1-1-1973

Diagnostic - remedial procedures for auditory processing disorders

Devika Rani R. Krishnaney

DIAGNOSTIC - REMEDIAL PROCEDURES FOR AUDITORY PROCESSING DISORDERS

by

Devika Rani R. Krishnaney

A RESEARCH PAPER
SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS IN SPECIAL
EDUCATION
(LEARNING DISABILITIES)
AT THE CARDINAL STRITCH COLLEGE
Milwaukee, Wisconsin
1973

This research paper has been
approved for the Graduate Committee
of the Cardinal Stritch College by

Sister Joanne Marie Kreidler
(Adviser)

Date May 12, 1973

ACKNOWLEDGMENTS

I wish to express my gratitude to Sister Joanne Marie for her advice, encouragement and constructive criticism toward the completion of this research paper.
I am grateful to Sister Laurem Moss for discussing the topic in the class.
My special thanks to Sister Stephanie, the librarian of Cardinal Stritch College, for her great assistance in the use of the library.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

THE BRAIN, SHIELDED from the world in its bony casing, has no direct contact with the external environment. It must receive information about the environment through data fed to it by sensory organs and must respond to the outer world through the effector organs of the neuromuscular system. Man's five senses, vision, hearing, olfaction, touch and gustation help him to establish a relationship between internal and external worlds. Most useful to him are his "distance senses" of hearing and vision through which he gets information about, and maintains contact with, the environment. Vision is basically a directional sense; it cannot function beyond the peripheral visual field. It is also a selective sense; it ceases to function in sleep, in the dark, and cannot travel through walls or around corners. By contrast, audition is non-directional and nonselective. We can hear from all directions simultaneously and we are always "tuned in." We can hear through walls, around corners, in light and darkness, and although hearing "shifts gears" in sleep, it does not cease. We can learn to ignore large segments of the sound world during sleep, but are easily awakened by the faint crying of the baby.

Hearing is man's primary scanning sense.[1] Moreover, it is the

---

[1] Naomi Zigmund Kerahman: Auditory Processes in Children with Learning Disabilities: in Lester, Learning Disabilities, Charles Thomas, 1969. p 196.

primary channel for language acquisition and interpersonal communication. Yet a survey of the broad field of perception soon discloses an abundance of material, both theoretical and empirical, on visual perception while the study of hearing lags far behind. There are five major reasons for the paucity of research in the auditory area:

1. Difficulty with instrumentation for production of controlled auditory stimuli has been a major drawback to research in auditory perception. From 1873 to the present, toys and noise makers, clackers and bells, whistles, tuning forks and a myriad of other devices have been used to elicit responses in infants and children. These instruments have produced stimuli of varying loudness and timbre differences which make it difficult and often impossible for experimenters to compare their results.

2. Determining a meaningful and reliable response is a second major difficulty in auditory research. Such diversified responses as eyeblink, startle response, eye movements, heart rate, respiration rate, increase or decrease in general movement, conditioned sucking or conditioned foot withdrawal, and waking from sleep have been used to determine the presence of auditory sensitivity in infants and young children. Some of these same responses plus verbal responses, pointing responses, button pushing and EEG have been attempted with older children. These results have not been comparable because of differences in attentional and adaptational factors, and because a total lack of response to auditory stimulation cannot be considered as specific evidence that a child cannot hear.

3. The organization, structure and use of sound in the environ-

ment is achieved at different ages by different individuals.

4. Confusion is generated by overlapping terms -- a term such as "psychic deafness" refers to diagnosis, a term such as "sound localisation" refers to a specific task, while a term such as "hi - frequency loss" refers to aspects of the stimuli.

5. Finally, because the deaf and severely hard-of-hearing child has been found to be extremely limited in his ability to communicate with others, in his personality development and in his educational achievement, researchers have tended to concentrate on techniques for the detection of auditory handicaps, and on the improvement of the communicative skills of such children, rather than on the development of auditory skills in general.

As a result, there is considerable clinical material available on the evaluation of hearing in children and data on the sensory mechanism and the psychophysical properties of the ear but little information available on the development of auditory processes.

PURPOSE OF THE STUDY:

The purpose of this paper was to provide:

1. An overview of the auditory processing tasks and disorders which can occur in processing auditory stimuli;

2. Diagnostic - remedial procedures feasible with different kinds of auditory processing disorders; and

3. The needs for future research in assessment and training of auditory processing disorders.

STATEMENT OF THE PROBLEM:

The auditory channel is one of the most important avenues through which children and adults receive information about their environment. The importance of hearing acuity for obtaining such information has been established, but there is little known about the central processing of auditory stimuli. There are children, whose hearing acuity is within the normal range of hearing, who have difficulty processing and obtaining meaning from auditory stimuli. The child with a generalised deficit in auditory learning hears, but he does not interpret what he hears. He understands neither spoken words nor environmental sounds. He is unable to structure his auditory world, to sort out and associate sounds with particular objects or experiences. Because he fails to make these associations, he responds inconsistently to sounds and sometimes he is thought to be deaf or hard-of-hearing.

In some ways these children are similar in behavior to the deaf. Since they do not interpret sounds, they become more visually and tactually oriented. They prefer colorful and mobile toys rather than those which produce sound. Most of them appear quiet and use few vocalizations. However, the vocalisations used vary in pitch and inflection, indicating a more normal vocal quality than found in the deaf.

A child who has difficulty processing auditory stimuli may be observed to perform poorly in some of the following tasks:

1. Identifying the source of sounds;
2. Discriminating among sounds or words;
3. Reproducing pitch, rhythm, and melody;
4. Selecting significant from insignificant stimuli;

5. Combining speech sounds into words; or

6. Understanding the meaning of environmental sounds in general.

Many of the observable behaviors which seem to be characterized by difficulty in perceiving auditory stimuli have been referred to as "auditory perceptual disorders." Myklebust[1] defines auditory perception as the ability to "structure the auditory world and select those sounds which are immediately pertinent to adjustment". According to Berry and Eisenson,[2] children with auditory perceptual disorders can hear sounds, but are unable to recognise the sounds that they hear. The term "auditory perception", as it is used here, refers to the central processing of auditory stimuli.

In 1954, Myklebust made a number of important distinctions concerning auditory disorders in children. Unfortunately, the present status of knowledge has not advanced very far beyond the early contributions of Myklebust, Goldstein, Nielsen, and others.[3]

The term "auditory perception" has been used to describe many behavioral responses to auditory stimuli. In order to present an organized view of auditory perception or auditory stimulus processing,

---

[1] H. R. Myklebust. Auditory disorders in children: A manual for differential diagnosis. New York: Grune and Stratton, 1954. p 158.

[2] M. F. Berry, and J. Eisenson. Speech disorders. New York: Appleton Century - Crofts, Inc. 1956.

