Verbo-Tonal Method for Rehabilitating People with Communication Problems

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2012, VERBOTALON BOOKS, PUBLICATIONS, UNITS AND TRAINERS

Book 1: Verbotonal Speech Treatment, by Professor Carl Asp, PhD, CCC-A/SL. Plural Publishing, San Diego, CA, 2006, revised, 2012. The book explains the Verbotonal Strategy and the global application for training both children and adults with various communication disabilities. Theory, terminology and specific training tools are described to provide the reader a basic understanding of the Verbotonal Strategy which is successfully implemented and acclaimed worldwide. This book is free on the Verbotonal UT Website (Verbotonal.utk.edu), or directly at (casp@utk.edu).

Book 2: The Verbotonal Method for Rehabilitating People with Communication Problems, by Professors Carl Asp, PhD, Professor Petar Guberina, PhD, and Dr. Mihovil Pansini, MD, published in 1981 by The World Rehabilitation Fund, NY, NY and revised, 2012. The book emphasizes theory, space perception, diagnosis, Suvag units, habilitation and rehabilitation of hearing impaired children and adults, speech listening-therapy for normal hearing clients, summarizes results, and includes research references. The book is available on the Verbotonal UT Website (Verbotonal.utk.edu), or directly at (casp@utk.edu).

Recent 2012 Verbotonal Publications:

1) Verbotonal University of Tennessee (UT) Website (verbotonal.utk.edu): has strategy, photos, video therapy, publications, the two free books above, glossary, references, testimony, etc. Links are available for other Verbotonal Websites Worldwide.

2) The Two Books above are available free through at the Verbotonal UT Website above (Verbotonal.utk.edu) or directly at (casp@utk.edu).

3) The 2012 Book 1 (first edition 2006) has been translated into Chinese, Arabic, Russian and, in the near future other languages. These translations are available through the Chinese publisher in Mainland China with the simple Chinese translation. The comprehensive Chinese translation is available from Hong Kong, and Taiwan publishers. Saudi Arabia publishers have the Arabic Translation available in most Arab countries. Russian publishers have the Russian translation available. Other translations are in progress. Most translations are sold by the publishers. Email Dr. Asp at (casp@utk.edu) for more information.

4) The Verbotonal Society Worldwide (registered since 1979 in the State of Tennessee through the University of Tennessee). The Society offers consulting, training and certification by Verbotonal Trainer listed herein and others worldwide.

5) Verbotonal Listen Auditory Training Units with microphones, vibrators, and headsets are available through Listen Incorporated, 602 South Gay Street, Unit 902, Knoxville, TN, 37902 (casp@utk.edu). These Listen units are a digital update of the Suvag units. Also, the Tennessee Optimum Speech Amplifier (TOFA) that uses octave filters to correct speech errors of normal-hearing children.

6) Recent Publications in 2012: 
   a) Verbotonal History in the USA, by Dr. Carl Asp and Ms. Madeline Kline, available from Zagreb, Croatia (simpozij2011@suvag.hr) or on the Verbotonal UT Website (Verbotonal.utk.edu).
b) **Timeless Verbotonal Body Movements** by Dr. Carl Asp and Ms. Madeline Kline, available from Zagreb, Croatia ([simpozij2011@suvag.hr](mailto:simpozij2011@suvag.hr)), or the Verbotonal UT Website ([Verbotonal.utk.edu](http://Verbotonal.utk.edu)).

c) **Verbotonal Worldwide** by Dr. Carl Asp, Dr. Kaz Koike and Ms. Madeline Kline, available in a book titled “Translational Speech-Language Pathology and Audiology”, 2012, by Plural Publishing, San Diego, CA, ([angiesingh@pluralpublishing.com](mailto:angiesingh@pluralpublishing.com)) or the Verbotonal Website ([Verbotonal.utk.edu](http://Verbotonal.utk.edu)).

d) **Verbotonal Body Movements** by Dr. Carl Asp, Dr. Kaz Koike and Ms. Madeline Kline, available in a book titled “Translational Speech-Language Pathology and Audiology”, 2012, by Plural Publishing San Diego, CA ([angiesingh@pluralpublishing.com](mailto:angiesingh@pluralpublishing.com)) or the Verbotonal Website ([Verbotonal.utk.edu](http://Verbotonal.utk.edu)).

e) **Verbotonal Rehabilitation: Are We Doing Enough** by Dr. Carl Asp, Dr. Kaz Koike, and Ms. Madeline Kline. Obtain this article by googling ([thehearingjournal.com](http://thehearingjournal.com) under the January 2012, Vol., 65, No 1, p 28-34, or from the Verbotonal UT Website ([Verbotonal.utk.edu](http://Verbotonal.utk.edu)).

f) **Ten Monthly Verbotonal Articles** by Dr. Robert Martin and Dr. Carl Asp, in The Hearing Journal, are in progress. Obtain these articles by googling ([thehearingjournal.com](http://thehearingjournal.com)). These articles start in January 2012 and continue under the Nuts and Bolts Section on Verbotonal, or from the Verbotonal Website ([Verbotonal.utk.edu](http://Verbotonal.utk.edu)).

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Verbotonal Trainers; contact Mr. Berry for their names and qualifications (www.bhssinc.com).

7) Dr. Mihovil Pansini, MD, ENT specialists, co-author of Book 2, Vestibular-Cochlea hearing and the role of Space Perception in the Verbotonal Strategy (fluent in French, Croatian, and English) (mihovil.pansini@zg.t-com.hr) Zagreb, Croatia.

8) Professor Youngsun Kim, PhD in Speech and Hearing Science, MA in Speech Pathology, CCC-S/L, Master Trainer, Consultant and Professor at the Ohio University, Athens, Ohio, Published the Rhythm and Intonation Speech Test (kimy2@ohio.edu) (fluent in English and Korean).

9) Professor Carole Johnson, PhD in Speech and Hearing Science, MA Audiology, CCC-A, Master Trainer, Consultant and Professor at Auburn, University, Auburn, Alabama (johns19@auburn.utk).

10) Professor Hsiaochuan Chen, PhD, in Speech and Hearing Science, MA in Audiology, Master Trainer, Taiwan University, Taiwan (fluent in English and Chinese, editor of the Chinese translation of Verbotonal Book 1).

11) Professor Claude Roberge, PhD in Linguist, Master Trainer, Consultant and Professor at Sophia University, Tokyo, Japan, (fluent in English, Japanese and French; author of Verbotonal publications in French, Japanese and English) (see Dr. Koike for contact information).

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27) **Dr. Olga Victorona, PhD**, Trainer, Russia University (fluent in Russian and English), and translator and editor of the Russian translation of Verbotonal Book 1. Russia has 29 Verbotonal Centers.

28) **Ms. Barbara Spletzer, MA, CCC-S/L**, Master Trainer and skilled in using acoustic filters and body movements to improve the listening skills of normal-hearing children to correct speech/language errors, Speech Pathologists, Toledo, Ohio.

29) **Dr. Sue Hume, PhD, CCC-S/L**, Trainer, University of Tennessee.


31) **Dr. Vivian Kirpatrick, PhD, CCC-S/L**, Master Trainer, Atlanta, Georgia.

32) **Dr. Charette Hubbard, PhD., CCC-S/L**, Trainer, East Kentucky University, Kentucky.

33) **Ms. Ann Browning, MA, CCC-S/P**, Trainer, Knoxville, Tennessee.

34) **Mr. Larry Boyd, BS**, Trainer, Engineer and Designer of Listen Auditory Training Units. The units have an amplifier, acoustic filters, speech vibrators, and headsets to develop listening skills for improving spoken language in children and adults.

35) **Email Additional Verbotonal Trainers** through the University of Tennessee, Verbotonal Website (verbotonal.utk.edu), the Links, or email the trainers above to locate other trainers throughout the USA and Worldwide in a variety of languages.

