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The development of principles underlying auditory training

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THE DEVELOPMENT OF PRINCIPLES UNDERLYING AUDITORY TRAINING

by

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CHAPTER I

INTRODUCTION

In recent years the idea of using amplified sound in the education of hearing handicapped children has received a great deal of attention from investigators and workers in the education of the deaf and hard of hearing. This idea has aroused interest even among laymen. This more general interest has been reflected in feature stories on the use of group hearing aids which have appeared in widely circulated popular periodicals.

Auditory training has been regarded by many as a concept of recent origin, but its history can be traced as far back as the first century A.D. when the use of ear trumpets for the deaf was suggested.[1] The long history of auditory training has often been overlooked. It should be of value to investigate the ideas concerning auditory training which have developed in the past. It should also be interesting to see what those who have formulated concepts of auditory training have considered of primary importance and how they have coped with the problems presented by auditory

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[1]Urbantschitsch, V., Über Hörübungen Bei Taubstummheit und bei Ertaubung im Spätern Lebensalter, Wien: Urban and Schwarzenberg, 1895, p. 4.

training. A review of the evolution of concepts concerning auditory training should contribute to a better understanding of present day procedures. It is hoped that such a study may be of help to those planning programs for hearing handicapped children.

Definition of Auditory Training

Auditory training may be defined as the process of teaching a hearing handicapped person to take full advantage of the sound clues still available to him, through stimulation or education of the hearing mechanism and associated sense-organs.[2] It is well to define the hearing handicapped, because different types of handicaps pose different problems for auditory training as well as for any other type of educational program. An attempt to clarify the widespread confusion resulting from lack of standard nomenclature was made by the Conference of Executives of American Schools for the Deaf, which proposed acceptance of the following classification in 1937:

1. THE DEAF: Those in whom the sense of hearing is non-functional for the ordinary purposes of life. This general group is made up of two distinct classes based entirely on the time of the loss of hearing:
   A. The congenitally deaf: Those who were born deaf.
   B. The adventitiously deaf: Those who were born with normal hearing but in whom the sense of hearing became non-functional later through illness or accident.

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[2]The terms auditory, auricular and acoustic work will be used synonymously throughout this review.

2. THE HARD OF HEARING: Those in whom the sense of hearing, although defective, is functional with or without a hearing aid.[3]

Auditory Training With Deaf Children

In the case of the deaf child the initial purpose of auditory training is to awaken a realization that sound exists. Once the pupil has experienced the new sensation of sound the teacher presents gross sounds associated with the instruments producing them.

With the adventitiously deaf it is important to obtain information about the age of onset of deafness and amount of speech learned prior to that time, so that the program can build on whatever foundation of words, language or sound patterns exists. Both congenitally and adventitiously deaf children are given work to develop the concept of pitch, and temporal and stress patterns as aids to better speech production and reception.

Many workers maintain that constant stimulation with sounds of all kinds is a form of auditory training applicable to both the deaf and the hard of hearing child. They believe that a hard of hearing pupil who has been fitted with a hearing aid should wear it as much of the day as possible and a deaf child with access to a group aid should take maximum advantage of it. Goldstein[4] has distinguished

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[3]Davis, H., (ed.), Hearing and Deafness, New York: Murray Hill Books, Inc., 1947, p. 353.

[4]Goldstein, M.A., The Acoustic Method, St. Louis: The Laryngoscope Press, 1939, p. 24.

between this type of incidental sound stimulation and the formal presentation of sound stimuli. He described the latter, or formal work, as active education, which he considered to encompass both drill work in listening to and repeating single phonetic elements and listening to phrases and sentences with which meaning is associated. In contrast, passive education consists of sound stimuli presented and discrimination acquired without conscious concentrated effort by the pupil. This form of stimulation with random noises and everyday speech is generally included in the definition of modern auditory training.

Auditory Training With Hard of Hearing Children

It may be helpful in defining the scope of auditory training for the hard of hearing child to state that such training is concerned with the use of the remaining hearing to achieve auditory discrimination, or ability to recognize differences among sounds. Auditory discrimination sorts sounds by the way they differ in frequency, intensity, overtone structure and temporal pattern.[5]

Whatever residual hearing the pupil possesses is used as a starting point for all methods used to achieve discriminations of the three types needed in everyday life. The simplest type of auditory discrimination required in daily life is the identification of very different and

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[5]Hearing and Deafness, pp. 276 - 300.

important sounds, such as thunder or a fire siren. This form of distinction among highly dissimilar sounds is called gross discrimination. The second type, simple speech discrimination, is the recognition of dissimilar phonetic elements, the vowels and consonants which make up speech. The third type, difficult speech discrimination, involves the recognition of similar phonetic elements. Of course, another parameter is the conditions under which the listening takes place. Difficult speech discrimination may involve listening to speech under noisy or other adverse conditions.

To develop gross discrimination in the hard of hearing child the teacher presents loud and various dissimilar sounds of the type found in daily life, associating them with the instruments producing them. To work for discrimination of simple sounds, vowels are spoken close to the ear through cupped hands or through an amplifying instrument. First, vowels with the most carrying power and greatest degree of difference from other vowels are presented. Consonant discrimination is next attempted. Syllables combining consonants and vowels are given, followed by words and finally by sentences. If possible the training progresses to discrimination of vowels, consonants, syllables, words and sentences through a background of varied and gradually increased sound. Obviously, the extent of progress depends upon the amount of residual hearing possessed by the individual pupil.

The Importance of Auditory Training to the Hearing Handicapped Child

The hard of hearing child often falls behind in school because he receives incomplete speech patterns. Auditory training can help him utilize his residual hearing to best advantage. It can also help remove the strain and frustration resulting from failure to keep up academically and socially which often causes introverted or anti-social behavior.

Auditory training is important for all the hard of hearing, but especially for hard of hearing children. It would seem logical that since listening carefully to sounds and noting differences among them is a sensory habit it would be developed most effectively if begun while the child is young. If a child receives no meaningful auditory impressions, he will ignore auditory stimuli and his ability to discriminate among sounds will be reduced. The importance of prophylaxis against deterioration of ability to discriminate is illustrated by Carhart's[6] contention that capacity, beyond a reasonable age level, for mastering sound discrimination diminishes with increasing age.

The deaf child fails to develop speech because he cannot hear and imitate it as the normal person does. Auditory training can help his speech develop more nearly normal phrasing, accent and inflection factors which greatly

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[6] Hearing and Deafness, p. 279.

influence the intelligibility of speech. Lip reading may also be aided.

Auditory training helps make the deaf child cognizant of the sounds of daily life. The assorted sounds which surround us much of the time not only convey information about the world, but they also make the environment vivid and closely related to the auditor. Although the congenitally deaf child does not miss what he has never known, auditory training can enrich his life and have a constructive psychological effect.[7]

The contention that deaf children should experience as many as possible of the impressions stimulating other children has been advanced to support the importance of auditory training for the deaf. Ewing[8] stated that because the ear is the natural route for receiving communication, any auditory impression, past or present, takes a primary position over all other forms of communications stimuli. It would follow that deaf children should be trained to receive as many such stimuli as possible.

The importance of auditory training is demonstrated by the existence of few other avenues of approach to communicate with the deaf, all of which have the disadvantage of being less direct than use of residual hearing.

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[7] Ibid., p. 398.

[8] Ewing, I. R., Lipreading and Hearing Aids, Manchester, England: Manchester University Press, 1944, p. 22.

Davis[9] stated that written speech symbols, visible speech machines, tactile impressions and the use of the glove aid all require coding or changing of language. Lip reading is the only other approach to communication which does not require altering of language. Incidentally, lip reading also employs the only other sense besides hearing which can operate rapidly enough to draw meaning from speech as it is produced. However, lip reading is difficult and unsatisfactory under some conditions.

The importance of auditory training to the hearing handicapped is further indicated by the limited number of ways in which impaired hearing can be utilized. There are only two major lines of approach to the exploitation of impaired hearing. One is amplifying sound with a hearing aid and the other is opening a new window by which sound can reach the inner ear, the fenestration operation. Although one of these two measures can help some patients with a loss of sensitivity, auditory training is recommended to provide help in the utilization of improvement gained by the therapeutic measure.

A person with loss of ability to discriminate cannot be helped by a hearing aid nor by an operation. Persons with a loss of discrimination can best be treated with auditory training--indeed, it has been described as the only

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[9]Davis, H., "Research at Central Institute," Volta Review, 48:75-76, 1946.

helpful course of action besides lip reading for them.[10]

In tracing the development of the major concepts concerning auditory training for children this study will deal with the following:

1. Physiological and Psychological activity in Auditory Training.
2. Objectives of Auditory Training.
3. Classification of Pupils for Auditory Training and the Place of Auditory Training in the Curriculum.
4. The Use of Amplified Sound in Auditory Training.
5. Evaluation of Auditory Training.

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[10] Hughson, W., Ciocco, A., Whitting, E. G., and Lawrence, P. S., "An Analysis of Speech Characteristics in Deafened Children," Laryngoscope, 51: 868-691, 1941.

CHAPTER II

PHYSIOLOGICAL AND PSYCHOLOGICAL ACTIVITY IN AUDITORY TRAINING

It has been difficult to assess changes in the end organ or central nervous system occurring during auditory training because of the inaccessibility of the areas involved. Definite knowledge of the effects of auditory training in the sensorium will have to await the development of new techniques to study the general processes of human learning.

However, there has been speculation about the basic nature of the process occurring during auditory training since Itard early in the nineteenth century began his pioneer work in the "development" or "improvement" of hearing through training the pupil to listen more effectively. Concepts concerning the activity taking place during auditory training may be said to classify it broadly as physical or mental in nature, or a combination of both.

Auditory Training as Physical Activity

There have been several views which have regarded auditory training as predominantly a physical process. The earliest such concept held that hearing of the deaf may be "dormant" and needs to be stimulated and "awakened" by means

of loud sound. As early as the first century Archigenes suggested stimulation of latent hearing function through shouting in the ear. Alexander of Tralles in the sixth century and Guido Guidi in the sixteenth repeated this suggestion. In his Traite des Maladies de l'Oreille Itard mentioned the "reawakening of the auditory sense" by the use of sound vibration. Beck stressed the necessity of using tones to enliven the decreased activity of the auditory nerve and arouse it from torpidity.

Urbantschitsch[1] coined the term "acoustic gymnastics" and suggested that exercise be used as a remedy for impaired hearing in the same way that exercise and massage are often used in nerve and muscle illness. It was his belief that although the acoustic nerve and acoustic center in the brain may be intact, damage could occur to the "functioning ability" of the ear, and this ability could be restored by acoustic training with exercises. He maintained that any sound transmitted to the inner ear stimulated and thereby increased the sensitivity of hearing.

Many German authors, including Beck, agreed with Urbantschitsch. Toward the end of nineteenth century Gillespie[2] employed auditory training at the Nebraska School

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[1]Urbantschitsch, op. cit., p. 2.

[2]Gillespie, J. A., "The Aural System for the Semi-Deaf, " American Annals of the Deaf, 29:185-190, 1884.

for the Deaf, but he wrote that he simply did not know whether the auditory nerve develops like an exercised muscle. Gordon reported in 1892:

> The prevailing opinion appears to be against the assumption that the physiological instrument of hearing, the auditory apparatus, can be cultivated and improved (as, for instance, a weak muscle may be strengthened) by judicious exercises; . . .[3]

It appears that the only evidence for the theory that improvement after acoustic training is in some cases produced by "awakening" acoustic sensitivity is provided by the existence of so-called "tonal islands." Bezold[4] gave this name to functioning areas in the cochlea ranging from the slightest area to two and one-half octaves in extent. These areas continue to operate although surrounded by damaged non-functioning cells.

Bezold found that one-third of the pupils in the deaf-mute asylum in Munich possessed "islands" of functioning cells, which he felt should be used more extensively by teachers of the deaf. Goldstein stated that clinical observations of otologists, notably Alexander, had proved

> Without further doubt, the presence of functioning elements in the ductus cochlearis, known as tone-islands.[5]

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[3]Gordon, J. C., The Education of Deaf Children, Washington, D. C.: The Volta Bureau, 1892, p. 139.

[4]Urbantschitsch, op. cit., p. 39.

[5]Goldstein, M. A., The Acoustic Method, St. Louis: The Laryngoscope Press, 1939, p. 23.

Goldstein and Urbantschitsch mentioned using the "islands" as beginning exercise points. They presented tones of frequencies which stimulated detectible "islands." They stated that perception for the neighboring tones gradually increased. Urbantschitsch used the presence of "islands" and his success in developing hearing for adjacent tones as support for his belief that in some cases there is not actual loss for tone, but only a "dormant" acoustic sensitivity.

Urbantschitsch's claims of clinical results showing improvement from exercising "islands" and adjacent areas of the cochlea should not necessarily be taken as proof that the results of auditory training are largely achieved by awakening "dormant" function. Urbantschitsch[6] had claimed that by using only three or four extant "islands" in an octave he could awaken hearing for the entire octave in many cases. Fowler, Jr.[7] Stated:

> No type of treatment, medication, or stimulation will improve the hearing of anyone whose deafness is due to meningitis or for whom a diagnosis of true nerve deafness can be made.

On the basis of Bezold's definition, "islands" is a term applying only to nerve deafness. This would seem to cast doubt on Urbantschitsch's claims. The improved hearing he reported may have been due to other factors.

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[6]Urbantschitsch, op. cit., p. 41.

[7]Davis, H. et al., Hearing and Deafness, edited by H. Davis; New York: Murray Hill Books, Inc., 1947, p. 88.

The lack of conclusive methods of testing excuses Urbantschitsch for maintaining he could awaken hearing in non-functioning cells. His conclusion from clinical experience that all the deaf should have the benefit of a chance for auditory training served the practical purpose of giving many individuals, some wrongly regarded as completely nerve deaf, new opportunities to be trained to use their residual hearing.

