses of the normal subjects. This difference was significant at the 0.05 level.

Types of Errors for the Naming Tasks as Proportions of Total Responses

Information is provided concerning the relative frequency of different types of errors in the total responses by

considering the data arranged in Table 8. The data depicted in Table 8 reveal how great a proportion of the total responses each type of error formed. As this table indicates, (1) Over-generalization errors made up 8% of the total responses of the subnormal subject, and 14.8% of the total responses of the

TABLE 8

DISTRIBUTION OF TYPES OF ERRORS IN TOTAL RESPONSES OF GROUPS IN THE NAMING TASKS

Type of Error	Normals (n=30)		Subnormals (n=30)		
	Number of Errors	Percentage of Total Responses	Number of Errors	Percentage of Total Responses	Percentage Difference*
1.	111	14.8%	60	8.00%	6.80%
2.	10	1.33	18	2.40	-1.07
3.	157	20.93	103	13.73	7.20
4.	10	1.33	99	13.20	-11.87
5.	7	0.93	33	4.40	-3.47
6.	46	6.13	204	27.20	-14.07
7.	6	0.80%	48	6.40%	-5.60%

* Positive percentages differences in favor of normals, minus differences in favor of subnormals.

normal subjects. (2) Under-generalization errors constituted 2.4% of the total responses of the subnormal subjects, and 1.33% of the total responses of the normal group. (3) Incorrect generalization took place 13.73% of the total responses of the subnormals, but on 20.93% of the normal group's responses. For the subnormal group, (4) Enumeration of names made up 13.2% and (5) Enumeration of functions made up 27.2% of their total responses, while for the normal group, the same two types of errors

respectively composed only 1.33% and 0.93% of their total responses. Error types (6) No Knowledge and (7) Similarity statement constituted, in that order, 27.2% and 6.4% of the responses of the subnormal group, but only 6.13% and 0.8% of those of the normal group. Examination of these data reveal that for the normal group, errors made up a substantially smaller part of the total responses. Furthermore, the data indicate that different types of errors were characteristic of each of the two groups when the relative frequency of each error type in the total responses was considered.

Types of Errors for the Naming Tasks as Proportions of Error Responses

Information concerning types of errors was provided by considering each type of error in terms of how large a proportion of the total errors it constituted, rather than by treating that type as a proportion of the total number of responses as was done in the previous section. When the data were organized to reveal the distribution of error types within total errors committed differences among types were emphasized. The data relative to this comparison are presented in Table 9.

As Table 9 reveals, for the subnormal group (1) Over-generalization errors made up 10.6%, (2) Under-generalization errors made up 3.18%, (3) Incorrect generalization errors made up 18.24%, (4) Enumeration of names made up 36.10%, and (7) Similarity statement errors made up 8.50% of the total number of errors which this group committed. For the normal group,

of their total number of errors, 31.90% were (1) Over-generalization errors; 2.88% were (2) Under-generalization errors; 45.24% were (3) Incorrect generalization errors; 2.9% were (4) Enumeration of names errors; 2.02% were (5) Enumeration of function errors; 13.26% were (6) No knowledge errors; and 1.79% were (7) Stated similarities errors. The normal and subnormal groups showed differences in proportion for each type of error. For the subnormal group the following types of errors

TABLE 9

RELATIVE FREQUENCY OF TYPES OF ERRORS MADE BY THE GROUPS IN THE NAMING TASKS

Type of Error	Normals (n=30)		Subnormals (n=30)		
	Number of Errors	Percentage of Errors	Number of Errors	Percentage of Errors	Percentage Difference*
1.	111	31.99%	60	10.62%	21.37%
2.	10	2.88	18	3.18	-0.30
3.	157	45.24	103	18.24	27.00
4.	10	2.88	99	17.53	-14.65
5.	7	2.02	33	5.84	-3.82
6.	46	13.26	204	36.10	-22.84
7.	6	1.73%	48	8.49%	-6.76%
	347	100.00%	565	100.00%	

* Positive differences in favor of normals; minus differences in favor of subnormals.

were proportionately more frequent: (2) Under-generalization errors, (4) Enumeration of names errors, (5) Enumeration of function errors, (6) No knowledge errors, and (7) Stated similarities errors. For the normal group the following types of

errors appeared with substantially higher proportional frequency: (1) Over-generalization errors, and (3) Incorrect generalization errors.