36) **Zagreb, Verbotonal Suvag Center**, (Zagreb@suvag.hr), in Zagreb, Croatia is the Parent Program where Professor Peter Guberina, along with Dr. Pansini, MD,
developed the Verbotonal Strategy for all communication problems. The Center provides Verbotonal training in English, Croatian, French, Spanish, Russian, and other languages (iti@svag.hr).

We The Above, Honor The Late Professor Petar Guberina, PhD. He laid the foundation for Verbotonal Worldwide, including the certification of Trainers and Consultants to train teachers and clinicians to develop good listening and speaking skills for successful mainstreaming into the spoken language of their society and other societies worldwide.
This monograph is the last in the International Exchange of Information in Rehabilitation series published by the World Rehabilitation Fund, Inc. under a grant from the National Institute of Handicapped Research. Under this project the World Rehabilitation Fund, Inc. commissions foreign authors to prepare brief monographs in topic areas in rehabilitation where there are information gaps in the U.S.

Under a companion grant, the International Exchange of Experts in Rehabilitation, U.S. experts have been selected to receive fellowships from WRF, Inc. to investigate exemplary rehabilitation programs, practices and policies in other countries with the agreement that these “fellows” will transmit the knowledge from abroad to the U.S.

Monograph #13 Verbo-Tonal Method for Rehabilitating People with Communication Problems is the product of the collaboration of a WRF expert, Carl Asp, Ph.D., who enhanced his knowledge of the Verbo-Tonal method by studying with the individual who developed the method in Zagreb, Yugoslavia, and Professor Petar Guberina who is that individual.

In addition to the Asp-Guberina collaboration, a highly skilled editor, Ms. Pat Kramer, contributed significantly with her expert manuscript revisions.

The WRF, Inc. is extremely pleased to have had the opportunity to coordinate and sponsor this effort.

It is our hope that this “product” will be useful to those in the rehabilitation community who are concerned about the communication needs of individuals with hearing impairments.

Howard A. Rusk, M.D.
President

New York, New York

June, 1981
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We wish to recognize the interest, the co-operation and the encouragement of the Verbo-Tonal teacher-clinicians, the researchers, the young and some not-so-young patients and their parents. We thank all of you who have contributed so much to developing this method.

Petar Guberina
Carl Asp
The task of presenting an introduction to the Verbo-Tonal Method has been difficult because the method is complex and can be applied to various communication problems or situations. Therefore, we have limited our introduction to discussing the rehabilitation procedures for people who have communication problems, primarily those who need speech and listening rehabilitation; we only briefly mention those who have speech and language disorders. Other aspects of this program, such as rehabilitating the speech of children who are socially and culturally handicapped, modifying dialectical speech, and teaching foreign languages, have not been mentioned.

We have attempted to introduce the general theory, to explain some diagnostic procedures, to describe the techniques for speech and listening rehabilitation, and to present some results from the programs in North America and Europe. We have supplied references to verify certain aspects of the theory or method and to direct the reader to supplementary information.

It is not possible to identify objectively one method as being superior to others. It is possible to determine if the goals have been achieved. If this method is applied by a competent Verbo-Tonal clinician, patients can develop good oral communication skills and can be successfully integrated into society. The goals have been and can be realized.

If this monograph helps clinicians to understand that the patient bears within himself the means for his rehabilitation, and if it stimulates research to improve rehabilitation, we will have achieved our purpose.
The Verbo-Tonal method of rehabilitation for people who have severe communication problems was developed in the 1950s by Professor Petar Guberina, a linguist who was particularly interested in speech perception. Underlying the method is the conviction that language evolved from spoken language and that speech (which is used interchangeably with spoken language) is a social event. We speak (i.e., we use spoken language) when we want to express something or when we react to an event. In this sense, the “meaning” of speech is transmitted not only by linguistic elements but also by the auditory and visual information present in the rhythm, the intonation, the loudness, the tempo, the pauses, the tension, and the gestures of the speaker. Thus the individual speaker is both a producer and a perceiver of speech. Most important, the auditory and visual information in his production reflects how he perceives speech. If his perception changes, his speech will also change. If we have corrected his speech, we have corrected his perception.

The Verbo-Tonal procedures follow the pattern of language development observed in babies who have normal hearing. Before a baby learns to speak, he cries, babbles, and coos—he produces sounds. His whole body participates in producing and receiving sounds. This vocal activity is not a response to his sense of hearing; rather, it is a response to his proprioceptive sense.

As the baby matures, his vocal play becomes more sophisticated. During this time, rhythm and intonation patterns and rhythmic motor activities, as well as his vestibular, tactile, and proprioceptive senses, contribute to his speech/language development. By the time he utters his first meaningful word at 9 to 12 months of age, he has already learned how to manipulate rhythm and intonation to assign different meanings to the word. For example, when he says “Mama” he may mean “Mama, come here” or “Mama, don’t go” or “Mama, I’m getting impatient. If you don’t hurry with my food, I’m going to scream.” And Mama learns quickly to understand these patterns.

Rhythm and intonation transmit meaning not only in infant speech but in adult spoken language as well. If we say “Mary came home yesterday,” and emphasize the first word, no more words are needed to convey the meaning that Mary came, as opposed to anyone else. If we emphasize the last word, we mean that she came yesterday and not on another day.

As early as 1938 Guberina stressed the importance of rhythm and intonation in producing and perceiving speech; moreover, as a result of his
research and experience, he proposed that the low frequencies transmit the rhythm and intonation patterns of language. In the early 1950s he began to apply these two principles to the habilitation of deaf children who have hearing only in the low frequencies (Guberina 1954). He reasoned that the brain would function best if it were to receive the auditory stimuli for which the ear is most sensitive; moreover, it would be enriched (in Piaget's terms) by these optimal stimuli; and with time and training, it would be prepared to respond to more difficult tasks, i.e., less favorable stimuli.

It wasn't until the late 1950s and early 60s that other researchers began to use low-frequency amplification with deaf children. Henk, Huizing, and Taselaar (1958) concluded that the main contribution to intelligibility is given by that part of the "tone scale" where the hearing is most sensitive. Later they said, "These results correspond closely to the experiments of Guberina" (Huizing & Taselaar 1959).

In North America, Daniel Ling (1963, 64, 65) was one of the early advocates of using the child's residual hearing in the low frequencies. After he visited the Center for the Verbo-Tonal Method in Marseilles in 1960, he reported that deaf children had excellent speech because the Verbo-Tonal instruments transmitted the low frequencies without distortion. As a result of Ling's research, Zenith developed the first commercial hearing aid that had an extended low-frequency response. Since that time many other manufacturers have developed similar hearing aids. Despite the wide availability of low-frequency and/or "high gain" hearing aids, the goal of intelligible, rhythmical, spoken language for most deaf children has not been realized.

Amplification alone will not guarantee good speech. Amplification must be accompanied by "appropriate auditory training" (Rosenthal, Lang, & Levitt 1975). During Verbo-Tonal training, deaf children are taught to speak and to perceive speech simultaneously. The speech stimulation procedures follow the developmental patterns which have been observed in normal-hearing children. The hearing-impaired children receive speech through vibrators that stimulate their vestibular, tactile, and proprioceptive senses and through headphones. The children learn to produce normal rhythm and intonation patterns (suprasegmentals) and normal voice quality by imitating bodily movements and rhythmic patterns. They learn to develop meaningful speech by participating in simulated communication situations.

Our goals are to help them develop good communication skills and to integrate them into a normal educational system. Thus the Verbo-Tonal method stresses the importance of simultaneously developing all the
senses; it does not advocate isolating any sense, exaggerating any stimuli, or substituting an alternative linguistic code. In short, it is not a “Total Communication” approach to rehabilitating hearing impaired individuals; if it is anything, it is a “unified sensory” approach which emphasizes the importance of spoken language.