The theory of "awakening slumbering acoustic sensitivity" added no new information about the processes of auditory training and practically disappeared from the literature around 1920. Goldstein could have been writing its epitaph with these words:

> We have no evidence, except in very occasional cases, that the Acoustic Method improves the physiological hearing capacity.[8]

The Relationship Between Auditory and Tactile Perceptions

Some investigators have felt that the sense of hearing and the tactile sense are closely related, and that confusion may have existed in attempting to differentiate between tactile and auditory impressions. Urbantschitsch remarked that a congenitally deaf person without training cannot tell an acoustic from a tactile impression, but he believed that this was usually possible after training. A student

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[8]Goldstein, M. A., The Acoustic Method, St. Louis: The Laryngoscope Press, 1939, p. 50.

may indicate at first that he feels the air from a musical instrument, for example, and only later become aware that he notices something else in addition. From continued exposure to sound, he learns that it is an acoustic impression. Urbantschitsch[9] believed that areas sensitive to tactile impressions often exist simultaneously with areas sensitive to auditory impressions, and it is especially helpful for auditory training if the areas overlap. He did not elaborate upon this statement.

Goldstein[10] observed that it is difficult to tell where a hearing impression ends and a tactile impression begins. He declared that the boundaries between taste and smell are unknown, and it is likely that the physiological limits of hearing are also still uncharted. Standards of normalcy for hearing have been set up only from averages.

Goldstein declared that the fundamental principle on which he based his acoustic method for the education of the deaf child was the possible translation or conversion of tactile impressions into auditory impressions. It was of the greatest interest to Goldstein that a sense organ might serve two different purposes in the same species of an animal genera, depending on the need in the environment.

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[9]Urbantschitsch, op. cit., p. 50.

[10]Goldstein, op. cit., p. 173.

He wrote:

> Even with the comparatively meager observations and advancements that have been made in this direction, there has already been suggested a new philosophy which seems to have many plausible and possible prospects, namely, that the sensory organs by which we gain our outward impressions may, to a considerable degree, be translated, one into the other. When Sir John Lubbock, nearly forty years ago, announced the observation that in certain bees and wasps the antennae of these insects served the combined purpose of touch, smell and hearing, a new and valuable scientific principle was evolved, the significance of which may be of tremendous importance in our work.[11]

As evidence for the feasibility of the idea that tactile impressions might be gradually translated into hearing sensation by some central stimulation or process, Goldstein cited experiments in teaching congenitally deaf subjects to understand sentences by feeling the paper diaphragm of a megaphone. He demonstrated a congenitally deaf pupil who repeated sentences perceived in this way. Gault trained a group of normal college sophomores to repeat messages received on the hand encased in a "soundproof" box. Experiments of Goldstein's with a pupil who could hear only vowels showed that the pupil could obtain as much speech when only the vowels were tapped out and spoken as when the whole sentences were tapped out and given in speech. He believed the pupil could hear so little, as shown by the audiogram, that she must be depending on her sense of touch. He believed:

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[11] Ibid., p. 232.

> The deaf child who cannot hear speech must have these impressions conveyed through visual and tactile impressions.[12]

The idea that the various senses are closely related was also championed enthusiastically by Morkovin. He believed that one type of sensation can be reinforced by another. He stated that a complete sensory pattern for speech understanding would involve auditory, visual, kinesthetic and rhythmic coordination of sensory impressions. In his opinion:

> The factors contributing to better speech perception are interdependent and are not detachable. The deterioration or improvement in one of them leads to the deterioration or improvement in the others. It is necessary not only to train or re-educate a single ability but also to improve the coordination and cooperation of all the other factors.[13]

Morkovin cited as typical the case of an adult who had once heard and who was wearing a hearing aid without auditory training. He became fatigued because he was receiving an incomplete speech pattern.

The training of the auditory, tactile and visual sensations have been effectively combined in the education of the deaf child. Auditory training, lip reading, tactile training and rhythm work have been coordinated. However, at least one voice has been raised in dissent to the opinion that every sense should be used in an effort to reach the

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[12] Ibid.

[13] Morkovin, B. V., "Aural Re-Education: Psychological and Therapeutic Aspects," Hearing Survey Quarterly, 1946, p.15.

deaf child. Stevenson stated that children who have lost their hearing through spinal meningitis are, as a rule, without sound perception. He wrote:

> Then there are others who possess so little or a degree so close to the threshold of feeling that it is wrong to try to make use of it.[14]

Most other workers have taken the position that every avenue of approach to a deaf child should be used to the maximum. It appears to be the opinion of most investigators that the important consideration in better utilization of sound is not the approach, but the results.

Auditory Training as a Mental Activity

Many investigators have regarded the processes of auditory training for all the hearing handicapped as basically mental in nature. They have described the process of auditory training as cerebral, involving concentration, closer observation and attention, with better use of available auditory clues. This process with deaf children may be described as cerebral orientation to sound. Silverman[15] has described such training for the hard of hearing or adventitiously deaf as "cerebral reorientation" to speech. This term expresses a new relationship to sound through learning to utilize it thoroughly.

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[14]Stevenson, E. A., "Hearing Aids--The Deaf--The Hard of Hearing," American Annals of the Deaf, 84:4, 1939.

[15]Silverman, S. R., "Training for Optimum Use of Hearing Aids," The Laryngoscope, 54:29-36, 1944.

The view that auditory training is primarily a mental process was first advanced in the latter part of the nineteenth century and the role of conscious mental effort has been increasingly stressed since that time.

Urbantschitsch[16] quoted Bonafont as saying in 1873 that those who experience a sudden improvement in their hearing must learn to listen and discriminate. Calkins[17] remarked that many children in public schools lacked precise discrimination of sound due to lack of proper development of "sense perception" rather than to defective hearing. Accurate means of assessing hearing were not developed in 1889, so the auditory status of the children referred to was questionable.

Many investigators have stressed the role which deliberate attention to sound plays in influencing how well sound is utilized. The observation has often been made that a hearing handicapped subject may give no response at all to a sound, though he is later found to have quite a bit of residual hearing. Urbantschitsch and many other contemporaries recognized the importance of attention, and he quoted Krugelstein who noticed as early as 1845 that hard of hearing children living in lonely, quiet regions often appeared to be deaf. Carhart stated that a habit of

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[16]Urbantschitsch, op. cit., p. 43.

[17]Calkins, N. A., Ear and Voice Training, New York: E. L. Kellogg and Co., 1889, p. 5.

of ignoring available sound stimuli which lack meaning to the hearer can have the effect of eventually reducing the amount of sound which can be used.[18] The fact that children long accustomed to ignore meaningless sounds can be trained to attend to and concentrate upon individual sounds and later combinations of sounds with an apparent increase of hearing sensitivity shows the importance of conscious effort in attending to sound.

The observation that the audiogram remains unchanged while hearing is apparently improved has been cited to bolster the contention that the improvement following auditory training is primarily mental. Goldstein[19] and Ewing and Ewing,[20] among others, have reported that the audiogram remains the same after auditory training although "hearing" is better. Morkovin[21] quoted the case of a veteran of the Second World War who "heard" so much better after lip reading and auditory training he could hardly believe that his new audiogram was exactly the same as the pre-training audiogram. Such observations indicate that the primary result of auditory training is improvement in utilization of available sound rather than improvement in

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[18]Davis, et. al. Hearing and Deafness, p. 280.

[19]Goldstein, M. A., Problems of the Deaf, St. Louis: The Laryngoscope Press, 1933, p. 221.

[20]Ewing, A. W., and Ewing, I., The Handicap of Deafness, London: Longmans, Green and Co., 1938, p. 226.

[21]Morkovin, op. cit., p. 19.

acuity of hearing.

On the other hand, Wedenberg and Fant stated that they achieved improvement in hearing acuity after auditory training. They reported:

> In a number of cases the tone audiogram has been improved beyond the limit of uncertainty, 10 db, whilst in other cases only the speech audiograms indicate an improvement.[22]

No case in the control group, consisting of subjects of similar loss without auditory training, showed an improvement of 10 decibels or more on the pure tone audiograms or any marked improvement in speech reception.

Since these results contradicted the reports of stability of the audiogram before and after auditory training it is well to explore them for possible explanations. The method of auditory training used in the study reported by Wedenberg and Fant was to present pure tone and speech through audiometry. Audiometry was also used to test improvement. The investigators believed that greater improvement was made in listening to speech than to pure tones because of the practice in listening carefully to the speech material presented through audiometry during the training.

Wedenberg and Fant presented no explanation for the improvement in the hearing for pure tones reported in their study. A pure tone is simply presented alone for a

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[22]Wedenberg, E., and Fant, G., "Auditory Training of Deaf Children," Acta-Oto-Laryngologica, 37:467, 1949.

short time; there is no opportunity to perceive differences in combination or to associate meaning. The investigators did state that Barczi had achieved improvement in word hearing following auditory training only with cases of inherited deafness showing bilateral, symmetrical deafness.[23] Barczi felt that this type of loss was caused by a defect in the cortex, similar to those causing aphasia, agraphia or alexia. It is reasonable to suppose that listening to sounds of any kind, even pure tones, would be more likely to produce apparent improvement in cases of involvement of the central nervous system than in cases of deafness with the damage peripheral to the central nervous system. If Barczi was correct in classifying the cause of bilateral symmetrical "deafness" as central in origin, the improvements shown on the audiograms of the subjects reported upon by Wedenberg and Fant resulted from better cortical use of available sound. The generalization that auditory training improves acuity of hearing cannot be made from the results reported by Wedenberg and Fant.

Observations that cerebration plays an important part in listening effectively led to efforts to break down the term "hearing" into its various aspects. In 1939 Braly[24]

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[23] Ibid., p. 462.

[24] Braly, K., "Hearing, Discrimination and Interpretation," Volta Review, 41:69-79, 1939.

outlined different mental levels of hearing. He defined hearing acuity as the sensitivity measured by the pure tone audiometer; sound discrimination as the ability to differentiate among sounds without attaching meaning to them; and sound interpretation as the ability to understand speech as meaningful words, and the ability to attach meaning to particular sounds in the environment.

Morkovin expressed the same general idea when he stated:

> It is not hearing, or even hearing and sight, which makes people understand the real meaning of spoken language, but rather the ability to discriminate and to interpret speech stimuli in terms of human situations and intentions.[25]

He continued:

> When we say we increase the discriminative and interpretive power of hearing we do not refer to physical hearing. It is the brain which, by organizing special attention through hearing, improves discrimination and interpretation of speech.

Similarly, Ewing and Ewing[26] suggested that the aim of ear training is to help a child interpret and assimilate all the sounds he can be enabled to hear. No mention was made of improving hearing acuity as measured by an audiometer.

McKenzie[27] discussed the definition of the term

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[25]Morkovin, op. cit., p. 19.

[26]Ewing, and Ewing, The Handicap of Deafness, p. 226.

[27]McKenzie, L. B., "Physiological and Psychological Factors to be Considered when Building a Program of Acoustic Education," Volta Review, 34:522-525, 1932.

"hearing" at some length. She agreed with Braly that perception of single tones does not indicate ability to interpret speech tones. Urbantschitsch[28] also reported that many deaf people can reach the point of hearing some vowels or words but cannot recognize nor understand them because they have learned no meaning for them. McKenzie continued her discussion of "hearing" by declaring the importance of the role of combination of sounds. She maintained a subject may be unable to comprehend simultaneous tones or noises, which is done in normal hearing. McKenzie described the combination of isolated tones into a unit or single tone as "chord hearing." "Chord hearing" is not sufficient to explain hearing for words, because such hearing must include perception of intervals and temporal qualities, and it must encompass comprehension of consecutive tones. Therefore, the subject must join perception of preceeding to succeeding tones through memory. In other words, his hearing must integrate receiving and recalling.

The importance of the role of combination of sounds was stressed by Barczi.[29] He believed that most cases of deafness were due to imperfect development of the sound-sensitive region of the cortex, and such patients could hear whole words but not separate tones. His method of education presented whole words. Barczi's success was great

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[28]Urbantschitsch, op. cit., p. 462.

[29]Wedenberg and Fant, op. cit., p. 462.

enough so that his method of education was introduced into the schools for the deaf of Hungary in 1922. Wedenberg and Fant believed that it still remains to be shown whether the separate sounds of speech or their combination are more important to auditory training.

Braly[30] asserted that it is very important to define "hearing" as carefully as knowledge permits. Loose use of terminology creates confusion and prevents exactitude. He felt that such statements as "the man has no usable hearing for speech" should be explained precisely. He pointed out that this statement could mean the man in question was feeble-minded, aphasic or lacking the ability to perceive or discriminate among sounds.

The need for a clarification of terms and careful use of words has been illustrated in the literature. Bodycomb provided an example of the widespread use of undefined terms in the literature when she stated:

> Many of the pupils who were in the partially deaf group when their training began can now be classified as hard of hearing.[31]

The precise criteria for this kind of judgment should be set forth. Stevenson[32] defined hearing as mental and physical, functional and unconscious. The reader is not told what

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[30]Braly, op. cit., p. 70.

[31]Bodycomb, M., "The Auricular Program at Mt. Airy," Volta Review, 39:202-204, 1937.

[32]Stevenson, op. cit., pp. 3-7.

is meant by the word "unconscious." Perhaps Stevenson meant that normal persons develop meaningful hearing naturally in early childhood, without conscious effort. Or perhaps he meant that attention to sound is never important to hearing.

Stevenson also said:

> Improvements of hearing devices make better and more certain advancement in speech, but such mechanical advancement can never change sound perception into hearing.[33]

This statement as it stands seems to imply that a person with impaired hearing can improve his speech through the use of a hearing aid without being able to perceive meaningful speech. It is not quite clear from his statement that Stevenson is aware that speech is connected and meaningful. If a hearing aid can improve speech as Stevenson says it can, it must be able to deliver meaningful speech. If the auditor can perceive and interpret well enough to apply his improved perception and interpretation of sound to his own speech, he is hearing, by most definitions. Therefore Stevenson's statement that hearing devices can improve speech, but not change sound perception into hearing illustrates the need for clarification of statements and definition of terms in the literature.

Attempts have been made to determine factors which influence the ability of various individuals with auditory

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[33] Ibid., p. 4.

handicaps to make mental use of sound. Among factors frequently mentioned are the language background and the intelligence of the listener. McKenzie[34] stated that a subject with considerable hearing but only a little understanding for language will be able to utilize less from a sample of speech than a subject with an excellent language background and less residual hearing. Therefore, it is important that teachers do not separate perception and interpretation any more than necessary when giving auditory training.

Wright[35] believed that intelligent pupils with less residual hearing could learn to comprehend more language through their ears than could less gifted children.