Since substantial percentage differences occurred between normal and subnormal groups with respect to types of errors, it was desired to subject these differences to statistical analysis. This was accomplished by use of the chi-square statistic after examination of the seven types of errors which occurred in the responses of the present samples revealed that they could be divided into two main categories: generalization errors and non-generalization errors.[10] Generalization errors include: (1) Over-generalization errors, (2) Under-generalization errors, and (3) Incorrect generalization errors. Non-generalization errors include: (4) Enumeration of names errors, (5) Enumeration of function errors, (6) No knowledge errors, and (7) Stated similarities errors. In the instances where generalization errors occurred, the subject was able to state an answer which was a generalization, even though that generalization was not correct. On logical grounds, generalization errors appeared to approximate correct naming responses more closely than did non-generalization errors. Thus, it seems accurate to state that generalization errors required more categorization ability than did non-generalization errors, and consequently could be considered as higher type errors.

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[10]Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Co., 1960), pp. 264-265.

On the basis of these considerations the normal and subnormal samples were compared to determine whether or not they differed significantly in the number of generalization errors which occurred in their total numbers of erroneous responses. These data are presented in Table 10. Examination of Table 10 reveals that among the erroneous responses for the normal subjects, 278 of the 347 errors were generalization errors. For the subnormal subjects, 181 of their 565 errors

TABLE 10

RELATIVE FREQUENCY OF GENERALIZATION ERRORS AND NON-GENERALIZATION ERRORS MADE BY GROUPS IN THE NAMING TASKS

Group	Generalization Errors	Non-generalization Errors	Total
Normals (n=30)	278	69	347
Subnormals (n=30)	181	384	565

$x^2 = 19.87$; d.f. = 1; $p < 0.01$

were generalization errors. When the chi-square statistic was applied to these differences they were found to be significant beyond the 0.01 level, and in favor of the normal subjects. Thus, when normal subjects were compared with the subnormal subjects, they showed a significantly larger number of generalization errors although their total number of errors committed was significantly less than that of the subnormal subjects. Since generalization errors required an apparently higher level

of categorization ability, the erroneous responses of the normal group were more like correct responses than were the errors made by the subnormal group.

Repeated Errors

It was also possible to determine from the data gathered in the present study the relative frequency with which the normal and subnormal groups repeated errors identical to those which they had committed earlier. This was accomplished by tabulating for each group all of the errors committed in the structured tasks which were identical to errors committed in the preceeding unstructured tasks. On the unstructured tasks the subject was required to impose on the test materials the most adequate category for classification which he could independently bring into action. On logical grounds it might be assumed that a subject who missed an unstructured task should be able to complete that task correctly when given the correct category for organizing the items as was the case in the structured tasks. Subjects in the present study were not always able to accomplish this correction. Table 11 depicts the data concerning this relationship.

Table 11 reveals that for normal subjects, 114 errors were committed on the unstructured tasks which were followed by errors in the structured tasks. In 33 instances the error on the structured task was identical to that on the unstructured task; this was in 28.90% of the instances in which errors were made in both tasks. On the other hand, subnormal subjects

committed 145 errors on the unstructured tasks which were followed by 75 identical errors on the same categories in the structured tasks; this made up 51.70% of the instances in which errors in unstructured tasks were followed by errors in structured tasks. The percentage differences between normal and subnormal subjects with respect to this tendency were significant beyond the 0.05 level. These data reveal that the subnormal subjects in the present study repeated a significantly greater number of errors which were identical than did the normal subjects.

TABLE 11

ERRORS IN UNSTRUCTURED TASKS WHICH NORMAL AND SUBNORMAL GROUPS REPEATED IN STRUCTURED TASKS

Group	Errors on Unstructured Followed by Errors on Structured	Errors on Unstructured Followed by Identical Errors on Structured	Percentage of Identical Errors
Normals (n=30)	114	33	28.90%
Subnormals (n=30)	145	75	51.70%
	Percentage by which identical errors of subnormals exceeded identical errors of normal		22.80%*

* Significant at the 0.05 level

The present chapter has presented data resulting from an investigation of the categorization abilities of normal and

subnormal children. The following chapter discusses the conclusions based upon these results, and some of the implications of the findings.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of the present study was to investigate some of the fundamental dimensions of simplicity and complexity of thinking in normal and subnormal children, as these are revealed by the performance of these subjects on tasks which required independent use of categories, verbalization of categories which had been used, and finding examples of categories when their names had been specified for the subject. At the outset of the investigation it was proposed that such studies as the present one are necessary in order to guage the reliability of the traditional assumption that thinking processes and patterns are simpler in subnormal subjects. While this assumption is commonly made concerning subnormal persons, little experimental data has accumulated which provides clearcut information regarding the part played by categories in intellective function.