[3] J. C. Chalfant, and M. A. Scheffelin. Auditory processing: Central processing dysfunctions in children: A review of Research. U. S. Department of Health, Education, and Welfare. 1969. p 9.

seven different auditory tasks have been identified and are presented in Table 1. It will be noted that the seven tasks are described according to the stimulus presented, the response required, and terms commonly applied either to the task or to failure in performing the task[1]. Each of the seven tasks will be described in separate sections, in Chapter III, which will include a discussion of:

1. Nature of the task;
2. Consequences of failure in performing the task; and
3. Diagnostic - remedial procedures.

Table 1. ----- Auditory Processing Tasks[2]

Stimulus presented	Response required	Common terminology
1. Auditory stimulus.....	Indicate awareness through verbal or motor response.	Attentional problem, distractible, hyperactive.
2. Sound versus no sound..	Yes/no.	Acuity, detection.
3. Sound from several different origins	Indicate direction from which originated.	Sound localization.
4. Sounds varying on one acoustic dimension ...	Same/different	Discrimination of pitch, loudness, speech sounds, noises.
5. Sequences and patterns of speech or nonspeech sounds varying on more than one acoustic dimension.	Reproduce sequence: (a) Imitation, e.g., tapping; (b) speaking; (c) singing.	Pitch, rhythm, melody, "arhythmical, can't carry a tune, tone-deaf, poor auditory memory."
6. Sound preselected as "figure" versus sound preselected as "ground".	Select "figure" sound.	Differentiate, discriminate.
7. Sounds from one or more sources	Identify by: (a) pointing to a visual representation of the sound source; or (b) naming the sound source.	Associating sounds with their actual sources.

---

[1] Ibid. p 11
[2] Ibid. p 12

SUMMARY

In this chapter, the writer has attempted to introduce the problem, the purpose of the study and define "auditory perceptual disorders." An attempt has also been made to identify various auditory processing disorders and tasks, viz.

1. Identifying the source of sounds;
2. Discriminating among sounds or words;
3. Reproducing pitch, rhythm and melody;
4. Selecting significant from insignificant stimuli;
5. Combining speech sounds into words; and
6. Understanding the meaning of environmental sounds in general.

****

CHAPTER II

REVIEW OF RESEARCH STUDIES

Disabilities and disturbances in learning processes have long been of interest to various professions. The medical professionals, especially neurologists, have been concerned with finding physiological and structural correlates of specific learning disorders. Pathology in particular brain areas has been related to certain disabilities.

While the medical specialist is concerned with the relation between communication disorders and the location of cerebral dysfunction in children, the special educator is concerned primarily with assessment of the behavioral symptoms and with designing the special methods of remediation required to ameliorate the disability.

In 1962 Kirk and Bateman[1] pointed out that for the past several years, interest at the Institute for Research on Exceptional children had been concentrated on the development of a scientific pedagogy in the area of learning disabilities. Psychological factors in language (psycholinguistic) functions with young children has been the specific concern. A scientific pedagogy in this field requires:

1. The development of behavioral diagnostic instruments of such a nature that the specific psycholinguistic disabilities can be differentiated and identified;

---

[1]Samuel A. Kirk & Barbara Bateman, Diagnosis and Remediation of Learning Disabilities. Exceptional Children. Oct. 1962. p 74

2. Validation of these tests by research studies; and

3. Determination of the educability of psycholinguistic disabilities through longitudinal training of a select group of children.

In 1962 the experimental edition of the Illinois Test of Psycholinguistic Abilities was itself being extensively tested and a few children were receiving tutoring. The test, its theoretical background, rationale, and illustrations of its diagnostic uses are discussed by Kirk and McCarthy. The test, according to the authors is presented, not as a classification instrument, but as a diagnostic instrument which leads to clues for remediation of deficits in various psycholinguistic functions found particularly among cerebral palsied, brain - injured, and some emotionally disturbed children.[1]

It is recognized by the authors that the ITPA does not make any assumptions with respect to neurological or neurophysiological cor - relates of behavior. Its emphasis is on assessing behavior manifestations in the psycholinguistic field, in relating the assets and deficits to a behavioral (not neurological) model, and in extending this type of behavior diagnosis to a remedial teaching situation.[2]

Some studies using the ITPA have demonstrated its usefulness and validity as a differential diagnostic test, and have also pointed out its limitations.

---

[1] S. A. Kirk and J. J. McCarthy. The Illinois Test of Psycho - linguistic Abilities - an approach to differential diagnosis. Amer. J. Ment. Defic. 1961, 66, p 411.

[2] Ibid. p 412.

Bocca and Calearo at the University of Sassani summarized an international problem:[1]

> The various tests aimed at exploring the central hearing processes are still insufficiently standardized; indeed, we know very little for certain about the modalities and the levels of integration, and each new test may show up some new disorder whose diagnostic value must then wait upon valid confirmation on the theoretical and clinical plane.

The development of psychoeducational instruments to measure auditory perceptual function in children has progressed slowly because of the limited theoretical understanding of this area of human behavior. However, auditory perception is used as a prime means of teaching. Meyerson[2] wrote:

> ...we live immersed in a world of sound. It is probable that human beings spend more time in listening than in any other activity and, yet, we do not know how an individual learns to listen, how this function develops, or the ways in which it is influenced by psychological variables.

According to Sabatino[3], the two major tests seemingly incorporating some measure of auditory perception are the Wepman Test of Word Discrimination and the experimental edition of the ITPA published in 1962.

The ITPA, Sabatino points out, is based on the psycholinguistic model of Osgood[4]. Strong, states Sabatino,[5] factored 92 tests and subtest variables utilizing computer based factorial analysis. He found that the auditory decoding and auditory - vocal automatic subtests of the ITPA correlate .58 and .51, respectively, with the brain damage syndrome.

---

[1] E. Bocca, and C. Calearo. Central Hearing Processes. In J. Jerger (Ed.), Modern developments in audiology. N. Y.: Academic Press, 1963. p 343.

Hasterok[6] found that visual and auditory difficulties as identified in ITPA profiles were unsuited to answering the important question of the relationship between learning problems and perceptual or sensory problems. He concluded that children cannot be matched for comparison purposes on the basis of sensory or perceptual problems. The problem is that the ITPA was designed as a measure of psycholinguistic skills and not perceptual functions.

Sabatino mentions four major dimensions or processes of auditory perception:[7]

1. The recognition of sound elements as meaningful information.
2. The retention of these units of information.
3. The integration of the symbolic relationships of these units as language concepts.
4. The comprehension of language symbols through the three previous stages or steps of auditory perceptual functions.

---

[2]L. Myerson. Hearing for speech in children, a verbal audiometric. Acta oto-Laryngologica, 1956 (Monogr. suppl. 129), p 7.

[3]David Sabatino. Test of Auditory Perception. Exceptional Children. 1969. p 730.