Goodfellow[36] was among those who suggested that some factor as yet unidentified determined ability to profit by auditory training. In 1942 he reported on a study concerning forty-eight subjects correlated with respect to hearing acuity according to audiograms, intelligence "as indicated by a rough subjective estimate" and ability to use residual hearing, as measured by the Northwestern University Speech Reception Test (consisting of 100 nonsense syllables using the speech sounds most often found in English).

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[34]McKenzie, op. cit., p. 523.

[35]Wright, J. D., "Light From Afar on a Home Puzzle," American Annals of the Deaf, 70:211-216, 1925.

[36]Goodfellow, L. D., "The Re-Education of Defective Hearing," The Journal of Psychology, 14:53-58, 1942.

The purpose of the study was to try to find factors influencing use of residual hearing by individuals with similar amounts of hearing. Neither general intelligence nor hearing acuity was found to be highly correlated with ability to use residual hearing. It was concluded that there must be some "characteristic difference" in an individual's "auditory perceptual organization" determining how well residual hearing will be used. This interesting idea is akin to the hypothesis that some unknown factor of organization is responsible for success in lip reading. However, the value of this study appears to be lessened because of the limited number of subjects, small range of variability of subjects' hearing losses, the choice of nonsense material (a very difficult form of discrimination) and the extremely rough way of determining the intelligence levels of the subjects. Actually Goodfellow found two factors, intelligence and hearing acuity, which did not appear to influence ability to use residual hearing among his subjects. His assumption that there is some kind of individual difference in ability to organize auditory perceptions must be regarded as merely an assumption.

Davis, et al. suggested a very closely related view of an undefined factor which influences ability to make difficult auditory discriminations. They reported:

> The ability to understand speech under difficult conditions, whether of interference by masking noise or of previous exposure to loud sounds, does not depend entirely on the ear, but also on a separate

ability, quite distinct from auditory acuity. This ability can be improved with practice. Even a considerably distorted message from the ear may be correctly interpreted, better by some men than by others.[37]

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[37]Davis, H., Morgan, C. T., Hawkins, J. E., Galambos, R., and Smith, F. W., "Final Report on Temporary Deafness Following Exposure to Loud Tones and Noise," Acta-Oto-Laryngologica Supplementum 88, 1950, p. 54.

CHAPTER III

OBJECTIVES OF AUDITORY TRAINING

Although the objectives which have been set for auditory training have been both varied and numerous, it is possible to list general classif ications of aims. The most important broad objectives of auditory training for the hearing handicapped child follow:

1. Improvement of hearing vocabulary.
2. Improvement of speech.
3. Psychological improvement.
4. Improvement of lip reading.
5. Academic acceleration through improvement in language.

It is necessary to discuss the goals of auditory training for the deaf and hard of hearing child separately because of the limitations imposed by the differences in auditory status of the two groups.

Objectives of Auditory Training for the Deaf Child

Development of Hearing Vocabulary.--Whether the development of hearing vocabulary is a valid objective of auditory training for deaf children is questionable. Some early workers have claimed that development of hearing

vocabulary is a very important objective of acoustic work with deaf children, and considerable confusion on this matter is evident in the literature.

Perhaps the confusion stems from lack of clarification of terms. The deaf child has already been defined as one whose hearing is not useful in communication. Therefore, it would appear that this definition invalidates development of hearing vocabulary as an aim with deaf children. An explanation of the meaning of "hearing vocabulary" is in order. Some workers have apparently used this term to refer to development of a few words which can be heard through the ear alone. Hearing vocabulary has been used by other workers to mean words in connected language rather than a few isolated words. It is used in the latter sense in this review. Since speech reception for deaf children is more appropriately related to another stated aim, the augmentation of skill in lip reading, it will be discussed under that heading.

Speech Improvement.--Speech improvement is considered the foremost objective of auditory training programs for deaf children at the present time. O'Connor expressed the opinion of most workers when he stated:

> It is pretty generally accepted by all today, however, that for the large majority of pupils in schools for the deaf the major objective of acoustic training is the development of better speech and that in aiming for this one objective intensively, through the seeing-hearing method, all the other objectives will be reached to the

fullest possible extent.[1]

Several different types of speech improvements have been stressed. Speech improvement aims have varied with the individual differences among pupils and the viewpoints of workers. Speech improvement aims set for auditory training have been of two general types--improvement in articulation and improvement in speech rhythm. Greater intelligibility has been the accepted general goal for all types of speech improvement.

Improvement in articulation of deaf children through auditory training has been widely regarded as a major aspect of improvement in speech. Urbantschitsch[2] believed that improved articulation could result from monitoring one's own speech by listening to a normal talker. As ability to listen for differences among speech elements increased, clearer impressions of the nature of these elements were attained. Improvements in articulation resulted. One type of auditory training described by Goldstein[3] consisted of listening for individual speech elements and repeating them, with improvement in articulation as the purpose of the response by speech. Ewing and Ewing[4] stated

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[1]O'Connor, C. D., "What Every Superintendent of a School for the Deaf Should Know About Hearing Aids and Their Use," Volta Review, 40:710-717, 711, 1938.

[2]Urbantschitsch, op. cit., p. 27.

[3]Goldstein, The Acoustic Method, p. 24.

[4]Ewing and Ewing, The Handicap of Deafness, p. 234.

that monitoring his speech by comparing it with that of a normal speaker would aid a hearing handicapped child correct his speech, including the factor of articulation.

Some workers, however, believe that some children are so severely deaf that no amount of amplification will enable them to hear certain speech elements at all, certainly not well enough to obtain a clear idea of their phonetic nature. These children must learn to speak by imitation and memory for speech movements. Therefore, some investigators believe it is important to specify the type of child for whom the objective of improvement in articulation is being considered appropriate.

Many workers believe that speech improvement through emphasis upon speech rhythm would be a more realistic aim for an auditory training program for severely handicapped deaf children. Improvement in speech rhythm is based upon giving the deaf child a concept of rate, stress, inflection and phrasing and helping him to apply these concepts to his own speech. Guilder and Hopkins[5] believed that improvement in speech rhythm is especially important for the 55 per cent of children they estimated were unable to develop discriminations among sounds.

The literature indicates that improvement in articulation as an objective of auditory training has been

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[5]Guilder, R. P., and Hopkins, L. A., "The Importance of Auditory Function Studies in the Educational Program of the Auditorially Handicapped Child," Volta Review, 38:69, 1936.

stressed to a greater degree than has improvement in speech rhythm. However, a few workers have strongly emphasized work with speech rhythm.

Ewing and Ewing[6] believed that speech rhythm would be improved to a greater extent through auditory training than would articulation. They stated that Goldstein began acoustic work by striving for discrimination of individual speech elements, an approach they described as analytical. Ewing and Ewing regarded their initial approach to auditory training as synthetic. Their primary concern was to teach more effective listening for speech elements in context. They believed that very young children should have access to amplification equipment to listen to their own and others' babbling. Babbling associated with rhythmic movements was recommended to improve imitation of speech patterns.

Barczi[7] and his followers stressed the importance of improvement in speech rhythm. They believed that the cortical centers of hearing of most deafened persons could perceive whole words but not separate tones. Therefore, improvement in perception for the rhythm of speech was essential. Michels also claimed that our attention cannot catch all impressions in speech separately, but receives them in rhythmic units. Long before articulation, rhythm

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[6]Ewing and Ewing, The Handicap of Deafness, p. 233.

[7]Wedenberg and Fant, op. cit., p. 462.

is apparent in the speech of a hearing child. Therefore, a deaf child needs a sense of normal speech rhythm more desperately and earlier than he needs articulation training. According to Michels,

> Rhythm is indispensable to intelligible speech. Without rhythm there is no language, there is no speech-learning, or speech teaching. Speech is easy to learn only through its rhythm.[8]

Michels differentiated among time-rhythm (altered time measures), rhythm of intensity (stress) and rhythms of melody (quality). He listed time rhythm as the most important factor for speech intelligibility. The main objective of the workers of the Hungarian School was improvement of ability to perceive time rhythm.

Some educators of the deaf believe that teachers devote relatively too much attention and time to articulation and not enough to speech rhythm, particularly to the subdivision of time rhythm. Michels stated the fault with speech taught when time rhythm is ignored lies in the observation that the time needed by the deaf to pronounce a single word exceeds the time-limits of consciousness. The result is that the word and the idea are not perceived simultaneously, as they are by hearing people. Michels stated:

> Rhythm makes the speech of the deaf motor-sensory, perceptible as a unity and utterable as such.[9]

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[8]Michels, P., Rhythmic Speech for the Deaf, Budapest: College for Medico-Pedagogical Teachers, n.d., p. 4.

[9]Ibid., p. 9.

Those who believed speech rhythm is more important to intelligibility than has been generally recognized have tried to express the relationship between the two factors as precisely as possible. Bell[10] remarked in 1914 that ordinary people have less difficult understanding a poorly articulated type of rhythmic speech than a well-articulated but slow and arythmic type. Hudgins and Numbers[11] observed that a sentence spoken with correct rhythm has a four to one chance of being understood over one with poor rhythm even though the quality of articulation is constant. They stated further:

> The relationship between speech rhythm and intelligibility is just as great as that between consonants and intelligibility and considerably greater than that between vowels and intelligibility.[12]

They supported the Hungarian contention that teachers should stress speech rhythm before work on articulation. They deplored the frequent practice of teaching articulation first, separately, and attempting to superimpose rhythm later.

The concept of stress is a part of the general concept of speech rhythm, and the importance of intensity to the speech of the deaf has been discussed. It is difficult

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[10]Bell, A. G., The Mechanism of Speech, New York: Funk and Wagnall, 1914, p. 15.

[11]Hudgins, C. V., and Numbers, F. C., "An Investigation of the Intelligibility of the Speech of the Deaf," Genetic Psychology Monographs, 1942, p. 352.

[12]Ibid., p. 388.

to teach a deaf child to incorporate stress into his speech because speech is fluid, with almost as many and varied patterns as the ideas expressed.

Today oral schools stress both articulation and speech rhythm work. Yet many educators feel with the Hungarian school that rhythm work has too often been neglected in speech teaching. Reports of results achieved under the Hungarian system indicate that perhaps speech improvement, with particular emphasis on time rhythm, should be universally considered as an important objective for auditory training with all deaf children.[13]

Psychological Improvement.--A basic objective of auditory training for the congenitally deaf is psychological improvement. Gillespie and Urbantschitsch mentioned the value of becoming cognizant of possessing a new sense when an individual is first made aware of auditory impressions. Ewing[14] believed that although sounds may be heard weakly the capacity to hear some sound is "vital" to one's "mental and social experience." Many deaf persons have reported that the addition of any sound to lip reading helps keep a listener in closer touch with the source of sounds about him.

Ramsdell[15] discussed in greater detail the psychological importance of hearing even any small sound. He divided

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[13]Silverman, S. R., Personal interview.

[14]Ewing, Lipreading and Hearing Aids, p. 5.

[15]Davis, et al., Hearing and Deafness, pp. 392-410.

normal hearing into three levels. The first is the social level, or level on which language is comprehended. The second is the warning, or signal, level, where such sounds as dogs' growls or brakes' screams are understood. The third level designated by Ramsdell is the primitive level, and it constitutes the level on which background sounds are heard.

Ramsdell stated that sounds such as the splashing of water or the roar of distant traffic belong on the third level. These sounds are not always noticed or identified by a listener, but their presence gives him a sense that the world is alive. A person who has heard and loses his hearing misses such sounds keenly. He complains that the world seems dead because he feels less closely tied to it, and often falls asleep when his hearing aid is turned off. A congenitally deaf child has the same apartness from his environment, although he does not realize it. But when he is enabled to hear sounds on the primitive level he appears to enjoy the experience. The inclusion of turntables on some group aids particularly to provide sound effects shows that some workers agree with Ramsdell's contention that hearing background noise is important to deaf children. Ewing agreed with Ramsdell that the psychological importance of hearing any sound at all is great. She believed that when the ability to experience or remember what sound is like has been lost "a serious loss of human

experience has occurred."[16]

Aesthetic enjoyment of sound has frequently been listed with psychological improvement, but it is usually regarded as a lesser objective of auditory training.

It is apparent that investigators have consistently included psychological improvement among the aims of an acoustic program. But it may be noted that this objective is generally listed among the minor aims and is rarely discussed in detail. This may be partly because other needs are so pressing and great that they assume the positions of primary consideration.

Lip Reading Improvement.--The influence of utilizable hearing upon lip reading ability has been increasingly realized in recent years. Ewing, Ewing and Littler[17] stated that speech development and general education can advance only when lip reading is aided by hearing experience. Ewing stated:

> Neither auditory stimulation nor visual stimulation by itself is entirely adequate. The combination of both is exceedingly effective.[18]

O'Connor wrote in the same vein when he proposed as the second most important objective of auditory training for

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[16]Ewing, Lipreading and Hearing Aids, p. 23.

[17]Ewing, A. W., Ewing, I. R., and Littler, T. S., The Use of Hearing Aids, Privy Council Medical Research Council Special Report Series; London: His Majesty's Stationery Office, 1936, pp. 1-40.

[18]Ewing, Lipreading and Hearing Aids, p. 5.

deaf children:

> Discriminate use of residual hearing as a major medium for language interpretation, which when combined with lip reading, will accelerate the pupil's educational program markedly.[19]

The deaf child must depend most heavily upon lip reading, but auditory training complements lip reading by providing an undercurrent of auditory impressions. Ewing[20] in a discussion of the joint use of lip reading and hearing aids stated that the experience of hearing speech persists and takes foremost position as long as any capacity to hear remains, even though the messages have been conveyed to the brain mainly through vision. She believed that the aim of ear training is to enable a child to assimilate and interpret all the sounds he hears, for reinforcement of lip reading.

One way in which auditory training can improve lip reading is by providing an idea of the continuity and flow of speech. Even with those children who can hardly detect the presence of sound at any intensity auditory training can convey impressions of stress, phrasing and inflection which add greatly to the literal meaning of lip read material. Myklebust[21] listed improvement of lip reading skill as an objective of auditory training for

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[19] O'Connor, op. cit., p. 711.

[20] Ewing, Lipreading and Hearing Aids, pp. 1-73.

[21] Myklebust, H. R., "The Use of Individual Hearing Aids in a Residential School for the Deaf with Implications for Acoustic Training," American Annals of the Deaf, 91:256, 1946.

pupils with losses of 90 to 94 decibels. Kennedy[22] reported many lip reading pupils maintained it is extremely hard for them to concentrate in utter silence. Hearing any slight sound helps them keep alert and assists them in grasping the meaning of the material.