In order to determine whether or not normal children were superior to subnormal children in their ability to employ categories, a test was devised which required utilization of conceptual categories in three types of tasks. These were: (1) unstructured tasks, which required subjects to use categories

independently in the organization of test materials, (2) naming tasks, in which subjects were required to verbalize a name for categories which they had employed, and (3) structured tasks, wherein subjects attempted to find items which represented a category name specified for them by the examiner. The objective of including these tasks was to gain an estimate of whether or not normal subjects were superior to subnormal subjects by virtue of possessing categories which were used with greater speed, which were used more independently, which were more completely understood by the subject, and which were relatively greater in number. These tasks were presented in a series of 27 cards which each included seven randomly ordered pictures, with four of the pictures representing the category being tested and the other three pictures not being pertinent to that category. It was the task of the subject to choose those of the pictures which represented the category being tested.

Two groups of subjects were compared in the present study. One of these groups was composed of 30 subnormal boys whose Goodenough intelligence test scores were in the 47 to 72 range and who were enrolled in special education classes for the educable mentally handicapped. The other group was made up of 30 boys whose Goodenough intelligence test scores were in the 94 to 108 range, and who were enrolled in regular classes. The chronological age range for these subjects (in both groups) was from 7 years and 6 months to 10 years and 6 months. All subjects were boys, all represented families of

the middle-middle or lower-middle socio-economic levels, and no subject had an observable gross physical handicap, visual disturbance, difficulty in hearing, or severe emotional disturbance. A summary of the findings of the present study and the conclusions drawn from them yield information describing the correct responses of the normal and subnormal groups, and describing the types of errors which characterized these groups.

Correct Responses of the Groups to Unstructured Categorization Tasks

Normal and subnormal subjects were compared on the basis of their responses to a series of unstructured categorization tasks. Comparisons were possible between the two groups in 24 of the 25 categories tested, and significant differences in favor of the normal subjects were observed in 21 of these categories. All differences were significant at or beyond the 0.05 level. The probability of this number of significant differences occurring because of chance alone is less than one in one thousand. Therefore, the first null hypothesis was rejected. The number of correct responses attained by the normal group was significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 unstructured categorization tasks were compared.

The comparison of the ability of the two groups to decide independently upon an appropriate category indicated that subnormal subjects were significantly less able than normal

subjects to accomplish these tasks. This knowledge appears to justify the conclusion that subnormal persons could be expected to have difficulty in getting meaning independently from their experiential surroundings. If independent use of categories is in fact an important tool for getting meaning from experiences, than individuals in whom the relative number of independently used categories is diminished would be expected to find a larger part of their experience incomprehensible. In fact, fewer subnormal boys in the present sample were able to voluntarily invoke appropriate organizing principles. This indicates that the experiences with which they come into contact must be fitted into a narrowed range of conceptual categories. Experiences which do not fit readily into this narrowed range may actually be lost to the experience of subnormal individuals. If this is the case, it might be expected that the content or the intellective operations in subnormal persons would be relatively limited, and that subnormal persons would be less well equipped than normals to interpret the wide range of new experiential stimuli which occur in everyday activity. Additional research is needed to evaluate this possibility.

Correct Responses of the Groups to Category Naming Tasks

Further comparisons of normal and subnormal subjects were made, with respect to their responses to 25 category naming tasks. The data reporting the results of these comparisons indicated that on the series of naming tasks a significantly

greater number of normal subjects attained correct responses for 12 of the 25 categories tested. These differences were significant at or beyond the 0.05 level. Twenty-four comparisons were possible between the two groups. In this number of comparisons the probability of 12 significant differences occurring because of chance alone is less than one in one thousand. Therefore, the second null hypothesis was rejected. The number of correct category names specified by the normal group was significantly greater than the number of correct category names specified by the subnormal group when members of each group were required to name the categories which they had correctly employed in the unstructured categorization tasks.

In assessing the importance of these findings it is necessary to consider that comparisons were made only of the numbers of subjects who attained correct naming responses for items which those subjects had answered correctly in the unstructured tasks. Otherwise, subnormal subjects would have been unduly penalized, since they would be predictably unable to specify names for categories which they had not been able to employ independently in the unstructured tasks. Even when this allowance was made, when the two groups were compared on the basis of their ability to name categories on which their previous responses had been correct, the subnormal subjects exhibited a level of performance significantly lower than that demonstrated by the normal subjects. Although subnormal boys in the present study might be able to point out items which represented a category, it did not necessarily follow that they

would be able to specify the name for that category.

