75-9872

SASS, Eleanor, 1921-
ON THE NATURE OF AUDING IN MENTALLY RETARDED AND NORMAL CHILDREN.

The City University of New York, Ph.D., 1975
Speech

Xerox University Microfilms, Ann Arbor, Michigan 48106

ON THE NATURE OF AUDING IN MENTALLY RETARDED AND NORMAL CHILDREN

by

ELEANOR SASS

A dissertation submitted to the Graduate
Faculty in Speech in partial fulfillment of the
requirements for the degree of Doctor of
Philosophy, The City University of New York

1974

This manuscript has been read and accepted for the Graduate Faculty in Speech in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy

Bernard B. Schlanger
_______________ date
Chairman of Examining Committee

Nov. 22, 1974
date
Executive Officer

Supervisory Committee

The City University of New York

ACKNOWLEDGMENTS

I wish to acknowledge my appreciation to Dr. Bernard Schlanger, Chairman, and the Drs. Arthur Bronstein and Philip Hood, committee members, for their help in the preparation of this study. This investigation could not have been undertaken without the sustenance provided by Dr. Oleh Wolansky, Director, and Dr. Rubin Pick, Deputy Director of Clinical Services at Suffolk State School, State Department of Mental Hygiene, Melville, New York.

I want to thank Dr. Michael Thomas, Principal of Manor Plains Public School, Manor Plains, New York who graciously permitted his students to be involved in this study. I owe a debt of gratitude to Miss Carol Harrow and Mrs. Carol Meltzer, members of the Speech and Hearing Department, for their meticulous help with testing.

A special acknowledgment goes to Dr. Louis Gerstman whose guidance and inspired statistical methods helped substantially to bring this study to its conclusion. To the mentally retarded residents at Suffolk State School I feel a singular warmth--they so willingly complied with the rigors of testing in our efforts to investigate an aspect of their puzzling language deficiencies.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM

Statement of the Problem

Since subnormal intelligence is frequently the basis for removing a child from the mainstream of daily life, IQ delineations can relegate retarded children to a process of dehumanization through sensory, social and emotional deprivation. Considering the fact that language is the vehicle through which, for the most part, IQ scores are generally obtained, and that an understanding of subnormal language functions are relatively unknown, a close scrutiny of functional categories of language skills of the mentally retarded is crucial.

In this writer's five years of work with mentally retarded children, empirical experience has indicated that intelligence scores are a poor index of functional skills in specific language tasks. There is also the question as to what degree language dysfunction is due to the condition as opposed to lack of training. If the mentally retarded individual were granted similar amounts and quality of environmental stimulation within the limitations determined by the condition, would the gap between them in language ability diminish?

Although investigators agree that on general language measures MRs score lower than normals (McCarthy, 1964; McGrady, 1968; Spradlin, 1963), as to expressive skills, Schlanger and Gottesleben (1957) found that 79% of a large institutional sampling of MR subjects were deficient in speech. Empirically, this writer has found that defective speech patterns appear to be the single most pervasive problem in the mentally retarded. From another empirical point of view, the listening skills of MRs are frequently affected by such behaviors as inattention, hyperactivity and emotional liability. Experimentally, in this area little more than auditory acuity of MRs has been investigated (McGrady, 1963). Very little information about the functions necessary for the integration of peripheral auditory information is available. Defective expressive speech patterns can result from deficiencies in auding functions since input - output processes are part of a complicated interwoven communication network (Hardy, 1965; Schlanger, 1967).

Auding, in this study, is a central mediating process which, following the schema by Kirk and McCarthy (1968), begins with the receptive process and ends prior to the expressive process. Hardy (1965) described the term as "the integrative function in the brain's management of acoustic information [p. 37]." He outlined several auding functions which underlie language operations: (1) receiving an adequate variety of auditory stimuli, (2) recognizing auditory stimuli, (3) distinguishing differences between auditory stimuli, (4) developing an intact memory system: long term, involving the storing of information and its recall, and short term, involving sequentiality, and (5) utilizing an adequate feedback system. Concomitants of these perceptive and integrative auding processes are conceptualization and learning ability.

It is apparent that auding functions as a major component of a complicated language chain. With the auding process seen as part of a larger system, some of its related functions with regard to mentally retarded children have been of some concern to investigators. Some studies in learning and memory functions indicated the possibility of some relatively intact performance by the mentally retarded such as speed of learning (Eisman, 1958; Goulet, 1968), recall in learning tasks (Stedman, 1963), retention of material (Jenson, 1963) and long-term memory (Ellis, 1970). Clausen (1966) suggested that perceptual variables showed less consistency of pattern than motor tasks for mentally retarded children but limited output was not necessarily the result of faulty input (Clausen, 1966; O'Connor & Hermelin, 1963). An aspect of input was investigated by Schlanger and Galanowsky (1966) who found that retarded children were deficient in auditory discrimination. Additional problems were indicated by MRs' lack of ability to establish a relationship between a functional category and its verbal description (Bolla, 1971; Luria, 1963; Stephens, 1966). Spitz (1966) found that arousal, attention, and holding information for permanent storage appeared to be the retardates' greatest deficiencies. Lipman (1963) indicated that retardates do not store associations as efficiently as normals and Stedman (1963) reported that poor recall in the retardate may indicate a retrieval breakdown rather than a primary storage problem. Spitz and Lipman agreed that retardates show a deficiency in input or filing. Spitz posed additional problems:

> Once we view human learning as being largely dependent on both imposed and intrinsic organization of the incoming stimuli, we must consider the possibility of qualitative differences with retardates deficient in organization capacity, not simply memory. It is clearly possible that retardates possess the physical ability to remember as well as normals but because of a deficiency in categorizing the mass of incoming data into a few large chunks, they are simply overloaded. It has been shown that retardates do, in fact, demonstrate a deficiency in abstracting common elements [p. 36].

The above findings clearly suggest that deficiencies in such auditory functions as auditory organization, categorization and storage and retrieval of auditory information appear to affect the language development of MR children.

With these findings in mind, this investigation inquired into the performance on eight auding tasks utilizing currently available standardized tests and subtests in order to estimate relative weaknesses and strengths in auding performance of MR children as compared to normal children. The test stimuli represented aspects of a theoretical model which assume categorization of functions to be tested. In actuality these categories cannot be clearly separated. Despite the limitations inherent in this problem, the use of a theoretical schema breaks down the complicated process of auding into potentially observable units.

Definition of Terms

The following are definitions of the major terms used in this study:

1. Mental Retardation. Mental retardation, as defined by the American Association of Mental Deficiency (Heber, 1961), referred to "sub-average general intellectual functioning, which originated during the developmental period and is associated with impairment in adaptive behavior." (See Appendix A for a more detailed description of terminology). Adaptive behavior was considered by Heber to include: (a) maturation (sensory-motor skills), (b) learning (academic skills), and (c) social adjustment (adult).

2. Normal. Normal in this study assumed an IQ of 80 or above as defined by the Wechsler Intelligence Scale for Children (1949). This assumption was based on the ability of the control group to participate

in regular preschool and grade school classes. In addition, these children attained vocabulary reception scores on the Peabody Picture Vocabulary Test relatively close to their chronological age.

3. Auding. Auding, as employed in this study, referred to "the ability necessary to recognize and/or understand what is heard . . . an organizing process which involves the internal manipulation of percepts, concepts, and linguistic symbols. It is a central mediating process elicited by the receptive process and preceding the expressive process [Kirk & McCarthy, 1968, p. 71]."

4. Auding Tasks. Auding tasks referred to the tests or subtests used in this study to evaluate various functions of auditory ability such as auditory reception, auditory grammatical and syntactic integration, auditory analysis, auditory synthesis, auditory discrimination and auditory sequential memory.

5. Mental Age. In this study, mental age is the standard score in months obtained by the subjects on the Peabody Picture Vocabulary Test (MA [PPVT]).

6. Language. According to Carroll (1967), language is a "structured system of arbitrary vocal sounds and sequences of sounds which are used, or can be used, in interpersonal communication by an aggregation of human beings, and which rather exhaustively catalogues the things, events, and processes in the human environment."

7. Expression. Expression was explained by Kirk and McCarthy (1968) as "those skills necessary to express ideas or to respond either vocally or by gestures or movements."

8. Reception. Reception is "the ability to recognize and/or understand what is seen or heard [Kirk & McCarthy, p. 7]," on the

automatic (perceptual) and representational (conceptual) level (Kirk & Kirk, 1971, p. 20).

9. Perception. Perception is "an input, output process which involves a complex system of integrations between the various sense fields and between present and past sensory impressions out of which integration grows the impression of relationships upon which action is based [Strauss & Kephart, 1955, p. 78]."

10. Concepts. According to Carroll (1964) a concept is "the internal representation of a certain class of experiences, these experiences being either the direct response to aspects of the external environment, or responses to other experiences [p. 81]."

CHAPTER II

RELATED LITERATURE

Introduction

Speech pathologists have moved from a major concern with speech defects to the investigation of a multi-dimensional view of language problems. While the focus was primarily on articulation defects, comparatively little work was done on the receptive and integrative aspects of language function (McCarthy, 1964). This concentration of activity was a result of the natural limitations of a comparatively new field, problems inherent in the many complexities associated with language development, and a lack of objective experimentation in the field. A number of studies demonstrate the effects of various auding variables upon language deficient and normal children.

Auding Problems in Mental Retardation

Auditory Perception

Spivak (1963) and Strauss et al. (1955) agree that auditory perception is more difficult to analyze than visual perception, and this fact may account for the limited number of studies available. Among those experimenters who reported on perceptual measures, Clausen (1966) studied constellations of impaired and intact functions in mentally retarded and normal children. The mentally retarded group was comprised of 276 subjects, chronological age range from 8 to 24 in three age groups. The normal group consisted of 112 subjects, 8 to 10 years of age. A comparison of three age groups of retardates with the normal group recorded perceptual measures to show less consistency of pattern than motor variables. Clausen found that simple motor tasks were relatively more impaired than perceptual measures. Since attention and cognition are involved with perception, and generally reported to be deficient in mentally retarded children, this finding was unexpected. He found that perceptual discrimination was restricted in proportion to the limitation of speech images for naming. This finding supported observations and formulations by Luria (1963) and Vygotsky (1962).

Wiener (1969) stated that the auditory modality in perceptual tasks appeared significantly inadequate in language deficient children with normal IQs and tended to be irreversible. According to him, the problem may be (a) confined to the verbal conceptual area, (b) involved with the processing of various auditory stimuli, and (c) connected primarily with the sensory avenue. Since mentally retarded children are usually language deficient children the problems may be analogous.

Schlanger (1958) studied the effects of six background noise conditions on the auditory discrimination of 24 brain injured mentally retarded children. The results indicated that there were no differences as a function of background noises. Another study was done by Schlanger and Galanowsky (1966) who investigated auditory discrimination in retardates and normals matched for mental age, from 4 years, 6 months to 10 years, 6 months. The subjects consisted of 85 institutionalized mental retardates and 86 normals, all of whom had normal hearing and intelligible speech. The battery of tests consisted of the Templin Picture Sound Discrimination Test, the Boston University Speech Sound Discrimination Test, the Wepman Auditory Discrimination Test, and nonsense syllable sound discrimination tests. The results indicated that normal children were significantly superior in auditory discrimination.

A look at the literature indicates that little work has been done on auditory perception in the language of mentally retarded children. More questions have been raised than answers have been found. What can be said in the light of present evidence is that mentally retarded children appear to be deficient in auditory perception.

Conceptualization

Theoretically, auditory perception is a function separate from conceptualization but actually cannot be clearly differentiated from it (McCarthy & Olson, 1964). While recognizing this problem, some investigations have attempted to deal with aspects of conceptualization in language deficient children (Schiefelbusch, 1972). Wiener (1969) compared the cognitive functioning of 25 experimental subjects, with measured language deficiency held constant, to 14 matched controls, six to eight years of age. Language deficiency was defined as difficulty with conceptual level tasks in the auditory modality. The short form of the WISC was used to find children with verbal IQs below 90 and at least 15 points below the WISC performance IQ. The experimental test battery was based on the Wepman (1960) model employing the visual and auditory modality on the perceptual and conceptual levels, and using the output modality in pointing, graphic and oral responses. The experimental group was significantly inferior to the control group on every test involving the auditory modality (conceptual and perceptual tasks). The auditory modality seemed to be a central organizing factor in the cognitive functioning of language deficient children.

Along different lines of study, O'Connor and Hermelin (1963) found that trainable retardates used concepts and categories in sorting tasks and could transfer principles of classification to similar problems. They may have needed many trials to learn, but they then appeared to remember. They claimed that the degree of learning was more important than the number of trials required for the task. O'Connor et al. stated that the "low level of responsiveness may account for general inhibition and lack of output rather than impairment of input mechanisms /p. 108/." This finding suggests that non-limbic associative auding deficiencies may represent the inability of retarded children to associate words and signs, i.e., a qualitative associative problem. This finding supports Geschwind (1968) who claimed that these neuro-sensory interconnections make the development of language possible. Lenneberg (1969) discussed the notion of lack of connection between neurological areas which could account for some deficiencies.

The purpose of a study by Stephens (1966), utilizing a different approach, was to examine the ways in which sub-normal individuals use the conceptual categories which they possess. The subjects were: (a) 30 subjects with average intelligence, IQ range 96-108, IQ mean of 101; and (b) 30 subjects with sub-normal intelligence, IQ range 47-72, with an IQ mean of 60. The procedure was an investigation of the ability to employ the appropriate category and the capacity to provide the correct verbal name for the category used. The method was a test of two sample cards and 25 test cards. Subjects were instructed to find the objects most alike. The cards were presented a second time and the subjects were asked to what category the cards belonged. The results showed that (a) sub-normals were inadequate in independent usage of categories, and (b) sub-normals had less ability to provide verbal names for the categories used. The conclusions were that when sub-normals could use a category independently, they still had difficulty in specifying the correct name. In addition, sub-normals were not able to conceptualize the relationship between the functional category and its verbal description.

Bolla, et al. (1971) attempted to evaluate the ability of retardates and normals to utilize the opposition concept. The subjects consisted of (a) those with average intelligence, 96 in number, who attended public schools, (b) familial retardates, 96 in number, who attended public school; and (c) 96 organically retarded children, 85 of whom were institutionalized. Four groups of mean MAs of six, seven, eight, and ten years were represented. In terms of the efficiency of concept usage, the retardates displayed verbal mediation deficits in (a) frequency of meeting criterion, (b) number of correct choices, and (c) time. Non-retardates were more efficient in the transfer of the opposition concept to other dimensions than familial retardates and organic retardates. With increasingly adequate verbal mediation, an increase in MA was found. In younger children, verbal mediation deficiencies were found in generalization of concept, not in the original learning. The conclusion was that the ability of the organically retarded to utilize concepts was inferior to familial retardates and normals of the same MA.

A study by Weatherwax and Benoit (1957) attempted to determine experimentally whether the presence of brain injury in mentally retarded children significantly affected their capacity for abstract thinking. The hypothesis was that both organic and non-organic groups were capable of abstract thinking, that they did not differ significantly in the capacity for abstract thinking, and that pertinent training was likely to induce a measurable increase in abstract thinking in organic individuals. The subjects consisted of 25 institutionalized children with known organic impairment, IQ from 35 to 62, mean IQ at 50, and 25 children with no such signs, IQ from 37 to 73 with mean IQ at 52. Twelve pictures comprised four categories of three items on separate cards presented one per four seconds for a total of six trials, each composed of a presentation and an oral recall. Results indicated that both groups were able to think abstractly in terms of words familiar to them at a level beyond that of chance. The division of the organic group into a training and non-training group resulted in the confirmation of the hypothesis that training was responsible for improvement. To summarize, mental retardates (a) appeared to be capable of choosing a correct concept, (b) seemed to have difficulty in verbalizing it correctly, and (c) demonstrated improvement with practice.

Further evidence of conceptual problems in mental retardation was reported by O'Connor and Hermelin (1963) who investigated 20 institutionalized male trainables in two groups of 10 subjects. The mean chronological age was 12 years, 9 months and the IQ 40 to 47. The purpose of the study was to inquire into how retardates use concepts as a principle of solution and how they transfer the ability to classify. The groups were heterogeneous as to retarded types. Results indicated that retardates appeared to use simple concepts as principles of solution, but did not follow through on the ability to use the concept for the purpose of classification. The conclusion was that the "absence of vocalization leaves a learned perceptual motor response unstable and easily reversible. Reinforcing verbalization leads to a stable and persistent 'set' which is difficult to reverse /p. 70/."

Ellis (1963) suggested that a subnormal central system may be characterized by a deficiency of available reverberatory circuits which produces a non-continuity between events. According to Ellis,

> . . . if a stimulus is compared with a standard previously experienced, even though the two stimuli are equal in some dimension (i.e., weight, brightness) the second will be judged greater than the standard. This effect is said to result from a comparison of the second stimulus with a fading trace of the standard, and the longer the interval between the two experiences, the longer the error /p. 135/.