Although improvement of speech reception for deaf children is being discussed in conjunction with improvement in lip reading skill, it must be emphasized that any words for which hearing can be achieved should be presented through the ear alone. Following this, words for which clear auditory impressions can be achieved should be presented in conjunction with lip reading material to coordinate the two skills. Utley, Braly and Harris[23] regarded the aim of acoustic work as giving all deaf children the opportunity to learn to receive language through their ears, although they did not claim that all could succeed in doing so, nor did they suggest that auditory training should in any way replace lip reading instruction.

The increasingly prevalent notion has been that lipreading and listening training are complementary in the education of the deaf child. This appears to be part of a trend to regard auditory training, lip reading, speech and language work as parts of one reception-expression

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[22]Kennedy, M., "Understanding," Volta Review, 46: 283-285, 1944.

[23]Utley, J., Braly, K., and Harris, E., "Some Aspects of Acoustic Work," Volta Review, 40: 325, 1938.

pattern. The belief that these aspects are interdependent was encouraged by the upward revision in estimates of the number of deaf persons believed able to benefit from auditory training. As more pupils were considered eligible, it was realized that many of them required the integration of all these approaches to communication to enable them to utilize sound effectively. In speech reception the trend has been to stress the utilization of hearing in coordination with lip reading.

O'Connor[24] indicated that this view has not always been held by educators of the deaf. In 1938 he reported that a few years before it was thought necessary to develop fine discriminate hearing without the aid of lip reading in any child exposed to auditory training. The children forced to listen for difficult discriminations without the aid of vision were under a great strain and many of their teachers became discouraged with the results of such training. Some abandoned auditory training entirely. This report of O'Connor indicated that the objectives of auditory training for a given child should be kept clearly in mind so that hearing and lip reading can be coordinated for efficient language reception.

Academic Acceleration.--Academic acceleration for the deaf child is closely related to the improvement of speech reception through better coordination of skill in

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[24]O'Connor, op. cit., pp. 710-717.

lip reading and in listening. It has been suggested that use of language can be improved following auditory training. This suggestion is based upon the belief that auditory training in combination with lip reading facilitates language reception. Facility in expression should result from ability to receive more speech at a more complex language level.

Objectives of Auditory Training for Hard of Hearing Children

Improvement of Hearing Vocabulary.--The primary objective of auditory training for hard of hearing children is improvement of hearing vocabulary. The specific type of improvement aimed at with various children is determined largely by the extent of their residual hearing and by the type of their hearing loss. By definition the hard of hearing child is one whose hearing, aided or unaided, is functional for communication. Therefore the type of hearing loss is particularly influential in determining the specific aims of auditory training to improve hearing for speech. A consideration of the type of loss tells what is most needed by a given child.

A hard of hearing child with a high tone loss will never be able to hear certain high frequency components of speech. He needs auditory training to make it easier to discriminate with sureness among the lower frequency speech components. With a firmer basis in hearing low

frequency components it will be easier for the child to apply lipreading to fill in the few elements he cannot hear. In other words, his perception for contextual auditory clues is strengthened.

Auditory training and a hearing aid can compensate for some losses of sensitivity in the low frequencies by making it easier to hear those speech elements which are already audible.

Auditory training can be of help to hearing aid users by increasing tolerance for loud sounds, thus increasing the auditory areas available for speech reception, and by instructing them to make most effective use of their aids in a variety of acoustic environments. The contributions which auditory training can make to improvement in use of a hearing aid will be discussed later.

Improvement in Lip Reading.--Lip reading improvement for the hard of hearing child is closely related to improvement in hearing vocabulary, but in general the relationship between the two is the reverse of that existing for the deaf child. With the deaf child the objective of auditory training was to provide at least a rhythmic reinforcement of lip reading skill through hearing; with the hard of hearing child lip reading is a supplement to fill in what he is unable to hear. Auditory training makes it easier to hear audible vowels and consonants and it may reduce the number of elements the child must depend exclusively upon

lip reading to supply.

Academic Improvement.--Academic improvement is an objective of auditory training for hard of hearing children which is obviously related to increasing hearing vocabulary. A relationship between unsatisfactory academic work and loss of hearing has been demonstrated. Waldman, Wade and Aretz[25] pointed out that hard of hearing children are one year behind normally hearing children in academic achievement. These investigators indicated that the divergence in achievement among hard of hearing children and normal children was not related to the intelligence of the children in the two groups.

Barrett[26] blamed the poor academic work of children with losses of only about 30 decibels partly on the fact that they have too much hearing to develop and rely upon lip reading skill, but not enough to hear accurately what they must hear to progress normally in school. Because these children hear a great deal, it is often undiscovered for long periods of time that they hear inaccurately. These children often become discouraged and fall behind or leave school.

Speech Improvement.--Speech improvement as an

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[25]Waldman, J. L., Wade, F. A., and Aretz, C. W., Hearing and the School Child, Washington, D. C.: Volta Bureau, 1930, p. 109.

[26]Barrett, K., "Trends and Progress in the Education of the Deaf and Hard of Hearing in the Chicago Public Schools," American Annals of the Deaf, 91:262-292, 1945.

objective of auditory training for the hard of hearing child presents two different kinds of problem, depending on the age of onset of hearing loss. A child who has had a hearing loss from the time he began to learn to speak will have developed faulty speech patterns, and the aim with him will be to correct these patterns as early as possible. In addition to making such a child more sure of the discriminations he can already make, auditory training should enable him to build up new discriminations. Speech lessons may be necessary to teach him how to form some of the speech elements new to him, but auditory training may be able to increase the number of sounds he will be able to produce correctly by imitation.

A child who developed a hearing defect after he developed speech will need speech "conservation." A program to preserve normal articulation and voice quality will make use of auditory training for practice in listening to differences among sounds. It will also coordinate speech work with lip reading lessons to encourage retention of normal speech habits. Since the hard of hearing person often omits high frequency speech elements which are difficult to hear, particular emphasis is placed on these elements.

Psychological Improvement.--Psychological improvement is frequently stressed as one of the most important objectives of auditory training for the hard of hearing

child. The importance of this objective is illustrated by descriptions of various investigators of the psychological problems often accompanying hearing loss. Silverman[27] has described truancy, lying, extreme introversion and other forms of compensation as types of atypical behavior sometimes accompanying hearing impairment in children. The White House Conference Report on Child Health of 1930 stated:

> Persons deprived of normal hearing tend to become socially maladjusted, to develop more or less serious psychopathic attitudes . . .
> The hard-of-hearing child is in a position vastly more unfortunate than that of the hard-of-hearing adult . . . the social adaptation which normally comes through contacts and communications with other children and with adults is grievously restricted in all cases and for many is made well nigh impossible.[28]

The greatest psychological improvement in hard of hearing children is achieved when hearing for speech is improved to the point at which it functions satisfactorily in communication. But the hard of hearing child may also need help in adjusting to his hearing loss and in becoming aware of the value of hearing aids or other remedial measures.

Improving the attitude of the child toward his handicap involves explaining the extent of the loss and

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[27]Davis, et al., Hearing and Deafness, p. 357.

[28]White House Conference on Child Health and Protection, Section IV, New York: The Century Company, 1931, p. 11.

fostering a positive attitude toward it. Because the child's attitude toward his hearing loss will necessarily be influenced greatly by the attitudes of those about him, it is important that parents, friends and teachers become familiar with his problems.

According to Gates and Kushner,[29] improvement of attitude toward a hearing aid should be included in any auditory training program. They stated that the crucial factor in determining whether a child will reject or accept an aid is whether he can adjust to it socially. Therefore, they strongly recommend that hard of hearing children who are beginning to use aids talk over their problems together. Teachers, parents and classmates should also be informed about what a hearing aid can do for the child and how to help him accept the instrument.

Psychological improvement has been stressed more strongly as an objective of auditory training programs for the hard of hearing than for the deaf child. In the first place, the psychological problems of the hard of hearing child appear to be greater. This may be so also because a child whose hearing is functional with or without a hearing aid, especially a child with only a slight loss, can be helped markedly by programs of which auditory training forms a part. Improvement in adjustment is noticeable in

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[29]Gates, A. I., and Kushner, R. E., Learning to Use Hearing Aids, New York: National Research Council, Bureau of Publications, Teachers College, Columbia University, 1946, p. 67.

relatively short periods of time in some cases, and it is possible to compensate for the hearing losses of many hard of hearing children to the point where hearing becomes socially satisfactory. Obviously, the accompanying psychological improvement is significant.

Many investigators believe that teachers should correlate efforts to achieve all the goals of an auditory training program. It is a popular opinion that auditory training will be most effective when work to achieve each of the aims discussed above is coordinated.

CHAPTER IV

CLASSIFICATION OF PUPILS FOR AUDITORY TRAINING AND THE PLACE OF AUDITORY TRAINING IN THE CURRICULUM

Classification of Pupils

Classification of children for auditory training programs involves grouping pupils according to their potentialities and needs for acoustic work. Because each child presents different educational problems and varying degrees of hearing loss the ideal approach would appear to be to consider each case individually. However, practical considerations dictate that groupings be set up for work with children presenting similar problems.

Some of the systems of grouping pupils have considered individual differences, particularly amount of residual hearing. Other systems of classification have approached the problem less directly, using less relevant criteria than amount of residual hearing. Those criteria for classification of deaf pupils which do not directly consider amount of residual hearing will be discussed first.

Etiology.--It was believed by many workers in the nineteenth century that etiology of deafness should determine whether a pupil was eligible for auditory training. According to Urbantschitsch,[1] it was generally believed

[1]Urbantschitsch, op. cit., p. 87.

around 1890 that acoustic exercises were useless in cases of deafness caused by meningitis, scarlet fever or diphtheria. But he claimed that some of his best responses were made by pupils who had had these diseases, which are frequently accompanied by complete destruction of the acoustic nerve or center. Though his cases were so diagnosed, it must be kept in mind that sure diagnosis of cause of deafness is often a difficult matter.

Goldstein disagreed with Urbantschitsch and stated that acoustic work is useless when the hearing loss has been caused by meningitis or influenza. Lane[2] has indicated more recently that experience at Central Institute for the Deaf shows this is not always the case. Goldstein stated further:

> It is rare to find total and profound deafness in the congenital biological deaf types. Deafness at early age caused by the eruptive fevers (measles, scarlatine, etc.) exhibits a large percentage of cases with hearing remnants. Deafness due to congenital syphilis is rarely complete in the early periods of its inroads, and many of these cases, if promptly recognized by blood Wassermann or spinal puncture and given antisyphilitic treatment, may not only be arrested, but occasionally improved.
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> These are some of the types to be included in training by the Acoustic Method, and if persistently studied and taught, will yield a large percentage of splendid practical results.[3]

Myklebust[4] stated that since children who had once

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[2]Lane, H. S., Personal interview.

[3]Goldstein, Problems of the Deaf, p. 218.

[4]Myklebust, H. R., "The Use of Individual Hearing Aids in a School for the Deaf with Implications for Acoustic Training," American Annals of the Deaf, 91:256, 1946.

heard normally were more successful in acquiring a sound pattern than those with the same degree of loss who are considered congenitally deaf, etiology is important to determination of whether a child might profit by auditory training. It appears that Myklebust was actually stressing the age of onset of deafness rather than the type of disease causing the loss.

Etiology as a criterion for classification of pupils has fallen into disuse. It appears that use of this basis for selection of pupils rested upon the unwarranted assumption that a certain disease always produces the same degree of hearing impairment.

Short Trial Periods.--Schools for the deaf have used short trial periods to select pupils for auditory training. Braly, Utley and Harris[5] deplored the notion that short trial periods were sufficient to select and classify pupils. It was their opinion that short trial periods were used mostly prior to 1938.

It seems probable that short trial periods have been used to classify and select pupils for acoustic work more frequently than is recorded in the literature. A survey of seventy-four day schools by Watson and Watson[6] revealed that eight of the schools used short trial periods

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[5]Braly, K., Utley, J., and Harris, E., "Some Aspects of Acoustic Work," Volta Review, 40: 325, 1938.

[6]Watson, N. A., and Watson, R. B., "Hearing Aids in Schools for the Deaf," Volta Review, 39:265, 1937.

combined with audiometry to assign children to group and individual aids. These investigators concluded that most schools assign aids haphazardly. It seems likely that some form of a systematic trial and error without supplementary use of audiometry played a part in this kind of assignment.

Intellectual or Scholastic Ability.--Intellectual or scholastic ability has been used as a criterion for classification of pupils for auditory training. Goldstein[7] implied that some schools for the deaf select pupils for this form of instruction on the basis of scholastic status when he declared that Central Institute for the Deaf would not use this criterion. O'Connor[8] agreed that intellectual ability should not be the basis for assignment of children to auditory training. But he recognized that scarcity of equipment sometimes necessitated some selection of pupils. In such cases he recommended consideration of academic achievement, but only among the oldest pupils.

Wright[9] lamented the presence in schools for the deaf of some pupils who were there partly because of mental deficiency, and stated that such pupils are often given

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[7]Goldstein, Problems of the Deaf, p. 219.

[8]O'Connor, C. D., "Minutes of the Thirty-First Meeting of the Convention of American Instructors of the Deaf," American Annals of the Deaf, 84:302, 1939.

[9]Wright, op. cit., pp. 211-216.

more than a fair share of acoustic work because they possess a greater amount of hearing. He felt this was unfair to the more intelligent pupils who possessed less hearing but who could learn to use their hearing to better advantage. In 1925 Wright urged that more consideration be given to the intelligence and achievement of the pupils assigned to acoustic work than was generally the case at that time. Some schools today have solved this problem by setting up entrance requirements based upon intelligence tests, but this problem remains serious in some places.

In actual practice it has been necessary to deny some pupils auditory training, and in some schools it has been decided that those children making the best scholastic records shall receive a speech-hearing education as far as possible. Those showing less academic progress are often relegated to manual classes. As facilities and funds are enlarged and trained personnel become available, this situation should improve. Most oral educators believe there should be no selection of pupils for auditory training on the basis of scholastic ability beyond fulfillment of the entrance requirements of the school. As yet there is no evidence that intelligence within normal limits and ability to profit by auditory training are highly correlated.