It could logically be predicted that any comprehensive understanding of a category would include both the ability to employ it independently and the ability to specify the name for that category. Neither the subnormal group nor the normal group in the present study were always able to specify the names for categories even though they had used them correctly. While the normal subjects exhibited a level of performance superior to that of the subnormal group in this respect, they were unable to specify correct names in about one-fifth of their attempts to do so.

The major conclusion to be drawn from these data regarding naming tasks is that the present subnormal sample evidenced by their relatively low scores on naming tasks a lack of understanding of the categories which they possessed. If this holds true, it would partially explain the comparatively low level of function which subnormal children demonstrate in academic work, where specific conceptual categories are utilized. A subsidiary conclusion is that although normal children in this study exceeded subnormal children in their level of performance on naming tasks, and thus evidenced a more complete understanding of the categories which they possessed, nevertheless their understanding did not keep pace with their performance on the unstructured tasks where only use of categories and not specific naming was required. It may be that this finding points to a sequence of category development in which general ability to use categories is followed by

the specific ability to name them. It is hoped that further research will explain these relationships more fully.

Correct Responses of the Groups to Structured Categorization Tasks

Another use of conceptual categories upon which normal and subnormal subjects were compared was their relative level of performance on 25 structured categorization tasks. In 14 of the 25 tasks, a significantly greater number of normal subjects attained correct responses. These differences were significant at or beyond the 0.05 level. The fact that 14 significant differences occurred led to the rejection of the third null hypothesis, inasmuch as the probability of this occurrence by chance alone is less than one in one thousand. The number of correct responses attained by the normal group was significantly greater than the number of correct responses attained by the subnormal group when the responses of the groups to each of 25 structured categorization tasks were compared.

The structured tasks were intended to compare the responses of the present samples when they were presented categorization tasks in a manner which was most favorable to their attaining correct responses should they possess the category under test at any functional level. In the structured tasks the subject was neither required to decide independently upon the appropriate category to employ, nor to name the category which he had employed. Instead he was required to find items representative of a category when it was specified for him by the examiner. This task was intended to assess in the normal

and subnormal groups their differential ability to find items representing the 25 categories presented. The data revealed that significantly fewer of the subnormal subjects could accomplish this task in 14 of the 25 categories tested.

From this finding it may be concluded that the subnormal subjects in the present study possessed relatively fewer categories, and could consequently be expected to be able to give meaning to a comparatively narrower range of life experiences than would normal subjects, who had relatively more categories at their command. Inasmuch as the subnormal subjects evidenced a smaller repertory of categories they could be expected to be less able to deal with complex conceptual relationships even when strong cues are provided them concerning the appropriate category to be employed. It remains for further research to specify the exact nature and practical consequences of this deficit.

Summary of Time Comparisons on Correct Responses to All Tasks

For each of the three main sets of tasks--the unstructured, the naming, and the structured--the mean time required by subjects in each group for the attainment of correct responses was recorded and analyzed for each task. Based upon the statistical analyses of the comparisons made between the normal and subnormal groups, the following action was taken regarding the null hypotheses related to time differences.

Comparisons of mean time required for successful completion of the unstructured tasks revealed significant differ-

ences in favor of the normal subjects in seven of the 15 categories where comparisons were possible. These differences were significant at or beyond the 0.05 level. In ten of the 25 categories, comparisons were not possible because of the small number of subjects in one or both groups who attained correct responses. The occurrence of seven significant differences led to the rejection of the fourth null hypothesis, since the probability of this number of significant differences by chance alone is less than one in one thousand. The mean time for correct responses attained by the subnormal group was significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 unstructured categorization tasks were compared.

When comparisons were made of the mean times required by each group to produce correct responses in the naming tasks, significant differences were found in three of the 25 categories. These differences were significant at or beyond the 0.05 level. It was possible to compare groups in only thirteen of the 25 categories because of the lack of a sufficient number of subjects with correct responses in 12 of the 25 categories. The occurrence of three significant differences in 13 comparisons was greater than the number of differences which could be expected on the basis of chance alone. This led to the rejection of the fifth null hypothesis. The mean time for correct responses attained by the subnormal group was significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of

25 category naming tasks were compared.

The comparisons of normal and subnormal subjects with respect to the mean time required by each group to attain correct responses to the unstructured tasks revealed that subnormals, as a group, required a significantly longer time to complete their correct responses in 19 categories. These differences were significant at or beyond the 0.05 level. Within the 25 categories tested, 23 comparisons were possible. The occurrence of 19 differences led to the rejection of the sixth null hypothesis, since the probability of this number of significant differences occurring by chance alone is less than one in one thousand. The mean time for correct responses attained by the subnormal group was significantly greater than the mean time for correct responses attained by the normal group when the responses of the groups to each of 25 structured categorization tasks were compared.