[4]Ibid. p 730.

[5]Ibid. p 730.

[6]G. S. Hasterok. The learning performance of retarded children with visual and auditory sense modality disabilities. Unpublished doctoral dissertation, Univer. of Ill.: 1964.

[7]Sabatino. op. cit. p. 730

The Test of Auditory Perception (TAP) was constructed to assess four auditory perceptual behaviors using six subtests, which are as follows:[1]

1. Auditory recognition: Auditory recognition is the ability to discriminate sounds or words with meaning from irrelevant background information.

   a. Recognition of sounds was assessed by pairing sound units that were slightly different and asking the child to distinguish the difference.

   b. Recognition of words was assessed by administering five words in a given unit that all sounded alike. Four of the words were nonsense and the child had to repeat the real word.

2. Auditory retention: Auditory retention is an act of perceptual storage or memory.

   a. Immediate memory for digits was a measure of immediate recall for non-sequentially aurally presented digits.

   b. Immediate memory for speech was the repetition of graded sentence units.

3. Auditory integration: Auditory integration was the sequential or temporal ordering of auditory information in order that it might be identified meaningfully and that meaning transferred to other perceptual (visual) tasks.

   a. Rhythmic structures. The child was requested to duplicate tapping responses to prerecorded patterns.

4. Auditory comprehension: Auditory comprehension is the summative ability of the child to receive, retain, and integrate units of aural language. It is the final, complex auditory perceptual act based on all functions previously established.

   a. The test of auditory comprehension required the child to

---

[1] Ibid. p 731.

listen to a story and respond to questions which generally called for factual one word response of "yes" or "no".

The data indicated that the TAP subtests of recognition, retention for sentences, and comprehension discriminated between the neurologically impaired and normal subjects, significant at the .01 level, when administered under normal conditions. All of the TAP subjects discriminated the two subject groups at the .01 level when administered under conditions of background noise. The subtests using digits (retention) and tapping (integration) were not good discriminators, indicating that meaningful language is necessary to discriminate between the auditory perceptual functions of normal and neurologically impaired children.[1]

The correlation between the various TAP subtests were positive but low. Support for the auditory perceptual model was obtained through an increase in correlation values among the higher level TAP subtests.[2]

Anderson and Novina[3] conducted a study to examine the relationship of the Tests of Central Auditory Abilities (T C A A)[4] with the Illinois Test of Psycholinguistic Abilities (I T P A)[5]

---

[1] Ibid. p 736.

[2] Ibid. p 736.

[3] Anthony Anderson and Joan Novina. A study of the Relationship of the Tests of Central Auditory Abilities and the Illinois Test of Psycholinguistic Abilities. Journal of Learning Disabilities, 1973, 6, 3, 167 - 169.

[4] A. Flowers, M. Costello, and V. Small. Flowers - Costello Tests of C A A. Dearborn, Mic.: Perceptual Learning Systems, 1970.

[5] S. A. Kirk, J. J. McCarthy and W. D. Kirk. Illinois Test of Psycholinguistic Abilities. Champaign; Univer. of Ill. Press. 1968.

The Tests of Central Auditory Abilities, according to the authors,[1] is a tape recorded test requiring approximately 20 minutes to administer. The calibration system provided consists of an auditory amplitude meter which indicates the intensity of a test tone recorded on the tape; this intensity is adjusted before administration of the test items. The test is presented through earphones (also a part of the test kit), with the child required to point one of three pictures for each item. His response completes an item by indicating the appropriate picture to complete a sentence, such as: "In the summer we like to eat ----------." Pointing to an ice cream cone would complete this item correctly. Nine practice items are provided for each of the two subtests.

The first subtest, Low-Pass Filtered speech, presents 24 items recorded in such a way that all voice frequencies above 960 Hz. have been electronically removed. The result is a recording on which the voice sounds "fuzzy" and unclear. The second subtest, Completing Messages, presents 24 items recorded at the same intensity and by the same voice that is telling an attractive children's story while the test items are being presented. The child is told that he is to listen only to the test items.

A total score is obtained by adding the number correct on both subtests, and norms are provided in terms of raw score means, standard deviations, and selected percentile points (10th, 25th, and 50th) for

---

[1]Anthony Anderson and Joan Novina. Relationship of T C A A and I T P A. Journal of Learning Disabilities. 1973. pp 167-169.

grades kindergarten through six. In addition, a reading expectancy chart for Kindergarten only is provided which allows an additional score conversion to stanines.

All Kindergarten pupils in a school of predominately minority enrollment (Mexican - American and Black) in Orange County, California, were administered the Tests of Central Auditory Abilities as a part of a pilot program of auditory perceptual assessment. Twenty pupils were chosen from this population and were individually administered the complete I T P A. Ethnically they consisted of 17 Mexican-American and 3 Black pupils. Pearson Product Moment correlation coefficients were computed between subtests of the respective instruments.

The authors, as a result of their study arrived at the following tentative conclusions:[1]

First, the TCAA apparently taps abilities at both the representational and the automatic levels of the ITPA model, enhancing the usefulness of the TCAA as a general auditory perceptual screening instrument.

Second, even though the Low-Pass Filtered Speech subtest would appear to be tapping an auditory closure ability, this task is apparently not significantly related to the Auditory Closure subtest of the ITPA. The ITPA requires the subject to fill in missing phonemes in the stimulus words presented, while the TCAA requires the filling in of missing audio frequencies which have electronically been removed. These processes are apparently of a qualitatively different nature and are not closely related.

---

[1] Ibid. p 169.

Third, as there were no significant relationships indicated between the I T P A Auditory Memory subtest and the T C A A, either a qualitatively different form of memory function is required on the different tests, or no great demand on memory is made by the T C A A. Future research may indicate that memory for digits (I T P A) is a qualitatively different task than memory for meaningful verbal information (T C A A). It is possible that the structure of the stimulus items on the T C A A does not place measurable demands on memory abilities.

Fourth, there appears to be an important need to develop separate norms for the T C A A for each subtest and the total raw scores. This separate set of subtest norms is needed because the subtests appear to be tapping different abilities. By combining the subtests into a total raw score as now necessary for normative interpretation, the differential diagnostic utility of the test is limited.

Even though the test's interpretation is limited by the structure of the present normative data, the T C A A appears to be one of the best instruments currently available in the area of auditory perceptual assessment and offers to the diagnostic specialist a well-standardized and efficient means of diagnosing deficiencies in this area. When interpreted in conjunction with the I T P A, a fairly comprehensive picture of a child's auditory perceptual capabilities can be constructed.[1]

---

[1] Ibid. p 169

S U M M A R Y

Studies by Kirk, Bateman (1962), McCarthy (1961), Sabatino (1969), Hasterok (1964), and Anderson and Novina (1973) have been reviewed in this chapter.