An example of a new descriptive technique based on a generative or transformational model of grammar was used by Menyuk (1964) to study the grammar of children. She theorized that the brain is unable to store information without categorizing or assigning membership to many stimuli. A generative model of grammar hypothesizes that the perceiver has incorporated both the generative rules of the grammar and heuristic component that samples an input sentence. A series of successive approximations determines which rules are used to generate a given sentence. In this way the child learns to formulate categories of sentence types, i.e., affirmative, negative, imperative, etc., and can understand how to build sentences with which he has no former experience. Ten children diagnosed as having infantile speech (IS) by a teacher and speech clinician, and 10 normal speaking children (NS) matched for age, IQ, and socio-economic status provided language samples. The children were 3 years to 5 years, 10 months, had IQs of 125, and were upper-middle class.

More NS children used more transformational types at an earlier age and with more consistency. A comparison of the two groups on the ability to repeat sentences containing various syntactic structures showed that more items were correctly repeated by the NS group and more items were repeated with omissions in the IS group.

The speech of a two-year-old child was taped and analyzed to compare the grammar of the IS children and a younger child. Menyuk concluded that infantile speech is a misnomer as the grammar of the oldest in the IS group did not match the youngest NS. She found quantitative and qualitative differences in the use of transformations and restricted forms by the two groups. The IS child was using the first approximations of rules with the fewest operations to form sentences. The striking dissimilarities in the repetition ability of the IS and NS groups appeared to be not due to an inability to hear but to problems in coding, according to Menyuk. The NS group seemed to use the syntactic structure inherent in the sentence as an aid to repetition while the IS children tended to repeat final utterances. This study was able to differentiate between the two groups on the basis of the grammatical model used and appears to have possibilities for establishing the priority of and sequence for learning of the various forms.

This study was an ingenious method of systematizing the learning of transformations by children with normal language and deficient language. A criticism of the study was her failure to identify the term "infantile speech." The possibility of problems on a phonemic level was not taken into consideration as infantile speech may well be characterized by substitutions, distortions, or omissions of phonemes. Thus, a phoneme which might have been misarticulated or omitted can be interpreted as a morphological error. This problem questions the validity of the findings. However, an important contribution to the cognition of language structure in language deficient children was made which has possibilities for application to mentally retarded children.

In a similar vein, Lee (1966) studied syntactic development of the child by setting up a theoretical construct of development of early syntactical structures in normal children called "developmental sentence types." A speech sample of a normally developing child and a language delayed child was analyzed according to the developmental sentence types to compare abnormal syntax with normal.

Four levels of language development were described: Level I: two word combinations which follow rudimentary rules and are the basis of eventual adult forms; Level II: the noun phrase which begins to differentiate word order; Level III: Constructions--expansions of previous levels; Level IV: Evolvement of the kernel sentence, and the beginning of transformations. The responses of two children three years of age were compared. The normal child used more types of sentences and more advanced transformations than the deficient child, and in a more consistent and meaningful way.

Lee concluded that this method isolated specific areas of syntactic deficiencies and that the construct may be useful in defining areas of linguistic inadequacy for planning therapy. She agreed with Menyuk that children with language delay did not follow the natural pattern of development at a slower rate, but appeared to be deficient in making linguistic generalizations necessary for normal syntactic development. A useful model of deviant and normal language has been presented, but the usual mammoth task of analysis limited the study to two children.

Many additional subjects, as well as the development of more parsimonious methods, will be needed to reach the goals of differential diagnosis and remediation. It appears from the available evidence that language deviant children have difficulties with the auding of grammar, but the auding categories which may show primary deficits require investigation.

Learning and Memory Functions

Perceptual and conceptual problems in the auding by mentally retarded children have been discussed. Learning and memory functions are additional concomitants of auding problems in mentally retarded children, and play an important and subtle role in the auding process. Spitz (1966) analyzed the learning process as follows: (a) arouse, (b) attend, (c) input, (d) hold, (e) temporary recall, (f) storage, and (g) permanent recall. Loss of auding information can occur anywhere along the line. Spitz claimed that arousal, attention, and holding information for permanent storage appeared to be the retardates' greatest deficiency. In terms of input, Spitz stated, "normals frequently act on the incoming information in ways which aid their learning and memory; retardates frequently do not act on the incoming material, or act on it in ways that hinder learning and memory [p. 53]."

Along these lines, Eisman (1958) compared three groups of public school adolescents (superior, average, and retarded) as to speed of learning of a seven-card paired-associate problem. No significant difference was found. The reasons for this result were postulated by Eisman to be that (a) IQ score is not a good prognosticator of learning ability in specific tasks, and (b) that differentiation as to the type of performance tasks involved is necessary among retarded individuals.

Johnson and Blake (1960) were interested in studying the relative response of retarded and normal children with equivalent mental ages to a number of intellectual tasks. The subjects consisted of 30 normals and 30 retardates from regular and special classes respectively. The chronological age of the retardates was 11 years, 3 months to 16 years, 11 months, mean 13 years, 5 months, while the CA of the normals was 8 years, 5 months to 11 years, 0 months, mean 9 years, 3 months. The MA of the retardates was 8 years, 2 months to 10 years, 11 months, with a mean of 9 years, 2 months. The MA of the normals was 7 years, 10 months to 11 years, with a mean of 8 years, 3 months. The procedure was the administration of a memory test consisting of six nonsense syllables to each retardate and normal subject with one-second exposure for each syllable. The criterion used for learning the syllables was two successive correct repetitions. The tasks involved were (a) immediate memory, (b) recognition of the learned syllables, and (c) recall of the learned syllables. There was no significant difference between the two groups on any of the three tasks.

Along different lines, Berkson and Cantor (1960) studied 24 mentally retarded youngsters with IQs of 55 to 85 who were divided into an experimental and control group. The normals, who numbered 30, were also divided into an experimental and control group, IQ between 86 and 115. Each subject learned three lists of paired associates. Results indicated that normal children learned paired associates more efficiently than retarded children. Findings indicated that verbal mediation did facilitate learning in both groups, and that the degree of facilitation in learning was not significantly related to IQ level in any group.

Rossi (1962) studied 180 normal and institutionalized retarded subjects, divided into groups based on MA obtained from the Peabody Picture Vocabulary Test (PPVT). Random words from four conceptual categories comprised a stimulus list presented to the subjects for free recall. Results indicated that normals clustered (recall in categories or in some structured manner) more than retardates. Improvement in clustering with practice occurred in both normal and retarded subjects. Another study, by Cantor, et al. (1961), on (a) 20 retardated educable special class children with a mean IQ of 72, mean CA of 9.02, and a mean MA of 5.8, and (b) 24 normal subjects attending kindergarten and first grade with a CA of 5.7 produced the following results: neither group showed significant differences in the relearning of paired-associated pictures.

Jensen, et al. (1963) tested 30 adults in a sheltered workshop with a mean age of 27 years, 5 months on six paired associates consisting of common objects. The experimental group was given mediation cues. This group did significantly better than the control group. However, the experimental group did not retain the material significantly better in a relearning exercise. Another investigation of paired associates (Stedman, 1963) measured the effects of associate clustering in recall behavior. The purpose was to explore associative clustering as it might apply to a variety of semantic categories. The subjects consisted of 14 normals and 14 retarded institutionalized children. Normals were from 18 to 35 years of age with average IQs. The retarded group was from 15 to 34 years of age with IQs between 43 and 83, IQ mean 64. The subjects were presented with randomly arranged series of 30 word pairs representing six categories of word relationships. Each subject was asked to recall as many pairs as possible. Recall was recorded and comparisons made.

Results indicated that normals recalled significantly more word pairs, clustered significantly more often, but did not differ from retardates in productivity behavior. Both groups generated similar recall behavior curve functions over a period of time. According to Stedman, percentage of cluster by category suggested a qualitatively different recall process in retardates.

Rieber (1964) attempted to investigate in detail the differences in the ability of normal and retarded children to utilize verbal mediation. Sixty-four children were used as subjects of which 22 were retarded children attending special classes with a mean MA of 8 years, 4 months, mean CA 11 years, 11 months, and mean IQ of 70. The normal children consisted of 32 second graders with a mean CA of 7 years, 9 months. It was assumed that the mean MA of this group would closely approximate its CA. The subjects were pre-trained with a verbal paired-associate task consisting of three stimulus response pairs (S-R). The stimulus items were line drawings and the response items were printed words denoting colors. Half of the subjects were required to verbalize both the stimulus and response items while the other half were required to verbalize only the response items. After pre-training, subjects were presented with a motor paired-associate task involving four stimulus words and four different colored push-buttons. For three of these S-R pairs, the stimulus items were words that denoted the stimuli used during the pre-training and the push-buttons were the colors denoted by the pre-training response items. In order to test for mediation, the response items and two of the S-R pairs were interchanged, one pair remaining the same and the fourth pair was introduced as a control.

The results were that both the normal and retarded subjects made the largest number of errors on the switched S-R pair and fewest errors on the original pair. The retarded subjects made more errors on all three types of S-R pairs than did the normals, but the difference was significant only for the switched pair. Verbalization of both the stimulus and response items during pre-training resulted in slightly greater mediation in both groups. Verbalization during pre-training did increase the discrimination response speeds of the normal subjects while decreasing speeds of the retarded subjects. This result supports the notion that verbalization may interfere with the auding process of the mentally retarded, when auding ability may be relatively intact.

Goulet (1968) found that retardates and matched MA normals learned verbal tasks at comparable rates; with the possible exception of serial learning. He claimed that normals were superior to retardates in serial learning but learned lists in the same manner. A series of 14 tests was given to groups of normal and retarded individuals (Ellis, 1970) to study the long term-short term memory (LTM-STM) distinction and STM differences between normals and retardates. Results indicated,

> . . . it would appear that information in the short task, falling within the subject's "memory span" can be stored in primary memory (PM). As greater demands are made on the system, by increasing task length, PM continues to store the same amount of information. When the system is maximally loaded, secondary memory (SM) serves to store the "overload." However, in the case of the retarded, this system fails. Therefore, the retardate's storage capacity reflects mainly PM. We have hypothesized that his rehearsal strategies are inadequate. These results support such a view /p. 16/.

In summary, experiments to date reveal abilities and disabilities in learning and memory which appear to affect the auding of mentally retarded children. The deficiencies appeared to be: (a) arousal, attention and information retention; (b) use of verbal mediation; (c) serial learning; and (d) secondary memory. The following learning and memory functions appeared to be relatively intact according to current literature: (a) recall in learning tasks; (b) speed of learning; and (c) primary memory.

From the literature, we can abstract the possibility that retardates function similarly to normals on some types of learning and tend to show a larger degree of qualitative than quantitative differences on others. Belmont (1966) reported from the conflicting results of studies, "There is almost no solid evidence either to support or contradict the classic hypothesis of retardate memory loss." Ellis (1970) suggested that long-term memory of a mental defective is equivalent to that of a normal, but short-term memory is defective.

Conflicting or limited information indicate that additional information is needed before conclusions can be made about how learning and memory functions affect auding variables. It is possible that the taxing of mentally retarded secondary memory in existing tests contaminates test scores. Further experimentation on auding variables is necessary in order to delineate problem areas.

Language and Intelligence

That relationship between language and intelligence exists is common knowledge to researchers, but the nature of this relationship remains obscure (Perkins, 1971). Geschwind (1968) projected the thesis that humans develop non-limbic associative neuro-sensory connections which make the development of language possible, while non-humans do not. Mentally retarded children, who by definition have primary intellectual deficits, may not develop associative neuro-sensory connections normally and thus might elicit abnormal language growth patterns. This concept can be likened to Lenneberg's (1969) description of a lack of connection between neurological areas.

Lenneberg (1964) posed the theory that the ability to acquire language is a biological development that is relatively independent of intelligence. His rationale is that children acquire language despite intellectual and physical defects, such as mental retardation and deafness, respectively. He believes that the basis for language capacity may be transmitted genetically. Neurological correlates in language capacity as posited by Lenneberg (1969) indicate the possibility of a hierarchy of complexity which may be independent of locus, and which does not appear to operate on a continuum from simple to complex. This position is supported by O'Connor and Hermelin (1963a) who found that retarded children had difficulty with some simple tasks but performed better on some complex tasks.

Lenneberg, et al. (1964) did a three-year follow-up study of some variables of language development with 61 non-institutionalized mongoloid children. The range of the subjects was from 3 to 22 years. The examination consisted of medical history, neurological, psychological testing, taping of spontaneous utterances, articulation, sentence repetition, vocabulary, understanding of commands, and nature of vocalization. They found that the stages of language development appeared to be controlled by maturational factors (motor milestones) to a greater extent than by IQ. According to Lenneberg, et al. many of these children, like normals, developed language by applying a very general principle of language (perception of patterns and classification).

Further language studies relative to intellectual ability by Mueller and Weaver (1963) found significant differences between mental age and language age on the Illinois Test of Psycholinguistic Ability (ITPA) with mean language age falling more than 18 months below the MA on the Stanford-Binet for MRs. In addition, Carlson (1968) examined intellectual functions by assigning 18 tests to represent six structures of intellect by Guilford, and administered them to 80 MR subjects. He found that distinctly separated memory functions appeared to exist, and that separate ability factors were present in the performance of retarded children. Carlson agreed with Berkman and Cantor (1960) that the degree of facilitation in learning was not significantly related to IQ.

In general, the literature indicates that (1) language may be controlled by maturation relatively more than by intellectual ability, and (2) retarded children may show abilities and disabilities in separate categories of intellectual processes.

Auditory Deprivation

In addition to their intellectual handicap, mentally retarded children, who are denied the social, educational, emotional, and environmental experiences provided for their normal peers, can be said to be environmentally deprived children. A deficient quantity and quality of sensory stimuli has a deleterious effect upon the auding process.

Goldfarb (1945) tested 15 institutional children and 15 foster home children, who were four months of age when placed. The institutional children were systematically deficient in specific psychological and linguistic measures as compared to foster home children. McCarthy (1946) reviewed studies on the effects of institutionalization. According to her, retarded children suffered from cultural and social deprivation, both non-institutionalized and institutionalized individuals.

Sensory deprivation, according to Solomon (1961) and Schultz (1965), resulted in measurable changes in activation levels. Bruner (1959) studied the effects of sensory deprivation in children and concluded that "not only does early deprivation rob the organism of the opportunity of constructing models of the environment, it also prevents the development of efficient strategies for evaluating information for finding out what leads to what likelihood." Any disruption of auditory feedback appears to disturb perception.

Hoch (1965) emphasized the effects of environmental stimulation on the development and maintenance of normal behavior (as per Hebb). Sensory activation, based on the neurophysiology of the reticular formation and association areas of the brain stem, is also crucial to normal behavior, according to Hoch. The problem of activation in mental retardation may be endogenous, a combination of endogenous and exogenous factors, or less likely may be completely exogenous. The important implications here are that (a) retarded children can probably overcome some effects of environmental deprivation through training, and (b) that these deficient children may show less differences from normal children in auding tests if exposure to auditory language stimuli were equal to that of normal children.

Some studies compared language parameters of institutionalized versus non-institutionalized children. Schlanger (1954) compared MRs living at home with those living in an institution on the parameters of CA, MA, IQ and ability to articulate consonants. Mean sentence length was greater for MRs living at home than for those living in an institution.

Mueller and Weaver (1963) compared the language abilities of trainable mentally retarded children in a state institution (I-TMR) to those attending special classes in day schools (DS-TMR). The ITPA and a speech fluency rating were given to each child. The results showed that I-TMR achieved higher means on all the ITPA subtests as well as a total language age. The group differences were significant both on total score and on individual subtests. The automatic-sequential tests contributed most to the overall differences. All the mean scores, except vocal encoding, differentiated the groups. These findings are in contradiction to the general notion that institutionalized retarded children obtain lower scores than community retardates on language measures.

Sievers and Esse (1961) compared institutionalized and non-institutionalized mentally retarded children on the basis of the DLFT and a speech and language evaluation. The subjects were 74 institutionalized mentally retarded children matched for MA with 74 community mentally retarded children. The results on the DLFT showed that the community group manifested superior performance on total score and all five subtests of the DLFT. Speech and language development appeared to follow the same pattern of growth for all groups. However, the community group showed higher IQ scores and this was probably a factor in their superior performance. The Schlanger and Galanowsky study (1966) indicated that institutionalized MRs were inferior to normal children living in the community on auditory discrimination measures. The conflicting results of the above studies on the effects of listening deprivation and institutionalization versus a community environment are probably related to differences in test construction and methodology. No conclusions can be drawn on the basis of this evidence.

Differential Diagnosis

The Illinois Test of Psycholinguistic Ability has been the measuring instrument for a number of studies on handicapped children that have some relationship to auding problems. Implications for evaluation and education were examined. Olsen (1961) based his research on differential diagnosis between children who cannot hear sound, and children who seem to hear sound, but who cannot make adequate utilization of these auditory sensations. Often audiometric evaluation yields no distinguishable differences between these groups.