Proportion of the Population.--In the early part

of the twentieth century it was widely believed that certain proportions of the population of a school for the deaf possessed enough residual hearing to be helped by acoustic work. The word "helped" has been defined by some workers and not by others. To some investigators it seems to mean any amount of benefit, however small; to others, a certain amount of improvement; to still others, improvement reaching a previously established goal.

The general trend in estimation of the proportions of the total number of pupils of schools for the deaf who should receive auditory training has been toward raising the proportions. The development and improvement of means to amplify sound has accelerated this trend, but it was discernible long before modern amplification equipment had been developed.

The Commission of the Royal Academy of Medicine of France,[10] after investigating Itard's work, agreed that roughly 40 per cent of "deaf-mutes" are capable of hearing speech "more or less distinctly." After a four-year period of study, this committee felt that 20 to 25 per cent of the pupils of the national school for the deaf of France could be considered "susceptible of amelioration" through acoustic work.

Politzer[11] believed that only certain proportions of

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[10]Gordon, op. cit., p. 129.

[11]Urbantschitsch, op. cit., p. 87.

the total number of deaf pupils could profit by auditory training. This was distinctly implied in his criticism of Urbantschitsch's theories. Urbantschitsch believed that it was unnecessary to estimate proportions of pupils able to benefit from auditory work. From his experience he believed long and determined efforts should be made to "awaken" residual hearing in every deaf child. He hazarded the opinion that perhaps every deaf child might eventually respond to sufficient training and he cited remarkable achievements with unpromising cases. Politzer supported the opinion that certain anatomical and pathological conditions rendered auditory training useless for some persons.

Clarke[12] reported after testing the hearing of pupils of the New York Institution and the Lexington School with a 3A audiometer that estimates of the proportions of pupils who could hear enough to be taught acoustically varied from 18 per cent to 27 per cent. Politzer[13] had felt that 30 per cent were eligible to benefit. Gillespie[14] reported that 15 per cent of the pupils of the Nebraska School for the Deaf had been taught with sound. He thought that those pupils were typical, and that the same proportion would also apply to other schools.

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[12]Gordon, op. cit., p. 140.

[13]Urbantschitsch, op. cit., p. 87.

[14]Gillespie, op. cit., p. 188.

In 1936 Guilder and Hopkins[15] reported that it had been previously believed that 15 per cent of the pupils of schools for the deaf could be helped by acoustic training. This estimate was later raised to 30 per cent. Guilder and Hopkins recommended the sight-hearing method of education for those pupils having "usable residual hearing," which involved 45 to 50 per cent of the school population. They suggested bone conduction aids for the remaining pupils. Their estimates were derived from a study of pupils at the National Institute in Paris and the Clarke School for the Deaf.

The Wright Oral School[16] in 1925 reported using acoustic exercises successfully with about 30 per cent of the pupils. Johnson[17] estimated that 45 per cent of all pupils of schools for the deaf were potentially able to understand language through the ear. This figure was based on the results of a questionnaire answered by forty-six public residential schools for the deaf. In the same year, 1945, an audiometric survey at the Illinois School resulted in the estimate that about 60 per cent of the pupils were capable of benefitting from training with electrically amplified speech.[18] Ewing[19] placed his estimate

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[15]Guilder, and Hopkins, op. cit., p. 69.

[16]Wright, op. cit., p. 211.

[17]Johnson, op. cit., pp. 279-295.

[18]Johnson, E., "Ability of Pupils in a School for the Deaf to Understand Various Methods of Communication,"

at 72 per cent.

Goldstein[20] noted widespread agreement about the proportion considered able to benefit. During the decade from 1920 to 1930 it was generally estimated that 30 per cent of all deaf pupils could benefit from auditory training. Goldstein was among the first to put into practice the idea that all pupils should be given auditory training. Since the founding of Central Institute for the Deaf, the nationwide trend has been toward making acoustic training available for all pupils.

One flagrant defect is apparent in the practice of classifying pupils by proportions of a total population. This method utilizes the statistical approach, and the proportions were obtained through studies of relatively large groups of pupils. In the classroom, where auditory training is applied, small numbers of pupils are dealt with and individual differences will loom large. It is unsound practice to apply to small groups standards achieved from studies of large numbers of persons.

Amount of Residual Hearing.--Before the development of the pure tone audiometer, and even at the present time, subjective judgments constitute one of the best ways for

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American Annals of the Deaf, 93:194-213, 1948.

[19]Ewing, and Ewing, The Handicap of Deafness, p. 233.

[20]Goldstein, Problems of the Deaf, p. 217.

experienced testers to estimate the hearing loss of young deaf children. A trained person can learn much by observing the child's reactions to speech and environmental noises and by listening to his voice quality.

Ability to hear vowels was one of the earliest, most commonly employed methods to determine whether a deaf person possessed enough hearing to warrant acoustic work. But this method cannot be relied upon in the case of persons unused to listening to sounds. For this reason Gillespie, Urbantschitsch, Ewing and Ewing and others have recommended repetition of the stimuli before decisions are made about amount of residual hearing.

Observations of nystagmus reaction in which eye movements occur in response to sound has been used to assess hearing, but the condition of the semi-circular canals determines this reaction. Goldstein recommended the presence of the nystagmus reaction as enough encouragement to proceed with acoustic work. Electroencephalograph and galvanic skin response techniques have recently shown promise as objective tools for evaluating hearing.

Measurement of residual hearing is the most widely used present day criterion for classification of children for auditory training. Many investigators became convinced that the classifications "deaf" and "hard of hearing" were too general. They pointed out that great differences in residual hearing existed among children who were all

classified as deaf because their hearing was non-functional for communication in daily life.

In 1892 a committee, consisting of Bell, Gordon and Clarke, appointed by the Third Convention of Articulation Teachers to investigate auditory training stressed the need for an instrument to test hearing accurately. The committee stated:

> Perhaps at some time in the future we may find a test of hearing such that we can say, all who come up to a certain point by this standard can be taught by the ear, and it is useless to waste time on those who do not. At present there is no such test.[21]

Although pure tone audiometry did not provide quite the conclusive information the committee had hoped for, its development furnished more accurate information about degree of loss than had been available previously. Day, Fusfeld and Pintner[22] believed that audiometry furnished appropriate information for selection of pupils for auditory training as well as for other "parts of the school's curriculum."

The development of pure tone audiometry made it possible to discuss in a quantitative context the various aspects of an auditory training program, such as the aims and the groupings of children. Investigators were now able to refer statements about auditory training to pupils

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[21]Gordon, op. cit., p. 140.

[22]Day, H. E., Fusfeld, I., and Pintner, R., A Survey of American Schools for the Deaf, Washington, D. C.: National Research Council, 1928, p. 289.

of specified quantitative auditory status. Descriptions of pupils according to specific types and degrees of hearing loss were found to be of more value than generalizations about auditory training, per se.

LaCrosse,[23] after testing with a 3A audiometer, suggested that uniform tests and standards could be set up to measure hearing and decide what pupils could benefit from auditory training. In 1925, he proposed setting up three groups, Group one, consisting of pupils with 40 to 85 per cent of normal hearing, was to try to develop careful listening through ten minutes of exercise once or twice a day. Group two, made up of pupils with 15 to 40 per cent of normal hearing, was to have exercise according to individual need, to correct speech and build vocabulary. Group three, consisting of pupils with from 15 to as little as 5 per cent of normal hearing, was to receive acoustic exercises, but the objectives were not listed.

Because Barrett[24] dealt with both deaf and hard of hearing children in public schools, the first two groups in her classification consisted of children with losses of less than fifty decibels. Group three on her chart was made up of children having losses of fifty to sixty decibels. They were thought to be able to "obtain" some speech,

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[23]LaCrosse, E. L., "Auricular Training in the Wright Oral School," American Annals of the Deaf, 70:302, 310, 1925.

[24]Barrett, op. cit.

though the amount was uncertain. Group four, with losses of sixty to one hundred decibels, were to work for improved lip reading, speech patterns and voice quality.

Myklebust's[25] least handicapped group was comprised of children with losses up to seventy-five decibles "in the speech range." The aim for these children was the development of comprehension through the ear with the use of amplification. Acoustic training was to be the predominant educational approach for these children. O'Connor[26] agreed that the first group should include children with relatively severe losses. He stated that there are few children with an average loss of less than 40 per cent of normal hearing to be found in schools for the deaf.

The aim for Myklebust's second group, consisting of children with losses of seventy-six to eighty-five decibels in the speech range, was the development of comprehension through the ear. Considerable variation in the amount of success was expected.

The goal of the third group, made up of pupils with losses of ninety to ninety-four decibels, was improvement in listening to supplement lip reading and speech training. Only some of these "borderline acoustic" pupils

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[25]Myklebust, H. R., "The Use of Individual Hearing Aids in a Residential School for the Deaf with Implications for Acoustic Training," American Annals of the Deaf, 88: 256, 1943.

[26]O'Connor, Volta Review, 40: 711, 1938.

could be expected to respond successfully to auditory training although the auditory approach was to be predominant until degree of response could be determined.

The last group was to consist of children with losses of ninety-five to one hundred decibels and they were to have acoustic training only incidentally to other methods. Hearing for words was expected only in rare cases where the pupil retained some sound pattern from the time prior to the onset of deafness. Myklebust stated that this last group constituted 37 per cent of the population of one school for the deaf.

O'Connor agreed quite closely with Myklebust, stating that usually less than 40 per cent of the population would have losses so great that no appreciable ability to discriminate meaning through the ear could be developed. With the advent of improved instrumentation for amplification Myklebust believed that re-evaluation of grouping and objectives was necessary. He prepared the chart mentioned above to fill this need. It is interesting to note that the tables grouping children according to hearing loss expressed in decibels sometimes neglect to specify the frequency at which the loss was measured.

Guilder and Hopkins[27] recommended studies of auditory function, through pure tone and speech audiometry as the basis for classification of pupils for auditory

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[27]Guilder and Hopkins, op. cit., p. 71.

training. They felt it was practical to obtain an objective score by the following method: add the pupil's test hearing for each of eight frequencies; divide by the figure denoting total loss for serviceable hearing at each frequency; multiply by 100; and subtract the resultant from 100. They believed this formula could be used to divide pupils reasonably well into classroom groups. It was their opinion that this sort of grouping would help the children use their hearing to best advantage. These investigators regretted that only a few schools, notably the Mt. Airy School and Central Institute for the Deaf, were trying to use residual hearing as the basis for classroom division at the time of writing (1936).

At least some of the formulators of charts classifying children by loss in decibels seemed to stress that the tables were intended as guides to probable results, not as efforts to label some children as unfit subjects for auditory training. Average objectives and achievements were charted, but there was no intention to preclude efforts to attain better results.

Expression of extent of residual hearing in terms of per cent of normal hearing reduced the value of some classifications. This form of expressing the amount of residual hearing is useless unless the method of determining percentage of normal hearing is described.

Utley, Braly and Harris disagreed with the popular

opinion that loss in decibels is a fit criterion for grouping of pupils for auditory training.

> In the past it has been assumed that some pupils could and some could not profit from acoustic work. Further, it has been assumed that we could determine the limits of these benefits. It was thought that by means of residual hearing and short trial periods we could select those pupils who could respond to aural stimulation sufficiently to make it worthwhile.[28]

For them the problem was not one to be stated in terms of classification of pupils at all, but in terms of finding the type of amplification and training which would be of most help to each pupil.

Classification of Hard of Hearing Children for Auditory Training

Because the hard of hearing child has been defined as one whose hearing, with or without a hearing aid, is functional in communication, it has been generally accepted that all the objectives of auditory training can be accomplished for him. Therefore, much less classification of hard of hearing children has been done. This may be due in part also to the dispersion of hard of hearing children, who are less often than deaf children gathered into special schools dealing exclusively with their problems.

It is likely that all the criteria suggested as suitable for classifying deaf children have been used in

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[28]Braly, Utley, and Harris, op. cit., p. 325.

various places at different times to determine extent and type of program for hard of hearing children. With the hard of hearing child, as with the deaf child, consideration of amount of residual hearing has been the most frequently used criterion for classification.

Charts listing aims and place in the curriculum of auditory training for hard of hearing children grouped according to hearing loss are seen less often in the literature than are tables giving similar classifications for the deaf. Barrett[29] listed children with losses of less than thirty decibels in the least handicapped group. These pupils were considered capable of attaining all the objectives usually set for auditory training, speech correction, educational acceleration, psychological improvement and improvement in listening coordinated with lip reading. The second group, those with losses of thirty to forty decibels, were to be helped particularly with respect to speech development and voice placement.

Hard of hearing children are sometimes divided into three groups for auditory training--slightly, moderately and severely hard of hearing.

The Place of Auditory Training in the Curriculum of Schools for the Deaf

Investigators considered the problems of classification of pupils for auditory training before they turned

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[29]Barrett, op. cit.

their attention to the question of the place auditory training should hold in the curriculum of schools for the deaf. When they did approach this problem they used several ideas parallel to those which had influenced the classification of pupils for auditory work.

Amount of Residual Hearing.--The idea was first expressed in the early part of the nineteenth century that pupils with a certain degree of residual hearing should have daily auditory training. Itard, Lehfeld and Gillespie were among early workers who suggested that schools provide acoustic training for pupils with sufficient residual hearing to benefit. As has been indicated previously, the charts grouping pupils according to hearing loss expressed in decibels contain evidence that amount of residual hearing has been regarded as a suitable criterion for determination of the place of auditory training in the curriculum.

The Short Daily Period.--The idea that auditory training should be presented in short periods set aside exclusively for acoustic work has greatly influenced the history of education of the deaf. Until recently the usual procedure in most schools has been to present listening training in short periods of from fifteen minutes to an hour daily or on alternate days.

Gillespie used an "Audiphone" half an hour daily to train the hearing of pupils in the Nebraska School for

the Deaf. Goldstein recommended a ten minute period of stimulation with musical instruments in addition to a considerably longer period of acoustic speech work. These procedures appeared to have involved a greater length of time than the typical periods devoted to acoustic work before the late 1930's. At the Wright Oral School in 1925 pupils "having 40-85% of hearing" were given ten minutes of exercises once or twice a day with the aim of developing careful listening.[30] Barrett[31] reported that the deaf and hard of hearing children in the Chicago Public Schools were given "about 25 minutes" of multiple hearing aid work daily in 1945.