The review shows that the two major tests seemingly incorporating some measure of auditory perception are the Wepman Test of Word Discrimination and the I T P A.

The Test of Auditory Perception (T A P) assesses four auditory perceptual behaviors viz.:

1. Auditory recognition;
2. Auditory retention;
3. Auditory integration; and
4. Auditory comprehension.

The Tests of Central Auditory Abilities (T C A A) apparently taps abilities at both the representational and the automatic levels of the I T P A model, enhancing the usefulness of the T C A A as a general and perceptual screening instrument.

It has been pointed out that the various tests aimed at assessing central hearing processes are still insufficiently standardized and there is a need to know for certain about the modalities and levels of integration.

****

CHAPTER III

DIAGNOSTIC - REMEDIAL PROCEDURES FOR VARIOUS KINDS OF AUDITORY PROCESSING DISORDERS

1. LACK OF ATTENTION TO AUDITORY STIMULI:

The child does not indicate awareness through verbal or motor response. He is inattentive to auditory stimuli. Inattentiveness to auditory stimuli might be related to:

1. low level or absence of hearing acuity;
2. distractibility involving competitive visual or auditory stimulus;
3. hyperactive behavior;
4. severe emotional disturbance;
5. severe mental retardation; or
6. inability to obtain meaning from auditory stimuli.

A thorough differential assessment of children who seem to have difficulty processing auditory stimuli should include an examination of all the correlates to the attentional factor.

Attention to auditory stimuli can be inferred from the subject's responses such as inclining one's head toward the source of sound, facial expressions, or verbal or motor responses.

There is need to develop systematic procedures for assessing the reasons for what appears to be inattentiveness to auditory stimuli.

There is little research available about the most efficient ways to teach the child to attend to auditory stimuli. The literature typi-

cally describes clinical suggestions or approaches to this problem. For example, the use of sound amplification can help intensify auditory stimuli and create an awareness of the differences between sound and no sound. Toys, musical instruments, and household appliances which can be manipulated by the child can be used for training purposes.

2. INABILITY TO DETECT SOUND:

The child is not able to differentiate sound from no sound. Lowered acuity in hearing and a hearing deficit will reduce the accuracy of discrimination.

A basic procedure in assessing sensitivity to sound is to present pure tone or warbled tone stimuli to determine if the child can differentiate sound from no sound. When a child gives no consistent responses, it is apparent that he lacks sound awareness. In order to train him, it is important to begin by making him aware of SOUND and NO SOUND. Without emphasising meaning, the teacher merely tries to help him to respond consistently to sounds. Toys such as bells, drums, toy pianos, or telephones are used to produce sounds and these are presented in a relatively quiet environment. The teacher shows the child each toy object and encourages him to manipulate it so that he has an active part in starting and stopping the sound. For example, the child is asked to push the piano keys or to ring the bell. Meanwhile the teacher, with facial animation and gestures, indicates that the child should listen. She might cup her ear and look quizically each time she hears the sound.[1]

---

[1]D. J. Johnson and H. R. Myklebust. Learning Disabilities: Educational Principles and practices. Grune & Stratton, Inc. 1967. p 69.

Toys should be selected which are attractive both visually and tactually, but at the same time it must be made certain that the child does not enjoy only the tactual or visual experiences. One boy with auditory agnosia enjoyed squeaking rubber animals, not for the sounds they produced, but for the pleasurable sensation of flattening the toy and feeling the air being emitted from the tiny hole. He was intrigued by the tactual sensation of the air and the change in the size of the animal, and as a result he did not attend to the sound.[1]

In addition to working with toys, the child should be encouraged to explore objects in his daily environment in order to become more aware of the presence and absence of sound. He might be asked to turn the radio on and off; as he turns the switch the teacher tries to make him conscious of the sound by using gestures and facial animation. He can be encouraged to perform tasks such as sharpening pencils; as he turns the crank he should listen for the sound. At home, under the supervision of an adult, he might turn on mixers, vacuum cleaners, or other appliances which are not dangerous. When new sounds are introduced, the environment should be as quiet as possible, so that the child hears only the sound produced by the object selected. As he manipulates them and turns them on and off, he not only becomes more aware of sounds but he also begins to relate them to objects and experiences.

When awareness has been established, the child should be encouraged to respond consistently. It is not sufficient that he merely be aware of sounds; he must learn to understand them and to react appropriate-

---

[1] Ibid. p 69.

ly. Eventually, after meaning has been developed, he should learn which to ignore and which to listen for, but initially, he will need help to respond consistently.

The following activities will encourage consistent responses:[1]

1. Select a toy piano or a bell with which the child is familiar and have him close his eyes or put his head on the table; ask him to sit up or uncover his eyes each time he hears the sound. If he cannot comprehend the task, help him holding his hand and simultaneously tapping the table each time the bell rings. Continue this procedure until he responds to the sound with assistance. In some instances the child is not asked to close his eyes but instead is told to raise his hand or tap the table each time he hears the sound. The exact procedure depends upon the degree of distractibility and integrative capacity. Although certain children can respond with their eyes open, others respond more consistently if their eyes are closed because they are unable to cope with both visual and auditory stimuli at the same time. As the sounds take on meaning, the children have less difficulty. Highly stimulating visual activities are not presented when they are expected to listen. They should be seated at a table, told to wait and to respond as soon as they hear the sound.

2. Have the child respond to the cessation of sound. Ring a bell behind him and ask him to raise his hand or tap the table each time the sound stops.

3. Select identical toys, e.g., two bells or two drums. Stand

---

[1] Ibid. p 71.

behind the child and ring the bell; he is to ring his bell when he hears the one behind him. To make certain that he understands the task, it may be necessary to pantomime the "game" and to help him with the first few trials.

4. Reduce the amount of structure and teach the child to respond to meaningful sounds. Ring a bell in the same way each day to indicate lunch time. Initially, ring the bell so that he can both see and hear it; later conceal it to see whether he responds to just the sounds.

5. Select other sounds to represent various activities during the school day, such as a drum for recess time or a whistle for dismissal. If buzzer or bell systems are utilized help the child to respond to them appropriately. Usually these are more difficult to learn because there is no concomitant visual experience to associate with the social sound. When actual objects are used, the child receives simultaneous visual and auditory experience.

As the child shows improvement, other meaningful sounds are introduced. Sounds which are important for self - protection should be taught as early as possible. The sounds of cars, trains, airplanes, and fire trucks should be included, as well as those of the telephone, doorbell, and a knock on the door. Each one should be introduced in a structured manner to avoid the task of selecting a certain sound from the conglomerate field. For example, when teaching the sound of a knock at the door, the classroom should be quiet and the child's attention guided in the proper direction.

Later, after considerable work has been done with actual objects, recorded sounds are applicable. The sound of a train is presented with

a toy train or with a picture of a train. All recordings should be clear and of sufficient duration to permit the child to distinguish each sound; a short sound effects recording is inadequate for teaching purposes. Each sound should be played several times since he needs to hear it repeatedly before he can make the correct association with the object.