Twenty-five deaf children, consisting of 21 profoundly deaf and four severely hard of hearing, and 27 sensory aphasic children with a hearing loss less than 40 dB were administered the ITPA. All subjects had chronological ages between 4 years and 9 years, 6 months, IQs between 80 and 120, a clinical diagnosis of deafness, expressive, or receptive aphasia, and no compound sensory deficits. A comparison of the three groups showed no significant differences among the groups.

Hammill and Irwin (1966) studied sound discrimination, abstraction, vocabulary, CA, and IQ as related to the speech of cerebral palsied and MR children. The subjects were 85 cerebral palsied youngsters and 76 mentally retarded youngsters between the ages of 6 and 17. The mean scores of the cerebral palsied youngsters tended to exceed those of the mentally retarded youngsters on all measures. Correlations were similar for both groups. According to results, the efficiency of predicting vocabulary from abstraction, and abstraction or vocabulary from sound discrimination, was poor.

A paper by Bateman and Wetherell (1965) showed that the typical profile for the child with an IQ below 75 demonstrated a deficit on the entire automatic sequential level on the ITPA as compared to the relative strength of the representational level. The educational implications of these findings indicated the usefulness of training in automatic and rote aspects of language usage. This finding implied the probable success of operant conditioning procedures for mental retardates.

Scores from tests at the representational level exceeded those of the automatic sequential in an experiment by Mueller and Weaver (1963) on two groups of mental retardates.

The purpose of a study done by Sabatino (1968) was to determine the ability of the Bender-Gestalt and the Experimental Test of Auditory Perception (TAP) to differentiate between known neurologically impaired and non-neurologically impaired children.

The subjects were 30 children with known minimal brain damage, 30 with no known cerebral pathology, age 6 years, 1 month to 12 years, 7 months. The TAP test measured four auditory variables: auditory recognition, i.e., word discrimination and sound, auditory retention (immediate recall of digits and immediate recall of connected speech), auditory integration (tapping response to pre-recorded patterns), and auditory comprehension (one-word answer to questions about a story).

Results indicated that the correlations were negative, i.e., the two tests, BG and TAP, were not assessing the same behavior. Under conditions of background noise the TAP subtests discriminated between the experimental and control groups. This experiment is an indication of the importance of the use of qualitative techniques to gain information.

The purpose of a study by Goodglass, et al. (1970) was to compare the vocabulary difficulty, sequential memory, and comparison of prepositions of 44 normal school children (4 to 9 years of age), 12 normal adults, and 52 aphasic adults, in five diagnostic classes. The procedure consisted of the administration of the Peabody Picture Vocabulary Test, a Directional Preposition Test, a Preposition Preference Test, and a Pointing-Span test (sequential memory). Results were that the diagnostic groupings could be differentiated on the basis of the subject's comprehension deficiencies. Significant differences between competence and performance were obtained, and auditory comprehension was found to be multidimensional. This study indicates that the refinement of standardized measurements on auding parameters may aid in further developing functional diagnostic categories as opposed to non-functional diagnostic labels for mentally retarded and normal subjects.

Medical Problems in Mental Retardation

Investigations have explored the relationships between medical problems in mental retardation and language test results. Sievers (1959) did a comparative study on mentally retarded children diagnosed as brain injured and non-brain injured using the DLFT. The brain injured group had evidence of some brain trauma or disease incurred either para- or postnatally. The controls consisted of the standardization results of the normal children on the DLFT. The normals, according to results, were superior to the brain injured retarded group in areas requiring verbal production and expression with meaning; the non-brain injured retarded group was superior to normals on the subtest requiring semantic meaning but no verbal production for success; the non-brain injured retarded group was superior to the brain injured retarded group on every subtest.

Sievers and Rosenberg (1960) did a study to compare types of seizures of brain injured children to their abilities on the DLFT. The DLFT, EEGs, and the Stanford-Binet form L were administered to 50 subjects. EEG patterns were either grand mal pure, grand mal and petit mal mixed, hypothalamic, or slowing. The results showed that on all subtests except word association, grand mal-petit mal mixed had the lowest scores but on word association they had the highest scores. There were significant differences between the groups on tests involving the auditory-vocal channel.

Clausen (1963) found that neurological signs and EEG abnormality were better prognosticators of specific abilities than etiological classifications. No distinctive differences were found in test results between familial and organic etiology.

The within-group studies discussed here have been so limited in number on any given variable that no trends can be indicated. They are included in this section primarily to compare them where applicable with the same variables investigated in this study.

Summary

The testing of language auding involves complex problems, one of which is the difficulty in separating categories of associative processes. Despite this problem and the presence of some overlapping of categories, this chapter reviewed some studies which dealt with six theoretical categories of auding problems in mental retardation: auditory perception, conceptualization, learning and memory functions, language and intelligence, auditory deprivation, and differential diagnosis.

The category of auditory perception demonstrated a limited number of studies done by such examiners as Schlanger (1958), Clausen (1966), Schlanger and Galanowsky (1966), and Wiener (1969). In light of present meagre evidence, mentally retarded children appear to be deficient in auditory perception.

In the area of conceptualization, a series of studies was reviewed with the following capsule results: Language deficient children demonstrated (a) capability of abstract thinking in a comparison of brain injured and non-brain injured mentally retarded children (Weatherwax & Benoit, 1957); (b) utilization by trainable retardates of concepts and categories, and demonstration of transfer of training to other similar tasks (O'Connor & Hermelin, 1963); (c) a deficiency in the use of available reverberatory circuits in mentally retarded children (Ellis, 1963); (d) a deficiency in making linguistic generalizations necessary for normal syntactic development in language deficient "normal" children (Lee, 1966; Menyuk, 1964); (e) ability to use a category independently, but deficiency in naming it (Luria, 1963; Stephens, 1966); (f) irreversible deficiency in the auditory modality in perceptual and conceptual tasks (Wiener, 1969); and (g) problems by mental retardates in the verbal mediation of the opposite concept, suggesting relatively intact auditory processes but verbal mediation problems which attenuate responses (Bolla, 1971).

Learning and memory functions were studied by such experimenters as Eisman (1958), Johnson and Blake (1960), Berkson and Cantor (1960) Rossi (1962), Jenson, et al. (1963), Stedman (1963), Rieber (1964), Stedman (1966), Goulet (1968), and Ellis (1970). Some of these experiments revealed deficiencies in learning and memory which appeared to adversely affect the auditory processes of mentally retarded children. These deficiencies were found to be (a) arousal, attention, and information retention; (b) use of verbal mediation; and (c) serial learning and secondary memory.

According to other experiments in learning and memory functions, the following appeared to be relatively intact: (a) recall in learning tasks, (b) speed of learning, (c) some types of mediation other than verbal, and (d) primary memory. There appears to be some evidence that some types of learning and recall reveal relatively larger degrees of qualitative rather than quantitative differences. Memory loss in the mentally retarded is not a foregone conclusion (Belmont, 1966): conflicting and/or limited information make generalizations difficult as to how learning and memory functions affect auding variables.

Another category of auding problems in mental retardation is involved with intelligence. Lenneberg (1964, 1964a) postulated that the acquisition of language is biologically determined, relatively independent of intelligence, and does not appear to operate on a continuum from simple to complex. Berkman and Cantor (1960), Mueller and Weaver (1963), and Carlson (1968) found that the degree of capability in learning was not significantly related to IQ. Carlson stated that distinctly separate ability factors were present in the performance of mentally retarded children. In that case, test design must consider ability factors to obtain useful information for habilitation.

The problem of auditory deprivation as an auding variable in mental retardation has to be seriously faced. Sensory deprivation studies by Bruner (1959), Solomon (1961), and Shultz (1965) showed measurable changes in activation levels of subjects. Deficiencies of auditory feedback, inexperience with the construction of models of the environment (Bruner, 1959), deficits in environmental stimulation (Hoch, 1965), are important factors which retard sensory activation. The implications are that if mentally retarded children can overcome some effects of environmental deprivation through training, they may demonstrate relatively less differences from normal children in auding tests. Within-group tests of institutionalized and non-institutionalized retardates show no conclusive evidence for or against auditory deprivation.

Studies of differential diagnosis in mental retardation and other handicapped children have been cited, but are so limited in number and comparability that no trends can be observed. Further scientific investigations are a pressing need in this area. The same is true with reference to relationships between medical problems and language test results.

Research Questions

From the foregoing studies, we may conclude that the auding behavior of MR children differs from that of normal children. Because investigations have placed little emphasis on analyzing auding categories, test designs have not clearly differentiated among the specific substrata of auding tasks.

The present study compares the performance of MRs and normal children, equated on a receptive vocabulary task, on the basis of a variety of these substrata. MRs are predicted to perform less well than normal children on all auding tasks. From another point of view, a visual perceptual variable was considered since visual integration of input was frequently a component of the auding task in varying degrees. It is predicted that mentally retarded children will be handicapped by visual perceptual problems as demonstrated by the Bender-Gestalt Test. If this prediction is true, then a visual component can be said to have contributed to lower scores by MRs on the auding tasks.

The following questions were posed in this study:

1. Do MR children produce lower scores than normal children on auding tasks when both groups are equated on a vocabulary reception test?

2. Whether MR scores are lower or not, do the patterns of performance differ between the two groups?

3. Do visual-perceptual deficiencies, if any, handicap the auding performance of MR children?

CHAPTER III

PROCEDURES

The design of the present experiment used two groups of subjects, one, mentally retarded, and the other, normal children. The experimental design required that the two groups of subjects be equated as nearly as possible in mental age as measured by scores on the Peabody Picture Vocabulary Test (PPVT).

Subjects

Selection of Subjects

The normal group consisted of 38 children (a) from Manor Plains Public School, Manor Plains, New York who attended regular kindergarten through second grade, and (b) pre-school and regular school children who attended summer school at Suffolk State School whose parent(s) was a professional employee at Suffolk State School. The grades pre-kindergarten through second grade were chosen because they represented the chronological age range which most nearly matched the mental age scores on the PPVT of the mentally retarded children.

The mentally retarded group was selected at Suffolk State School, a residential school for approximately 1800 mentally retarded individuals of all ages, and with degrees of intellectual deficiencies ranging from borderline retarded to profoundly retarded (see Appendix A for definitions). A large proportion of the residents at Suffolk State School are in the severely or profoundly retarded range, many with multiple handicaps. Approximately 200 attended school in a separate building which housed classrooms and sheltered workshops.

The decision to use this school group was based on the probability that these children represented the more "capable" children in the institution. Before admission to Suffolk State School, a diagnosis of mental deficiency was required by a team consisting of a medical doctor, social worker, and psychologist. The prerequisites for attendance at the school building were that the child be ambulatory, toilet trained, able to function in a group situation on a minimal social and emotional level, and be relatively able to profit from exposure to learning experiences.

Case histories were compiled from all available information at the public school and all information found relevant to this study in the Suffolk State School files (see Appendix B for a sample of case history forms). The public school normal children had normal or corrected vision and hearing acuity. The mentally retarded children had no prior records on hearing acuity or had such non-objective records as to be inconclusive. Only one child wore glasses, although it appeared that others would have profited from an opthalmological examination. This observation was based on clinical observation by the tester when the children made obvious compensations such as close eye contact, squinting, and/or angling of the head for visual tasks. For this reason it seemed advisable to obtain additional information about the visual modality.

The Bender-Gestalt Visual-Motor Test (Bender, 1938; Koppitz, 1964) contains nine plates, which are visually perceived Gestalten, with configurations on each to be observed and copied. No verbal image or formulation is required in this purely visual-motor task. This test provided a means for comparing the visual perception of both groups in the absence of visual acuity tests for the mentally retarded group. The fact was also recognized that auding involves temporal and spatial perceptive processes which, according to Birch (1964) are intersensory. Another consideration was that some of the subtests of the test battery provided visual clues so that possible differences in visual perception between the two groups might contaminate the findings. If Luria (1963) was correct in his theory that motor tasks were relatively easier for MRs to manage than verbal formulations, the mentally retarded children might perform this task relatively efficiently. The method utilized was not to analyze the results of the test but rather to assess whether five sophisticated judges could differentiate mentally retarded children from normal children on the basis of their visual-motor task which was not involved with verbal formulation. MR and normal groups were given the Bender-Gestalt Test following the instructions in the test manual. For procedures concerning the administration of the test see Appendix C, D, and E.

The Bender-Gestalt Test was scored as follows: The retarded and normal subject responses were grouped in random fashion and were presented to a group of five judges. The judges consisted of the two speech pathologists who were involved in the testing of both groups, one psychologist, one pediatrician, and a registered occupational therapist. The last three were experienced in the interpretation of the Bender-Gestalt. All of the judges were familiar with this type of retarded population.

They were instructed to designate the Gestalt impression of each test on the basis of a five-segment choice (see Appendix C and D). The judges were instructed to realize that errors were to be expected in both groups because of handicap or low CA. The judges were given a frame of reference in the form of an example of Choice #1 and Choice #5 (see Appendix E for the examples of Choice #1 and Choice #5). The ratings were tabulated and averaged.

The Bender-Gestalt Test results were surprising. There was clinical evidence, such as close eye contact to the work sheet and head angling, suggesting that a good number of retarded children would have benefited from a visual acuity and visual perception examination. Despite this apparent handicap of the retarded children, the two groups yielded similar scores (MR mean and standard deviation 2.87 $\pm$ 1.05; normal, 3.06 $\pm$ 1.12). A possible explanation for this finding was that any eye handicaps might have been compensated for by the higher CA of the MRs giving them an advantage in motor development and experience. In addition, Luria (1963) found that MR subjects performed better in motor tasks than on verbal mediation tasks. It was recognized that MR performance on the BG Test indicated visual perceptual deficiency relative to high CA, 10 years to 18 years, 2 months and mean CA, 5 years, 1 month. Performance by the normal group indicated visual perceptual developmental inadequacies to be expected in a young sampling, 2 years, 8 months to 8 years, 4 months and mean CA, 14 years, 1 month. Because the findings indicated that the judges could not differentiate between the two groups, the BG was considered a synchronous measure which could be interpreted as a range of relatively similar visual perceptual functioning in both groups. It was further understood that as the CA of the normal children increased, visual perceptual function of the normal children would improve as the MRs remained static.

Another step in the selection process was to administer a hearing screening to each subject in the mentally retarded (MR) group and the prekindergarten normal group as approved by the AMA and AAOO, at 500, 1000, 2000, and 4000 Hz at 25 dB, 20 dB, 20 dB, and 25 dB respectively, using ISO 1964 standards. The subject passed the screening if he attained no worse than the above levels in at least one ear. Recently calibrated Maico 16 audiometers were used. The public school normal group was accepted as hearing normally if the subject passed a hearing screening administered by the school nurse at the beginning of the school semester. The hearing screening consisted of a sweepcheck of 250 through 8000 Hz at 15 dB on a Beltone Model 9C-serial #17866.

A battery of tests was administered to 70 MR children who attended classes at the school building and who were available during the scheduled testing hours. Experience by the examiner demonstrated that the MRs who attained a score of 2 years, 6 months or above on the Peabody Picture Vocabulary Test responded to the balance of the subtests. Those who did not attain an MA score of 2 years, 6 months on the PPVT were nonresponsive to the balance of the tests, or responded so minimally that a useful set of scores was unobtainable.

Forty-five of the 70 children passed the criteria described above, i.e., the audiological screening, and the PPVT minimum MA. These MRs were then given the complete battery of tests. The normal subjects were then equated to the MRs in mental age on the PPVT as far as possible. To balance the PPVT scores between groups, seven of the lower MR scorers were deleted. Thus, 38 MRs were retained for the study.

Description of Subjects

The chronological age (CA), mental age (PPVT), and sex of the normal and MR groups were tabulated as indicated in Table 1.

Table 1

Chronological Age, Mental Age (Peabody Picture Vocabulary Test), and Sex of Normal and Mentally Retarded Groups

	Normal (N=38)		Mentally Retarded (N=38)	
Statistic	Mean	Range	Mean	Range
Chronological Age	5-8	2-8 to 8-4	14-3	8-9 to 10-0
Mental Age (PPVT)	6-8	2-8 to 10-4	6-2	2-8 to 10-10
Statistic	Normal female	Normal male	MR female	MR male
Sex	22	16	16	22

Mentally retarded group. In order to assess various factors associated with MR, the mentally retarded group was tabulated in terms of etiological classifications, seizures, medication and behavior problems from information found in the medical case history. The classifications of subjects according to etiology were based on Heber (1959). The following is a breakdown of the associated factors and the number of subjects found in each category (N=38): (1) Brain damage (a) cause known, 11; (b) cause unknown, 17; (c) no brain damage, 10; (2) Seizures (a) absent, 26, (b) present, 12; (3) Medication (a) absent, 19; (b) present, 19; (4) Behavior problems (a) absent, 12; (b) present, 26. The known causes of brain damage among the retarded subjects were: birth trauma, epilepsy, Down's Syndrome, physical anomalies, and phenylketonuria.

