Auditory-Visual Training Paradigm for Hearing-Impaired Adults

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Milestones in the history of auditory training are reviewed as they relate to considerations in auditory-visual training. This paper describes preliminary procedures used in the evaluation and remediation of auditory-visual communication skills in hearing-impaired adults. The development and use of videotaped Utley Lipreading Test sentences for determining baseline measures in training is described in detail. This is followed by discussion of the design and implementation of a training program which systematically isolates and recombines linguistic content, competing noise, and situational cue parameters under a plan of decreasing redundancy of information. Four sample cases are described to illustrate clinical application of this auditory-visual training program paradigm. Finally, conclusions drawn from preliminary use of this procedure are presented along with suggestions for future research.

Auditory training is a critical component of aural rehabilitation for many hearing-impaired people. Although widely accepted, its history is largely unremarkable. In its early years, auditory training focused on meeting the communicative needs of severely hearing-impaired children. Educators of the deaf assumed responsibility for the design and implementation of auditory training programs. These educators were influenced by the teachings of Max Goldstein whose Acoustic Method convinced many of the importance of developing the hearing-impaired person's residual hearing capability (Nerbonne & Schow, 1980).

The next milestone in auditory training history was reached with the commitment to rehabilitate hearing-impaired World War II veterans. Spurred by Raymond Carhart's work at Deshon Hospital and his landmark publications, audiologists and others developed an interest in auditory training for all hearing-impaired individuals, regardless of age or degree of loss. Carhart's principles have since become regarded as the "traditional approach" to auditory training.

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Carhart recognized that many adults would benefit from reeducation of communication skills lost through hearing impairment. In his program, the underlying theme was to help the adult develop an attitude of critical listening. To exercise these skills, he provided training under three sets of listening conditions. To prepare his clients to optimize their use of residual hearing in understanding everyday messages, he developed listening tasks incorporating use of relatively intense, nonspeech, competing noise. To further exercise the development of communication skills under adverse conditions, auditory training activities also incorporated the use of competing speech signals, creating what Carhart termed a perceptual masking effect. Finally, Carhart included telephone communication exercises in his auditory training program to help the hearing-impaired adult gain success in commonly experienced, often-times difficult, listening conditions (Nerbonne & Schow, 1980). In brief, Carhart's approach toward adult auditory training was to provide experience in improving auditory communication skills under difficult, yet commonly encountered, listening conditions.

In more recent times, Sanders (1971) has suggested that the listening exercises proposed by Carhart should be organized and presented under conditions of decreasing redundancy of information. Sanders proposed that linguistic and situational cue variables be controlled and ordered. According to Sanders, redundancy of information may be controlled through the introduction of various types of competing noise in the auditory training program. Sanders also suggested that auditory training incorporate the use of visual stimuli in a simultaneous and unified fashion. Auditory training then, at least for some people, would include exercises to develop combined auditory-visual speech perception skills.

The idea of combining auditory with visual information in aural rehabilitation is not new. Numbers and Hudgins (1948) and Whitehurst (1964) were among the early investigators who demonstrated that visual and auditory cues enhance each other in the total speech perception process, even though auditory cues may be distorted and visual cues are often obscured or absent. Several investigators have found that combined auditory-visual speech discrimination yields information about the hearing-impaired person's ability to understand everyday conversational speech (Dodds & Harford, 1968; Siegenthaler & Gruber, 1969; Whitehurst, 1964). Alpiner (1978), Binnie (1973) Erber (1974) and Garstecki (1976, 1979, 1980 a,b), have long supported the need for bisensory evaluation procedures. In auditory training, it seems logical to direct efforts toward maximizing the hearing-impaired adult's ability to use combined sensory input in message perception since this is the type of information processing skill that is required in everyday face-to-face conversation.

Although there is general agreement with the principles of auditory training developed by Carhart and expanded by Sanders and others, at present there is no generally accepted plan for determining the need for auditory-visual (AV) training or for developing auditory-visual training program goals. The purpose of this paper is to describe preliminary efforts to develop such procedures in an adult aural rehabilitation program. It will focus on improvement of skills employed in auditory-visual perception of everyday messages. It is not intended to address other important concerns in auditory training such as hearing aid evaluation, selection, fitting or orientation, earmold modification, measurement and modification of room acoustics, and other such responsibilities of the rehabilitative audiologist.

BASELINE MEASURES

It is not as difficult to recognize the need for AV training as it is to determine the starting point and sequence of steps in the training program. The need for training may be surmised from a case report, interview, and observational data. Audiologic test findings provide a measure of distortion in the speech processing system and suggest the probable level of dependence placed on visual input in everyday speech processing. However, to determine a starting point in the training process, two types of measures are useful. Since everyday communication for most people requires auditory and combined auditory-visual communication skill, in the Northwestern University Aural Rehabilitation Program a baseline measure of each type of skill is obtained.

The first is a measure of speech discrimination ability using audiotaped recordings of standard audiologic test materials such as NU Test No. 6 (Tillman & Carhart, 1966) or the California Consonant Test (CCT), by Owens and Schubert, 1977, stimuli which are presented in the sound field at 60 dB HL. If feasible, test stimuli are presented in competition with multispeaker babble at a 0 dB signal-to-noise ratio (SN). The hearing-impaired client, in his natural aided or unaided listening mode, completes the assessment, and results are analyzed in terms of overall percent correct, as well as for patterns in acoustic confusions. These results serve as a baseline measure of auditory communication ability, a starting point in auditory training. This measure of auditory system speech processing potential under difficult listening conditions provides a place to begin reeducation of skills required for auditory comprehension of everyday messages, devoid of linguistic content, such as telephone numbers; addresses; and names of people, places, and things.