3. DIFFICULTY IN SOUND LOCALIZATION:

Some children have difficulty in localizing or indicating the source or the direction of a sound. When the source of sound is equidistant from both ears, it is difficult to locate the sound. If the sound source is moved, either to the right or to the left of the midline of the body, it is closer to one ear than the other, and the closer ear is stimulated somewhat earlier. Since the acoustical complexity of a sound is partially a function of distance from the ear, the ear closest to the sound will receive a stimulus of greater complexity than the ear farther away. The sound should then appear different to the two ears. The time difference between the detection of the signal presented to each ear should also be a clue which can be used to detect the source of sound. Children having difficulty in identifying the source of sound may not learn that different people have different voices or that the sound made by one person is specific to that person and not produced by a random source.

In reviewing the literature, not much data were found on the assessment or training of sound localization. However, "Hide and Seek" type of games will be useful in improving localization and listening behavior.

Some of the techniques suggested by Johnson and Myklebust include the following:[1]

1. Seat the child at a table and ask him to close his eyes; then ring a bell on his right and have him turn toward the sound. If he is not successful, ask him to open his eyes and simultaneously follow the sound by both looking and listening. As he learns to direct his attention, ask him to close his eyes and repeat the initial procedure. Later, make the task more complex by moving to different positions in the room and presenting sounds from various directions.

2. Teach him to "follow the sound." Blow a whistle while walking around the room and have the child follow. After he understands the task, have him close his eyes and follow just by sound; make certain that there are no obstructions.

4. DIFFICULTY IN DISCRIMINATING SOUNDS VARYING ON ONE ACOUSTIC DIMENSION:

For the writer's purposes, auditory discrimination is defined as indicating whether two acoustic stimuli are the same or different. Given a pair of auditory stimuli, the subject must indicate whether the two members of the pair are alike or different. The response required varies from vocal ("same - different", "same - not the same", "now I hear it") to various forms of nonverbal communication (turning toward the source of sound, performing an agreed upon action representing "same" or "different", pointing to a pair of similar objects, rather than a pair of unlike objects).

---

[1] Ibid. pp 71 - 72.

Auditory stimuli may vary along several acoustic dimensions and several presentational dimensions. Individual acoustic stimuli can be measured on several physical scales such as frequency and intensity. These physical scales are related to auditory - psychological dimensions such as pitch and loudness. Presentational dimensions which include number, rate, and duration of stimuli have auditory - psychological counterparts in rhythm and melody. The kind of sound (speech versus nonspeech sounds) and the location of the sound are also presentational dimensions. Auditory stimuli may be presented either simultaneously or successively to one ear or both ears. The relationship of the hearer to the acoustic stimulus will affect his judgment of the auditory stimulus. For example, the farther away a person is from the source of the acoustic stimulus, the lower the pitch and the softer the intensity will appear to be.

There are individuals who have adequate hearing acuity, but who do not discriminate one sound from another. Failure to discriminate between auditory stimuli has a number of possible consequences. If children are unable to hear the differences or similarities in initial or final sounds of words, consonant blends, or vowels, they will have difficulty in acquiring, understanding, and using spoken language. Some individuals have difficulty in distinguishing between single speech sounds. It is more difficult to discriminate between similar sounds (/d/, /t/, /p/) than if the sounds are widely different (/h, /k/, /s/). Some individuals are aware that a difference exists between two sounds, but may not be able to specify the nature of the difference.

The assessment of differential responses to pairs of auditory sti-

muli involves discrimination along one or more acoustic or presentation dimensions. There are two major classes of sound sources - viz. human sources which include vocal sounds and words, etc., and non-human sources, which include bells, watches, machines, etc. Most standardized discrimination tasks include stimuli from either one or both classes of sound sources.

In view of the fact that a large proportion of human communication consists of speech, a series of vocal acts, it is not surprising that several tests of speech - sound discrimination have been developed. Among the most widely used tests are the Wepman Auditory Discrimination Tests,[1] the P E R C Test,[2] and the Goldman - Fristoe - Woodcock Test.[3]

In reviewing the measurement techniques, Reichstein and Rosentein[4] recommend that four important variables should be studied. These include the selection of the stimuli, the mode of input, the method of response and motivational factors. They have summarized both the various modes of presenting auditory stimuli and the kinds of responses that are required. The pure tone audiometer is used to present auditory stimuli.

---

[1]J. M. Wepman. Auditory Discrimination Test. Chicago: Language Research Associates, 1958.

[2]C. P. Drake. P. E. R. C. Auditory Discrimination Test. Sherborn, Mass.; Perc. Ed. & Research Center, 1965.

[3]Goldman - Fristoe - Woodcock. Test of Auditory Discrimination. American Guidance Service, Inc. 1970.

[4]J. Reichstein and J. Rosentein. Differential diagnosis of auditory deficits. A review of the literature, Exceptional Children, 1964, 31 (2), 73-82.

Similar to the pure tone is the warbled pure tone which differs only in that the tone is not steady. When the auditory stimulus is speech, word lists or word games are often used. Complex nonspeech stimuli such as music, noise makers, and animal sounds are frequently employed as another mode of presenting auditory stimuli.

The child may be required to respond in a variety of ways. His perception of the auditory stimulus may be measured by a reflex response which the stimulus evokes or by an indication of locating the stimulus. The child may be required to voluntarily indicate his perception by saying something or raising his hand. In the conditioned response method the child is conditioned to reach for or do something pleasant each time he perceives an auditory stimulus. In the simple "play" conditioned response, the child performs a simple motor act when he hears the auditory stimulus. In the complex "play" conditioned response upon hearing tone the child is to respond by performing some action with a complex toy.

Johnson and Myklebust have suggested the following training procedures:[1]

1. Select two noise makers having different sounds, e.g., a drum and a bell. Have the child gain experience with the toys so that he knows the sound which accompanies each object. Then stand behind him with an identical set of toys and ring the bell to see if he can point to the correct object. As he progresses, select sounds more nearly alike and continue the exercises with variations to assure the necessary

---

[1]Johnson and Myklebust. Learning Disabilities; Educational Principles and Practices. p 72

motivation and enjoyment.

2. When success has been gained with two sounds, introduce a third one, making the task more complex. For example, use a drum, a bell, and a clapper, gradually working toward finer discriminations.

3. Record a series of common, everyday sounds, such as these made by trains, airplanes, animals, and household appliances, and select pictures to go with each of them. Then place three or four pictures in front of the child and play one of the sounds. He is to identify the picture associated with it.