Based upon the data gathered concerning the significance of time differences in the performance of normal and subnormal subjects, the following conclusions seem warranted. Not only did the subnormal boys in the present study have relatively fewer functional categories at their disposal, less well delineated ideas concerning these categories, and more difficulty in using these categories voluntarily; they also required significantly greater lengths of time to carry out tasks requiring the use of these categories in structured and unstructured tasks and in naming tasks. On this basis the subnormal subjects in the present study could be expected to require more time than

normal subjects in life situations which are similar to the test situation. It is hoped that further research will pursue this line of investigation.

Types of Errors Made by the Normal and Subnormal Groups

In addition to comparing the normal with the subnormal group on the basis of their correct responses to three types of categorization tasks, the present study presented a descriptive analysis of the types of errors which characterized each group. This consideration of types of errors was confined to the responses of the subjects to the naming tasks, since these responses gave the most direct information concerning the way in which the subjects viewed the categorization tasks. For the present samples, seven types of errors were observed. These were: (1) Over-generalization errors, (2) Under-generalization errors, (3) Incorrect generalization errors, (4) Enumeration of names errors, (5) Enumeration of function errors, (6) No knowledge errors, and (7) Similarity statement errors. The data indicated that errors on the naming tasks formed a significantly greater proportion of the total naming responses of the subnormal subjects than they did for the normal subjects; for the subnormals, errors made up 75.33% of their total responses, while for the normals, they constituted 46.25%.

When errors were considered as a whole, the subnormal subjects were found to have a greater proportion of (2) Under-generalization errors, (4) Enumeration of names errors, (5) Enumeration of function errors, (6) No knowledge errors, and

(7) Similarity statement errors. On the other hand, the normal subjects, although they made significantly fewer errors overall, had higher proportions of: (1) Over-generalization errors, and (3) Incorrect generalization errors. In order to gain further understanding of the types of errors which characterized normal and subnormal children, the seven types of errors were divided into two main categories: generalization errors, and non-generalization errors. The chi-square statistic was applied, and the results of this analysis revealed that the normal group, although they made significantly fewer errors overall, committed a significantly greater number of errors of the generalization type. Non-generalization errors were significantly more frequent for the subnormal subjects. Differences were significant beyond the 0.01 level. Based on these data the conclusion was drawn that the errors of normal subjects tended to be higher level errors, and that the generalization errors of the normal subjects required more categorization ability than did the non-generalization errors of the subnormal subjects.

Repeated Errors

The data provided by the present study were also analyzed to yield information regarding the relative frequency with which normal and subnormal subjects repeated errors which were identical to earlier errors which they had committed. It was possible to explore this relationship by examining instances in which errors made on the unstructured tasks were repeated

on the structured tasks. On logical grounds it might be predicted that subjects would be able to correct their errors when specifically instructed as to which category to use on a given task, even though they had been unable to independently arrive at that category under the unstructured condition. However, the two groups in the present study differed significantly in their ability to correct their errors when given the opportunity to do so in the structured tasks. The normal boys repeated identical errors in only 28.9% of the tasks compared, but the subnormal subjects committed identical errors on 51.7% of their structured task responses. This difference was significant beyond the 0.05 level.

In the past, similar repetitious performance has been cited as evidence of "rigid" behavior on the part of subnormal subjects. It must also be recognized, however, that other causes may have operated to produce identical error responses, both by the normal and the subnormal subjects. For example, if the subject could not understand the relationship of the items in the unstructured task, he may have chosen items based upon a simpler category which was sensible to him, but not known to the examiner. Thus, this type of repetitious response--in both normal and subnormal subjects--might be attributable as much to limited categorization ability as to a hypothesized rigidity. It is hoped that further research will explain these relationships more fully.

Summary of the Conclusions

At the outset of this study it was submitted that the common assumption that subnormal persons possess simpler patterns of thought was of little utility to workers in the field of subnormality because experimental data was not available to specify the dimensions of this simplicity if it in fact existed. It was furthermore suggested that investigation of the abilities of normal and subnormal children in the use of conceptual categories could provide an experimental basis for critical evaluation of this alleged simplicity.