Although we receive information from the low frequencies, we must also discriminate speech sounds. Normal listeners can discriminate low-pitched words and sounds through a low-frequency band, but they do not comprehend high-pitched words. They can comprehend high-pitched phonemes (e.g. /i/), however, if we pass one low-frequency band (0.5 Hz to 300, 600, or 1000 Hz) and one high band (3200 to 6400 Hz). The intensity level for the low band can be at the person’s threshold level or slightly above (0 to 20 dB S.L.), while the high band need be only near the person’s threshold level. This Guberina calls “discontinuous hearing.”

Other researchers have confirmed that we can perceive speech through discontinuous frequency bands. Palva’s results (1965) show that listeners comprehend 18% of the words when speech is passed through 480-660 Hz; they comprehend 25% when it is passed through 1800-2400 Hz; but when sound is passed through both bands simultaneously, they comprehend 70% of the words. For other results see Matzker (1956), Linden (1964), Ticinovic & Sonic (1971).

When Rosenthal, Lang, and Levitt (1975) discussed the importance of low frequencies for hearing-impaired individuals, they also mentioned that the addition of one band of high frequencies improves comprehension significantly. Barbara Franklin’s results (1969, 1973, 1975, 1979) confirmed that both normal and hearing-impaired listeners comprehend speech better through discontinuous transmission than through a broad frequency band. Furthermore, the previous studies support our own investigations and observations that speech discrimination percentages are greater during discontinuous transmission than the sum of the percentages for the individual bands.

Thus far we have discussed the significance of speech production, of the low frequencies, and of discontinuous frequency-band transmission in speech perception. The hearing-impaired individual has yet another perceptual process which helps him discriminate and acquire speech. When he is given the opportunity to practice listening through his most perceptive frequency bands (his optimal field of hearing), he perceptually discovers in the speech signal the clues he needs to distinguish one sound from another. In other words, when he receives speech through his optimal field of hearing, he can learn to discriminate all speech sounds even though some acoustic information is diminished.
The central nervous system receives information from all the senses. It is responsible for organizing this information by eliminating those stimuli which create cybernetic noise (von Bekesy’s sensory inhibition, 1967) and by selecting those stimuli which are optimal for it to function. According to Verbo-Tonal theory, sensory information is subordinate to the function of language. The brain can be taught to structure the information through functional rehabilitation.

2. SPACE PERCEPTION

Through motor activity and vibro-tactile stimulation, children learn to develop good motor control and good oral communication skills. The movements an infant makes while on his back or stomach help his metabolism and increase the activity of the vestibular nuclei. Mothers can stimulate their infants by walking them, rocking them, and generally moving them from room to room. Infants who are given the opportunity to explore their environments develop better co-ordination than those who are restricted. The body, its movement, and the vestibular sense play an important role in rehabilitating children who are profoundly deaf.

The Vestibular Sense

Embryologically, the vestibular organ first began as a thickening of the ectoderm and then developed specific sensory cells (mechano-receptors). The sense organ includes the otolith and the cupula. The sensory cells of the otolith have four essential functions: (1) perception of the gravitational fields, (2) perception of linear acceleration, (3) perception of angular acceleration, and (4) some response to sound. The cupula enhances perception of angular acceleration.

Phylogenetically, the vestibular sense is older than the vestibular sensory organ. During the paleozoic period, the lagena evolved in the fish. This small growth, anterior to the sacculus, expanded to become the cochlea for audition. However, the primitive auditory function of the otolith was not lost along the way. Neurophysiological investigation has established that the otolith responds to tones as high as 1000 Hz to sup-
plement cochlear activity. The capacity of the vestibular organ for hearing is yet to be explored fully. Perhaps the limits are greater than we suspect.

Since the vestibule and the cochlea comprise the inner ear, one could refer to vestibulo-cochlear hearing rather than merely to cochlear hearing. Vestibular and auditory reception overlap for frequencies between 16 and 1000 Hz. Frequencies below 16 Hz are perceived only by the vestibular organ. The thresholds of the vestibular response are not known because it is difficult to separate vestibular and auditory reception.

Sensory input to the vestibular nuclei also goes to the reticular formation, the cerebellum, and the collateral auditory pathways. This input influences the role of the macular structures (utricle and sacculae).

A spatial stimulus activates the mechanism of spatial perception. One must recall that every healthy sensory organ supplies redundant information and that perception occurs even under unsuitable conditions. When hearing is defective and redundancy is limited, perception depends on other biological mechanisms such as the spatial sense. These mechanisms are more primitive and thus are more resistant to damage. For example, if a patient is aphasic from a vascular insult, he may lose his capacity to comprehend speech; yet he may retain the more primitive function of singing. If both functions are impaired, singing will be re-established before speech.

Vestibular Exercises

The patient's vestibular sense should be evaluated prior to rehabilitation. Since these tests are well known, they will not be discussed here. To rehabilitate deaf children who do or do not have peripheral vestibular function, their central vestibular sense is essential for perceiving the rhythm and intonation of speech (Guberina et al. 1972). Results of Frequency Following Response Audiometry at the Zagreb Suvac Center indicate no differences in the early neurophysiological responses to low frequencies by the cochlear and vestibular portions of the inner ear and the stato-acoustic nerve [VIII] (Ribaric et al. 1975). The differences appear later, and they depend on where the bioelectric potentials go, how they are structured, and what role individual organs play within the whole sense of spatial perception.

In 1944, Cawthorne and Cooksey first introduced exercises to rehabilitate people who have peripheral vestibular damage. In France,
Portmann expanded these exercises to correct centrally caused defects of balance; Briand and his colleagues developed other exercises.

Damage to the peripheral vestibular organ inhibits the flow of bioelectric potentials to the vestibular nuclei. Vestibular function depends on a fine balance of bioelectric potentials in the vestibular nuclei from both sides. Any imbalance distorts information about the movement of the body through space. If the vestibule is damaged, the central information is incorrect; consequently, the body's position or balance is lost or disrupted and the patient appears to be dizzy. There are several ways, however, that the central system can compensate for this imbalance:

1. If the vestibular nucleus on one side lacks bioelectric potentials, the patient could have symptoms of strong ataxia, dizziness, and neurovegetative disturbances such as nausea and vomiting. These symptoms can be suppressed if the cerebellum decreases the bioelectric potentials from the healthy side, thereby correcting the imbalance.

2. If the vestibular nucleus is healthy, it will gradually produce a steady number of bioelectric potentials by receiving inputs from other areas, and not only from the damaged vestibule. These bioelectric potentials eventually equal the number on the opposite side. Then balance is restored and can be observed when the rotator vestibular test gives a nystagmus of equal strength on both sides, and the turning test of caloric stimulation does not provoke nystagmus. This is known as Ruttin's phenomenon.

Although the bioelectric potentials in the vestibular nucleus of the damaged side probably come from that site, they may also come from other areas for space perception. We do not know what relation one sense has to the others. Nor do we know how the number of bioelectric potentials equalizes.

3. If one vestibule receives imperfect information, it will send fewer bioelectric potentials to the central mechanism. The central mechanism can compensate for the difference between the vestibular inputs by constructing a state of balance.

4. When a person closes his eyes or turns out the light, his balance can be threatened because the visual input to his vestibule has been disrupted. The central mechanism can maintain balance by using information from the other sensory organs for space perception.

In the Verbo-Tonal method, we use vestibular exercises to rehabilitate balance, to develop an input to the central monitoring system, and to increase the vestibular input for space perception. For children, these
exercises are games that are within their physical potential: jumping rope, changing positions or directions while swinging, walking on a balance beam with eyes open or closed, turning around in each direction, turning on a cross bar, rolling forward and backward on the ground, and jumping and completing a circle in two to four jumps.

We present the vestibular exercises in three ways, proceeding gradually from the analytic to the global-structural approach. Even when the patient advances to a higher level, we repeat the earlier procedures:

**Level 1.** In the analytic approach, we select space exercises that use each of the five senses. We introduce new movements gradually until the child is unable to perform them. Later, these movements are re-introduced as his performance improves. Although we use exercises for vision, hearing, proprioception, and touch, the exercises for the vestibular sense are the most important for hearing-impaired children.