5. DIFFICULTY IN DISCRIMINATING SOUND SEQUENCES VARYING ON SEVERAL ACOUSTIC DIMENSIONS:

A child may be able to discriminate one sound from another, yet experience great difficulty in discriminating or reproducing groups or patterns of auditory stimuli. Rhythm is the sequential pattern of several auditory stimuli in time. Processing auditory stimuli varying on several acoustic dimensions is an important factor in the acquisition of spoken language. At present, there is little information about the wider implications of disorders of rhythm, pitch and their combination, melody.

One of the important aspects in examining children is to determine the conditions under which they find it difficult to perform tests based on rhythm. Is it actually a problem in analyzing accoustical images? Is it a defect in the regulatory role of verbal instructions? Is it defective motor functioning? Is it the shift from reproducing one rhythmic structure and then another which is an indication of the mobi-

lity of nervous processes?

Some of the training exercises by Johnson and Myklebust are outlined below:[1]

1. Face the child and clap your hands once. Ask him to imitate. Next, clap twice and have him do the same. Then see if he can imitate a pattern of three. When he understands and can follow the sequence while facing you, stand behind him and have him imitate from audition alone. Initially, the task should be presented both auditorially and visually because he may need to both see and hear. With practice and emphasis on listening, he should be able to remember and imitate the number of sounds he hears.

2. Draw a circle on the blackboard, then clap once to indicate that one figure represents one sound. Next draw two circles and clap twice. Follow with three and then with four. Ask the child to look at each series of figures and clap the correct number of times for each set. Then stand behind him and clap a certain number of times; ask him to point to the set of figures, corresponding with the number of sounds that he hears. If the child has number concepts, the teacher can write the numerals 1, 2, 3, or 4 on the chalkboard, then clap and have him point to the number representing the number of claps. These exercises can be performed with drums or sticks, but the tactual and kinesthetic experience of clapping seems more advantageous.

6. AUDITORY FIGURE - GROUND SELECTION:

Some children experience difficulty in selecting the relevant

---

[1] Ibid. pp 72-73

from the irrelevant auditory stimuli in their environment. Because most verbal communication takes place by auditory speech signals, a child who is unable to attend to speech sounds or to differentiate speech sounds from the remainder of the auditory stimuli in the environment will probably experience difficulty in learning to comprehend and in acquiring language as a communication system. Other behaviors sometimes include distractibility, short attention span, and ignoring some auditory stimuli in listening activities.

Assessment of the interference effects created by competing auditory stimuli may be accomplished by presenting a significant stimulus, and at the same time, presenting stimuli which have been declared by the examiner to be insignificant. The response required of the subject is to indicate either that he has heard the significant stimulus, or that he can reproduce the significant stimulus. Little is known about children's performances on a task of this type. There are many clinical reports of children who respond to insignificant auditory stimuli during testing and teaching situations. The so-called distractible child is an example of a person who appears to attend to the irrelevant auditory stimuli of a situation.

Little research has been done on methods or materials for teaching a child to select significant from insignificant auditory stimuli. There is need to conduct a systematic program of research in which various aspects of attention, organic conditions in the brain, effects of drugs, and nature and presentation of auditory stimuli are thoroughly explored.

7. DIFFICULTY IN ASSOCIATING SOUND WITH SOUND SOURCES:

Some children seem to have difficulty establishing a correspondence between sounds and their producers. The inability to link sounds with their sources may involve correlates such as intelligence, auditory memory, the ability to localize sounds, and acoustic discrimination. The end result is difficulty in obtaining meaning from sound and acquiring the use of language as a means of receptive and expressive communication.

The term auditory agnosia refers to an impairment in an individual's recognition of sounds or combinations of sounds and his attachment of meaning to those sounds. The problem is not one of acuity. The person is aware of sounds and hears sounds but does not relate these sounds to other experiences.

Myklebust distinguishes between auditory agnosia and aphasia as follows:[1]

> * * * the aphasic finds all sounds in his environment useful and meaningful with the exception of the spoken word. In contrast, the auditory agnosia not only cannot use these spoken sounds in this environment but he cannot attribute meaning to any sounds in his auditory world.

Myklebust further points out:[2]

> Severe auditory perceptual disturbances and auditory agnosia are highly similar in symptomatology but comparatively the condition of agnosia seems to be considerable more severe. It seems that an auditory agnosia does not occur unless an aphasia also is present.

The person with an agnosia for acoustic stimuli is unable to reco-

---

[1] H. R. Myklebust. Aphasia in children, In L. Travis (ed.). Handbook of speech pathology. New York. Appleton - Century - Crofts, 1957. p 511

[2] Ibid. p 511

gnize sound patterns and requires training to establish associations between sounds and situations, sounds and their sources, and sounds and actions.

While reviewing the literature, the writer did not find any specific assessment and remedial techniques. But since correlates such as intelligence, the ability to localise sounds, acoustic discrimination, and auditory memory, are involved, the same assessment and remedial procedures as in 3 - sound localisation; 4 - discriminating sounds varying on one acoustic dimension; and 5 - discriminating sound sequences varying on several acoustic dimensions, may be used.

According to Kirk and Kirk,[1] in evaluating auditory memory, it would be wise to check the child's ability to learn his telephone number and street address at a reasonable age, his ability to learn jingles, poems, prayers, etc., and his ability to repeat digits as presented on the Binet and WISC tests.

The subtest - Auditory - Vocal Sequencing of ITPA[2] may be added to the above assessment procedures.

In training auditory memory it is advisable to use content the child will utilise in his everyday life. For example, if a child does not talk or is delayed in talking and has a deficiency in auditory se-

---

[1]S. A. Kirk and W. D. Kirk. Psycholinguistic Disabilities. Univ. of Illinois Press. 1971. p 115.

[2]J. J. McCarthy and S. A. Kirk. The Illinois Test of Psycho - linguistic Abilities. Urbana: Univ. of Illinois Press. 1961.

quential memory, it is wise to train his auditory sequential memory withwords, phrases, and sentences rather than with digits or nonsense syllables.[1]

Some of the activities for training auditory memory by Bush Wilma Jo and Giles Marian Taylor are given below:[2]

1. Alphabetical sequencing.

2. Numbering sequencing.

3. Word sequencing.

4. Instruction sequencing.

5. Rhymes.

6. Reading a selection to the children which relates a short series of events. Then asking the child to retell the events in order that they happened.

7. Having the children repeat their full names, their addresses, their telephone numbers, the names of their entire family, and the name of their school. Encouraging them to speak in good short sentences. Repeating with each child until he is able to communicate well.

8. Having a child say his own telephone number and then asking the next child in line to repeat the number.

9. The days of the week and the months of the year may be learned in sequence; all the counting numbers to one hundred, as well as skipping counting, may also be learned.

10. Musical songs with lots of repeats in a sequential pattern provide interest. Tapping out the rhythm pattern encourages listening for different patterns.

11. Repetition of sentences.

12. Repetition of sounds in the environment.

---

[1]Kirk and Kirk. Psycholinguistic Disabilities. p 159.