The PPVT as Independent Variable

The MA (PPVT) range of the MR group was 2 years, 8 months to 10 years, 10 months and the MA (PPVT) range of the normals was 2 years, 8 months to 10 years, 4 months. The CA of the normal group (range from 2 years, 8 months to 8 years, 4 months) depended upon its relative proximity to the MA (PPVT) of the MR group, since it was assumed that the

CA and MA (PPVT) of the normal group would be relatively similar. The MA (PPVT) of the subjects in each group were matched from ± 0 to 12 months.

Another important factor, the PPVT represented a defined auding variable which eliminated verbal response and limited the integrative task to the conceptualization of a single vocabulary word. With the PPVT as the independent variable, speculations concerning the task in both groups could be made relative to integrative and verbal expressive task requirements in varying degrees and kind.

In addition, the PPVT appeared to penalize the MR subjects relatively less than an IQ test, since many MRs scored on the PPVT, but did not on an IQ test. This ability to score on the PPVT could probably be traced to the relatively simple and structured format as well as the non-verbal response mode. The language task featured (1) understanding vocabulary items denoting objects, actions and states on a hierarchy of frequency of usage and morphological complexity and (2) conceptualizing from the concrete to varying degrees of the complex.

The task synchronously provided a relative commonality for both groups from which the dependent variables could diverge.

Instruments Used

The auding subtests which comprised the test battery were chosen to fulfill the following criteria: (a) the primary stimulus in each case was provided through the auditory channel, (b) the receptive and integrative processes, of each subtest, as used in the ITPA model (Kirk, McCarthy, & Kirk, 1968), were operationally described as intended by the author of the test or subtest (see Table 2) and (c) response encoding was limited to "simple" motor movement, a single word.

The PPVT, the equating variable (Dunn, 1958), is an auditory word comprehension test with visual clues consisting of 150 plates with four pictures to a plate. It requires no verbalization, no syntactic comparison, a minimum of auditory memory, and no sequential memory. This subtest involves the recognition of words on the conceptual level.

A description and rationale for each of the eight subtests used in the battery are:

1. The Auditory Reception subtest (ITPA) contains 50 items taken from the PPVT and features recognition of vocabulary without visual clues. It minimizes vocal and/or motor expression, which is limited to a verbal or motor yes or no response. In order to give the correct response, the stimulus question (which consists simply of three words: the auxiliary verb do plus a noun plus a verb) must be understood. The association evoked by the noun and verb must be accepted or rejected by the subject. Similar to the PPVT, the AR subtest deals with the understanding of auditory language with the addition of comprehension of grammar and the question transformation. Also, no visual clues are presented so that the subject must depend purely on auditory perception.
Example: "Do ponies shave?" This test measures the receptive process on the conceptual level.

2. Auditory Vocal Association (ITPA), a 42-item test, is more complicated than Auditory Reception because it requires a complex integration in the form of an analogy. The ability to conceptualize, categorize auditorially and formulate a verbal response is required. Here grammar and syntax continue to be simple.
Example: "Grass is green: Sugar is ______." This test measures auditory integration on the conceptual level.

3. The Grammatic Closure Test (ITPA) has 33 items which are a series of incomplete statements accompanied by pictures presented to the individual for closure. This test assesses the automatic integration of often repeated verbal grammatical expressions. Form rather than content is stressed. The understanding of concepts is a necessary concomitant. A combined auditory-visual presentation is made, i.e., a statement and a picture. The response is limited to one word, but requires verbal mediation.
Example: "Here is a dog. Here are two ______." Grammatical integration on an automatic level is evaluated.

4. The Auditory Closure Test (ITPA) consists of 30 meaningful utterances with one to three phonemes or syllables deleted from each utterance. The subject needs to combine synthesis with analysis. He must perceive the "Gestalt" of the word to supply the missing phoneme.

Example: "Banan__." This test evaluates a perceptual synthesizing process.

5. The Sound Blending Test (ITPA) has 32 words of increasing difficulty from two to seven segments each. The ability to synthesize discrete units is tested in three stages of difficulty.

Example: /t, ɛ, l, ə, f, o, n/ This test measures the analyzing process on the automatic level.

6. The Parsons Language Sample (Comprehension subtest only) consists of a series of vocal and/or gestural commands to which the examinee gives the appropriate motor responses. This test was developed specifically for use with mentally retarded children but does not have normative data. Its strong points are that it requires no fine visual-auditory association nor verbal response, but depends on motor and gesture ability. It involves the automatic recognition of verbal commands and requires auditory sequential memory on the conceptual level.

7. The Boston University Speech Sound Discrimination Test (Pronovost & Dumbleton, 1953) consists of 36 plates with six pictures in three sections, presented in pairs, one unlike and two alike. Each word pair is phonetically balanced so that only one phoneme varies in each word of the pair. The test was chosen because the discrimination task was expected to be simple enough to include pre-kindergarten normal children and sub-trainable retarded children. It involves auditory discrimination on the conceptual level.

8. The Northwestern Syntax Screening Test (Comprehension), somewhat analogous in purpose to the Grammatic Closure subtest of the ITPA, primarily examines grammar, syntax, and concepts. Since the tests have some features in common, it will be interesting to see if they yield similar scores inasmuch as the mode of presentation differs. In this test, the response is pointing, while in the Grammatic Closure ITPA item, the response requires verbal mediation. The stimulus is auditory and visual combined. The NSST(C) consists of a 20-item receptive subtest. The subject points to the picture which refers to the sentence he heard. Short-term memory, recall and auditory-visual association are requirements (see Table 2). Syntactic integration on the conceptual level is measured according to the definition in Table 2.

Table 2

Description of Auding Test Battery

Test title	Description of variable	Stimulus format	Level[1]	Expression task (Motor)
Peabody Picture Vocabulary Test	Vocabulary reception	One word, four pictures, oral and visual	Conceptual	pointing to one of four pictures
ITPA				
Auditory Reception	Auditory reception	Simple question, oral only	Conceptual	oral or pointing (yes, no)
Auditory-Vocal Association	Auditory integration	Sentence, one word deletion, oral only	Conceptual	one word closure
Grammatic Closure	Grammatical integration	Sentence, one word deletion, visual and oral	Perceptual	one word closure
Auditory Closure	Auditory analysis	Phoneme deletion, oral only	Perceptual	one word phoneme closure
Sound Blending	Auditory synthesis	Discrete phoneme presentation of word, oral only	Perceptual	phoneme synthesis comprising a word
Northwestern Syntax Screening Subtest (Comprehension)	Syntactic integration	Oral presentation of two sentences representing two in a matrix of four pictures, oral and visual	Conceptual	pointing to one of four pictures
Boston University Speech Sound Discrimination Test	Auditory discrimination	Two words presented in three random combinations: word 1--same; word 2--same; words 1 & 2--different. Oral and visual	Conceptual	pointing to one of three pictures
Parsons Language Sample	Sequential memory	Commands	Conceptual	carrying out commands

[1]Source: Kirk and McCarthy (1968).

Administration and Scoring Instruments

Administration

The tests were administered during school hours for the retarded and normal groups in a quiet room in two or more sessions. Where more than two sessions seemed desirable, a third session was scheduled. Each child was seen individually.

The examiner administered all of the auditory subtests of the Illinois Test of Psycholinguistic Ability (ITPA), the Parsons Language Sample (PLS), and the Bender-Gestalt Test to the mentally retarded group. One staff member administered the Boston University Speech Sound Discrimination Test (BUSSDT) while a second staff member administered the Northwestern Syntax Screening Test (NSST). The complete test battery was given to the normal group by the two staff members.

The staff members were trained in test administration by the examiner as follows: (a) an observation period during which the experimenter demonstrated the subtests in the battery to staff members, (b) a practice period during which the testers gained proficiency in administering the tests to 10 or more children who did not participate in the study, (c) an ongoing daily inservice course by the examiner in which the administration of tests by staff members was observed and critiqued, and (d) periodic observation of testing procedures in connection with the study by the experimenter.

Scoring

Test instructions were followed for each subtest to obtain raw scores. For a tabulation of descriptive data and raw scores see Appendix F and G.

CHAPTER IV

RESULTS AND DISCUSSION

The data for this study consisted of the test scores of 76 children, half of whom were mentally retarded and half normal, on eight tests of auding. In addition, the BG ratings of all the children from each of five judges were tabulated. Table 3 presents the range of observed scores, means and standard deviations for these several variables.

Table 3

Range of Scores, Mean Raw Scores and Standard Deviations on Thirteen Tests Presented to Mentally Retarded and Normal Children

Test[a]	Highest and lowest score	Mentally retarded (N=38)		Normal (N=38)	
		Mean	S.D.	Mean	S.D.
AR	41 - 01	21.26	10.56	26.79	10.38
AA	36 - 05	16.42	6.54	22.24	7.74
GC	29 - 01	12.13	7.70	16.55	7.05
AC	25 - 03	12.97	6.93	16.68	5.74
SB	21 - 03	10.74	4.48	13.21	4.91
PLS	19 - 10	13.76	2.31	14.58	2.55
NSST(C)	40 - 17	33.82	6.13	31.68	6.65
BUSSDT	36 - 16	30.74	7.36	33.03	4.51
BG 1	5 - 01	2.32	1.23	2.63	1.42
BG 2	5 - 01	3.29	1.16	3.63	1.20
BG 3	5 - 01	2.84	1.26	3.05	1.16
BG 4	5 - 01	2.95	1.21	3.03	1.22
BG 5	5 - 01	2.63	1.16	2.84	1.22

[a]See Appendix J for list of abbreviations on this and all subsequent tables.

The data showed that the means on all performances were higher, with the exception of one task, for the normal children than the mentally retarded children. The one exception was the NSST(C) task where a slight difference in the opposite direction was noted. The prediction that MRs would obtain lower scores than normals on the auding tasks is supported with the one acknowledged exception.

Because of similar scores, the prediction that the mentally retarded children would be differentiated from normal children on the basis of a visual perceptual task is not supported. The section on selection of subjects in Chapter III discusses this dimension in detail.

To be certain that the differences between groups were not adventitious events, the data for each group of subjects were submitted to principal component factor analysis procedures. For this purpose library-type computer programs were employed (Dixon, 1973). The particular program employed was program BMD03M, a program which computes orthogonally rotated factor matrices for data and yields factor scores for individual subjects as well. A table of intercorrelations of the variables used in the factor analysis for each group is given in Appendix H and Appendix I.

For these analyses the input consisted of the variables summarised in Table 3, together with the sex, age and PPVT scores of the subjects summarised in Chapter III.

Tables 4 and 5 present the rotated factor matrices from these analyses. Each analysis yielded a three-factor solution accounting for 74% of the variance in the MR data and 78% of the variance in the normal data. The principal factor loadings above .50 have been underlined in the two tables.

Factor Analysis for MR Subjects

As indicated in Table 4, the MR data shows that Factor 1 accounts for 54% of the variance and has high positive loadings on PPVT and the auding variables only. Factor 2 accounts for 13% of the variance and has high loadings on all of the BG ratings only. Factor 3 accounts for 7% of the variance and has high coefficients on sex and age only. The PPVT data appeared to be just another auding task. Factor 1 consisted of auding tasks, Factor 2 of BG and Factor 3 of sex and age. The result was a clear-cut separation of auding tasks, visual perceptual tasks and sex and age.

Table 4

Rotated Factor Matrix on Data for Mentally Retarded Children

Variable	Factor 1	Factor 2	Factor 3
Sex	0.30479	-0.35428	0.57878
CA	0.07915	0.34246	0.81970
PPVT	0.82332	0.33760	0.17991
AR	0.76584	0.21882	0.28522
AA	0.84003	0.34926	-0.04408
OC	0.80112	0.27349	0.21672
AC	0.59146	0.21525	0.37011
SB	0.67729	0.20864	0.19238
PLS	0.72322	0.34526	-0.27183
NSST(C)	0.72329	0.40122	-0.06760
BUSSDT	0.71931	0.12441	0.23510
BG 1	0.27390	0.86318	0.01485
BG 2	0.49138	0.73897	0.18430
BG 3	0.30965	0.86458	0.08420
BG 4	0.33528	0.86679	0.07842
BG 5	0.29380	0.90831	0.03802
Percent of variance accounted for	54%	13%	07%

Factor Analysis for Normal Subjects

The three-factor solution, however, as seen in Table 5, is not as clear-cut for the normal group. Factor 1 accounts for 63% of the variance and has high positive loadings for PPVT and the auding variables with the exception of PLS and BUSSDT. CA, BG 1, BG 4 and BG 5 also have loadings above .50, but are lower than any of the auding variables. Factor 2 accounts for 9% of the variance and has high loadings on sex and PLS only. Factor 3 accounts for 6% of the variance and has loadings above .50 on CA, BUSSDT and the BG ratings. As before, PPVT loaded on the same factor as an auding task. This result is to be expected since the PPVT tests the same function as an auding task in terms of input and organization. The low CA of the normal subjects seemed to be equalized by the experiential dimension.

Table 5

Rotated Factor Matrix on Data for Normal Children

Variable	Factor 1	Factor 2	Factor 3
Sex	-0.10164	0.89053	0.14095
CA	0.69241	0.06029	0.57354
PPVT	0.75939	0.20349	0.44151
AR	0.81981	-0.01786	0.36885
AA	0.74888	0.01694	0.55788
OC	0.85000	0.08377	0.31640
AC	0.70637	0.02483	0.48622
SB	0.76476	0.26625	0.09900
PLS	0.44924	0.69009	0.09012
NSST(C)	0.70122	0.01142	0.42975
BUSSDT	0.47217	-0.02932	0.66269
BG 1	0.69106	0.11443	0.50185
BG 2	0.25379	0.28044	0.81946
BG 3	0.25355	0.10176	0.87816
BG 4	0.56928	0.15963	0.73669
BG 5	0.61198	0.12999	0.64206
Percent of variance accounted for	63%	09%	06%

Comparison of both groups. Although the factor structure for the normal data was more complicated than that for the MR data, one generalisation emerges from both analyses. That is, that to a first approximation, the auding tasks were essentially replicates of each other and the PPVT, the potential exception being only PLS and BUSSDT in the normals.

With this one exception, the test data for MRs and normals were sufficiently similar as to warrant a comparison of the performances of MRs and normals taken together. The logic of this analysis was to determine the joint factor structure for the two sets of data taken together and then determine whether MRs could be distinguished from the normals in terms of factor scores. For this final factor analysis only the data summarized in Table 3 were considered, since the other three variables, sex, CA and PPVT, were part of the subject selection process rather than the consequence of empirical measurements.

Combined Factor Analysis

Table 6 presents a rotated factor matrix for this combined analysis. The computer program found a two-factor solution accounting for 71% of the overall variance. All of the auding variables loaded on Factor 1 and all of the Bender-Gestalt ratings loaded on Factor 2, with essentially no overlap between them. The fact that the auding variables did not separate out into more than one factor further emphasizes the essential uniformity of performances on these eight tasks and suggests that it is not likely that either normals or MRs differed substantially amongst themselves in respect to the separate tasks. Stated another way, the factor scores on Factor 1 are the single best estimators of the overall performances of the 76 subjects.

Table 6

Rotated Factor Matrix on Mentally Retarded and Normal Children for Combined Data

Variable	Factor 1	Factor 2
AR	0.79375	0.34131
AA	0.79107	0.44120
GC	0.82104	0.34412
AC	0.74905	0.29963
SB	0.75256	0.22327
PLS	0.53839	0.34675
NSST(C)	0.55145	0.47842
BUSSDT	0.70715	0.25437
BG 1	0.38193	0.79621
BG 2	0.39778	0.77245
BG 3	0.25639	0.87038
BG 4	0.36138	0.87096
BG 5	0.35969	0.86589
Percent of variance accounted for	62%	09%

Analyses Using Combined Factor Scores

Difference in factor scores between MRs and normals. Table 7 provides the means and standard deviations of the two factor score distributions for both groups of subjects. The table further indicates the results of *t* tests on the two means which demonstrate in turn that the difference between the MRs and normals was highly significant on the auding tasks and insignificant on the BG ratings. These findings further support the hypotheses (1) that MRs produce significantly lower auding scores than normal children and (2) that differences between groups in a visual perception task are insignificant.

Table 7

Means and Standard Deviations on Factor Scores for Mentally Retarded and Normal Children

	Factor 1 (Auding)		Factor 2 (BG)	
Group	Mean	S.D.	Mean	S.D.
MR (N=38)	-.342	1.036	.054	1.08
Normal (N=38)	.342	.845	-.054	.930
t	3.109		0.463	
p	$< .01$		insignificant	

In addition, the results showed that there was one single basis for discriminating the mentally retarded children from the normal children; namely, that one basis inhered in their different performances on the auding tasks. The auding tasks themselves were not very discriminable one from another, and the factor scores themselves could now be thought of as the single best scores of the two groups of subjects.