**Level 2.** In the synthetic approach, we attempt to stimulate all the senses. Initially, we integrate only a few senses; more are added as the child progresses.

**Level 3.** In the global-structural approach, we use exercises that develop automatic motor behavior which is used in daily life. Since Verbo-Tonal rehabilitation attempts to unify the sensory inputs, these vestibular exercises enhance the child's ability to restructure behavior (see Chapter 8).

### 3. EVALUATION PROCEDURES

Initially all children and adults are examined by an otolaryngologist and are tested using standard audiometry. If the patient has a hearing loss he is given the appropriate Verbo-Tonal tests. Some young, congenitally deaf children may not be able to respond to the Verbo-Tonal tests until after they have received some therapy. Therefore, they would enter therapy having had only standard audiometry, and they would be given Verbo-Tonal tests when possible. The purpose of the tests is to determine the patient's sensitivity for speech and to evaluate his ability to understand speech. Furthermore, the patient's responses help us to plan the therapy and evaluate his progress.
Threshold Evaluations

VERBO-TONAL SPEECH DETECTION THRESHOLDS

Guberina developed the stimuli for his tests from his early investigations of speech perception. He passed vowels and consonants through octave-band filters and asked normal-hearing listeners to identify them. He observed that certain consonants and vowels were easily identified in specific octave bands (Guberina 1964, 1972; McKenney & Asp 1972; Asp 1975; Miner & Danhauer 1977). When the C-V (consonant vowel) syllable is filtered through a frequency band other than its "optimal" band, it is perceived as some other consonant-vowel combination. Therefore, he selected those consonant-vowel combinations which were identified consistently for each octave-band and used them for the stimuli in the speech detection test (see Table 1).

Each two-syllable, frequency specific stimulus is called a logotome. We recorded the logotomes unfiltered and filtered through their respective "optimal" octave bands, and the patients respond at hearing threshold levels (dB HTL) relative to the average threshold responses of normal-hearing listeners.

Because the logotome is "optimal" for its frequency band, the patient's threshold responses to these stimuli indicate his sensitivity not only for the logotome but also for the frequency band. In other words, we use speech stimuli (Verbo) to evaluate sensitivity for various frequencies (Tonal).

<table>
<thead>
<tr>
<th>Logotomes</th>
<th>Optimal Octave of Logotome (Hz)</th>
<th>Comparable Pure Tone (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/bru bru/</td>
<td>50-100</td>
<td>75</td>
</tr>
<tr>
<td>/mu mu/</td>
<td>75-150</td>
<td>125</td>
</tr>
<tr>
<td>/bu bu/</td>
<td>150-300</td>
<td>250</td>
</tr>
<tr>
<td>/vo vo/</td>
<td>300-600</td>
<td>500</td>
</tr>
<tr>
<td>/la la/</td>
<td>600-1200</td>
<td>1000</td>
</tr>
<tr>
<td>/ke ke/</td>
<td>1200-2400</td>
<td>2000</td>
</tr>
<tr>
<td>/i i/</td>
<td>2400-4800</td>
<td>3000</td>
</tr>
<tr>
<td>/si si/</td>
<td>4800-9600</td>
<td>6000</td>
</tr>
<tr>
<td>/si si/</td>
<td>6400-12,800</td>
<td>8000</td>
</tr>
</tbody>
</table>

TABLE 1

Verbo-Tonal Audiogram: Detection Thresholds

Pure Tone Audiogram: Detection Thresholds
We compare the patient’s detection thresholds for the filtered and unfiltered logotomes to his thresholds for pure-tones (see Table 1). If his threshold for a filtered logotome is significantly better than his threshold for the comparable pure-tone, he has the potential to understand speech through his “optimal” frequency area. Conversely, if his threshold for the logotome is poorer than his pure-tone threshold, he may have difficulty using this frequency region to discriminate speech.

TRANSFER TESTS
In Chapter 1 we said that hearing-impaired people can learn to perceive phonemes which are outside their pure-tone sensitivity range. Guberina designed “Transfer Tests” to assess the patient’s potential to perceptually transform speech sounds and to evaluate his progress in therapy. In these tests, the patient’s thresholds for logotomes which are filtered through their respective optimal bands are compared to his thresholds for logotomes which are filtered through (Guberina’s “transferred to”) non-optimal bands.

In the test of Low Transfer, a high-frequency logotome, e.g. /si si/, is filtered through a low-frequency band, e.g. 200-400 Hz. If the patient is more sensitive for /si si/ in the non-optimal, low-frequency band than in its optimal band (4800-9600 Hz), he has the potential to perceptually transform speech in the low frequencies. This is not to be confused with “frequency transposition,” in which computers transpose acoustic information into the low frequencies—a physical process. We are speaking here about the patient’s potential to transform the stimulus—a perceptual process.

For the test of High Transfer, a low-frequency logotome is passed through a high-frequency band. If the patient detects the stimulus better in the high frequencies, he may be able to use the high frequencies for discrimination.

We discussed discontinuous transmission and speech perception in the first chapter. To test the patient’s potential to use a discontinuous frequency band, we pass a high-frequency logotome simultaneously through its optimal-octave band and through a low-frequency band. The patient’s discontinuous threshold is compared to his optimal-octave threshold. If his discontinuous threshold is better, he has the potential to combine low and high frequencies to enhance his perception of the high frequencies.
Speech Discrimination Evaluation

We are concerned not only with speech detection but also with speech discrimination. How well does the patient discriminate words that are presented at levels above his detection thresholds? At what intensity and in what frequency regions does he discriminate the words best? To explain the development of the stimuli for these supra-threshold tests, we must discuss the idea of "tonality" in speech sounds.

Earlier studies in psychoacoustics (Fairbanks 1940, 1950; Black 1949) related the vowel's pitch to the physical measurement of fundamental frequency (F₀). Some of the studies used listener's judgments, while others did not. In most studies, the physical measurement of F₀ and "pitch" were used interchangeably. However, whispered vowels, which do not have normal phonation, can be recorded in pairs and judged for pitch (Harbold 1954). Moreover, when two different vowels /a/ and /i/ are produced with the same F₀, most listeners will choose /i/ as being higher in "pitch." This choice cannot now be related to the F₀; rather, it is related to the higher formant structure of /i/. These are the same formants that help us distinguish one vowel from another.

To differentiate between the judgment of "pitch" that is related to the vocal qualities (F₀) and the judgment of spectral "pitch" that may be involved in phoneme discrimination, the authors use the term "tonality" for the latter.

Normal-hearing subjects judged the tonality of consonants as well as vowels (Peterson 1971; Peterson & Asp 1972; Boring 1942). After all of the phonemes have been judged, we can arrange them on a perceptual continuum and divide the continuum into five tonality categories: low, low-middle, middle, middle-high, high. Thus, consonants and vowels that fall into any one of the categories are homogeneous and can be combined to form a syllable having the same tonality. For example, /u/, /p/, and /b/ all have low tonality, and the syllables /pu/ and /bu/ have the same tonality. These five tonality categories represent a progression on the same frequency continuum as the logotomes. In other words, low tonality stimuli are low-frequency stimuli. When a patient responds to low tonality syllables, he responds to low-frequency stimuli.

SPEECH DISCRIMINATION CURVE

To develop the stimuli for the speech discrimination tests, we selected English words that contained homogeneous-tonality phonemes. Then, normal-hearing listeners were asked to judge the tonalities of the words.
The results indicated that the words can be arranged in the same order on the frequency continuum as the logotomes. That is, the unfiltered tonality words correspond to the frequency regions of the logotomes when the latter are filtered into their optimal bands (Asp, Berry, & Bessel 1978; Bessel & Asp 1980). For example, "cease" is a high tonality word, and its tonality is the same high frequency as the optimal-octave as /si si/ — 4800-9600 Hz. Furthermore, because the words were distributed along the frequency continuum, they can be grouped into the five tonality categories mentioned previously.