[2]Wilma Jo Bush and Marian Taylor Giles. Aids to Psycholinguistic teaching. Charles E Merrill Publishing Co. 1969. pp 191-215.

13. Performing rhythms which the child duplicates.

14. Singing a song with repetitions.

15. Reading a story to the child. He may answer questions regarding the content or retell the story in his own words.

16. Retelling stories.

17. Reporting news.

18. Tongue twisters.

19. Absurdities. Having the child listen to catch the absurd sentences in a group of sentences.

20. Parts of speech. Asking the child to listen and repeat descriptive words, naming words, or telling words.

21. Building sentences.

SUMMARY

In this chapter, the writer has attempted to define the following auditory processing disorders:

1. Lack of attention to auditory stimuli.
2. Inability to detect sound.
3. Difficulty in sound localisation.
4. Difficulty in discriminating sounds varying on one acoustic dimension.
5. Difficulty in discriminating sound sequences varying on several acoustic dimensions.
6. Auditory Figure - Ground selection.
7. Difficulty in associating sound with sound sources.

An attempt has also been made to discuss different diagnostic - remedial procedures for the above - mentioned auditory processing disorders.

****

CHAPTER IV

CONCLUSION

This study provided an overview of the auditory processing disorders which occur in processing auditory stimuli. Diagnostic - remedial procedures feasible with different kinds of auditory processing disorders were presented. The review of literature shows that in contrast to the body of knowledge which has been gathered on hearing acuity, comparatively little research has been done relative to processing auditory stimuli. There is need to more clearly identify auditory processing tasks, and describe and categorize the observable behaviors which are associated with these tasks. There is also need to describe the behavioral symptoms which characterize efficient auditory processing, as well as dysfunctions in auditory processing.

Research is needed to explore the behaviors of auditory processing disorders related to:[1]

1. attention to auditory stimuli;
2. differentiating sound from no sound;
3. sound localisation;
4. discriminating sounds varying on one acoustic dimension;
5. discriminating sound sequences varying on several dimensions;

---

[1] J. C. Chalfant and M. A. Scheffelin. Central Processing Dysfunctions in Children; NINDS Monograph No. 9. Public Health Service. 1969. p 17.

6. auditory figure - ground selection; and

7. associating sounds with sound sources.

The use of precise terms will help facilitate communication about these behaviors.

The lack of reliable and valid diagnostic procedures and the lack of standardized terminology make fine diagnostic differentiation a difficult task. DiCarlo[1] for example, re-evaluated 67 children who had been diagnosed as aphasic by other diagnosticians. He found that 28 children were mentally retarded, 15 peripherally deafened, and 20 were emotionally disturbed. He found only four to be aphasic. It is difficult to identify the causes of auditory processing disorders because different etiological factors are often characterized by many of the same behavioral symptoms. Failure to respond to auditory stimuli may be attributed to peripheral deafness, central deafness, mental retardation, severe emotional disturbance, aphasia, or to auditory imperception.[2] One of the most basic research steps which should be taken is to attempt to provide more detailed and comprehensive descriptions of the behavioral responses to auditory stimuli which differentiate these conditions.

The literature concerning the evaluation of auditory capacity and

---

[1] M. DiCarlo. Differential diagnosis of congenital aphasia. Volta Review. 1960, 62. 361-364.

[2] Myklebust. Auditory disorders in children: A manual for differential diagnosis. 1954.

[3] I. R. Ewing and A. A. B. Ewing. The ascertainment of deafness in infancy and early childhood. Journal of Laryngology & Otolaryngology, 1944, 59, 309-333.

behavior is quite extensive.[1]

At present, however, clinical observation of behavioral symptoms seems to provide the main basis for assessment, evaluation and diagnosis. There is very little experimental evidence to support these clinical observations, and there is need to conduct systematic investigation in these areas.[2]

To better evaluate children with auditory processing disorders, there is need to develop more effective procedures for presenting auditory stimuli, eliciting responses, and increasing the number of response modes. Greater efficiency in selecting the stimulus mode of input, the method of indicating response, and motivating the child to respond may help reduce the amount of response inconsistency.

A thorough assessment and diagnosis often requires skill and training beyond that of the individual practitioner. The Otolaryngologist, pediatrician, neurologist, psychiatrist, psychologist, audiologist, speech pathologist, and educationist all have specific contributions to make. Research is needed, however, to develop and recommend administrative alternatives for mobilising these individuals and creating administrative structures which will permit them to work as a team.

---

[1]W. G. Hardy and J. E. Bordley. Special techniques in testing the hearing of children. Journal of speech and hearing disorders. 1951, 16, 123-131.

B. Barr. Pure tone audiometry for preschool children. Acta Oto - laryngologica. 1955, 1-84 (suppl. 121).

E. L. Lowell, G. Rushford, G. Hoversten and M. Stoner. Evaluation of pure tone audiometry with preschool age children. Journal of speech and hearing disorders, 1956, 21, 292-302.

[2]Chalfant and Scheffelin. Central processing sysfunctions in children: NINDS MONOGRAPH 9. p 16.

The purpose of auditory training is to help the child make active use of his hearing. This concept has been implemented in working with the residual hearing of hard - of - hearing children but comparatively few studies have been reported concerning the training of auditory perceptual disorders. As in many other areas of perception the litera - ture is heavily weighted in favor of diagnosis and the development of diagnostic procedures. There are a few studies which indicated that some degree of amelioration is possible. Unfortunately, these studies often fail to provide a detailed description of the remedial procedures which are used or the nature of the disorders to which remediation was applied. The methods section of reported studies often consists of abbreviated lists including such topics as hearing and distinguishing sounds; listening games; listening to contrasting sounds; loud and soft; fast and slow; high and low; following directions; hearing through poetry; listening through stories; music to develop sound discrimination; reproduction of auditory stimuli; and auditory memory training. Despite the lack of detail in reporting remedial approaches, there seems to be clinical agreement that training should be attempted in the deficit areas.[1]

There is need to identify and distinguish the different auditory activities and develop specific remedial approaches for these activities. Table 1, on page 6 of chapter I, for example, attempting to make distinctions between seven different kinds of auditory activities, provides some direction for developing remedial procedures.

---

[1] Ibid. p 19.

Some practical research questions which need to be answered are: How can the principles of learning be applied to help expedite the remediation of auditory processing disorders? How can children be helped to attend to auditory stimuli; associate sound with experience sequences; reorganise and recall word names; analyse sound sequences; synthesise isolated sounds; retain melody and rhythm patterns; differentiate significant from insignificant stimuli; localise sound; and discriminate between sounds?

SUMMARY

This chapter summarizes the purpose of the study and points out that lack of reliable and valid diagnostic procedures and the lack of standardised terminology make fine diagnostic differentiation and remediation a difficult task. Research in assessment and training of auditory processing disorders is needed. Some practical questions which need further research have been included.