Classification according to auding factor scores. The next step was to look at any possible overlap of scores between the two groups. One way of assessing this possibility was to attempt to discriminate normals from mentally retarded subjects on the basis of their factor scores. For this purpose, recourse was had to a new library program, namely BMD04M, a program which attempts to discriminate two different groups on the basis of a set of scores. A correlation between group membership and factor scores was found to be .344, a highly significant difference between the two groups. Despite this large difference an overlap was found between the two groups to the extent as shown in Table 8.

Table 8

Classification of Groups According to Auding Factor Scores

		Actual group membership	
		MR	Normal
Proposed group membership	MR	23	10
	Normal	15	28

The computer program misclassified 10 normal children as mentally retarded and 15 mentally retarded children as normal. Therefore, the factor scores in auding, on the average, did distinguish an MR child from a normal child but all MR children were not discriminated from all normal children. On the contrary, the data suggest that the auding performance of at least some MR children was in the normal range. This finding can be accounted for by the higher CA of the MRs which in some cases indicated that the maturation process could compensate for lower auding ability. Because of lower CA, the normal children will continue to develop, while the MR children will reach a plateau showing relatively small change. However, the possibility of equalized environmental stimulation by providing improved opportunities for MRs would probably raise MR scores to a degree.

Discussion of Auding Tests

A review of each of the eight auding tasks allows us to speculate on various factors which might account for low scores by MRs. The discussion falls into two categories: the conceptual level and the perceptual (Kirk & McCarthy, 1968). Each test is identified as to the variable it represents within its conceptual or perceptual framework and is discussed within this framework. Table 2 presents these breakdowns in some detail.

Starting with the conceptual level, the Auditory Reception test represented the auditory reception variable. This test required no verbal expression, a factor which usually handicaps MR scores, and would therefore be eliminated as a reason for low scores. The mediation task was then analyzed as the probable source of difficulty. The relationship between actor and action had to be understood in the context of a question transformation without the help of a visual clue. A basic difficulty may have been an inability to experience the concept of actor and action.

The Auditory Association subtest, on the conceptual level, representing the auditory integration variable, provided no visual stimuli which might have served as clues and, in addition, required a complex integration in the form of an analogy. The subject was expected to understand compound grammatical and semantic relationships and to sort out, categorize, and formulate the required concept and, in addition, express the correct word. The analogy required relatively sophisticated conceptualization. The subject was further taxed by the necessity to decode the spoken input and provide the necessary integration to formulate a response. This test appeared to be one of the more difficult tasks for the MRs. Table 3 shows that the AA and AR subtests of the ITPA demonstrated the greatest difference in mean scores between the MRs and normal children of the eight auding tasks. This finding supports Bolla (1971) who found that MRs were deficient in the mediation of the opposite concept, a requirement for the analogy task in AA.

The Parsons Language Sample, on the conceptual level and the sequential memory variable, required a motor activity in response to a verbal command without the handicap of verbal expression. The mental retardates had difficulty managing the auditory information which required motor sequentiality. Two overlapping factors were probably involved--an overloading of short-term memory (Ellis, 1970) and the disability to sequence the information efficiently (Goulet, 1968). The task was clearly a problem of reception since neither verbal formulation nor verbal expression was involved. Elements of the sequential memory requirements appeared to differ from the other auding subtests. Both PLS and SB can be discussed in reference to present theories about short-term memory deficits in MRs. For example, poor scores by MRs on SB, a short-term memory test in phoneme synthesis, support findings by Ellis (1970) who distinguished between the MR and normal child on primary and secondary memory functions. He claimed that as task length increased, "primary memory" at some point became "maximally loaded" at which time "secondary memory" stored the overload. The mentally retarded, according to Ellis, had a faulty secondary memory system. This theory can account for why MRs, regardless of chronological age, tended to perform poorly on SB. The normal subjects produced higher test scores, an indication that they possessed a more intact secondary memory apparatus, according to the Ellis theory.

In like manner, the Parsons Language Sample indicated poor scores for MR subjects on a motor sequential task. If the Ellis theory is correct, in this context, the primary memory of the mentally retarded subjects became "maximally loaded" before that of the normal subjects and did not transfer to secondary memory. Clinically, the normal subjects finished the task item while the MR stopped short in confusion before the task was completed, an empiric description of the Ellis theory. Levy (1971) found that acoustic and articulation features were used in short-term memory while semantic and visual features appeared to play a relatively small role in retrieval from short-term memory. The memory deficit could account for an important auding deficit which affects language learning in particular and intellectual ability in general. The various investigations outlined above suggested that memory functions need to be categorized into separate ability factors in order to diagnose and remediate auding problems.

A relatively small difference between mean scores of the PLS indicates the probability that the younger normal children may not master sequentiality and memory tasks developmentally as early as conceptual, grammatical and speech coding tasks.

The Boston University Speech Sound Discrimination subtest, a conceptual level and the auditory discrimination variable, requires no verbal mediation, nor any verbalization. It is a comparatively simple task of recognizing phoneme variation in a pair of words uttered by the examiner with pictures as props. The test presented a single distinctive difference between one-syllable words in CVC combinations with visual clues. Acoustically, the CVC combinations were apparently integrated in parallel. Whole words and picture props were used. The fine phonemic distinction which must be auditorially processed and possibly the required short-term memory appears to present problems to the mentally retarded child.

The Northwestern Syntax Screening Test (Comprehension), representing the conceptual level and the variable described as syntactic integration, presented four visual choices to an auditory cue. The subject was required to comprehend and distinguish the correct grammatical category. This grammatical comprehension task apparently necessitated the ability to distinguish grammatical differences, a difficult verbal mediation task for the MRs.

On the NSST(C), MRs were able to comprehend and distinguish correct grammatical and conceptual categories similarly to normal subjects. The fact that no verbal expression was required on this test and that clear visual cues were provided probably contributed to this success. However, this was the only test on which MR subjects had a somewhat higher mean score than normals. This finding may indicate that this test was too easy for both groups to make it an effective tool to extract potential differences.

On the other hand, Grammatic Closure (ITPA) which possessed a number of conceptual and grammatical items similar to the above, was presented in a very different stimulus format. The contrast in performance between NSST(C) and GC demonstrated how differences in stimulus format affected responses and therefore affect test results.

The five conceptual tasks were discussed above. The following portion theorizes about the automatic level tasks.

The Grammatic Closure subtest, on the automatic level, measuring the grammatical integration variable, offered "simple" grammatical sentences with visual and auditory cues. One might postulate that experience and maturation would compensate for grammatical deficiencies but the younger normal children obtained higher scores on this test than the older MRs. It would appear that other factors than the simple cued grammatical forms were limiting the performance of the MRs. Menyuk (1964) and Lee (1966) suggested the probability of different systems of language development for language deficient children as compared to normal children. The question can be posed as to whether "infantile speech" as described by Menyuk was basically an auditory perceptual problem rather than a grammatical one, i.e., a deficiency in processing the articulated phonemic stimuli through a faulty auding system, rather than a defective innate structure for developmental grammar. The language deficient children in the study by Menyuk may have indicated deviant developmental patterns because of primary auditory perception deficits which were not differentiated from primary grammatical ones. Rees (1973) cited evidence from recent investigations for a separate set of rules which govern speech perception. Further investigation on the understanding of these processes is needed.

Another relevant study by Wiener (1969) compared two groups of normal children, one of which was language deficient. The language deficient group was significantly inferior to the control group on every perceptual and conceptual auditory test including ITPA tasks.

With specific reference to the analysis of individual items in the Grammatic Closure subtest, this writer (Sass, 1974) investigated the frequency distribution of errors on Grammatic Closure items for both groups. A higher frequency distribution of correct GC items by MRs was found on 9 of 33 items. The grammatical form categories represented in these items were: (1) plural nouns, leaf - leaves and sheep - sheep, (2) past tense, wrote, hung and opened, (3) pronoun objects, himself and themselves, and (4) prepositions, under - on and prepositional phrase, at night. Items which indicated the poorest performance by MRs were found in (1) plural dog - dogs, dress - dresses, man - men, mouse - mice, (2) the comparative big - bigger, good - better, (3) the superlative more - most and (4) the adjective any.

The MRs showed relatively smaller number of errors than normal subjects on plural form leaf - leaves, but relatively larger number of errors than normals on dog - dogs or dress - dresses. The latter were "simpler" plural forms than the former. This discrepancy could be hypothesized as follows: leaf - leaves provided two clear discriminative clues in final CC / v, z / both auditorially and visually. On the other hand, MRs did relatively poorly with man - men where one weak discriminative clue, medial V / æ, ɛ /, adjacent to each other on the vowel triangle, was relatively more difficult to discriminate. Examining the past perfect form, the MRs had relatively more correct responses than normals on hung but showed relatively low scores compared to normals on opened. The MRs apparently knew the irregular past-tense hung relatively better than they perceived the final / d / in the regular past-tense opened.

Another form of auditory perceptual difficulty following the same pattern appeared to be operating in sheep - sheep and soap - soap. A relatively higher number of correct responses by MRs than normals was obtained by default, i.e., the normals tended to generalize the plural form incorrectly to sheeps, while the MRs tended not to generalize. The MRs seemed to perceive the final phoneme less consistently than normals in similar manner to their performance on dog - dogs. On this item, the normals had 100% of responses with no errors and the MRs obtained 86.95 of their responses with no errors. Dog - dogs was the first item on the test and ostensibly one of the easier grammatical items. The tendency for MRs with higher CA to delete the final plural form / z / as compared with normals of lower CA seemed to be a problem in perceiving the final / z / in dog - dogs and in failing to produce a non-perceived phoneme which inadvertently was a correct response in sheep - sheep. MRs appeared to fail items with easier grammatical forms because of auditory perceptual difficulties and passed on more advanced grammatical forms where perceptual problems were relatively reduced.

In addition to the alleged perceptual difficulties analyzed above, conceptualization was revealed to be another category of difficulty for the MR subjects. It was found that the quantifying adjective any produced relatively lower scores for MRs than for normal subjects. In like manner, MRs appeared to have relative difficulty with the comparative big - bigger, good - better, and the superlative more - most than normal subjects. Quantitative and qualitative degree is described in these adjectives. In addition, the MRs had relatively more difficulty with the comparative than the superlative degree. This finding may be related to the relatively absolute boundary of most as compared with the open-ended position between positive and superlative of bigger and better.

In summary, the GC frequency analysis indicated a pattern of auditory perceptual and conceptual deficiencies for MRs as compared to normal subjects. Some interesting speculations can be drawn from the above analysis. For example, relatively less difficulty with some "advanced" plural forms than some "simple" high frequency "familiar" ones by the MR subjects compared to normal subjects was indicated. The greater difficulty demonstrated by MRs with the GC sub-item dog - dogs than the past perfect hang - hung when compared to the normal subjects is an example. This finding is supported by O'Connor and Hermelin (1963a) and Lenneberg (1969) who found that MRs performed better on some complex tasks than on some simple tasks. A different set of rules appeared to be operative for separate functions. Stephens and McLaughlin (1971) theorized that cognitive development is relatively independent of parallel language development. Fay and Butler (1968) showed some evidence of the developmental non-convergence of two independent systems: "an audio-motor system and a deficient syntactic-semantic system /p. 370/." The possibility is that certain auditory conceptual difficulties occur on a hierarchy of semantic complexities which are relatively independent of auditory perception and grammar.

The GC subtest leaves us at a loss to assess whether conceptualization, a deficiency in linguistic coding or a combination of both is the issue. If a way to separate the assessment of these ability factors could be found, the habilitation process for MRs could be facilitated. Another confusing variable is found in a basic flaw in the test design for the purposes of this investigation. Although assigned to the automatic level on the theoretic model (Kirk & McCarthy, 1968), the subtest involves a complexity of concepts, complicated integration and memory factors which belied the alleged automaticity of the task.

The Auditory Closure (ITPA) subtest, on the perceptual level and defined as the auditory analysis variable, required the psychological phenomenon of closure with auditory clues provided. This condition appeared to be quite different from the phonological, syntactic and semantic problems presented by other auditory ITPA tests. The AC task requirement was phoneme analysis, i.e., closure of one or more missing phonemes in a word. Although prosodic clues provided a probability of occurrence of the missing phoneme(s), and the psychological phenomenon of closure furnished a "set" towards task completion, the MRs had lower scores than normal subjects. The finding again implies a difficulty with phoneme processing.

The ITPA auditory subtest Sound Blending was a perceptual level task and the auditory synthesis variable. This test required (1) short-term sequential memory of individual phonemes and (2) their integration to obtain meaning. Recent investigations in speech decoding were examined for possible reasons for poor performance. SB consisted of a presentation of individual phonemes at approximately one-second intervals. No prosodic features were included in the stimulus format and no visual clues accompanied the auditory presentation. The response consisted of the ability to synthesize the discrete phonemes sequentially to form a meaningful one-word utterance. The acoustic presentation was not made according to the speech code in which phonetic units are transmitted in parallel but rather each phoneme was presented as an individual cipher (Cooper, 1972). There was a one-to-one correspondence between the minimal unit and the encoding transmitted by the examiner. Young normal children seemed to "catch on" while older MRs had difficulty with this processing. According to Liberman et al (1967), speech is "a special code that must often make use of a special perceptual mechanism to serve as its decoder [p. 451]." The vowel presentations may have been processed as steady state vowels to the non-dominant hemisphere (Shankweiler, 1971) and they did not show preference for the right ear as do consonant stops, CV, or CVC syllables (Shankweiler). MRs may lack the hemispheric dominance necessary for the left hemisphere to process the speech code effectively in parallel. The vowels were probably processed like non-speech sounds to the right hemisphere, thereby interrupting the parallel acoustic processing of CV syllables in the left hemisphere. This possibility is highly speculative but presents many possibilities for investigation.

On the other hand, AC was a phoneme presentation in CV syllable combinations with prosodic features included. Here the MRs should have fared better. Enough redundancies were apparently present to obtain good performance. The probability of occurrence of the missing phoneme, given the surrounding contextual syllabic clues, made the task a relatively easy one. Despite these redundancies, MRs demonstrated somewhat greater difference in mean scores than normal children on AC as compared with SB. This finding indicates that distinctly different ability factors are probably in operation in the two tasks, and that MR children do indeed appear to show categorical deficits in the types of phoneme processing required, as in GC, AC, and SB.

Discussion of Factor Analyses

The research hypotheses indicated that MRs would not perform as well as normals on all of the auding tasks.

Comparison of mean scores for the eight auding tasks in Table 3 shows that MRs obtained lower scores than normal children, with one exception, NSST(C), in which MRs showed a slight difference in the other direction. Table 7 indicates that, taking MR and normal factor scores as a whole, the difference in performance on all auding tasks by MRs as compared to normals was highly significant, while the BG ratings showed insignificant differences between the two groups.

The hypothesis that, in general, MRs would not perform as well as normal children on auding tasks is supported.

Discussion of Factor Matrices

Table 4 demonstrates a three-factor solution for the MRs in which each of the factors is clear-cut and falls easily into rational and homogeneous categories: (1) auding tasks, (2) visual perception judgments and (3) age and sex independent of the first two. On the other hand, the three-factor solution as seen in Table 5 is not as clear-cut for the normal group. PLS and BUSSDT do not appear in the principal factor loadings, BG 1, BG 4 and BG 5 are related to the six underlined principal factor loadings, and CA is related to the auding variables.

Some comments can be made about these findings. The Parsons Language Sample was a test designed for and standardized on MRs. For this reason, its presence on the MR Factor 1 was a distinguishing factor that did not appear on the factor analysis of the normal subjects. BUSSDT consists of simple line drawings which are an important concomitant of the test format. This test appeared to have been related to BG for the normal children in terms of the visual concomitant of this test while this finding did not appear for MRs. It is possible that BUSSDT might have been so trivial or easy for the normals that it fitted into a non-auding category. However, the MRs did appear to be trying harder since this differentiation did not appear in the MR factor analysis.

As to BG, the background experience of the judges was reviewed to observe what, if any, distinguishing feature existed which could explain the difference in factor loading between the two groups. The BG 1 rater had limited experience with the test, the BG 2 and 3 raters were experienced, while the BG 4 and 5 raters had no previous experience with the test. Judges' 4 and 5 limited experience in administering the test could have accounted for the appearance of BG 1, 4 and 5 on Factor 1 of the normals. Similar BG differentiation did not appear in Factor 1 for the MRs. One could interpret this to mean that the relatively inexperienced judges had more difficulty in interpreting the BG test for the normals than for the MRs. An additional consideration is that Factor 1 showed a measure of relatedness for normals between the auding variables and BG. This somewhat tentative relatedness may indicate that the visual clues which were part of some of the auding test formats were related to higher scores in auding tests for normal children as compared to MRs. In support of this contention, all of the normal children had corrected or normal vision while visual data were not available for MRs. However, clinical observation revealed apparent visual problems.