The idea was advanced in this study that subnormal persons might possess relatively fewer categories, in which case they would be unable to find items representing as great a number of categories as would normal individuals in a test situation. It was also proposed that they might possess a stock of categories which were less well delineated or understood by them, in which case their verbal descriptions of their categories might not keep pace with their use of categories in a test situation. Third it was submitted that if the subnormal person had a limited understanding of the categories which he possessed he would be limited in his ability to employ conceptual categories independently. Finally, it was suggested that subnormal persons might require more time to utilize categories. If this were true, an observer might assume that subnormal persons carried out categorization tasks with greater difficulty than normal subjects.

On the basis of the data yielded by the present study, and within the limitations posed by the samples and by the age, sex, and intellective characteristics of the subjects of this study, the following tentative conclusions have been drawn:

1. Subnormal children appear to possess relatively fewer conceptual categories than do normal children with similar age and sex characteristics.

2. Subnormal children appear to have a limited understanding of some of the categories which they are able to employ. While the understanding of normal children appeared to exceed that of subnormal children, the normal subjects also evidenced a lack of understanding of some of the categories which they employed.

3. Subnormal children appear to have less success than comparable normal subjects in the independent utilization of categories.

4. Subnormal children appear to require relatively greater lengths of time than do normal children to perform categorization tasks.

5. The categorization errors committed by the subnormal children appear to require less categorization ability than do the errors committed by normal children.

6. Subnormal children commit errors which appear to be more repetitive than those committed by normal children on categorization tasks.

Implications in the Present Study

An evaluation of the results of the present study reveals implications for at least three areas which are important in the field of subnormality. These are: (1) patterns of thinking in subnormal children, (2) educational procedures for subnormal children, and (3) research in subnormality.

Implications Concerning Patterns of Thinking in Subnormal Children

General implications. The present study has introduced the idea that simplicity in thought patterns, if it exists, may be discovered by investigating the use of conceptual categories in normal and subnormal children and by comparing the performance of these groups in order to determine the types of differences, if any, which are observed. Inasmuch as several specific differences were ascertained in the present study, there seems to be sufficient merit in its approach to justify further work along similar lines of investigation. This added investigation, in combination with the present findings, should enable a more detailed understanding of the nature of patterns of thinking in normal and subnormal children as these patterns are expressed through the use of conceptual categories. If continued research proves that investigation of category usage provides increased understanding of patterns of thinking, it may be that this approach will be developed more fully and incorporated into a general theory of subnormality. A theoretical foundation is needed by workers in subnormality, and at this

time none is in evidence.

Specific implications. The present study has not provided information concerning the operation of category use in thinking processes. However, it has furnished information which is basic to an understanding of these processes by investigating the categories which are utilized in thinking processes. It seems logical to postulate that an understanding of processes of thinking must be preceeded by a fuller comprehension of the extent and nature of the repertory of categories which are employed in thinking, and of the potential uses of these categories in intellective function. The common scientific procedure of attempting to understand function on the basis of a knowledge of structure seems analogous to attempting to understand thinking processes on the basis of a knowledge of conceptual categories.

It would appear that any comprehensive knowledge of patterns of thinking in subnormal persons must proceed from data describing the ways in which subnormal individuals learn categories, the types of categories which they learn most readily, the ways in which they use their categories, and the extent to which they grasp the parameters of the categories which they possess. In short, the question of category repertory and use seems to be central to the understanding of intellective function, in that knowledge of a child's repertory and use of categories at the same time reflects the adequacy with which he has performed in past learning experiences and the

intellective restrictions within which current learning takes place.

Implications Concerning Education of Subnormal Children

The lack of theory and experimental data in the field of subnormality has also been felt by educators of subnormal children. Educational procedures have been based on a minimum amount of experimental data. Often, practices are utilized with only limited understanding of the theoretical foundations underlying them. Typical of such practices are the use of extended repetition in teaching subnormal children, and the emphasis on so-called concrete instruction.

The advisability of drill. If it is true, as the present study indicates, that response to new experiential material is to some degree dependent upon possession by the child of functional categories, then repetitive drill appears to be relatively useless. Unless appropriate categories have developed the child may find many new experiences incomprehensible. Probably categories are not developed by repetition, but by association over a period of time of related objects or ideas.

The limitations of concrete instruction. With respect to concrete instruction, it was found that subnormal children in the present sample were able to deal fairly adequately with categories which have been called abstract as well as with those which are commonly termed concrete. It is possible that teachers of subnormal children have mistakenly concentrated on relatively safe areas of instruction where concrete instruction

is possible, and have failed to investigate the possibility that their pupils are able to learn that which is ordinarily considered abstract. If subnormal children are capable of developing relatively abstract categories, it is possible that this ability can be enhanced by efforts to develop categories which the child can use as a basis for organizing his learning experiences. Certainly the use of sensory training techniques with subnormal children merits further investigation in this connection.