Urbantschitsch[32] was among the first to criticize the policy of presenting acoustic stimuli in short periods. He suggested that frequently efforts to train residual hearing were not continued over long enough periods of time to achieve results or provide evidence for prognosis. It has been observed many times since that residual hearing sometimes becomes apparent only after weeks or months of training.

In the late 1930's the idea that acoustic training should be given in short daily periods began to be critically examined in light of the objectives of the program. Guilder

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[30]LaCrosse, op. cit.

[31]Barrett, op. cit., p. 281.

[32]Urbantschitsch, op. cit., p. 19.

and Hopkins[33] reported in 1936 that formerly auricular training had been given in a fifteen minute period set apart exclusively for listening. Later when the seeing and hearing method of education came to be widely used in oral schools to teach all pupils, auditory training was given concurrently with all other school work.

O'Connor[34] indicated that by 1937 many schools for the deaf were using auditory training all day to supplement lipreading. Johnson[35] reported that in 1942 group and individual aids in forty-six public residential schools were available to 37 per cent of the pupils for more than half their academic time and to 26 per cent of the pupils for all their academic time.

Braly, Utley and Harris[36] were among those who believed that short daily, or less frequent, practice periods yield only slight results. They emphasized the value of constant stimulation with all of the sounds of the classroom as well as natural language. In their opinion it constituted

> The essential part of a full-time acoustic schedule.

Ewing and Ewing[37] agreed with the opinion that short daily

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[33]Guilder and Hopkins, op. cit., p. 69.

[34]O'Connor, C. D., "Speech, Acoustic Training and Related Problems," Volta Review, 39:267-270, 1937.

[35]Johnson, O. W., op. cit.

[36]Braly, Utley and Harris, op. cit., p. 325.

[37]Ewing and Ewing, The Handicap of Deafness, p. 226.

periods of stimulation are insufficient to achieve the numerous objectives of an auditory training program. They thought the deaf child should have opportunity to listen through amplification equipment to conversation and class discussions. They described the latter as the most valuable source of complete words and sentence patterns for the severely deaf child. Restriction of listening to a few minutes a day would defeat their aim for acoustic work, interpretation and assimilation of all audible sounds.

Numbers believed that acoustic work should not be given in a short daily period only. She feared that auditory training had been regarded as a minor activity in many schools. She reviewed the common complaint the schedule is so crowded with subjects needing to be taught that some educators have felt there is not time for extensive work in auditory training. She maintained:

> Auricular training is not a fad nor an addition to our program, but a means to an end. We cannot train residual hearing effectively if we think of it as an extra activity.[38]

Myklebust[39] experimented to see how long listening practice must be sustained to train hearing most effectively. He provided evidence that the short daily period is insufficient for optimum training of hearing. He used forty hard of hearing children as subjects. The subjects were fitted

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[38]Numbers, M., "Using the Hearing of Children so Deaf they Entered School Speechless," Volta Review, 39:133-137, 1937.

[39]Myklebust, American Annals of the Deaf, 91:256, 1946.

with aids and they used them daily for long periods in various situations from one to three years. Discrimination and speech comprehension tests were given periodically. Increased ability to discriminate and comprehend speech occurred throughout the first year during which an aid was used. Myklebust concluded that on the average at least one year of constant acoustic stimulation is required to establish a sound pattern. Though the subjects of this experiment were hard of hearing children, it would seem that deaf children also must require long exposure to sound to be able to utilize it as effectively as possible. There is little further evidence on the length of training required to train hearing most effectively.

View of Auditory Training as a New Type of Curriculum.--Recently some investigators have regarded auditory training as a method of education which constitutes a new type of curriculum.

E. Johnson, Goldstein, Jones and others have referred to the acoustic or auricular "method of education" as differentiated from the oral or manual methods. Schools have been organized into manual, oral or acoustic classes. Goldstein, in titling his work on auditory training The Acoustic Method, stated that this method was to be distinguished from the oral and manual methods of instruction. The implication was that an entirely different system of education was to be presented. However, nowhere does this

work indicate that the tools which are used in oral schools to teach speech reception and expression can be replaced by the use of amplified sound.

An illustration of the current enthusiasm for auditory training is provided by O'Connor's[40] statement that all pupils should have access to a group or individual aid during all their academic time for at least the first five years in school. Many other investigators agree that every young child should be given the benefit of doubt about his auditory status and a chance to learn to listen more effectively. But O'Connor did not claim that use of amplified sound could accomplish any but the most limited objectives for some deaf children. Fear has been expressed that those who are not thoroughly familiar with the basic speech and language problems of the deaf child will not realize the limitations of auditory training. They may think that auditory work can be relied upon to replace necessary instruction.

Reiter[41] also expressed concern that auditory training may be regarded as a distinct method of education. This concern lead him to title the eighty-second annual report of the principal to Members of the Corporation of the Clarke School for the Deaf "Hearing Aids not a Substitute for Lack of Hearing." He was alarmed with the growth of the idea that

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[40] O'Connor, Volta Review, 40:710-717, 1938.

[41] Reiter, F. H., "Hearing Aids Not a Substitute for Lack of Hearing," American Annals of the Deaf, 95:249-253, 1950.

puting a hearing aid on a deaf child could preclude his need for special education. He stressed that deaf children can be taught only through special methods and procedures.

The auditory training program of the Lexington School for the Deaf has been outlined by O'Connor[42] and a committee of teachers. This outline makes it clear that auditory training at that school occupies an important place in the curriculum. But it is evident also that the limitations of auditory training are realized.

The auditory training program at this school is divided into four categories by type of activity. Listening and association training is presented in the four activities listed: gross sound work, music work, speech development and correction, and language growth. This acoustic program aims to provide an overall program integrated with the course of study of the school. The principle is to present acoustic activities to fit the auditory capacity of every pupil. The rationale behind this approach to auditory training seems to be that acoustic work is most effective and meaningful when coordinated with the regular program of the school.

Silverman[43] and Reiter agree that training in listening is properly regarded as a technique, and not a

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[42]O'Connor, C. D., "The Utilization of Residual Hearing," New York, Lexington School for the Deaf (mimeographed).

[43]Silverman, S. R., Personal interview.

type of curriculum. They stress that auditory work be used in conjunction with, but not instead of, lip reading, language and speech work.

CHAPTER V

THE USE OF AMPLIFIED SOUND IN AUDITORY TRAINING

The formulation of principles basic to the use of amplified sound had to await the invention of the vacuum tube. Until that time a variety of instruments were used to produce or amplify sound. The early workers interested in acoustic work would have agreed with Gillespie's statement that he believed in using ear trumpets, "Audiphones" or any other "artificial aid to speech and hearing."[1] Because electrically amplified sound is the most popular medium for auditory training it is well to consider desirable characteristics of sound systems.

Maximum Acoustic Output.--Investigators seeking to establish the desirable characteristics of sound systems have considered maximum acoustic output, which may be defined as the intensity level beyond which a sound system will not further amplify. Maximum acoustic output is related to tolerance for sound.

Discussion of tolerance involves the concept of the auditory area, or area available for hearing. Wegel[2]

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[1]Gillespie, op. cit., p. 189.

[2]Wegel, R. L., "Physical Data and Physiology of Excitation of the Auditory Nerve," Annals of Otology, Rhinology and Laryngology, 41:740-799, 1932.

suggested that there is not only a threshold of audibility marking the lower limit of the auditory area, but also an upper limit, a threshold marking the maximum intensity at which sound can be tolerated. Silverman, et al.[3] indicated that Wegel may have had some conception of what might be called the dual nature of this upper limit of the auditory area. Wegel tried not only to measure the intensity of sound at the limit of tolerance, in decibels, quantitatively, but also suggested that the sensation experienced could be described qualitatively.

The upper limits of the usable auditory area are now regarded as the three thresholds of discomfort, tickle and pain. Davis stated that:

> . . . For the average listener tones become uncomfortably loud, begin to tickle, and begin to hurt at about 120 decibels, 130 decibels and 140 decibels, respectively, regardless of their frequency.[4]

Silverman, et al.[5] reported that thirty hard of hearing subjects representing a fairly well balanced distribution of clinical types were systematically exposed to loud sounds. The subjects listened to pure tones and speech and reported at what point they experienced discomfort, tickle and pain.

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[3]Silverman, S. R., Lane, H. S., and Harrison, C. E., Tolerance for Pure Tones and Speech in Normal and Hard-of-Hearing Ears, Report No. 6303, Office of Scientific Research and Development, St. Louis: Research Laboratory, Central Institute for the Deaf, 1946, pp. 1-95.

[4]Davis, et al., Hearing and Deafness, p. 43.

[5]Silverman, et al., Tolerance for Pure Tones and Speech.

Systematic elevation of thresholds for pure tones and speech for both normal and hard of hearing listeners was reported. The ultimate levels for discomfort for speech for normal and hard of hearing subjects, respectively, were 129.5 and 130 decibels.[6] Considerable retention of tolerance for speech occurred. It was concluded that tolerance may be developed by exposure to loud speech at a level just below the threshold of discomfort for several minutes a day every three or four weeks. The investigators concluded:

> . . . The high level of tolerance thresholds reached experimentally suggests that there is an approachable and potentially useful portion of the auditory area beyond the range of present audiometry. Consequently, some individuals who have heretofore been termed "totally deaf" as a result of audiometric tests might be reached by auditory stimulation through properly designed apparatus.[7]

The use of auditory training to raise the limits of tolerance and increase the auditory area is a recently accepted idea in the use of amplified sound. It found practical application in the suggestion that the maximum acoustic output of an individual hearing aid need no lobger be permanently set at 120 decibels or lower. Some hearing aids now provide for a gradual increase in the maximum acoustic output to the point of 130 decibels, shown to be the practical level of tolerance.

The question whether exposure to intense sound might

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[6] Ibid.

[7] Ibid., p. 39.

have a deleterious effect upon hearing was raised. The suggestion was made that in raising the tolerance thresholds at the upper boundary of the auditory area through exposure to loud sound the threshold of audibility at the lower limit of the auditory area might be raised. Silverman, et al. stated that this fear was unfounded. Exposure producing the greatest elevation of tolerance thresholds caused at most only a slight temporary rise in the threshold of acuity.

It was suggested that the ears of hard of hearing persons might be less or more "tender" than those of normally hearing people. In case hard of hearing persons' ears were more "tender," auditory training might be injurious. Silverman, et al. indicated that all the hard of hearing subjects exhibited less temporary hearing loss following exposure to loud sound than did the normal listeners.

The problem of limiting the output of a hearing aid was considered in relation to tolerance levels. The peaks of intensity of sound may rise uncomfortably far above the average level of intensity. Two general approaches have been made to the problem of limiting output above a designated intensity level. "Peak clipping," or cutting off the tops of peaks of intensity, was the first generally used approach. An objection to peak clipping is that an incomplete sound wave is transmitted.

Another approach to limiting output is compression amplification. Because some hard of hearing persons can

use only a fairly narrow range of the auditory area it was suggested that all sound be compressed to fit within this usable range. Davis described compression amplification as "equivalent to an instantaneous automatic volume control."[8] This method of limiting output causes less distortion of wave form than does peak clipping.

It appears that automatic volume control must be carefully used. If the objective of auditory training is speech improvement, particularly improvement in articulation, then automatic volume control might make discrimination easier and improve articulation by delivering sound of greater intensity. But if the aim is to improve speech rhythm with severely deaf children, extreme compression might be useless. It could reduce the differences in intensity greatly enough to destroy the information carried by dynamic stress patterns.

Very recently compression amplification was incorporated into an individual aid, which necessitated making the aid somewhat larger. This increase in size is the first reversal of a trend to make aids smaller and less conspicuous. It indicates that performance characteristics are being considered of primary importance by some manufacturers.

Selective Amplification.--The idea that the most desirable sound system would be "fitted" to the hearing loss of the individual auditor became popular in the decade

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[8]Davis, et al., Hearing and Deafness, p. 200.

from 1930 to 1940. The theory of selective amplification proposed amplifying sound at the various frequencies in proportion to the loss, or "mirroring the audiogram." This theory has apparent face validity.

Recently the theory of selective amplification has been critically examined. Davis, et al. stated:

> The subject's audiogram if interpreted according to the prevalent rule of "mirroring" the slope of the audiogram "in order to restore the patient's hearing to normal" is often definitely misleading.[9]

Among the objections to the theory of selective amplification listed by these investigators is the fact that the audiogram is a measure of how well the ear functions at threshold. Hearing at a comfortable listening level would be a more realistic criterion by which to judge auditory function.

Recruitment, or disperportionate increase of loudness with intensity, is another factor to be considered. In some cases the hearing loss is indicated by an abrupt slope of the audiogram curve. If efforts are made to compensate exactly for the loss, recruitment and distortion will occur. Then too, peaks of speech will be clipped off if speech is so greatly amplified that the limits of maximum acoustic output are reached quickly.

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[9]Davis, H., Stevens, G. E., and Ross, D. A., Hearing Aids, and Experimental Study of Design Objectives, Cambridge, Mass.: Harvard University Press, 1947, p. 103.

Davis, et al.[10] tested the theory that "fitting" a hearing aid by selective amplification provides optimum performance. The subjects were eighteen hard of hearing listeners with various kinds of typical audiograms. The subjects' hearing was tested through a "master hearing aid" capable of furnishing desired frequency responses, to assess ability to discriminate. Several types of frequency response were represented. The flat response provided high fidelity response, with a plus or minus one decibel deviation from 100 to 7,000 cycles per second. The High-Pass 6 setting produced relative suppression of the low frequencies with a smooth rise at the rate of 6 decibels per octave from 100 to 7,000 cycles, while High-Pass 12 produced a 12 decibel rise per octave over the same frequency range. The Low-Pass 6 setting gave a 6 decibel decrease in intensity per octave and Low-Pass 12 produced a 12 decibel decrease in intensity per octave in the same frequency band.

Davis, et al. stated that on the basis of this experiment either the Flat or High-Pass 6 pattern was the first choice for every ear. If the High-Pass 6 frequency response had been prescribed for all the subjects of the experiment, there would have been 92 per cent of optimum performance. The two subjects who would not have achieved maximum scores with the High-Pass 6 setting would have done so with the Flat pattern. If the theory of selective

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[10] Ibid.

amplification had been correct, those subjects with sloping audiograms would have had optimum performance with frequency responses mirroring their audiograms. The investigators included quality perference tests and the majority of the listeners preferred the Flat pattern.