For the discrimination tests, two words from each tonality category were recorded to form discrimination lists of 10 words each. We use these lists to evaluate the patient's discrimination (% correct) at each 10 dB increment above his detection threshold. We continue to increase the intensity until we have reached the patient's tolerance level or the audiometer's output limit. For the speech discrimination curve, we plot the discrimination score as a function of intensity. In previous years this display was called the articulation curve; recently it has been called the PI function (performance vs. intensity).

TONALITY TESTS

Although the speech discrimination score gives us some information about the patient's performance as a function of intensity, it does not tell us what perceptual errors he is making or what these errors mean. Which sounds are easy for him? How has he progressed from one training session to another? Which hearing aid is the best for him? The tonality tests were designed to supply this information.

The stimuli for the tests are five words from each of the five categories. Using these twenty-five words, we can establish the patient's "performance vs. frequency" (PF) function because each tonality group represents a portion of the frequency continuum.

In the first tonality test the stimuli are presented in "free field," unaided, at normal conversational level if possible, to obtain a baseline measurement for each category.

After we have established the baseline, we use the tonality words and a SUVAG II instrument to determine the patient's optimal field of hearing (OFH) for training. The SUVAG II is a multi-channel filter which allows the examiner to transmit speech at various intensity levels through different frequency responses (see Chapter 4). The OFH is the frequency response that elicits the patient's best discrimination score. When the to-
nality words are presented through the patient’s optimal field of hearing, we gain valuable information about his listening ability.

Earlier we said that we evaluate the patient’s potential to discover acoustic clues (perceptual transformation) when we obtain threshold responses to the logotomes in the Transfer Tests. However, the optimal octaves of the logotomes are linked to the tonality categories on the frequency continuum. Therefore, if the patient’s responses to the logotomes at threshold levels represent his potential to transform the stimuli, then his responses to the tonality words at supra-threshold levels should indicate his ability to transform the stimuli. Furthermore, if we can measure this ability as a function of frequency (PF), we can also monitor his progress in therapy.

As the patient progresses in therapy, he may be able to understand speech through a wider frequency response than his initial OFH, with no deterioration in his performance. We continue to enlarge his field of hearing until he no longer improves. At this point, the tonality lists are again used to evaluate the patient’s performance with hearing aids.

Additional Evaluations

Even after a child or adult has started a therapy program, his program may continue to be “diagnostic-therapy.” We may need up to six months to present a detailed diagnosis and therapy plan for some patients, especially for those who have severe communication disorders.

We are thankful for other professionals who help us evaluate the patients. An otolaryngologist or audiologist administers the vestibular tests. Previous studies at the Zagreb Center have shown a close relationship between the vestibular function and the child’s motor and speech ability. If the vestibular response is normal, the prognosis for the child is good. Occasionally, the child’s vestibular response improves during regular therapy.

A speech pathologist evaluates normal-hearing patients who have speech and language disorders, and a psychologist evaluates the children who have learning problems.
The instruments used in the Verbo-Tonal Method are SUVAG I, SUVAG II, SUVAG Lingua for classroom, SUVAG Lingua for individual therapy, and Mini-SUVAG hearing aid. The operation and characteristics of each unit are described below.

The SUVAG I auditory training unit is used daily for individual therapy and for classroom activities with six to ten hearing-impaired children. The teacher selects the output condition which can be either a flat frequency response (0.5 to 20,000 Hz) or a low-frequency band pass (0.5 to 300, 600, 1000, 2000 Hz). The teacher’s microphone is positioned near her mouth to provide a good signal-to-noise ratio. The children wear a bone vibrator (SUVAG Vibar) strapped to their wrists, and/or circumaural headsets (Koss K-6). The equipment is designed to allow the teacher and the children to move freely.

The SUVAG II is a multiple filter unit that is used during individual therapy for hearing-impaired people. It has five independent channels: (a) a flat frequency response (0.5 to 20,000 Hz); (b) low-pass filters; (c) low-peaking filters; (d) high-pass filters; and (e) high-peaking filters. The filters have variable cut-off frequencies and slopes and independent dB level controls for each channel. Thus the SUVAG II can be adjusted to produce almost any frequency response. The clinician selects the frequency response where the patient achieves the best understanding of speech (optimal field of hearing). During training sessions, she adjusts the frequency response to correct the patient’s perceptual errors.

The SUVAG Lingua for classroom is an instrument that facilitates teaching a foreign language to groups of 10 to 30 pupils. This unit can be set for a flat frequency response (0.5 to 20,000 Hz), a 320 Hz low-pass filter, a 3200 Hz high-pass filter, or a mid-frequency response with emphasis at 500 Hz and at 4000 Hz. The SUVAG Lingua modifies the prerecorded foreign language lessons which are presented to the class through a high quality loudspeaker. With the low-pass setting, the people hear the rhythm and intonation of the language they are trying to learn. The high-pass filter is added to obtain more tension in the production and perception. Once the pupils learn the correct rhythm and intonation, the teacher switches to the mid-frequency response to develop the correct production and perception of the phonemes (speech sounds) of that language. Then the flat frequency response is used to prepare the student for everyday listening situations.
The SUVAG Lingua which we use for individual therapy is a multiple filter unit similar to SUVAG II. It has seven independent channels, which include the following: (a) a flat frequency response (0.5 to 20,000 Hz); (b) a low-pass filter of 320 Hz and lower frequencies; (c) high-pass filters of 3200 Hz and higher; and (d) four band-pass filters, each of which is capable of ⅛-, ⅜-, and ⅜-octave settings and a wide range of center frequencies (8 to 8000 Hz). The low-pass and high-pass filters are used as described above in the SUVAG Lingua classroom application. The band-pass filters emphasize the phoneme the pupil is trying to perceive. With this unit, the pupil can learn to produce and perceive the correct rhythm and intonation as well as the phonemes of the target language. It is used in foreign language training and in rehabilitating normal-hearing patients who have speech disorders.

The Mini-SUVAG hearing aid is a wearable, "body" hearing aid that can be used as an auditory training unit when the child is away from the center or school. It has a frequency response that is similar to the SUVAG I (8 Hz to 20,000 Hz) and can be set for a low-pass condition. This portable aid is capable of driving a vibrator (SUVAG Vibar) and a pair of headphones (Koss K-6) or hearing aid receivers, simultaneously. It is especially useful for people who cannot understand speech through the air conduction channel. For these people, the vibrator can be strapped to their wrist to develop their sensitivity for speech; the air conduction mode is added later.

Information on these units is available from Dr. Hilton Smith, President, University of Tennessee Research Corp., 404 Andy Holt Tower, University of Tennessee, Knoxville, Tennessee 37916; (615) 974-3466.

5. HABILITATION FOR HEARING-IMPAIRED CHILDREN

Diagnostic-Therapy Program

When a child's responses to standard audiometry suggest or confirm that he has a hearing loss, he is enrolled in a Verbo-Tonal diagnostic-therapy program. The purpose of this program is to evaluate his ability to imitate rhythm and intonation patterns, to assess his muscular co-ordination, and to observe his reaction to amplification. We discuss the results and their
implications with the parents, and we explain the therapy program. The child is then enrolled in therapy with a group of children who have similar diagnostic results.

**Pre-School Program**

Groups of six to ten hearing-impaired children receive three to five hours of training daily. The children usually begin this program when they are three years old and they stay for a minimum of three years. The percentage of children who can be integrated increases if they start therapy earlier or if they continue in therapy for a few years beyond the first grade (see Chapter 8).

The classroom teacher and the individual therapist are responsible for the child's training. The parents do not have to become special educators. They are encouraged to treat their hearing-impaired child in the same way that they would treat a normal-hearing child. However, if the parents prefer to become more directly involved, they are not discouraged from doing so.

The format of the pre-school program has advantages for parents who work: (1) the children are occupied for an extended period of time each day so the parents don't have to make special arrangements for transportation and baby-sitting as they would if the child attended a 1 hr. session 3 days/week; (2) the cost is reduced because we can train the children in group sessions rather than privately; (3) the parents can use their time at home to fulfill their obligations as parents, however they understand this role.