Further research may reveal that use of the concrete-abstract continuum as a guage of the quality of intellective function is inappropriate for evaluating the intellective patterns of subnormal children. The fact that this concept has been employed in investigations of thinking pathology does not automatically make it suitable for other purposes. There is a possibility that it is more important to subnormal children that their learning experiences be structured, rather than concrete. Should this be true, it may be possible to devise methods of structuring "abstract" as well as "concrete" learning experiences. If so, this would provide subnormal children with educational programs which are broader in scope than those programs proceeding from the assumption that only concrete experiences are suitable for meeting the needs of subnormal children in learning situations.

Justifiable teacher expectations. In addition to giving evidence that drill and concrete instruction may be less valuable than has traditionally been believed, the present study

has implications concerning the levels of performance which teachers may justifiably expect from subnormal children. Teachers may find through further investigation that subnormal pupils lack many categories which those teachers have taken for granted. Instruction based upon the assumption that these categories are functionally available to pupils is apt to produce as much confusion in the child as it does enlightenment. Teachers would be able to deal with this problem more effectively if some means were available to them to determine the repertory and utility of categories in their subnormal pupils.

On the basis of the data gathered in the present study it is not possible to give specific information concerning the manner in which categorization ability is related to particular areas of instruction. An instrument which would give teachers more complete information regarding the extent to which subnormal pupils were in possession of categories related to specific subject matter areas could be of great value for planning instruction. It may be possible and worthwhile to construct such an instrument by analyzing some of the main conceptual categories which are required for the mastery of the various subject matter areas. On the basis of this analysis an instrument could be devised which would determine the status of the conceptual categories possessed by subnormal pupils in each of the subject areas. It would be expected that certain categories would be fundamental to comprehension of material in all subject matter areas, while other categories would be

more specifically related to one area or another.

Equally important to teachers would be conclusive data to reveal whether or not categories can be "taught" in the classroom, and if so, to specify how this may be accomplished most effectively. A finer theoretical point which would also be of interest to teachers is whether or not it might be possible to teach certain categories in the classroom, but not worthwhile in terms of the pupil and teacher effort necessary to attain these categories. If this were the case, instructional procedures might be more meaningful to subnormal children if formulated in terms of conceptual categories which either were already present in the pupils or could readily be attained by them. Further research may delineate more fully the manner in which these problems may be approached through the investigation of categorization ability. Educators of subnormal children would be expected to view research in all of these areas with great interest.

Implications Concerning Further Research

Further investigation of the categorization abilities of children is required before the results of the present study can be fully evaluated. Several major areas merit further investigation. First, the basic structure of categories and their interrelationships should be explored. Furthermore, the function of categories in the thinking processes should be investigated. It also would be of value to determine the nature of the relationships which exist between categorization ability

and other varieties of intellective function. In addition, normative data are needed which will describe age and sex differences in categorization ability. Finally, the developmental aspects of category repertory and usage must be explored, with particular attention to the personal and social factors and to the learning and maturation processes which enter into this development. Only through investigation of these and related problems can an adequate body of knowledge be amassed.

As a supplement to theoretical knowledge, educators would profit from research which would describe the manner in which the use of conceptual categories is related to various types of learning situations. They would also profit from information which specifies those categories which are necessary for effective learning experiences in different subject matter areas.

In the past, logic and clinical observation have led to tentative conclusions regarding these areas which are so little understood. However, evaluation of past efforts to provide theoretical formulations and to design appropriate educational approaches clearly demonstrates at least one point. This is the fact that experimental research is required in order to produce a comprehensive theory of mental handicap which can serve as a foundation for educational practices and a guide for research workers in the field of subnormality.