Age relatedness to auding variables in Factor 1 for normal children indicated that findings were variegated for the normal children who were younger than the MRs (age range 2-8 to 7-6 and 8-9 to 18-2 respectively) and who were undergoing dynamic and critical growth periods. For this reason older MRs presented more stable patterns in the factor analysis than normal children.

A look at the factor matrix in Table 4 indicates that the AA test represents the best auding measure in relationship to the other measures for MRs, while the GC represents that for the normal subjects. The PPVT, the equating variable, factors out as an auding task for both groups. For the most part, the auding tasks are representative of each other and the PPVT for both groups. The PPVT is a general auditory language measure limited to a single word in a relatively simple stimulus presentation, omitting the encoding process. The general language task featured (1) understanding vocabulary items denoting objects, actions and states on a hierarchy of frequency of usage and complexity and (2) conceptualizing from the concrete to varying degrees of the complex. The task provided a commonality for both groups synchronously from which the dependent variables could diverge. The PPVT apparently is effective in specifying the auding tasks and does a creditable job of representing them in this study.

The joint factor structure in Table 6 minimizes the differences in the pattern of the factor loadings of the two groups shown in Table 4 and maximizes the homogeneity of the auding tasks for normals and MR children. Beyond this finding, Table 8 demonstrates that MR children can show auding ability within the normal range, and cannot in every case be differentiated from the normal sampling. One interpretation of this finding is that in selected categories of auding ability, some MRs can do as well as normal subjects. Previous investigations support this contention (Belmont, 1966; Carlson, 1968; Luria, 1963; O'Connor & Hermelin, 1963; Stephens, 1966). Essentially the eight auding tasks selected showed a uniformity of performance and the predicted lower scores by MRs, i.e., the MRs showed a uniformity of performance at a lower level than the normal subjects who also showed uniformity of performance on the auding tasks.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary of Study

The complex interaction among the sending, receiving, and self-monitoring of information in the human communication system defies analysis. Breakdown can occur in any part of the complicated interacting network. Recently, attempts have been made to provide models which represent an orderly multi-dimensional view of the language process for the purpose of study. This study utilized a theoretical model (Kirk, McCarthy, & Kirk, 1971) which attempts to categorize sensory input according to levels and processes. See Table 2 for a description of the subtests which indicates the level as conceptual or perceptual and describes the auditory variables which the subtests represent.

Instruments

The subtests were chosen (1) to feature the auditory mode, (2) to represent the receptive and integrative processes (Kirk et al., 1971) on the perceptual or conceptual level, (3) to eliminate entirely, or at most limit response encoding to a single word or an echoic utterance and (4) to utilize current standardized tests or subtests.

A description of the instruments used can be found in Chapter III. The equating variable was the Peabody Picture Vocabulary Test, a receptive vocabulary test. The conceptual level tests were Auditory Reception, Auditory Association, Northwestern Syntax Screening Test, Boston University

Speech Sound Discrimination Test and the Parsons Language Sample. The perceptual level tests were Grammatic Closure, Auditory Closure and Sound Blending. These tests were presumed to evaluate the performance of mentally retarded and normal children on categories of auding tasks. Auding in this study was viewed as the understanding of percepts, concepts and linguistic coding when the auditory channel was the primary sensory mode.

The questions researched in this study were (1) whether the mentally retarded children would perform less well than the normal children when equated on a vocabulary receptive task, (2) whether the patterns of response would be different between the two groups, considering the existence of brain damage, seizure and medication in the medical histories of the MRs (see description of subjects which follows), and (3) would visual perception, as measured by the Bender Gestalt Test, handicap the auding performance of mentally retarded children.

Subjects

The normal group consisted of 38 children from pre-kindergarten through second grade whose ages ranged from 2 years, 8 months to 8 years, 4 months with a mean age of 5 years, 1 month. These subjects represented the chronological age range which most nearly matched the mental age scores on the Peabody Picture Vocabulary Test of the mentally retarded children. The MR group consisted of 38 subjects who attended special classes in a state institution for the mentally retarded. The chronological age was 10 years to 18 years, 2 months, with a mean age of 14 years, 1 month. The mental age (PPVT) mean of the normal subjects was 6 years, 8 months; the mental age (PPVT) mean of the MR subjects was 6 years, 2 months. The sex distribution of the normals was 22 females and 16 males;

that of the MRs was 16 females and 22 males.

Visual acuity was normal or corrected for the normal children. No records were available for the retarded children who showed clinical evidence of visual problems such as close eye contact and/or angling of the head and squinting for visual tasks. Both groups were required to pass a hearing screening to meet criteria for normal hearing, and were subjected to judges' ratings of their performance in visual perception on The Bender-Gestalt Test as described in Chapter III.

Information from the records of the 38 MRs was tabulated as to etiological classifications, seizures and medication. Twenty-eight had brain damage and 10 did not have brain damage (presumed cultural-familial), 26 did not have seizures, and 12 had seizures of various types and degrees. As to medication, 19 took none and 19 took some form. Thirty of the 38 mentally retarded children had gait and/or fine motor coordination problems in varying degrees. Twenty-six of the 38 children presented behavior problems. All of the normal children were reported to have no physical, mental, or emotional problems that could not be handled in a regular classroom.

Scoring

The tests were administered individually in a quiet room in two or more sessions. Scoring procedures were followed as prescribed by the author(s) of each test. Raw scores were obtained and subjected to a series of factor analyses.

Review of Factor Analyses

The task performances of MRs and normal subjects equated on a language reception task, the Peabody Picture Vocabulary Test, were compared. Table 3 compares the means and standard deviations of the eight auding variables and the five Bender-Gestalt ratings. In general, the hypothesis that the MR subjects would score lower than normal children on auding tasks was supported with the exception of NSST(C) where there was a slight difference in the direction of errors. In addition, all of the judges' ratings on BG demonstrated lower mean scores for the MRs than the normal subjects, although differences were uniformly minimal. A factor analysis of MR data including sex, age and PPVT scores yielded extremely clear-cut results as seen in Table 4. Three distinct factor groupings were present separating all of the auding tasks, the visual perception judgments and the sex and age factor.

On the other hand, Table 5 indicates that the factor loadings for normal subjects was not as clear-cut as those of the MRs. PLS and BUSSDT were not present in the principal factor loadings, BG 1, BG 4 and BG 5 are related to the six underlined factor loadings, and CA is related to the auding variables. The generalization that appears for both groups is that the PPVT is representative of the auding tasks and that the auding tasks replicate each other, with the possible exception of PLS and BUSSDT for the normals. Discussion of these differences in factor loadings between the two groups is found in Chapter IV in the discussion of the factor analyses.

This finding led to a factor analysis using the combined data of both groups. Table 6 shows that all of the auding variables are found under one factor for both groups, a further indication of the uniformity of performance on the auding tasks by both groups. MRs and normal subjects appear to be similar in their performance in auding tasks, taking into consideration that MRs obtain lower scores than normal children.

According to Table 7, the BG factor scores indicated that the difference in means between MR and normal children was insignificant. This finding demonstrates that visual perception did not handicap MR performance on the auding tasks. On the other hand, a highly significant difference in mean auding task factor scores between the two groups confirmsthe finding that the auding tasks taken as a whole are the single basis for distinguishing the differences between the MR and normal children. At the same time Table 8 demonstrates that 15 out of 38 MR children could not be distinguished from normal children in terms of their auding factor scores. This finding indicates that some MRs performed like some normal children on given tasks.

Review of Auding Tasks

The eight auding measures were reviewed for interpretations to account for low scores by MR children as compared to normal children. The discussion section in Chapter IV gives a detailed auding task analysis in an attempt to assess the difficulties in each task performed by the MRs. In summary, beginning with the conceptual level test assessments, the following deficits are presumed to account for the lower scores found in the MRs:

1. AR. The concept of actor→action.
2. AA. The relatively sophisticated concepts of opposites and analogies, decoding the input information and formulating the verbal response. The MRs obtained the largest mean score difference between test scores for both groups on this test.
3. PLS. Short-term sequential memory.
4. BUSSDT. Auditory discrimination.

On the perceptual level, deficiencies in the following areas were presumed to account for the problems encountered by the MR children:

1. GC. The linguistic coding required for recognising the phonemic differences which were necessary for formulating correct grammatical utterances.

2. AC. Auditory analysis.

3. SB. Auditory synthesis.

Taken as a whole, the specific deficiencies which are recorded above appear to be conceptualisation, short-term sequential memory, auditory discrimination, linguistic coding, auditory analysis and auditory synthesis. General terms such as decoding and formulation are so vague as to give us little information.

It is evident that each subtest is contaminated by so many variables that are external to the test author's definition, that it is almost impossible to make a categorical assessment. This factor severely restricts an evaluator's ability to determine a specific area of deficiency, and remains a critical problem in test construction.

Conclusions

The following conclusions seem warranted. It appears that the standardised auding tests used in this study did not serve the purpose of distinguishing among their defined auding categories. Along similar lines, it is noted that the stimulus format of the auding tests used in this study was not effective in assessing differential ability factors in MR and normal children. In fact, the PPVT, which was the equating variable, served to replicate the auding subtests used in this study, although each was theoretically defined to represent a separate auding category. The auding tests, in addition, did not distinguish one from the other, so that they could not serve to differentiate among categories of auding disabilities. On the other hand, some mentally retarded children were not discriminable from some normal children based on performance in auding tasks, i.e., depending on the selection of auding task and subject some MR children can do as well as normal children.

Along these lines, it is interesting to speculate on how amazing it is that the patterns of response between the two groups did not differ from each other. The descriptive statistics of the MR subjects indicated that 28 were diagnosed as brain damaged, 12 had seizures, 19 took some form of medication and 26 of the 38 MRs presented some form of behavior deviation. This finding supports Lenneberg's (1969) theory that an internal structure exists which regulates a system of language development. MR children may have a faulty system which limits language production but does not affect the pattern of production. This possibility implies that if the environmental stimulation offered to MRs were improved, production would probably improve and lessen the gap between the performance of the two groups. The implication is that improvement in language stimulation programs should be encouraged and begin early because consideration must be given to the fact that older MRs have already been exposed to major critical stages of language development while the younger normal children face dynamic growth periods.

This fact indicates that the language growth of MRs in this study will taper off while the normal children will continue to make visible gains. Despite this reality, a synchronous study of this type is useful to observe performance within a given temporal framework using a matching variable such as was used in this study.

The research questions posed and the conclusions based on the findings in this study are first,

Do MR children produce lower scores than normal children

> on auding tasks when both groups are equated on a vocabulary reception test?

The conclusion based on this investigation is that the scores of the mentally retarded children were significantly lower than those of the normal children, although equated on a vocabulary reception test.

The next question investigated was,

> Do the patterns of performance differ between the two groups?

Given that the MRs performed less well than the normal children on a series of auding tasks, the factor analysis indicated uniformity of the pattern of responses for both groups. In fact, based on factor scores, MRs were indiscriminable from normals in their response patterns.

The last inquiry under investigation was,

> Do visual perceptual deficiencies handicap the auding performance of MR children?

According to this study, differences in judges' ratings on the Bender-Gestalt Test were insignificant between the two groups. Therefore, visual perception did not appear to handicap MR performance on auding tasks.

Recommendations for Future Research

Recommendations for future studies are (1) to develop tests that can discriminate among separate auding ability factors, (2) to identify and separate dysfunctions in memory processes, conceptualization, and linguistic coding as they affect auding ability, (3) to identify and categorize memory functions into ability factors for effective diagnoses and remediation and (4) to discover what differences, if any, MR subjects demonstrate in processing the speech code.

LIST OF APPENDICES

APPENDIX A

DEFINITION OF MENTAL RETARDATION

Word Description and Range in IQ (Heber, 1961)

Word description of retardation in Measured Intelligence	Corresponding range in IQ scores for tests with Standard Deviation of 15
Borderline	70-84
Mild	55-69
Moderate	40-54
Severe	25-39
Profound	Below 25

APPENDIX B

AUDITORY RECOGNITION IN MENTALLY RETARDED AND NORMAL SCHOOL CHILDREN
PRELIMINARY CASE HISTORY

NAME__________________________ COTTAGE #______ DATE__________
HOSP #________ SEX - M__
AGE_________ BIRTH DATE________ F__

DIAGNOSIS: __ENCEPHALOPATHY __OTHER
__MONGOLISM

FAMILY HISTORY:

MEDICAL HISTORY: PRENATAL SEIZURES
BIRTH
PREINATAL

ILLNESSES: SEVERITY DATE

VISUAL ACUITY DATE OF LAST EXAM: EAR INFECT. YES NO DISCHARGE YES NO
RESULTS: ALLERGIES YES NO

SURGERY: __YES TYPE DATE SURGEON
__NO

IQ: TESTS SCORES DATE

ACADEMIC ABILITY: PROBLEMS: (SCHOOL) SPEECH PROBLEMS:

EMOTIONAL AND SOCIAL HISTORY: GOOD___
PASS___
POOR___

COMMENTS:

APPENDIX C

INSTRUCTIONS TO JUDGES OF THE BENDER-GESTALT TEST

A group of Bender-Gestalt test configurations are presented to you for your judgment. You are asked to examine the visual-motor "Gestalt," i.e., the ability of the subject to coordinate his eye and hand to copy the configurations.

We are not interested in the judgment of organicity or emotional disturbance, but only in a total aspect of visual-motor ability.

Observe the two sample configurations. One is an example of little or no reproductions of configurations or number one on the five-point scale. The other is an example of point five or good reproduction of configurations for the subjects of this population. These samples are representations of the "worst" and the "best" kind of configurations in this sampling.

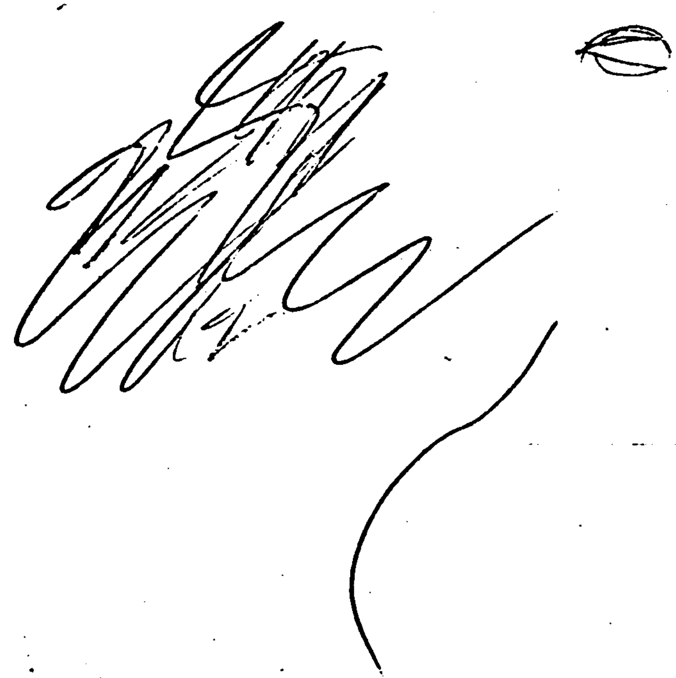
Please write the number of letter assigned to each sample on the score sheet in the appropriate column.