**Procedures**

The SUVAG I auditory training unit is set for a wide frequency response (0.5 to 20,000 Hz) or for a low-pass response (0.5 to 300, 600, 1000, or 2000 Hz), depending on the requirements of the children in the group.

The teacher's microphone is positioned near her mouth to provide a good signal-to-noise ratio. During the group sessions, the children receive visual clues naturally; however, they don't receive any lipreading instructions.

When the young children begin therapy they sit on a sounding board that is driven by bone vibrators (SUVAG Vibar) from the output of the SUVAG I unit. During this stage, the children use the upper half of their bodies for "movement activities." As the child adapts to the situation and responds to the activities, a bone vibrator is strapped to his wrist.
so that he can move about freely. If the child responds to speech that is transmitted by air conduction, he is given Koss K-6 circumaural head-phones in addition to the vibrator.

When the child has acquired some rhythm and intonation patterns, the clinician attempts to evaluate his optimal field of hearing (see Chapter 3) and correct his perceptual errors through a SUVAG II. Eventually, the SUVAG II can be used for the individual therapy in the same way that it is used for hearing-impaired adults (see Chapter 6).

Young profoundly deaf children use a Mini-SUVAG hearing aid when they are away from the Center. This body hearing aid has a frequency response similar to SUVAG I, and can be worn with a vibrator and headphones or hearing aid receivers.

For children who have a moderate-to-severe hearing loss, a commercial hearing aid is recommended in the early stages of therapy if they can listen and respond to spoken language.

**Therapy Methods**

Group lessons occupy 80% of the child’s time in the first stage of therapy. During these lessons we concentrate on helping the children develop the rhythm and intonation patterns of spoken language with a normal voice quality. They receive continuous, but informal, speech stimulation.

The children learn the social aspect of speech through structured play situations which promote spontaneous physical and emotional reactions. They learn to play with one another and as a group. They become so involved in the activities that even three-year-olds will “work” for three hours with only a few short breaks. Consequently, the children have fun learning to speak because they have something they want to say. They learn how to say it through “phonetic rhythm” games which include movement activities and nursery rhythms.

In Chapter 2 we discussed the importance of the vestibular sense in developing the rhythm and intonation patterns of language. Movement activities stimulate this sense of space perception. They help develop the child’s memory for motor patterns. These activities promote muscular generalization: by manipulating and controlling the muscle tension throughout his body, the child learns to control the tension in his speech musculature.

The tension in the movement activities corresponds either to the tension in the intonation pattern or to the relative tension of the phonemes. For example, when the intonation pattern rises in the game the children are playing, the movement activity is more tense and is directed
away from the body's state of rest. If the intonation pattern falls, the tension decreases in the movements and the activity is directed toward a state of rest.

As the child develops natural motor patterns, he feels (SUVAG Vibar) and hears (low frequencies from SUVAG II) the associated speech patterns. To facilitate the child's correct perception, the clinician initially uses low- and mid-tonality sounds in the syllables (see Chapter 3). If high-tonality sounds are introduced too early in the training, the child will incorrectly perceive them as a low-tonality sound and will receive confusing information from the movement activity.

We must stress here that the clinician controls the speech stimulation in these activities, and she corrects the child's production indirectly. If the child's intonation pattern is incorrect, the clinician can change the tension in the movement activity, alter the duration, or substitute another phoneme—one that is different in tonality and/or tension. If the child produces incorrect phonemes, the clinician can modify the rhythm and intonation pattern, alter the duration, or change the tension in the movement activity. During this time the child is unaware that the clinician is correcting his speech. He continues to have fun with the different "games."

The movement activities are taught not only in games but also in meaningful play situations. These situations are designed to elicit emotional expressions (happy, sad, surprise, etc.) and the appropriate physical reactions from the children and the teacher. Initially, the teacher supplies the verbal response. Thus the children learn to associate the rhythm and intonation that they produce, feel, and hear with the meaning. They learn that the same utterance (e.g., "oh") can be modified to express different meanings. They learn that the intonation patterns not only are fun but also convey information.

When the child can produce some simple repetitive syllables using the correct intonation patterns, the clinician introduces the nursery rhythms. Initially the children learn simple rhythms that have low-tonality sounds, e.g. "ah boo bah boo boo bah," and they progress to complex rhythms that contain high-tonality words, e.g. "Shower, shower, take a shower, wash your shoulders, take a shower." The children memorize the motor and auditory patterns, and they enjoy performing these rhythms alone or in groups.

A small amount of time is allotted to "unaided" listening practice daily. The group teacher takes each child aside for five minutes to assess his ability to imitate some basic rhythm patterns when he receives the auditory stimuli "unaided," i.e. without amplification, vibrations, or vis-
ual clues. To do this, she speaks very close to the child's ear; gradually she increases the distance. This practice prepares the child to use the rhythm and intonation information when he receives a commercial hearing aid.

Each child also has individual therapy for 15 to 30 minutes daily. During this session the teacher-clinician gives him the attention that the classroom teacher could not give him in the group. When the child is ready for a body hearing aid, she introduces him to the Mini-SUVAG hearing aid, teaches him how to use it, and monitors his progress.

Initially, the child uses the SUVAG I and the SUVAG Vibar for the individual therapy session just as he does for the group session. After he has control over the rhythm and intonation and has acquired some language and listening skills, the clinician attempts to evaluate his optimal field of hearing on the SUVAG II (see Chapter 3). When the clinician is able to use the SUVAG II for the individual therapy session, the profoundly deaf child is then functioning as a hearing-impaired person, and the therapy is structured accordingly (see Chapter 6).

The children are taught to read and to write in the final stages of therapy, after they have acquired reasonably intelligible oral communication. This is similar to the developmental sequence that normal-hearing children follow.

The results of these extensive training procedures are that most of the children have voice quality and suprasegmental patterns that are close to normal (Sanatore 1980; Asp 1981). Their oral language skills are good, often similar to the average of their normal-hearing peers, because they have perceived and learned spoken language in meaningful situations.

Integration Programs

The goal of the Verbo-Tonal Program is to integrate hearing-impaired children into regular educational and social situations. Integration can be accomplished in a number of different ways. The most common way is to enroll those preschool children who have developed normal oral and social skills into kindergarten or the first grade either part-time or full-time. All of these children should continue to have 20-30 minutes of individual therapy daily from a Verbo-Tonal clinician to preserve the child's skills and to increase his ability to function in a classroom where the signal-to-noise ratio is usually very poor. As the children progress, these sessions can be less frequent and scheduled when necessary.

For those children who cannot be integrated at six or seven years of age, a specialized elementary school program should be available as part
of the Verbo-Tonal Program. At the SUVAC Center in Zagreb the children continue with the basic Verbo-Tonal procedures described earlier, and they follow the academic program for normal-hearing children in public schools. Having had this extended Verbo-Tonal Training, many of the children can be integrated between seven and twelve years of age (see Chapter 8).

Another way to integrate the children is to structure the pre-school program so that the hearing-impaired children receive 1½ to 2 hours of specialized training each day, and then they spend the rest of the day in a class with normal-hearing children. This class would follow a standard nursery school program that has many activities and opportunities to use oral communication skills. To obtain the best result, one or two hearing-impaired children should be enrolled with 20 normal-hearing children. With this approach, the hearing-impaired children have more time to communicate with normal-hearing children. Sometimes the normal-hearing children can participate in the Verbo-Tonal training session.

The most difficult children to integrate are those who have multiple handicaps in addition to hearing impairments. These children usually have neurological damage which affects their gross motor control as well as their speech articulation. They need intensive training in motor patterning to develop rhythm and intonation. Their training period is usually longer and their integration with normal-hearing children may not be possible. Success depends on the structure of the program and on the availability of intensive training.