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APPENDIX 1

TABLE 12

FORM USED TO RECORD RESPONSES OF SUBJECTS IN THE PRESENT STUDY

Name _____ Goodenough _____ Results: No. correct % correct

School, Teacher _____ Visual acuity _____ Unstruc: _____ _____

Date _____ Color vision _____ General: _____ _____

C.A. _____ Hearing _____ Struc: _____ _____

M.A. _____ Percept. _____ Total _____ _____

Category	Unstructured	Time	Generalization	Time	Structured	Time

APPENDIX 2

TABLE 13

COMPARISON OF VARIANCES FOR MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN UNSTRUCTURED TASKS

Category	Variance for Means of Normals (n=30)	Variance for Means of Subnormals (n=30)	F value
1.	65.7	134.2	2.04*
2.	34.4	148.6	4.32*
3.	144.1	87.3	1.65
4.	38.7	133.9	3.46*
5.	116.2	354.2	3.04*
6.	130.5	46.5	2.81
7.	58.7	....	....
8.	22.6	....	7.40*
9.	347.5	....	....
10.	49.7	196.5	3.96*
11.	225.9	....	....
12.	101.6	62.5	1.62
13.	51.5	36.5	1.41
14.	27.6	68.4	2.48*
15.	35.1	385.3	10.98*
16.	94.7	290.4	3.07*
17.	43.9	42.0	1.04
18.	219.4	....	....
19.	233.7	....	....
20.	....	....	....
21.	18.6	19.3	1.03
22.	274.0	....	....
23.	130.8	63.6	2.05
24.	5.0	....	....
25.	....	....	....

* significant at 0.05 level on basis of F table

APPENDIX 2

TABLE 14

COMPARISON OF VARIANCES FOR MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN NAMING TASKS

Category	Variance for Mean of Normals (n=30)	Variance for Mean of Subnormals (n=30)	F value
1.	8.5	31.7	3.75*
2.	110.4	30.8	3.26*
3.	30.6	76.0	2.48*
4.	19.6	30.4	1.55
5.	43.8	57.7	1.32
6.	3.1	2.9	1.07
7.	10.3	....	....
8.	5.2	....	....
9.	37.2	....	....
10.	18.2	20.2	1.11
11.	63.3	....	....
12.	4.0	17.6	1.82
13.	13.0	9.0	2.13
14.	17.5	27.7	1.59
15.	14.7	....	....
16.	....	....	....
17.	28.3	....	....
18.	....	....	....
19.	1.9	....	....
20.	....	....	....
21.	6.1	12.7	2.08
22.	10.4	....	....
23.	9.2	12.0	1.31
24.	0.8	....	....
25.	....	....	....

* significant at 0.05 level on basis of F table

APPENDIX 2

TABLE 15

COMPARISON OF VARIANCES FOR MEAN NUMBER OF SECONDS REQUIRED FOR CORRECT RESPONSES IN STRUCTURED TASKS

Category	Variance for Mean of Normals (n=30)	Variance for Mean of Subnormals (n=30)	F value
1.	4.7	32.5	7.54*
2.	4.1	13.1	3.24*
3.	5.6	30.0	4.61*
4.	4.2	18.6	4.47*
5.	7.9	29.9	7.87*
6.	4.7	14.1	3.02*
7.	9.3	18.5	1.98
8.	16.4	29.9	1.83
9.	103.1	29.0	3.55*
10.	4.8	16.1	3.35*
11.	13.9	38.5	2.77*
12.	5.6	19.8	3.54*
13.	16.0	9.1	1.77
14.	9.2	18.9	2.06*
15.	37.3	27.1	1.37
16.	15.4	6.6	2.34
17.	6.2	21.4	9.91*
18.	17.7	154.0	8.72*
19.	10.8	22.9	2.13
20.	....	....	....
21.	9.4	26.6	2.82*
22.	6.9	32.1	4.66*
23.	4.6	28.8	6.29*
24.	21.2	43.4	2.04*
25.	246.8	....	....

* significant at 0.05 level on basis of F table

APPENDIX 3

TABLE 16

PROBABILITY OF OBTAINING n OR MORE SIGNIFICANT STATISTICS BY CHANCE IN A GROUP OF N AS USED IN THE PRESENT STUDY[1]

n	1	2	3	4	5	6	7
N							
12	.4596	.1184	.0196	.0022	.0002		
13	.4867	.1354	.0245	.0031	.0003		
15	.5367	.1709	.0362	.0055	.0006	.0001	
23	.6926	.3206	.1052	.0258	.0049	.0008	.0001
24	.7080	.3392	.1159	.0298	.0060	.0010	.0001
25	.7226	.3576	.1272	.0341	.0072	.0012	.0002

[1]Bryan Wilkinson, "A Statistical Consideration in Psychological Research," Psychological Bulletin, XLVIII (1951), 158.

APPENDIX 4

TABLE 17

SUMMARY OF SPLIT-HALF RELIABILITY DATA WHEN TEST ITEMS ARE MATCHED FOR DIFFICULTY AND WITH SPEARMAN-BROWN PROPHECY FORMULA COMPUTED

Condition of Administration	Normal Subjects	Subnormal Subjects
Unstructured	r = .88	r = .72
Naming	r = .77	r = .91
Structured	r = .76	r = .84