****

BIBLIOGRAPHY

BOOKS

Berry, Mildred F., and Eisenson, J. Speech Disorders. New York: Appleton Century-Crofts, Inc. 1956.

Bocca, E. and Calearo, C. Central Hearing Processes. In J. Jerger (Ed.), Modern developments in audiology. New York. Academic Press, 1963, 337-368.

Bush, Wilma Jo, and Marian Taylor Giles. Aids to Psycholinguistic Teaching. Charles E. Merrill Publishing Company, Ohio. 1969.

Flowers, A., Costello, M. R., and Small, V. Flowers - Costello Tests of Central Auditory Abilities. Dearborn, Mich.: Perceptual Learning systems, 1970.

Gallagher J. J. The tutoring of brain injured mentally retarded children. Springfield, Ill.: Charles C. Thomas, 1960.

Goldman - Fristoe - Woodcock. Test of Auditory Discrimination. American Guidance Service, Inc. 1970.

Goldstein, K. Language and Language Disorders. New York: Grune & Stratton, 1948.

Johnson D. J. and Myklebust, H. R. Learning Disabilities. Educational Principles and Practices. Grune & Stratton, Inc. 1967.

Kirk S. A., McCarthy J. J., and Kirk W. D. Illinois Test of Psycho - linguistic Abilities. Champaign: Univ. of Ill. Press, 1968.

McCarthy J. J. and Kirk, S. A. The Illinois Test of Psycholinguistic Abilities. Urbana; Univer. of Ill. Press, 1961.

Mecham, M. J., Berko, M. J., Berko, F. G., and Palmer, M. F. (eds.), Communication Training in Childhood Brain Damage. Springfield, Ill.: Charles C. Thomas, 1966.

Meyerson, L., and Michael, J. L. The measurement of sensory thresholds in exceptional children: An experimental approach to some problems of differential diagnosis and education with special reference to hearing. Houston, Texas: University of Houston, 1960.

Miller, G. A. Language and Communication. New York: McGraw - Hill, 1951.

Myklebust, H. R. Auditory Disorders in Children. A manual for differential diagnosis. New York: Grune & Stratton, 1954.

---------- Aphasia in Children. In L. Travis (ed.). Handbook of speech pathology. New York: Appleton - Century - Crofts, 1957.

Sloane, H. N., and MacAulay, B.D. Teaching and the environmental control of verbal behavior. H. Sloane and B. MacAuley (eds.), Operant procedures in remedial speech and language training. Boston: Houghton Mifflin Co; 1968.

Streng, Alice, Fitch, J., Hedgecock, L. D., Phillips, J. W., and Carrell, J. A. Hearing therapy for children. New York: Grune & Stratton, Inc., 1958. 63, 430-432, 463.

Tarnopol, Lester. Learning Disabilities: Introduction to Educational and Medical Management. Charles C. Thomas. 1969.

Utley, J. What's its name: A guide to speech and hearing development. Urbana, Ill.: University of Illinois Press, 1950.

Wolfe, W. G., and MacPherson, J. R. The evaluation and development of techniques for testing the auditory acuity of trainable mentally re - tarded children. Austin: University of Texas. 1959.

Zigmond, Naomi Kershman. Auditory Processes in Children with Learn - ing Disabilities in Tarnopol Lester: Learning Disabilities. Charles C. Thomas. 1969.

PERIODICALS AND JOURNALS

Anderson Anthony H. and Novina Joan, A study of the relationship of the Tests of Central Auditory Abilities and the Illinois Test of Psycholinguistic Abilities. Journal of Learning Disabilities, 1973, 6, 3, 167-169.

Bangs, Tina E. Evaluating Children with Language Delay. Journal of Speech and Hearing Disorders. 1961, 26, 6-18.

Chalfant, J. C., Scheffelin, M. A. Auditory processing: Central processing dysfunctions in children. A review of research. NINDS MONOGRAPH NO. 9. U. S. Dept. of Health, Education, & Welfare. 1969. 9-19.

DiCarlo, L. M. and Bradley, W. H. A. Simplified auditory test for infants and young children. Laryngoscope, 1961, 71, 628-646.

DiCarlo, L. M., "Much Ado About the Obvious." Volta Review. 1966, 68,

269-273.

DiCarlo, L. M., Kendall, D., and Goldstein, R. Diagnostic procedures for auditory disordered children. Folia Phoniatrica, 1962, 14, 206-264.

Geyer, M., and Yankauer, A. Teacher judgment of hearing loss in children. Journal of speech and hearing disorders, 1959, 24, 482-486.

Guilford, F. R., and Haug, C. O. Diagnosis of deafness in the very young child. Archives of Otolaryngology, 1952, 55, 101-106.

Hardy, W. G., and Bordley, J. E. Special techniques in testing the hearing of children. Journal of speech and hearing disorders. 1951, 16, 123-131.

Hasterok, G. S. The Learning Performance of Retarded Children with Visual and Auditory Sense Modality Disabilities. Unpublished doctoral dissertation. University of Illinois, 1964.

Karlin, I. W., and Fowler, E. P. Jr. Differential diagnosis of communication disorders in children referred for hearing tests. Archives of Otolaryngology, 1954, 60, 468-477.

Kass, Corrine. Some psychological correlates of severe learning disability. Unpulished doctoral dissertation. Univer. of Illinois, 1962.

Kirk, S. A., and Bateman, Barbara D. Diagnosis and remediation of learning disabilities. Exceptional Children. 1962, 29, 73-78.

Kirk, S. A., and McCarthy, J. J. The Illinois Test of Psycholinguistic Abilities - An approach in differential diagnosis. American Journal of Mental Deficiency. 1961, 66, 399-412.

Kodman, F. Identification of hearing loss by the classroom teacher. Laryngoscope, 1956, 66, 1346-1349.

Meyerson, L. Hearing for speech in children, a verbal audiometric. Acta Oto-laryngologica. 1956. (Monogr. suppl. 129).

Olson, J. L. A comparison of sensory aphasia, expressive aphasia and deaf children on the Illinois Test of Language Ability. Unpublished doctoral dissertation. Univer. of Illinois, 1960.

Reichstein, J., and Rosentein, J. Differential diagnosis of auditory deficits: A review of the literature. Exceptional Children. 1964, 31, (2), 73-82.

Sabatino, David A. The construction and assessment of an Experimental Test of Auditory Perception. Exceptional Children. 1969, 35, 729-736.

Sortini, A. J. Hearing evaluation of brain damaged children. Volta

Review. 1960, 62, 536-540.

Wepman, J. M. Auditory discrimination, speech and reading. Elementary School Journal, 1960, 60, 325-333.

White-hurst, Mary, W. Testing the hearing of pre-school children. Volta Review, 1961, 63, 430-432, 463.

****