In summary, the Verbo-Tonal method stresses intensive intervention strategies using both group and individual therapy sessions. Hearing-impaired children develop good voice quality and rhythm and intonation patterns because they use wide-band amplification and vibro-tactile stimulation when they are developing these skills. Thus they develop intelligible speech and language which enable them to communicate with others. Once they have developed spontaneous oral skills, they learn to read and to write normally. Most of these children adapt easily to amplification and use their listening skills to participate in a “hearing” society.
After we have evaluated the patient’s hearing, using both standard and Verbo-Tonal procedures, and after we have identified the optimal field of hearing, we schedule the hearing-impaired adults for auditory training on SUVAG II. The training sessions are 30 to 60 minutes, two to five times per week. The training period is one to three months for adults who acquired a hearing loss after they had developed normal speech. Our task is to help them improve their listening ability, even though their sensitivity (hearing loss) may remain the same.

The listening exercises are filtered through the patient’s optimal field of hearing (OFH). The OFH is explained in Chapter 3; briefly, it is a limited frequency band, usually two or more octaves wide, having slopes and cut-off frequencies that can be changed by the clinician. We begin therapy using the patient’s OFH because he perceives speech best in this frequency region, and he needs less intensity here than in the frequency areas where he is least sensitive. Thus he is less likely to be bothered by recruitment or injured by intense sounds.

The patient receives speech through the vibrator (SUVAG Vibar) and/or circumaural headsets (Koss K-6). The vibrator is placed on different parts of the head or body to enhance the perception of intonation and rhythm. Hence, the patient learns to extend his listening skills to include the information available in the rhythmic patterns of speech. The headsets are used simultaneously with the vibro-tactile input or separately. When the patient can use the auditory system for rhythm and intonation, the vibrator is no longer necessary.

The clinician helps the patient to correct his perceptual errors by changing the frequency response on SUVAG II or by altering her voice and rhythm patterns temporarily. If the clinician uses a rising inflection, her voice will have more tension, making it easier for the patient to perceive a higher pitched sound. Also, speaking more slowly or increasing or decreasing the duration of a phoneme or a syllable will alter perception. When the patient perceives the word or words correctly, the clinician ensures that he can then perceive the words correctly through his OFH without her having to alter her voice.

During each session, the patient practices perceiving speech without any amplification. The clinician finds the distance from the patient at which he can perceive speech and delivers the practice words or sentences. For one patient this distance might be five inches from his ear; for
another it might be three feet. Speaking at normal conversational level, the clinician attempts to increase the distance during each session. At the end of V-T training, a patient who could perceive unaided speech at a distance of three feet at the beginning of therapy, usually perceives it at six feet.

After we have corrected his perception through his OFH, we attempt to broaden the patient's OFH without increasing his errors. During the last few weeks of therapy, we recommend a hearing aid that has a frequency response corresponding to his final optimal field of hearing.

The schedule of the SUVAC Center in Zagreb demonstrates how intense and organized this training can be. Each clinician works one shift and has ten, one-half hour sessions per day (10 patients). There are a total of ten clinicians on the two shifts, so 100 patients receive regular training each day. Observers for the World Rehabilitation Fund were impressed to see such intense training for listening skills prior to careful hearing aid selection (Santore 1980; Asp 1981).

Although we discuss results in Chapter 8, we think one study is worth noting here. In 1975c Asp and Berry reported that adults who received regular Verbo-Tonal training improved their speech discrimination by 20%. They also observed that the patients were able to transfer these skills to daily listening situations and were able to function better with or without amplification. The patients were able to use amplification better in noisy situations than those patients who had not received training.

In summary, Verbo-Tonal training has a positive influence on the communication ability of people who have acquired hearing losses. They can be prepared to use amplification by being taught to use limited frequency bands in which they have the best speech discrimination.

7. SPEECH AND LISTENING REHABILITATION FOR NORMAL-HEARING PEOPLE

Normal-hearing people who have mild-to-severe speech and/or language disorders use a SUVAC Lingua auditory training unit, with circumaural headsets and vibrator (SUVAC Vibar). We present the speech stimuli at normal conversational level and we modify the frequency response to present a clear signal without the interference of background noise.
By passing the speech through one-third, one-half, or one-octave filters, we alter the acoustic characteristics of the stimuli. For example, the 300 Hz low-pass filter enhances the rhythm and intonation patterns, whereas adding the 3000 Hz high-pass filter enhances intelligibility and increases the tension of the sounds; the octave band 200-400 Hz enhances the perception of the vowel /u/, and the band 6400-12800 Hz emphasizes the consonant /s/. The band is adjusted higher or lower in frequency and/or intensity according to the response given by the client. We adjust the filters to correct perceptual errors while we help the client develop the correct motor patterns of speech. After the error is corrected, the patient should be able to produce the correct speech sound when speech is transmitted through a wide-band frequency response or when it is transmitted naturally without the SUVAG.

The speech departments at the SUVAG Center in Zagreb and the Gent Center in Belgium provide services for people who have speech, language, and learning disorders. In September 1980, the University of Tennessee received a grant to develop these procedures for normal-hearing children who have misarticulations (Asp 1981). At the University of Tennessee, we also see children who have severe expressive language disorders. These children have normal receptive language and intelligence, but highly unintelligible speech. They improve significantly when they are given group and individual therapy similar to that which is given to the hearing-impaired children.

At the Zagreb Center, Mrs. M. Stajnko, a speech pathologist, and Dr. M. Lipovesk, a neurologist, have demonstrated that neurologically impaired individuals who have normal hearing benefit from Verbo-Tonal therapy. The majority of the patients are elderly people who have had strokes, tumors, or other neurological trauma caused by severe accidents. As a key member of the neurological diagnostic team, Mrs. Stajnko observes each patient’s surgery to better understand and plan the rehabilitation process.

The rehabilitation program includes early, intensive intervention, simultaneous speech and physical rehabilitation, and frequent consultation between the clinician and the surgeon. Rehabilitation can begin immediately after the trauma, and it continues for at least 2 hours daily, including weekends (Asp 1981).

The Zagreb Center provides group and individual training daily for normal-hearing pre-schoolers who have severe motor and visual problems in addition to severe speech and language disorders. A specialist works with these children to develop motor patterning and to improve gross motor skills through rhythm and body movement exercises. These
exercises help them to produce normal rhythm and intonation patterns and intelligible speech (Asp 1981). Recently Bennett (1980) demonstrated a relationship between motor, suprasegmental, and language skills.

Workers at the Zagreb Center do not wait to see if maturation will correct speech and language problems in very young children. When they identify a problem, they begin therapy. Furthermore, Mrs. Stajnko has devised a program for babies who are likely to have problems, i.e. "high-risk" babies, and their families (Santore 1980).

In summary, results suggest that using SUVAG instruments and movement therapy may lead to a shorter and more effective rehabilitation process for those people who have speech-language disorders.

8. RESULTS

For hearing-impaired children and adults, the goal of Verbo-Tonal therapy is to help them develop good oral communication skills which will allow them to freely interact with normal-hearing people. Young hearing-impaired children should be integrated into regular classrooms as soon as possible. In this chapter, we will attempt to assess how Verbo-Tonal Centers in North America and in Europe achieve this goal by reviewing the evaluations of their patients' communication skills and integration rates.

The University of Tennessee Verbo-Tonal program provides regular training for young hearing-impaired children. Evaluators of this program have reported that the children showed significant improvement in oral communication skills as a function of therapy (Asp 1969; Bradbury 1970; Asp, French, & Lawson 1970; Asp 1973a; Asp, Archer, & Kline 1979; Asp 1981). Pre-school children who had the most therapy talked more frequently with normal-hearing pre-schoolers than those who had less VT therapy (Shirley 1972).

When the Verbo-Tonal program was compared to other programs, our children had better listening and speaking skills than those who were enrolled in a comparable oral day program (Woodfin 1971; Woodfin & Asp 1971), and they had better articulation and oral reading skills than children who were in a signed English (Total Communication) program at a residential school for the deaf (Duncan 1976).
Between 1972 and 1978, 53% of the hearing-impaired children at the University (average loss 90 dB in the better ear) were integrated into public school classrooms (Asp, Archer, & Kline 1979). For the years 1976 to 1978, the percentages were 60, 62, and 71% respectively. More of these children could have been integrated if they could have continued in therapy beyond six years of age (Asp, Archer, & Kline 1979).