APPENDIX D

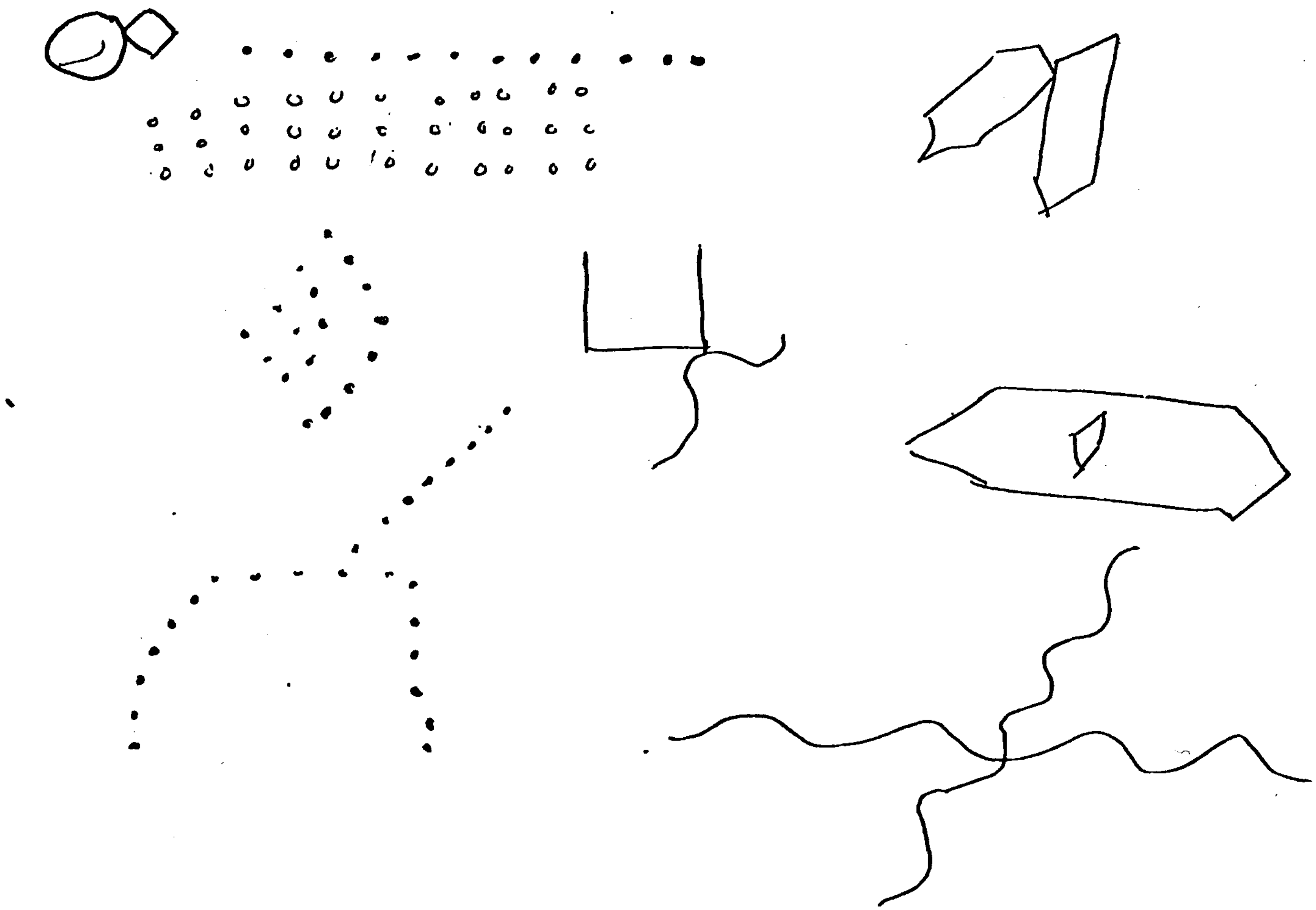
SCORE SHEET FOR BENDER-GESTALT TEST

1	2	3	4	5
Little or no production of configurations	Rudimentary production of configurations	Passable reproduction of configurations	Fair reproduction of configurations	Good reproduction of configurations

APPENDIX E. BENDER-GESTALT, CHOICE #1



APPENDIX E--Continued--CHOICE # 5



APPENDIX F

Descriptive Data and Raw Scores for All Auding Tasks on Mentally Retarded Children

Sex	CA	PPVT	AR	AA	GC	AC	SB	PLS	NSST(C)	BUSSDT	BG 1	BG 2	BG 3	BG 4	BG 5
M	162	82	41	29	26	25	21	17	40	35	3	4	3	4	4
F	151	77	34	26	21	21	13	17	38	36	3	4	3	3	3
F	211	73	32	23	16	14	12	13	40	36	3	4	2	4	3
F	214	73	38	25	27	24	12	13	40	36	3	3	3	3	3
M	209	72	34	22	20	22	13	16	38	35	5	5	5	5	5
F	163	71	38	20	23	14	16	13	38	34	1	3	2	2	1
M	180	71	18	22	15	21	10	16	36	36	3	3	3	3	3
F	189	69	34	26	21	4	9	19	39	36	3	5	5	4	4
F	211	69	25	22	20	23	19	15	40	36	4	5	5	5	4
F	168	68	36	23	18	12	15	15	38	34	2	4	3	4	3
M	187	65	22	14	17	9	11	12	36	35	4	4	4	4	4
F	144	64	24	18	24	16	11	14	29	36	1	3	1	1	1
M	152	61	21	20	14	24	21	15	38	36	3	5	5	4	3
M	128	60	34	16	6	6	10	15	36	33	2	4	3	3	2
M	169	60	18	10	14	9	10	12	26	33	3	3	3	3	3
M	175	60	19	19	25	25	16	19	40	27	2	4	4	5	4
M	130	58	21	21	12	7	9	16	40	33	5	5	5	4	4
F	202	56	35	20	16	21	11	14	40	36	4	5	5	5	4
M	178	54	20	24	7	15	13	14	37	34	3	3	3	3	3
M	158	54	16	22	8	3	11	14	38	35	4	4	3	4	4
F	212	53	17	11	12	17	17	14	34	34	2	4	3	3	2
M	215	53	31	19	5	7	6	13	33	33	1	3	2	3	2
M	188	49	20	14	10	13	12	14	37	34	3	4	4	3	3
F	148	48	14	14	15	15	10	15	33	34	1	3	3	2	3
M	187	48	19	12	6	8	10	12	29	27	1	3	2	2	2
M	121	31	9	10	5	8	1	11	30	4	1	2	2	3	2
F	137	46	20	15	6	13	11	12	34	33	1	3	2	1	1
M	124	45	14	18	11	14	6	16	34	35	3	3	3	3	3
M	218	45	7	10	8	15	3	10	32	29	1	2	2	1	1
M	166	45	6	9	7	5	7	11	25	14	3	3	3	3	3
M	128	42	15	14	7	4	6	13	32	18	1	2	2	3	2
M	190	41	12	13	4	15	5	12	38	31	2	2	1	2	2
M	126	40	4	9	2	1	8	10	18	16	1	1	1	1	1
F	175	40	15	7	3	8	10	10	19	27	1	2	2	2	2
M	120	39	6	5	2	9	12	11	35	25	1	1	1	1	1
F	191	36	18	4	5	14	8	11	21	20	2	4	3	3	3
F	164	36	20	12	2	9	6	14	28	29	1	1	1	2	1
F	132	25	1	6	1	3	7	15	26	33	1	2	1	1	1

Note:--BG 1 through BG 5 indicates Bender-Gestalt Test judges 1 through 5.

APPENDIX G

Descriptive Data and Raw Scores for All Auding Tasks on Normal Children

Sex	CA	PPVT	AR	AA	GC	AC	SB	PLS	NSST(C)	BUSSDT	BG 1	BG 2	BG 3	BG 4	BG 5
F	79	78	39	27	28	21	15	19	37	35	4	4	2	3	3
M	100	78	41	36	30	22	20	19	35	36	5	5	5	5	5
F	89	77	41	34	29	21	21	15	40	36	3	4	4	4	3
F	82	72	33	35	25	24	21	17	40	36	5	5	5	5	5
M	89	68	40	31	25	23	19	14	36	35	4	4	4	3	4
M	75	68	38	32	22	23	21	15	38	35	4	5	3	4	3
F	86	68	32	29	21	23	12	21	32	33	4	5	4	4	4
F	62	68	30	26	23	21	13	14	30	35	3	3	3	4	4
F	82	67	38	27	25	21	21	14	32	36	5	5	5	5	5
M	70	67	38	25	15	14	14	11	28	35	2	5	4	4	3
F	89	65	41	35	26	20	21	17	40	36	3	5	4	4	4
F	72	65	31	23	25	23	17	17	40	36	5	4	3	4	4
F	73	64	22	23	8	18	11	14	36	36	2	5	5	4	2
M	70	62	34	25	19	21	17	14	30	36	1	3	2	2	2
F	48	61	13	10	10	3	13	15	31	31	1	2	1	2	2
F	85	61	23	27	18	22	19	13	38	35	4	4	3	4	4
F	62	60	25	21	8	11	19	19	33	35	2	4	3	3	3
F	88	59	22	20	14	21	11	16	33	35	2	5	4	4	3
F	67	59	22	22	14	21	11	14	36	35	4	5	3	4	4
M	70	59	32	19	17	13	10	11	38	35	4	4	4	3	4
F	75	59	36	21	21	15	12	15	36	36	4	5	4	4	3
M	71	57	21	17	12	17	10	17	36	32	2	3	3	3	3
M	88	57	25	29	19	18	4	13	38	35	3	3	3	4	3
M	60	56	41	30	20	21	12	15	37	36	4	4	3	4	4
F	55	56	17	18	14	12	11	14	21	35	2	4	4	2	2
M	67	55	29	18	15	18	11	13	30	33	3	2	2	2	2
M	67	55	33	24	19	23	13	11	35	35	2	2	3	3	3
M	66	52	15	15	11	16	9	15	23	30	1	4	3	2	2
F	49	51	18	13	13	11	12	15	21	19	1	3	2	1	1
F	71	50	35	22	10	19	12	19	32	33	3	2	3	3	3
F	57	48	17	14	14	13	16	14	32	34	1	3	1	2	1
F	43	46	22	20	15	11	8	15	21	33	1	3	3	2	2
M	53	45	7	16	9	10	10	13	19	28	1	3	3	2	1
F	56	45	17	20	9	13	3	13	27	33	1	4	3	2	3
M	48	44	16	11	6	4	8	13	27	23	1	1	1	1	1
M	45	39	15	17	7	9	8	11	30	35	1	3	2	1	1
M	41	38	6	8	8	9	10	11	19	23	1	1	1	1	1
F	32	24	13	5	5	9	7	11	17	20	1	2	1	1	1

Note:—BG 1 through BG 5 indicates Bender-Gestalt Test judges 1 through 5.

APPENDIX H

Intercorrelations of the Variables Used in the Factor Analyses for the Mentally Retarded Subjects

Sex	1.00000	0.18896	0.10998	0.31081	0.07648	0.25164	0.15907	0.18329	0.08873	-0.03573	0.28035	-0.17761	0.11025	-0.06301	-0.09658	-0.14908
Age	0.18896	1.00000	0.35727	0.36477	0.22901	0.30318	0.40927	0.18514	-0.01363	0.24754	0.35064	0.29283	0.35880	0.30829	0.36996	0.33928
PPVT	0.10998	0.35727	1.00000	0.81634	0.84082	0.86502	0.56262	0.65570	0.54361	0.65922	0.62269	0.54965	0.64799	0.50703	0.55966	0.55167
AR	0.31081	0.36477	0.81634	1.00000	0.77272	0.69920	0.44948	0.51119	0.47621	0.59854	0.55970	0.37121	0.60876	0.42238	0.52893	0.42447
AA	0.07648	0.22901	0.84082	0.77272	1.00000	0.72871	0.49480	0.50440	0.69459	0.77726	0.60397	0.54621	0.60663	0.49555	0.59170	0.56877
GC	0.25164	0.30318	0.86502	0.69920	0.72871	1.00000	0.66785	0.60677	0.59186	0.59866	0.50713	0.43379	0.59422	0.50478	0.52103	0.53263
AC	0.15907	0.40927	0.56262	0.44948	0.49480	0.66785	1.00000	0.60761	0.39838	0.52712	0.43506	0.32355	0.42759	0.40060	0.39706	0.37978
SB	0.18329	0.18514	0.65570	0.51119	0.50440	0.60677	0.60761	1.00000	0.43819	0.47733	0.51956	0.34321	0.56068	0.45066	0.43702	0.37682
PLS	0.08873	-0.01363	0.54361	0.47621	0.69459	0.59186	0.39838	0.43819	1.00000	0.61626	0.53576	0.42627	0.59179	0.54329	0.54877	0.54862
NSST(C)	-0.03573	0.24754	0.65922	0.59854	0.77726	0.59866	0.52712	0.47733	0.61626	1.00000	0.59252	0.53744	0.59679	0.52673	0.58329	0.51509
BUSSDT	0.28035	0.35064	0.62269	0.55970	0.60397	0.50713	0.43506	0.51956	0.53576	0.59252	1.00000	0.42341	0.51537	0.35865	0.25390	0.31425
BG 1	-0.17761	0.29283	0.54965	0.37121	0.54621	0.43379	0.32355	0.34321	0.42627	0.53744	0.42341	1.00000	0.74695	0.79659	0.77455	0.86569
BG 2	0.11025	0.35880	0.64799	0.60876	0.60663	0.59422	0.42759	0.56068	0.59179	0.59679	0.51537	0.74695	1.00000	0.88014	0.80245	0.78774
BG 3	-0.06301	0.30829	0.50703	0.42238	0.49555	0.50478	0.40060	0.45066	0.54329	0.52673	0.35865	0.79659	0.88014	1.00000	0.82752	0.85160
BG 4	-0.09658	0.36996	0.55966	0.52893	0.59170	0.52103	0.39706	0.43702	0.54877	0.58329	0.25390	0.77455	0.80245	0.82752	1.00000	0.90085
BG 5	-0.14908	0.33928	0.55167	0.42447	0.56877	0.53263	0.37978	0.37682	0.54862	0.51509	0.31425	0.86569	0.78774	0.85160	0.90085	1.00000

APPENDIX I

Intercorrelations of the Variables Used in the Factor Analyses for the Normal Subjects

Sex	1.00000	0.02402	0.12856	-0.01233	0.01945	0.08310	0.05593	0.16922	0.39247	0.06455
	0.07698	0.11793	0.27595	0.13219	0.19591	0.15382				
Age	0.02402	1.00000	0.81266	0.71988	0.82783	0.74829	0.79111	0.56192	0.47045	0.75161
	0.65121	0.71702	0.65098	0.70441	0.81842	0.74849				
PPVT	0.12856	0.81266	1.00000	0.74899	0.80283	0.81283	0.67578	0.69247	0.52023	0.70214
	0.66638	0.69481	0.64146	0.62081	0.77893	0.72065				
AR	-0.01233	0.71988	0.74899	1.00000	0.83518	0.82044	0.72658	0.62300	0.38015	0.68854
	0.63241	0.73241	0.51650	0.55702	0.70966	0.72735				
AA	0.01945	0.82783	0.80283	0.83518	1.00000	0.83056	0.80880	0.62404	0.42031	0.71735
	0.72491	0.72468	0.65509	0.70185	0.81821	0.78517				
GC	0.08310	0.74829	0.81283	0.82044	0.83056	1.00000	0.75376	0.67284	0.38684	0.63073
	0.57075	0.77053	0.51906	0.51818	0.70621	0.73045				
AC	0.05593	0.79111	0.67578	0.72658	0.80880	0.75376	1.00000	0.53106	0.38372	0.65903
	0.62293	0.73322	0.55756	0.57805	0.76184	0.74119				
SB	0.16922	0.56192	0.69247	0.62300	0.62404	0.67284	0.53106	1.00000	0.38838	0.52158
	0.42288	0.55377	0.44235	0.37757	0.55050	0.52063				
PLS	0.39247	0.47045	0.52023	0.38015	0.42031	0.38694	0.38372	0.38838	1.00000	0.34731
	0.25960	0.40402	0.37439	0.29833	0.41168	0.41665				
NSST(C)	0.06455	0.75161	0.70214	0.68854	0.71735	0.63073	0.65903	0.52158	0.34731	1.00000
	0.72469	0.71320	0.49169	0.44319	0.74126	0.69671				
BUSSDT	0.07698	0.65121	0.66638	0.63241	0.72491	0.57075	0.62293	0.42288	0.25960	0.72469
	1.00000	0.55833	0.61428	0.60932	0.70858	0.64996				
BG 1	0.11793	0.71702	0.69481	0.73241	0.72468	0.77053	0.73322	0.55377	0.40402	0.71320
	0.55833	1.00000	0.58584	0.60117	0.81643	0.86914				
BG 2	0.27595	0.65098	0.64146	0.51650	0.65509	0.51906	0.55756	0.44235	0.37439	0.49169
	0.61428	0.58584	1.00000	0.79336	0.74899	0.64501				
BG 3	0.13219	0.70441	0.62081	0.55702	0.70185	0.51818	0.57805	0.37757	0.29833	0.44319
	0.60932	0.60117	0.79336	1.00000	0.78185	0.71199				
BG 4	0.19591	0.81842	0.77893	0.70966	0.81821	0.70621	0.76184	0.55050	0.41168	0.74126
	0.70858	0.81643	0.74899	0.78185	1.00000	0.87539				
BG 5	0.15382	0.74849	0.72065	0.72735	0.78517	0.73045	0.74119	0.52063	0.41665	0.69671
	0.64996	0.86914	0.64501	0.71199	0.87539	1.00000				

APPENDIX J

LIST OF ABBREVIATIONS

N	Normal
R	Retarded
MR	Mentally Retarded
PPVT	Peabody Picture Vocabulary Test
MA	Mental Age on the Peabody Picture Vocabulary Test
ITPA	Illinois Test of Psycholinguistic Ability
ITPA Subtest	
AR	Auditory Reception
AA	Auditory Association
GC	Grammatic Closure
AC	Auditory Closure
SB	Sound Blending
PLS	Parsons Language Sample
NSST(C)	Northwestern Syntax Screening Test (Comprehension)
BUSSDT	Boston University Speech Sound Discrimination Test
BG	Bender-Gestalt Test

BIBLIOGRAPHY

Abbs, J., & Sussman, H. Neurophysiological feature detection and speech perception: A discussion of theoretical implications. Journal of Speech and Hearing Research, 1971, 14, 23-36.

Bateman, Barbara. The Illinois Test of Psycholinguistic Abilities in current research: Summaries of studies. Urbana, Ill.: Institute for Research in Exceptional Children, 1961.