It has become widely believed in recent years that extensive tests and fittings are unnecessary in the selection of an aid. Davis, et al. stated:

> There is at present no experimental or adequate clinical validation in terms of some independent criterion (such as articulation scores, quality judgments or patient's preferences) for the method of residual hearing loss as a basis for selection.[11]

Emphasis in the use of amplified sound has shifted from "fitting" the individual ear to designing and constructing sound systems with better performance characteristics.

In order for engineers to design effective amplification equipment it is necessary for them to know what specifications are desirable. Harrison[12] and Watson and Watson[13] have suggested that teachers, physicists and manufacturers should cooperate in drawing up specifications.

Gain.--The gain of a sound system is the amount of amplification it provides. Standards for amount of gain required in amplification equipment have been set up in a

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[11]Davis, H., Stevens, S. S., Nichols, R. H., Jr., Hudgins, C. V., Marquis, R. H., Peterson, G. E., Ross, D. A., "The Selection of Hearing Aids," The Laryngoscope, 56: 87, 1946.

[12]Harrison, C. E., Personal interview.

[13]Watson and Watson, op. cit., pp. 261-266.

general way by the Council of Physical Medicine and Rehabilitation of the American Medical Association, which approves only instruments with a gain of at least thirty decibels.

Noise.--Inherent and external noise are factors which must be considered in use of amplified sound with auditory training. Harrison[14] recommended that the inherent noise of a group instrument be sixty decibels below the signal. Noise in the room influences the proper utilization of sound by users of aids, but little work has been done to set up standards to measure the effect on auditory training of various acoustic environments.

Mechanical Factors.--Children wearing individual hearing aids are often annoyed by the mechanical properties of their aids. Thirty-five of the thirty-eight children interviewed by Gates and Kushner[15] reported irritation with the size, weight and discomfort of using individual aids. These investigators reported, however, that none of the thirty-eight children rejected an aid because of mechanical annoyances alone.

Group aids are often large and awkward. Teachers have complained that the equipment takes up too much space. The children get tangled in the wires connected to the earphones, which necessitates frequent repair. These factors may seem trivial, but many experienced investigators,

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[14]Harrison, C. E., Personal interview.

[15]Gates and Kushner, op. cit., p. 16.

including Silverman,[16] hold the opinion that they are sometimes an influential factor in determining how much use is made of amplification equipment.

Simplification of controls has been found desirable. The most satisfactory form of microphone has been found to be a microphone suspended from the ceiling with non-directional pick-up.

The Place of Amplified Sound in Auditory Training.--The role of amplification as a tool in teaching is sometimes misunderstood. Emphasis upon equipment has become so great that amplification is sometimes thought of as synonymous with auditory training. The danger in this notion is that attempts may be made to solve the deaf child's educational problems entirely by giving him a hearing aid.

It is more plausible to suggest that children who developed speech before the onset of deafness and still retained discrimination for sound might solve their sound reception problems completely by using an aid. Whitehurst[17] indicated that use of an aid without auditory training is not conducive to maximum speech reception even with adults. From her experience in Hoff General Hospital with men who lost their hearing in the second World War, she stated that even those men who adjusted quickly and easily to aids and those with losses too slight to warrant the use of an aid

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[16]Silverman, S. R., Personal interview.

[17]Whitehurst, M., "Auricular Training is Here to Stay," Volta Review, 48:149-150, 1946.

profitted by auditory training.

Carhart[18] maintained that every user of a hearing aid can benefit by auditory training. Davis, et al.[19] stated that regardless of frequency response of an aid, auditory training is and will continue to be important for the severely hard of hearing. Caziarc[20] believed that the key to the successful "fitting" of hearing aids at Hoff General Hospital in Wordl War II was due not to any work done in a sound laboratory, but rather to auditory training.

Preparation for Using a Hearing Aid.--Psychological and educational preparation for using an individual hearing aid has been stressed as an essential part of a program designed to facilitate most satisfactory use of an aid.

It has been noted that adults frequently choose an aid which does not provide the frequency response giving optimum performance. Adults sometimes show a need for instruction in appreciation of the sounds of speech. It appears that hard of hearing children could benefit from the same type of instruction.

Advance information about performance limitations and mechanical annoyances may save a new aid user much

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[18]Carhart, R., "Tests for Selection of Hearing Aids," The Laryngoscope, 56:792, 1946.

[19]Davis, H., Stevens, S. S., Nichols, R. H., Jr., Hudgins, C. V., Marquis, R. J., Peterson, G. E., and Ross, D. A., Hearing Aids, an Experimental Study of Design Objectives, Cambridge, Mass.: Harvard Univ. Press, 1947, pp. 1-192.

[20]Caziarc, D. R., "It Can be Done for Civilians," Hearing Survey Quarterly, 1946, p. 43.

disappointment. Gates and Kushner[21] recommended a period of guidance and advance information to make the physical adjustment to an aid easier.

Gates and Kushner showed that psychological preparation for the use of an individual hearing aid influences acceptance of the instrument by hard of hearing children. They reported that the one child in three who rejected his aid was the child who was not well informed about the use and values of the aid and who was unwisely treated by parents, friends and teachers when beginning to use the instrument.

Gates and Kushner suggested several ways to prepare children for the use of a hearing aid. They proposed that bulletins, perhaps issued by hearing aid companies, be distributed to tell purchasers how best to use aids in various situations, such as dancing or playing games. Group discussions with other children beginning to use aids and counseling with persons familiar with the problems of deafness were recommended. Advice to parents and teachers in meeting the problems caused by the hearing loss was suggested. The formulation of this list of recommendations indicated that the investigators believed little work has been done in educational and psychological preparation for aid using with children.

Morkovin[22] stressed that users of hearing aids should

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[21]Gates and Kushner, op. cit.

[22]Morkovin, op. cit., p. 31.

have positive psychological direction so the shock of using the instrument may not aggravate the trends toward maladjustment sometimes found in the hard of hearing. Davis, et al.[23] stated that psychological factors should be carefully handled in the case of every patient.

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[23]Davis, et al., Laryngoscope, 56:162, 1946.

CHAPTER VI

EVALUATION OF AUDITORY TRAINING

In the long run, the significance of auditory training in the educational program for hearing handicapped children will depend on a thorough-going evaluation of results. In this chapter the problems related to techniques and principles of evaluation will be discussed. Evaluation will be discussed in terms of the objectives of auditory training.[1]

Evaluation of Improvement in Lip Reading

A valid, reliable test to measure lip reading ability is essential for objective measurement of progress. A multitude of problems stand in the way of the development of suitable tests.

Norms.--The complete lack of norms makes lip reading ability particularly hard to evaluate. Reid[2] recognized the complexity of this problem by proposing that norms designate

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[1]It will be recalled that these aims are improvement in lip reading, academic acceleration, improvement in speech, psychological improvement, and increase in hearing vocabulary.

[2]Reid, G., "A Preliminary Investigation in the Testing of Lip Reading Achievement," American Annals of the Deaf, 91:403-413, 1946.

what constitutes adequate lip reading ability under a variety of conditions,

Validity.--Day, Fusfeld and Pintner[3] first used sentences as lip reading test material. They believed that sentences had high face validity. Utley described a technicolor motion picture with pauses in the film to give the observer time to record answers. This form of test uses contexts which reflect familiar life situations. Utley believed:

> The validity of the test was established by its logical derivation as a representative work - sample from everyday life.[4]

Use of material suitable to pupils of every age group as well as every walk of life has been considered essential to a valid test of lip reading. Effots are being made to construct a series of tests covering all age levels past three years.

Many workers have observed that some lip readers apparently can grasp more from a situation than others. Such situational clues as expression, gestures, environment and bodily movements seem to be of greater help to some lip readers than others. Some pupils may appear to be lipreading more than they actually are. In order to eliminate the

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[3]Day, H. E., Fusfeld, I., and Pintner, R., A Survey of American Schools for the Deaf. Washington, D. C.: National Research Council, 1928, pp. 1-289.

[4]Utley, J., "A Test of Lip Reading Ability," Journal of Speech Disorders, 11:116, 1946.

influence of situational clues motion picture tests showing only the lower portion of the face have been used. Reid[5] described a test of ability to lipread single speech elements and sentences. The question can be raised whether situational clues were reduced to the point of unreality. Furthermore, single vowels and consonants are not found in speech outside of context.

Johnson[6] criticized the rationale behind presenting lip reading tests silently. She believed that tests of ability to hear and lipread simultaneously would be more realistic and meaningful than the usual tests of lip reading alone. Johnson commented on the lack of tests making use of a combination of the two abilities. Her opinion was that it is relevant to measure ability to lip-read in silence only for those too deaf to benefit from any of the rhythms of speech. Only such persons will be forced to rely on lip reading alone. Proponents of silent lipreading tests would object that only assessment of lip reading ability is being sought, and other factors should be excluded.

Reliability.--More evidence has been presented to substantiate the claim that reliable tests of lip reading can be constructed than has been presented to indicate

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[5]Reid, op. cit., p. 412.

[6]Johnson, E., "Ability of Pupils in a School for the Deaf to Understand Various Methods of Communication," American Annals of the Deaf, 93:194-213, 1948.

validity. Heider[7] reported a correlation of 82 plus or minus .03 for a motion picture test of forty-three children tested at an interval of one year. Utley[8] reported even higher reliability for a technicolor motion picture test. She stated that the coefficient of reliability for the entire test was .943, which she considered high internal reliability.

Scoring.--Mason[9] stated that many workers score lip reading tests consisting of sentences by marking the sentence either right or wrong. She suggested that a more exact idea of progress over a period of time could be obtained if the tests were graded word for word.

Other Variables.--Evaluation of the influence of auditory training upon lip reading ability necessitates control of several additional factors. These include the method of presenting lip reading material, type of material, length of instruction, amount of hearing of the pupils, mental ability and language ability of the pupils and individual differences in aptitude for lip reading.

Little experimental work has been done to evaluate the improvement in lip reading following auditory training.

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[7]Heider, F., "Studies in the Psychology of the Deaf," Psychological Monographs, 52:124-153, 1940.

[8]Utley, op. cit., pp. 109-116.

[9]Mason, M., "Objective Scoring in Tests of Visual Hearing," Volta Review, 39:576-593, 1937.

Johnson[10] tested the lip reading ability of 102 children at the Illinois School who had had auditory training with a test consisting of sentences. Average score when a hearing aid was used was eighty-three points. When it was not used, the average score was sixty-four points.

Heider[11] compared the lip reading ability of a group of children who had been given auditory training and a group who had not. The test was presented with silent motion pictures, a manner of presentation which would seem likely to penalize the children who had learned to listen while they lipread and favor those who had never depended upon sound. The average score of the children who had auditory training was fifty. The children who had not had auditory training made a mean score of thirty-eight. Heider did not show that the two groups had received comparable lip reading instruction or that the other variables mentioned above were controlled.

Johnson[12] stated that the manual, acoustic and oral pupils of the Illinois School for the Deaf differed greatly in lip reading ability though they were described as roughly comparable in intelligence and hearing experience

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[10]Johnson, E., "Testing Results of Acoustic Training," American Annals of the Deaf, 84:223-233, 1939.

[11]Heider, F., "Acoustic Training Helps Lipreading," Volta Review, 45:135, 1943.

[12]Johnson, American Annals of the Deaf, 93:194-213, 1948.

before onset of deafness. Lip reading proved to be two and one-half times as efficient a method of communication for the acoustic pupils as for the oral group. The lip reading ability of the oral pupils was so inferior to that of the acoustic pupils that Johnson recommended auditory training for all oral pupils with any residual hearing. Johnson did not mention the degree of difference or the type of instruction given both groups.

Silverman[13] believed that although many problems remain in the field of evaluation of lip reading ability, constructive approaches have been made to the problem of evolving new techniques.

Evaluation of Academic Progress Following Auditory Training

Standardized tests and experimental and control groups have been used to measure academic progress. Standardized tests of academic achievement are the most meaningful measurements for deaf and hard of hearing children because they provide comparison with the achievement of large groups of hearing children.

Evaluation by the use of control and experimental groups has been hampered by the scarcity of controlled acoustic programs. Myklebust[14] in attempting to make a general evaluation of the effectiveness of fifteen years of

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[13] Silverman, S. R., "Implications for Schools for the Deaf of Recent Research on Hearing Aids," American Annals of the Deaf, 94:325,339, 1949.

[14] Myklebust, H. R., "The Use of Individual Hearing

use of hearing aids in schools for the deaf reported that controlled acoustic programs had not been carried out in a standardized manner from school to school.

Teacher evaluation has continued to be the chief technique for assessment of academic progress in programs of auditory training. O'Connor[15] stated that two beginning classes entering Lexington School for the Deaf with losses of 40 to 60 per cent of normal hearing and no speech attained "at least a 50 per cent acceleration" over the average entering class.

Gates and Kushner[16] compared two groups of hard of hearing children with respect to academic progress. The group which continued to use aids had a much greater fund of general information at the end of a three year period. The school achievement of the pupils using aids increased consistently. Less tutoring was required by these pupils. No auditory training had been given either group, but children with slight losses in the aid group may have given themselves some training through incidental listening experience.

Numbers[17] discussed an experimental group of seven

Aids in a Residential School for the Deaf," American Annals of the Deaf, 88:270, 1943.

[15]O'Connor, Volta Review, 40:710-717, 1938.

[16]Gates and Kushner, op. cit.

[17]Numbers, op. cit.

children who entered school with no usable speech. This group was taught with groups aids during a large part of each day for four years. At the end of this period the children's educational quotients on the New Stanford Achievement Tests were relatively high. In the test for language ability the children using the group aids achieved nearly double the average gain for the school as a whole. Numbers did not state how this group compared with the school as a whole in intelligence or length of individual instruction.

Johnson compared acoustically, manually and orally taught pupils at the Illinois School for the Deaf. The pupils given systematic listening experience possessed more hearing than did the others, and they attained the greatest academic achievement. These pupils achieved a mean score of 88 per cent on form one of the Gates Survey of reading ability, compared with 60 per cent for the manual pupils and 68 per cent for the oral pupils. Those pupils receiving listening training were superior in reading achievement at all grade levels except the sixth. Johnson concluded:

> The more restricted the speech-hearing experience whether by reason of early onset of deafness, severe loss of acuity or lack of auditory training, the greater the retardation in reading.[18]

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[18]Johnson, E., "Ability of Pupils in a School for the Deaf to Understand Various Methods of Communication," American Annals of the Deaf, 93:194-213, 1948.