If the frequency response for the auditory training and the hearing aid is carefully chosen, the rehabilitation time for adults and children who developed hearing losses after they had developed language will be shorter than for young congenitally deaf children (Asp & Berry 1975c). To ensure that the test scores agree with the patient's personal evaluation of his "handicap," it is necessary to include a noise and reverberation background with the speech stimulus (Mason 1977). When tested appropriately, most patients show a 20% improvement in discrimination within 3 months of regular training (Asp & Berry 1975c). Some patients improve their speech reception thresholds even though pure-tone thresholds remain the same (Vertes et al. 1972). Generally, Verbo-Tonal training helps the patients adjust to amplification and it improves their communication ability in everyday listening situations.

The New York League for the Hard-of-Hearing provides aural rehabilitation for hearing-impaired adults and some children. Santore reported that the Verbo-Tonal method satisfied the diagnostic and therapeutic needs of the hearing-impaired population better than other auditory training programs previously used at the League. The procedures identified auditory functions that are not ordinarily diagnosed with standard audiometric procedures. Therefore, the therapy was particularly beneficial for people who did not function well in daily situations even though they had good speech discrimination scores or for people who were not able to adjust to amplification. In a five-year study of 80 adults, 71% of the patients had a significant improvement in auditory perception (Santore 1978b).

Eisenberg & Santore (1976) presented a case study of a 12-year-old child who had a congenital, profound bilateral sensori-neural hearing loss. Despite substantial auditory training, he was unable to comprehend any speech material through his binaural amplification or through the audiometer prior to Verbo-Tonal therapy. Following two and one-half years of VT therapy, he was able to use his residual hearing to perceive speech. His aided speech discrimination scores improved from 0% (prior to therapy) to 56%. The authors suggested that this method should be tried with other children who have not benefitted from standard procedures.
The Western Pennsylvania School for the Deaf, a residential school, has adopted the Verbo-Tonal Method for all grades. All of the children, from those in the nursery school to those in the upper school, improved in receptive and expressive communication skills. The professionals have developed an interesting integration program in which the deaf children and normal-hearing children are brought together either in the regular public school classroom or at the residential school. Generally, the results have been positive; however, the investigators have cautioned that such a program must be carefully organized and frequently reviewed if it is to be successful (Craig, Douglas, & Burke 1979).

Over the years a number of other programs in North America have reported results. Investigators who evaluated the program at the Alexander Graham Bell School for the Deaf in Columbus, Ohio, reported that the method had advantages that traditional systems lacked (Black 1971). The children improved their speech intelligibility and their rhythm and intonation patterns (Card, Jones, Prillerman 1972). The Metropolitan School for the Deaf in Toronto, Ontario, reported that the deaf children in all the Verbo-Tonal classes progressed at least as much as the children in the regular program, and in some cases their progress was exceptional (Roberts 1969).

Through two independent fellowships from the World Rehabilitation Fund, Santore (1980) and Asp (1981) were able to observe and evaluate major Verbo-Tonal Centers in Europe where the method is used in different languages and cultures. In the following review, we will combine information from the fellowship reports with results of studies which were completed at the various centers.

The SUVAG Center in Zagreb, Yugoslavia, has grown over the past 25 years, and currently is the most comprehensive Verbo-Tonal Center in the world. It provides services for people who have many kinds of communication problems. In an early study sponsored by the United States Government, the SUVAG Center evaluated the progress of 100 hearing-impaired children over a five-year period (Guberina et al. 1972). The results showed that 44% of the children were integrated into regular public school classrooms, where they performed at the appropriate grade level. (The number increased after the reporting period, December 1966, because some of the children were still in training at that time). Thirty percent of the children improved significantly in speech discrimination; 97% improved when speech was presented through their optimal field of hearing; 92% improved in their ability to understand speech in a free field presentation; and 23% achieved 100% intelligibility through a hearing aid at a distance of ten feet. More recent statistics showed that 75 to 90%
of the hearing-impaired children from this center are integrated (Asp 1981).

Santore (1980) reported that the Zagreb pre-school children who had moderate-to-severe hearing losses had uniformly excellent speech, language, auditory skills, voice qualities, rhythm and intonation patterns. She attributed this result to the fact that they used body movement activities and musical rhythm exercises to develop the auditory system for speech and language acquisition. The children who had profound hearing losses had good voice quality, rhythm and speech patterns, and they were able to communicate orally. In general, she was impressed with the speech intelligibility and the spontaneous language skills of these children.

Researchers at the Zagreb Center have studied the vestibular function and motor skills of the hearing-impaired children. These studies showed that the children who had greater hearing losses also had more vestibular impairment. The children who had better peripheral vestibular function benefitted more from training. During the period of rehabilitation, the majority of the children showed an improvement in central vestibular responses which correlated with their improvement in motor and oral communication skills (Guberina et al. 1972).

The researchers also compared the sleep patterns of deaf children from the VT program, deaf children who had not received VT training, and normal-hearing children. The children from the VT program had rapid eye-movement patterns (REMs) similar to those of the normal-hearing children. The REMs of the deaf children who had not received VT training were different from those of the normal-hearing children (Stojanovic & Guberina 1975).

Dr. Busquest is the director of the Verbo-Tonal center in Argenteuil, France; L’Ecole Intree Casanova. The center is fortunate to have a school for normal-hearing children next door where they can integrate the deaf children. Eight other elementary schools also participate in the integration program. During the 1979-80 school year, there were 134 hearing-impaired children enrolled at L’Ecole Intree Casanova. Although all of the children use speech in class and in social situations, their speech was better in structured situations than in spontaneous ones (Santore 1980). Fifty-six per cent of the children between 3 and 14 years of age were integrated on a partial or a full-time basis (Asp 1981).

The Verbo-Tonal Center in Paris, France, is co-ordinated by Professor Gospodnetic. Over the past few years, 68% of the hearing-impaired chil-
Children were integrated into the public schools. Those who could not be integrated were children who had a hearing loss greater than 100 dB (Asp 1981).

The Verbo-Tonal Center in Gent, Belgium, with Co-ordinator Madame Layon, has over one thousand patients who have all types of communication problems. The Gent Center has a comprehensive program for infants (0 to 3 yrs.) and their parents which prepares the infants for the pre-school program (3 to 6 yrs.). The overall organization and quality of therapy in this Center is truly impressive. The Center integrates 99% of the hearing-impaired children into regular classrooms by the sixth grade. Of these, 40% are integrated by the second grade (Asp 1981).

In summary, the European Centers had the following integration rates: (1) 75 to 90% at the Suvag Center in Zagreb; (2) 99% at the Gent Center in Belgium; (3) 56% at the Argenteuil Center, and (4) 57% for the Paris Center. These results indicate that the Verbo-Tonal programs have been extremely successful in integrating the deaf children who begin therapy at 2 or 3 years of age, even if the parents lack the time, the finances, or the education to become involved. Moreover, the results from those centers that have an Infant/Parent program or from those where the children can continue in therapy beyond the first grade suggest that the children who are integrated are not the exception—they are the rule. Most deaf children can develop good oral communication skills, and they can enter a “hearing society.”

9. TRAINING AT THE INSTITUTE OF AURAL REHABILITATION

The Institute of Aural Rehabilitation (IAR) at the University of Tennessee has been established to train and certify Verbo-Tonal clinicians. The Institute provides the following: (1) certified instructors who supervise the training; (2) information about educational and therapy materials (video tapes, books, slides, curricula, etc.); and (3) information about the SUVAG Auditory Training Units.

The IAR offers regular 15-day workshops on the U.T. campus and in other locations. The successful trainee is certified in one of the following areas: (1) rehabilitating hearing-impaired children and adults; (2)
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