Bateman, B., & Wetherell, J. Psycholinguistic aspects of mental retardation. Mental Retardation, 1965, 3, 8-13.

Belmont, J. Long-term memory in mental retardation. In N. Ellis (Ed.), International review of research in mental retardation. Vol. 1. New York: Academic Press, 1966.

Bender, L. A visual motor Gestalt test and its clinical use. New York: The American Orthopsychiatric Association, 1938.

Berkson, G., & Cantor, G. A study of mediation in mentally retarded and normal school children. Journal of Educational Psychology, 1960, 51, 82-86.

Berry, M. Language disorders of children. New York: Appleton-Century-Crofts, 1969.

Birch, H., & Lefford, A. Two strategies for studying perception in brain-damaged children. In H. Birch (Ed.), Brain damage in children. Baltimore, Md.: Williams & Wilkins, 1964.

Blue, M. Peabody Picture Vocabulary Test: Temporal stability and alternate form probability with the trainable mentally retarded. American Journal of Mental Deficiency, 1969, 73, 745-748.

Bolla, D., Slyfco, S., & Zigler, E. Use of the opposite concept and outer-directedness in intellectually average, familial retarded and organically retarded children. American Journal of Mental Deficiency, 1971, 75, 663-680.

Bruner, J. Cognitive consequences of early sensory deprivation. Psychosomatic Medicine, 1959, 21, 89-95.

Budoff, M. Peabody Picture Vocabulary Test performance of institutionalized mentally retarded adolescents. American Journal of Mental Deficiency, 1962, 67, 756-760.

Cantor, G., & Ryan, T. Retention of verbal paired-associates in normals and retardates. American Journal of Mental Deficiency, 1961, 66, 861-865.

Carlson, D. Language and figural ability hypothesis in retardates of MA 4. American Journal of Mental Deficiency, 1968, 73, 105-111.

Carroll, J. Language and thought. Englewood Cliffs, N.J.: Prentice-Hall, 1964.

Carroll, J. Psycholinguistics in the study of mental retardation. In R. L. Schiefelbusch, et al. (Eds.), Language and mental retardation. New York: Holt, Rinehart and Winston, 1967. Ch. 3.

Carrow, Sister Mary Arthur. The development of auditory comprehension of language structure in children. Journal of Speech and Hearing Disorders, 1968, 33, 99-112.

Carter, C. H. Handbook of mental retardation syndromes. Springfield, Ill.: Charles C. Thomas, 1966.

Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: MIT Press, 1965.

Clausen, J. Ability structure and subgroups in mental retardation. Washington, D.C.: Spartan Books, 1966.

Cooper, F. S. How is language conveyed by speech? In J. F. Kavanagh and J. G. Mattingly (Eds.), Language by ear and by eye. Cambridge, Mass.: MIT Press, 1972.

Dixon, W. J. (Ed.) BMD: Biomedical computer programs. Berkeley: University of California Press, 1973.

Dunn, L. Peabody Picture Vocabulary Test (expanded manual). Minneapolis, Minn.: American Guidance Service, Inc., 1958.

Dunn, L., & Hottel, J. Peabody Picture Vocabulary performance of trainable mentally retarded children. American Journal of Mental Deficiency, 1961, 65, 448-452.

Eisenson, J. Aphasia in adults--classification and examination procedures. In E. Travis (Ed.), Handbook of speech pathology. New York: Appleton-Century-Crofts, 1972.

Eisman, B. S. Paired-associate learning, generalisation and retention as a function of intelligence. American Journal of Mental Deficiency, 1958, 63, 481-489.

Ellis, N. The stimulus trace and behavior inadequacy. In N. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw Hill Book Co., 1963. Ch. 4.

Ellis, N. Memory processes in retardates and normals. In N. Ellis (Ed.), International review of research in mental retardation. New York: Academic Press, 1970. Pp. 1-32.

Fay, W., & Butler, B. Echolalia, I.Q. and the developmental dichotomy of speech and language systems. Journal of Speech and Hearing Disorders, 1968, 225-248.

Fraser, C., Bellugi, U., & Brown, R. Control of grammar in imitation, comprehension, and production. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 121-135.

Geschwind, N. Neurological foundations of language. In H. Mykelbust (Ed.), Progress in learning disabilities. New York: Grune and Stratton, 1968.

Goldfarb, W. Effects of psychological deprivation in infancy and subsequent stimulation. American Journal of Psychiatry, 1945, 102, 18-33.

Goodglass, H., Gleason, J., & Hyde, M. Some dimensions of auditory language comprehension in aphasia. Journal of Speech and Hearing Research, 1970, 13, 595-606.

Goulet, L. Verbal learning and memory research. In N. Ellis (Ed.), International review of research. Vol. 3. New York: Academic Press, 1968. Pp. 97-134.

Guilford, J. Three faces of intellect. American Journal of Psychology, 1959, 14, 469-479.

Hammill, D., & Irwin, O. Relations among measures of language of cerebral palsied and mentally retarded children. Cerebral Palsy Journal, 1966

Hardy, W. Human communication--ordered and disordered. Volta Review, 1962, 64, 354-362.

Hardy, W. On language disorders in young children. Journal of Speech and Hearing Disorders, 1965, 30, 13.

Heber, R. Manual on terminology and classification in mental retardation. American Journal of Mental Deficiency, 1959 (Monogr. Suppl.)

Heber, R. Modifications in the manual on terminology and classifications in mental retardation. American Journal of Mental Deficiency, 1961, 65, 499-500.

Hirsh, I. Information processing in input channels for speech and language: The significance of serial order of stimuli. In C. Millikan et al (Eds.), Brain mechanisms underlying speech and language. New York: Grune and Stratton, 1967. Pp. 121-123.

Hoch, P., & Zubin, J. Psychology of perception. New York: Grune and Stratton, 1965.

Irwin, J., & Marge, M. (Eds.) Principles of childhood language disabilities. New York: Appleton-Century-Crofts, 1972.

Jenson, A., & Rohiver, J. The effect of verbal mediation on the learning and retention of paired-associates by retarded adults. American Journal of Mental Deficiency, 1963, 68, 80-84.

Johnson, G., & Blake, K. Learning performance of retarded and normal children. New York: Syracuse University Press, 1960.

Kirk, S., & Kirk, W. Psycholinguistic learning disabilities: diagnosis and remediation. Urbana, Ill.: University of Illinois Press, 1971.

Kirk, S., McCarthy, J., & Kirk, W. Examiner's manual ITPA. (Rev. ed.) Urbana, Ill.: University of Illinois Press, 1968.

Koppitz, E. Bender-Gestalt Test. New York: Grune and Stratton, 1964.

Lee, L. Developmental sentence types: A method for comparing normal and deviant syntactic development. Journal of Speech and Hearing Disorders, 1966, 3, 311-330.

Lenneberg, E., Nichols, I., & Rosenberger, E. The brain and disorders of communication: primitive stages of language development in mongolism. Research Publication of Association for Research in Nervous and Mental Disease, 1964, 42, 119-137.

Lenneberg, E. A biological perspective of language. In E. Lenneberg (Ed.), New directions in the study of language. Cambridge, Mass.: MIT Press, 1964. (a)

Lenneberg, E. Notes from a lecture held at City University of New York, March 28, 1969.

Lerea, L. Assessing language development. Journal of Speech and Hearing Disorders, 1958, 68, 75-85.

Levy, B. Role of articulation in auditory and visual short-term memory. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 123-132.

Liberman, A., Cooper, F., Harris, K., MacNeilage, P., & Studdert-Kennedy, M. Some observations on a model for speech perception, in Models for the perception of speech and visual form. Cambridge, Mass.: MIT Press, 1967.

Liberman, A., Cooper, F., Shankweiler, D., & Studdert-Kennedy, M. Perception of the speech code. Psychology Review, 1967, 74, 431-461.

Lipman, R. Learning: Verbal, perceptual-motor, and classical conditioning. In N. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw Hill Book Co., 1963.

Luria, A. The mentally retarded child. New York: MacMillan Co., 1963.

Malheny, A., Jr. Comparability of WISC and PPVT scores among young children. Exceptional Children, 1971, 38, 147-152.

McCarthy, D. Language development in children. In L. Carmichael (Ed.), Manual of child psychology. New York: Wiley, 1946. Pp. 476-581.

McCarthy, J. A test for the identification of defects in language usage among young cerebral palsied children. Cerebral Palsy Review, 1960, 21, 3-5.

McCarthy, J. Research in the linguistic problems of the mentally retarded (Department of Health, Education and Welfare). Mental Retardation Abstracts, 1964, 1, 3-27.

McCarthy, J., & Kirk, S. The construction, standardization and statistical characteristics of the ITPA. Urbana, Ill.: Institute for Research on Exceptional Children, 1963.

McCarthy, J., & Olson, J. Validity studies on the Illinois Test of Psycholinguistic Abilities. Madison, Wis.: Photo Press, 1964.

McGrady, H., Jr. Language pathology and learning disabilities. In H. Mykelbust (Ed.), Progress in learning disability. Vol. 1. New York: Grune and Stratton, 1968. Pp. 199-233.

McNeill, D. Developmental psycholinguistics. In F. Smith and G. Miller (Eds.), Genesis of language. Cambridge, Mass.: MIT Press, 1966. Pp. 15-84.

Mecham, M. Development of audiolinguistic skills in children. St. Louis, Mo.: Warren H. Green, 1969.

Menyuk, P. Comparison of grammar of children with functionally deviant and normal speech. Journal of Speech and Hearing Research, 1964, 109-121.

Milgram, N. Verbalization and conceptual classification in trainable mentally retarded children. American Journal of Mental Deficiency, 1966, 70, 763-765.

Mykelbust, H. Learning disabilities: Definition and overview. In H. Mykelbust (Ed.), Progress in learning disability. New York: Grune and Stratton, 1968.

Newfield, M., & Schlanger, B. The acquisition of English morphology by normal and educable mentally retarded children. Journal of Speech and Hearing Research, 1968, 11, 693-706.

O'Connor, N., & Hermelin, B. Speech and thought in severe abnormality. New York: The MacMillan Co., 1963.

O'Connor, N., & Hermelin, B. Recall in normals and subnormals of like mental ages. Journal of Abnormal and Social Psychology, 1963, 66, 81-84. (a)

Olsen, J. Differential diagnosis: deaf and sensory aphasic children. Exceptional Children, 1961, 27, 422-424.

Osgood, C. Method and theory in experimental psychology. New York: Oxford Press, 1953.

Osgood, C. Motivational dynamics of language behavior. Nebraska Symposium on Motivation. Lincoln, Neb.: University of Nebraska, 1957.

Perkins, W. Speech pathology in applied behavioral science. St. Louis, Mo.: C. V. Mosby, 1971.

Piaget, J. The language and thought of the child. New York: Harcourt, Brace, 1929.

Prehm, H., & Crosson, J. The mentally retarded. Preview of Educational Research (American Educational Research Association), 1969, 39, 6.

Pronovost, W., & Dumbleton, M. A picture-type speech sound discrimination test. Journal of Speech and Hearing Disorders, 1953, 18, 258-266.

Rees, N. Auditory processing factors in language disorders: The view from Procrustes' bed. Journal of Speech and Hearing Disorders, 1973, 38, 304-315.

Rossi, F. Associative clustering in normal and retarded children. American Journal of Mental Deficiency, 1967, 62, 691-699.

Rieber, M. Verbal mediation in normal and retarded children. American Journal of Mental Deficiency, 1964, 68, 634-641.

Rheingold, H., Gewirtz, J., & Ross, H. Social conditioning of vocalization in the infant. Journal of Comparative Physiological Psychology, 1959, 52, 68-73.

Sass, E. A comparison of frequency distributions of items on the Grammatic Closure subtest of the Illinois Test of Psycholinguistic Abilities between mentally retarded and normal children. Unpublished study, 1973.

Schiefelbusch, R. Language disabilities of cognitively involved children. In J. Irwin and M. Marge (Eds.), Principles of childhood language disabilities. New York: Appleton-Century-Crofts, 1972.

Schlanger, B. Speech measurements of institutionalized mentally retarded children. American Journal of Mental Deficiency, 1953, 58, 115-122.

Schlanger, B. Environmental influences on verbal output of mentally retarded children. Journal of Speech and Hearing Diserders, 1954, 19, 339-343.

Schlanger, B. Results of varying presentations to brain damaged children of an auditory word discrimination test. American Journal of Mental Deficiency, 1958, 63, 464-468.

Schlanger, B. The effects of listening training of the auditory thresholds of mentally retarded children. U.S. Office of Education Project #973 (8936.) Morgantown, W. Va.: West Virginia University, 1961.

Schlanger, B. Issues for speech and language training of the mentally retarded. In R. Schiefelbusch et al. (Eds.), Language and mental retardation. Baltimore, Md.: University Park Press, 1972.

Schlanger, B., & Galanowsky, G. Auditory discrimination tasks performed by mentally retarded and normal children. Journal of Speech and Hearing Research, 1966, 434-440.

Schlanger, B., & Gottsleben, R. Analysis of speech defects among the institutionalized mentally retarded. Journal of Speech and Hearing Disorders, 1957, 22, 98-108.

Schultz, D. Physiological effects of sensory deprivation. In D. Schultz (Ed.), Sensory restriction: Effects on behavior. New York: Academic Press, 1965. Pp. 35-58.

Scott, J. Critical periods in behavioral development. Science, 1962, 138, 949-958.

Shankweiler, D. An analysis of laterality effects in speech perception. In D. Horton and J. Jenkins (Eds.), The perception of language. Columbus, Ohio: Charles E. Merrill, 1971.

Sievers, D. A study to compare the performance of brain-injured and non-brain-injured mentally retarded children in the Differential Language Facility Test. American Journal of Mental Deficiency, 1959, 63, 839-884.

Sievers, D. Studies in language development in children using a psycholinguistic theory. Sixteenth International Congress of Psychology. Bonn: German Society of Psychology, 1960.

Sievers, D., & Essa, S. Language development in institutionalized mentally retarded and a group of community mentally retarded children. American Journal of Mental Deficiency, 1961, 66, 413-420.

Sievers, D., & McCarthy, J., et al. Selected studies on the ITPA. Urbana, Ill.: University of Illinois Press, 1963.

Sievers, D., & Rosenberg, C. The Differential Language Facilities Test and eeg's in brain-injured mentally retarded children. American Journal of Mental Deficiency, 1960, 65, 46-50.

Skinner, B. F. Verbal behavior. New York: Appleton-Century-Crofts, 1957.

Solomon, P. Sensory deprivation and social isolation. In P. Solomon (Ed.), Sensory deprivation, symposium. Cambridge, Mass.: Harvard University Press, 1961.

Spitz, H. Field theory in mental deficiency. In N. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw Hill, 1963. Pp. 11-41.

Spitz, H. The role of input organization. In N. Ellis (Ed.), International review of research in mental retardation. New York: Academic Press, 1966. Pp. 29-56.

Spivak, G. Perceptual processes. In N. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw Hill, 1963. Pp. 480-511.

Spradlin, J. Language and communication of mental defectives. In N. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw Hill, 1963.

Spradlin, J. Language studies of mentally retarded children, assessment of speech and language of retarded children: The Parsons Language Sample. Journal of Speech and Hearing Disorders, 1963, 8 (Monogr. Suppl. 10). (a)

Stedman, D. Associative clustering of semantic categories in normal and retarded subjects. American Journal of Mental Deficiency, 1963, 67, 700-704.

Stephens, B., & McLaughlin, J. Analysis of performance by normals and retardates on Piagetian reasoning assessments as a function of verbal ability. Perceptual and Motor Skills, 1971, 868-870.

Stephens, W. Category usage by normal and mentally retarded boys. Child Development, 1966, 37, 355-356.

Strauss, A., & Kephart, N. Psychopathology and education of the brain-injured child. Vol. 2. New York: Grune and Stratton, 1955.

Vygotsky, L. Thought and language. Cambridge, Mass.: MIT Press, 1962.

Weatherwax, J., & Benoit, E. Concrete and abstract thinking in organic and non-organic mentally retarded children. American Journal of Mental Deficiency, 1957, 62, 548-553.

Wechsler, D. Wechsler Intelligence Scale for Children. Manual. New York: The Psychological Corp., 1949.

Wepman, J. Studies in aphasia. Journal of Speech and Hearing Disorders, 1960, 25, 323.

Wepman, J., & Wiener, P. Standardization and validation of a diagnostic test battery for language impaired children. Chicago: University of Chicago, 1967.

Werner, H., & Kaplan, E. Development of word meaning through verbal context: An experimental study. Journal of Psychology, 1950, 29, 251-257.

Wiener, S. The cognitive functioning of language deficient children. Journal of Speech and Hearing Research, 1969, 53-64.

Zigler, E., & Bolla, D. Luria's verbal deficiency theory of mental retardation and performance of sameness symmetry and opposition tasks: A critique. American Journal of Mental Deficiency, 1971, 75, 400-414.