Since the subjects in the three groups were "roughly equal" in intelligence according to the Chicago Non-Verbal Examination, Johnson believed hearing experience had a greater effect on reading ability than did intelligence.

Fowler, Sr. described a study in which the Stanford Achievement Test was given to twenty-six pairs of children, matched for degree and type of loss, for behavior and "psychologically" after a three-year period during which one group used aids and the other did not. No statistically significant difference in scores on the Stanford Achievement Test was shown, but a trend toward better achievement for the aid users was indicated.[19]

Brill,[20] using an especially designed test of academic achievement, tested ninety children who became partially deaf before the age of six. The children were tested after a five-year period of education which did not include auditory training. Brill found their scores in achievement were scarcely greater than those made by severely deaf children. He believed the lack of auditory training was a possible cause of the lack of progress of children with some hearing. Since Brill did not know the influence of intelligence or language ability, he could not explain

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[19]Fowler, E. P., Sr., "The Value of Individual Hearing Aids for Hard of Hearing Children in Public Schools," The Laryngoscope, 56:26-32, 1946.

[20]Brill, R. G., "The Prognosis of Reading Achievement of the Deaf," American Annals of the Deaf, 86:227-241, 1941.

his results completely.

Evaluation of Psychological Improvement Following Auditory Training

Since the relative emphasis of the various aims of auditory training for deaf and hard of hearing children differ, it is well to discuss psychological improvement for each type of child in its own context. It has proved harder to assess psychological improvement for the deaf child, who often lacks the command of language and the vocabulary necessary to permit him to be tested by standard psychological tests. More interest has centered on evaulation of psychological improvement for hard of hearing children, not only because it is usually easier to measure, but also because the improvement resulting from using auditory training and amplified sound with hard of hearing children is more striking and readily apparent.

Evaluation of Improvement in Deaf Children.--The difficulty of measuring psychological improvement of deaf pupils is in part a function of the type of psychological improvement which is an objective of auditory training with deaf pupils. The main objective of psychological improvement through auditory training for these pupils is the development of a sense of being related closely to the world through experiencing environmental sounds. Urbantschitsch claimed that hearing some sound "humanized" the deaf. Ramadell described the coupling of the auditor with the

environment. It can be seen that it would be difficult to evaluate such psychological effects objectively or quantitatively.

Evaluation of psychological improvement for the deaf has been based largely on the subjective judgment of teachers. This is unfortunate as teachers are likely to have an emotional affinity for a particular method of instruction.

Evaluation of Improvement in Hard of Hearing Children.--Many investigators believe that the best way to evaluate psychological improvement following auditory training would be to apply standardized psychological tests. The variables mentioned as effecting evaluation of improvement in lip reading would also be influential here. Very little rigorous experimental work to assess the influence of auditory training has been done.

Stanton[21] described twenty-six pairs of hard of hearing children matched as nearly as possible for degree and type of hearing loss, for behavior and for psychological status. She did not elaborate the term "psychological." One child in each pair wore aids and the other did not. The aids were worn for three years, from 100 to 700 hours, but no formal auditory training was given the hearing aid group. After three years all the children were tested with Aspects of Personality and the Pupils Portrait Tests.

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[21]Fowler, op. cit., pp. 26-32.

There was no statistically significant difference between the two groups, but there was a "trend to improvement in social and school adjustment" in the group using hearing aids.

Gates and Kushner[22] applied the Bernreuter Personality Inventory to thirty-eight hard of hearing children in the New York City public schools. The children were all given hearing aids, but they did not receive auditory training. The children who continued to use their hearing aids made higher test scores than those who stopped using them, but the evidence from the Bernreuter test was regarded as not completely dependable.

Silverman suggested that atypical behavior of the compensatory type may be an index of hearing loss. It follows that removal of such traits as introversion and lying following auditory training should constitute evidence for psychological improvement. Using questionnaires and interviews Gates and Kushner determined that those hard of hearing children in a group of thirty-eight who used their hearing aids thought more realistically about future vocations than the children who rejected their aids did. These investigators found that the aid users engaged in more group activities after beginning to use aids. Parents and teachers counted fewer behavior difficulties among the aid using than among the aid rejecting groups.

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[22]Gates and Kushner, op. cit.

Gates and Kushner also suggested that the acceptance or rejection of the aid in itself may serve as an assessment of the social adjustment of the hearing aid user. These workers concluded:

> The one child in three, approximately, who refuses to continue to wear the hearing aid is the child who is not well informed about its uses and values and who is not wisely treated and advised by his parents, teachers and companions when he begins to use the instrument.[23]

Acceptance or rejection of hearing aids would evaluate what might be regarded as an inclusive auditory training program, one encompassing preparation for using an aid. Acceptance or rejection does not evaluate psychological improvement quantitatively, but Gates and Kushner believed it indicates whether the child could reach the point of security necessary to adjust socially to an aid.

Barrett[24] reported from her experience in the public schools that auditory training had improved the mental hygiene of both deaf and hard of hearing pupils.

Evaluation of Improvement in Speech Following Auditory Training

Hudgins and Numbers found that

> Speech errors and degree of hearing loss are highly correlated.[25]

If this is so, speech improvement following auditory training would indicate that the effects of the hearing loss

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[23] Ibid., p. 77.

[24] Barrett, op. cit.

[25] Hudgins, and Numbers, op. cit., p. 380.

were somewhat reduced.

It is difficult to determine what constitutes normal speech and to measure degrees of deviation therefrom. Furthermore, the quantification of speech intelligibility and maintenance of equivalent testing conditions present serious problems.

Methods of evaluating the rhythm of the speech of the deaf are little more objective than they were in Bell's day. The fluid nature of speech makes it particularly difficult to set standards for speech rhythm. Lack of measurement and emphasis upon articulation have combined to divert attention from the problems of assessing speech rhythm.

Hudgins and Numbers studied recorded speech samples of 192 pupils from two schools for the deaf. On the basis of judgments of untrained auditors it was found that:

> Partially deaf children who have had consistent and systematic training with hearing aids make fewer errors than those with the same degree of hearing loss who have not enjoyed this advantage.

Hughson, et al.[26] studied the speech of 366 children at the Pennsylvania School for the Deaf. One hundred eighteen had auditory training while 248 had not. The children were classified into three groups on the basis of acuity of the better ear. The first group consisted of children who could perceive at some intensity all tones from 128 to 21,048 cycles per second or higher. The second group consisted

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[26] Hughson, et al., op. cit.

of pupils who could perceive only tones from 128 to 1,024 cycles at some intensity. Those who could perceive no tones at the highest intensity of the audiometer, or at best only frequencies below 512 cycles per second, made up the third group.

The children read familiar words without practice from a list of words containing all the speech elements. Recordings of the speech of the children were made and judges studied the speech samples. The judges also listened to recorded speech of normal children of the same age level.

Speech rhythm was judged on the basis of syllable continuity and expression. The judges studied articulation with respect to explosiveness and audibility of initial consonants and holding, explosiveness and audibility of final consonants and of vowels.

The speech of the children who had had auditory training was judged to be more like normal speech than that of the other children. Vowel quality, general articulation and expression were particularly better. Hughson et al. concluded that amount of residual hearing apparently had "little or no bearing" on the speech response of the children who had not had auditory training. The speech of the children given auditory training continued to improve as long as the training continued. The speech of the other children did not improve steadily.

Numbers[27] attempted to apply a numerical rating scale to intelligibility. She stated that seven children who entered Clarke School with no speech, except for one with baby talk characteristic of a two-year old, were given four years of systematic training using group aids for a large part of each day with regular methods of instruction. All the pupils of the school were given speech tests, with judges rating breath control, speech rhythm and intelligibility on a point scale.

At the end of the four-year period the seven children in the experimental group ranked among the highest eighteen at the school with respect to intelligibility. Before the training they had been among the thirty-three highest. In use of breath control these seven children gained 40 points during the four-year period as compared with the school average of 12 points. Speech rhythm improved markedly for the experimental group. The seven children might have been selected for special training because they showed greater potentialities. If this were the case, the results might have been influenced by factors other than auditory training.

Myklebust[28] applied a rating scale to the voice quality, rhythm, rate, inflection, and intelligibility of the speech of twenty-one pupils of a school for the deaf

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[27]Numbers, op. cit., pp. 133-137.

[28]Myklebust, American Annals of the Deaf, 91:255-261, 1946.

who had worn hearing aids for periods of from one to three years. One point was allowed for slight improvement, two for moderate improvement and three for a great deal of improvement. Maximum improvement in all characteristics would yield a score of fifteen. The mean speech improvement scores ranged from 4.4 to 13.7 and the aggregage mean score was 9.8 with speech intelligibility showing the most improvement. Comparison with speech improvement scores of a control group would have increased the value of this study.

Johnson[28] reported that 102 deaf children who had had auditory training read ten unpracticed sentences to four college students not previously associated with the deaf. Points were given for perfect recording on each of the first two readings. The mean score was 63 per cent. There is a difficulty inherent in giving any speech intelligibility test in the manner Johnson described. The listeners, who had not been familiar with the speech of the deaf when they began listening, became progressively more familiar with it as the test continued. This factor may have favored judgments of the intelligibility of the speech of the last pupils to be heard.

Silverman[29] raised an objection to the frequently

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[28]Johnson, American Annals of the Deaf, 84:223-233, 1939.

[29]Silverman, S. R., "The Speech Program of Central Institute," Volta Review, 45:12-15, 1943.

used technique of asking a child to read a selection, with a listener indicating degree of intelligibility. Silverman felt that this situation was actually oral reading, giving no indication how well the child could speak when he wanted to speak spontaneously. He believed the use of memorized material could be criticized on the same grounds. He remarked that testing for speech intelligibility in an interview situation tends to favor the child, as the responses to questions of the interviewer can often be anticipated.

Silverman favored recording the child's speech with high-fidelity equipment without the child's knowledge. The teacher's part in the conversation may be deleted to remove contextual clues which would influence judgment of intelligibility. Silverman was aware of one escapable drawback to this method of testing. He realized that the child's ability to use language would influence the intelligibility of his speech.

Hudgins[30] agreed that recording spontaneous speech constituted a combined speech and language test. He preferred that the child read unrelated sentences. Hudgins stated that scores on tests made up of unrelated sentences correlated between .73 and .77 with teachers' rankings. He believed this indicated fairly high validity.

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[30]Hudgins, C. V., "Concerning the Validity of Speech Tests," Volta Review, 45:271-272, 1943.

Most workers would agree with this statement of Silverman:

> Evaluative techniques used periodically to measure speech progress and to determine individual speech difficulties have not yet attained the degree of objectivity comparable to that achieved in the subject matter and skill fields.[31]

Silverman suggested a supplement to periodic assessments of speech intelligibility. He believed it might prove valuable to try to ascertain the long-range results of measures designed to improve speech intelligibility. Silverman cited as an example the alumni correspondence program of Central Institute for the Deaf. Questionnaires are sent alumni asking how well their speech serves them in business and social situations. With the lack of objective methods of measuring, speech intelligibility may perhaps be evaluated most meaningfully at present in terms of satisfactory use to the individual.

Silverman has stated that teachers' judgments of pupil progress have a unique contribution to make to the evaluation of speech progress, as the teacher knows the speech of the pupil more thoroughly than does anyone else.

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[31]Silverman, Volta Review, 45:14, 1943.

CHAPTER VII

SUMMARY

This study has attempted to trace historically the evolution of the major concepts related to auditory training as it affects the education of the deaf and hard of hearing child. The study has been concerned with the nature of the process involved in auditory training, objectives of auditory training, the place of auditory training in the curriculum, the use of amplified sound and the evaluation of the results of auditory training.

The beneficial possibilities of auditory training have long been recognized. In the nineteenth century it was widely believed that auditory training involved improvement in peripheral hearing. This belief has been largely supplanted in the last three decades by the opinion that improvement in "hearing" results from better central use of available sound. The difficulty of determining what changes occur in the sensory areas led to attempts to describe the end products of auditory training. Investigators undertook to define the levels of "hearing" and to investigate the factors influencing ability to profit by auditory training.

The objectives of an auditory training program are

generally determined by amount of residual hearing. The objectives for the deaf child, in order of importance, follow:

1. Improvement in speech
2. Improvement in lip reading
3. Academic acceleration
4. Psychological improvement

The objectives of auditory training for the hard of hearing child, in order of importance, follow:

1. Improvement in hearing vocabulary
2. Psychological improvement
3. Academic acceleration
4. Improvement in speech
5. Improvement in lip reading

A trend to coordinate efforts to achieve each of the appropriate objectives has developed. This is an expression of the larger movement to regard the child as an entity.

In the early days classification of pupils was based upon etiology of deafness, upon short trial periods, upon intelligence, or upon fixed proportions of a given population of pupils who might be given auditory training. The pure tone audiometer has been used to group children according to hearing loss in decibels and to determine how much academic time should be devoted to auditory training. At the present time almost all pupils are considered

eligible for acoustic work. The trend has been to present auditory training in coordination with the teaching of each school subject instead of during short daily periods set aside exclusively for listening. Many experienced educators regard as dangerous the recent notion that auditory training is a new type of education, sufficient by itself to solve the educational problems of the deaf.

The development of electro-acoustics has yielded better amplification of sound, particularly with respect to maximum acoustic output, gain and frequency response. The emphasis in use of amplified sound has been away from "fitting" an instrument to the individual ear and toward design and construction of equipment with better performance characteristics. The use of auditory training to increase tolerance for loud sound and to increase the available auditory area has been recently accepted. Increasing emphasis has been placed upon the importance of psychological and educational preparation for use of individual hearing aids.

It has been difficult to construct valid and reliable instruments to evaluate the results of auditory training. Suitable tests to measure the effect of this form of training upon lip reading skill, speech, psychological adjustment and ability to utilize available sound are lacking. Standardized tests of academic achievement are available, but here, as in the other problems of assessment,

control of variables presents difficult problems. Auditory training in conjunction with other traditional approaches to the child is assuming an increasingly important place in the education of the deaf and hard of hearing child.

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