Next, combined auditory-visual message perception skills are assessed. As with standard speech discrimination tests, the purpose of this measure is to help determine relative differences in speech understanding across a clinical population. Video-audio taped recordings of Utley Lipreading Test (Utley, 1946) sentences serve as the test stimuli. Sentences are presented under controlled listening/viewing conditions. Results are analyzed according to overall correctness of sentence perception and according to the amount of linguistic information (word count) perceived. The responses are evaluated for possible acoustic, visual, and linguistic confusions. They serve as a baseline measure of auditory-visual communication ability and suggest the level of difficulty a person may have in auditory message perception when linguistic content and visual speech perception or speechreading cues are available. This skill is important for understanding everyday face-to-face communication.

Utley Lipreading Test sentences are used in this measure because they are readily available to most professionals concerned with audiologic assessment, auditory training, and lipreading. They may be used with hearing-impaired adults having a third grade or higher reading ability. Each of the two forms of the videotaped Utley Test materials has been found to yield a similar distribution in item difficulty across sentence lists in administration to 32 normal-hearing/seeing college freshmen. The stimuli are presented at 72 dB SPL in the presence of a competing, multispeaker babble at a -12 dB signal-to-noise ratio. Standard deviations and range of scores obtained on both Forms A

Table 1
Means, Standard Deviations and Ranges of Scores for 32 Normal-Hearing Adults in Auditory-Visual Perception of Forms A and B of the Utley Lipreading Test Sentences

Score	Form A	Form B
Mean (% correct)	62.8	62.6
Standard Deviation	14.9	15.8
Range	32.2 to 91.9	23.0 to 88.1

and B suggest the possibility of these forms being used interchangeably to determine pre- and post-remediation measures of auditory-visual sentence perception ability (see Table 1). The correlation between scores obtained on Form A with those on Form B was .75. Further clinical utility of these materials is suggested by item analyses which demonstrate a relatively similar and even distribution of item difficulty across each form. The latter requires further investigation, but it suggests that it may be possible to use such materials to determine a degree of auditory-visual sentence perception (see Table 2).

TRAINING PROGRAM PARADIGM

The general goal of auditory-visual training is to move the hearing-impaired adult toward successful everyday communication as efficiently and

Table 2
Utley Lipreading Test Sentence Item, Auditory-Visual Intelligibility Range for 32 Normal-Hearing Adults

A-V Intelligibility (% correct)	Form	Sentences
0 - 21.9	A	1,4,5,7,10,13,23
31.3 - 46.9	A	6,9,12,14,15,18,19,21
53.1 - 68.8	A	2,11,16,20,22,26,29,30
75.0 - 96.9	A	3,8,17,24,25,27,28,31
3.1 - 25.0	B	2,4,5,6,8,9
37.5 - 46.8	B	3,7,18,21,22,24,28
53.1 - 68.8	B	1,11,12,13,15,20,23,26,27,29
75.0 - 93.8	B	10,14,16,17,19,25,30,31

effectively as possible. The program should help the adult understand the factors that influence the communication process and how s/he can use this information to optimize her/his opportunities for successful communication. It should provide a logical, systematically progressing plan of activities to help the adult achieve realistic, individually determined communication goals while allowing for individual performance differences.

In the Northwestern University Aural Rehabilitation Program, hearing-impaired adults have demonstrated progress toward improving their AV communication skills when the major parameters of everyday communication are isolated and systematically recombined. In isolating message parameters, the clients become aware of the influence of each parameter on their own communicative performance. For example, some adults "discover" that background noise levels are of little consequence for their particular degree of hearing loss. Other adults find that competing message presentation levels are of critical importance to them in predicting their success in understanding a spoken message. As they identify message parameters for which there must be either control or compensation in specific instances, the clients also have the opportunity to develop improved communication skills through activities in which these parameters may be recombined to eventually simulate conditions actually experienced in everyday communication.

In this experimental program, four message parameters are systematically varied to either increase or decrease the redundancy of information provided. The message parameters include message-type or linguistic cues, listening conditions or competing noise type, primary-to-competing noise ratio, and situational or background cues. Redundancy of information varies along the continuum shown in Table 3 where: (a) message types range from meaningful

Table 3

Auditory-Visual Communication Training Program Parameters (revised 4-81)

		N_4			↑
	M_3	N_3	SN_3		Redundancy Increase : Decrease
	M_2	N_2	SN_2	C_2	
	M_1	N_1	SN_1	C_1	
Baseline Condition	M_0	N_0	SN_0	C_0	
	M_{-1}	N_{-1}	SN_{-1}	C_{-1}	↓

M = Message Type

M_3	=	Stories
M_2	=	Paragraphs
M_1	=	Related Sentences
M_0	=	Unrelated Sentences
M_{-1}	=	Words

N = Noise Type

N_4	=	Quiet
N_3	=	Environmental Sounds
N_2	=	White Noise
N_1	=	Single-Speaker Babble
N_0	=	Multispeaker Babble
N_{-1}	=	Cafeteria/Multispeaker Babble

SN = Signal-to-Noise Ratio

SN_3	=	>+12 dB
SN_2	=	+12 dB
SN_1	=	+6 dB
SN_0	=	0 dB
SN_{-1}	=	-6 dB

C = Situational Cue

C_2	=	Descriptive auditory and/or visual background cue
C_1	=	Related auditory and/or visual background cue
C_0	=	No background cue
C_{-1}	=	Auditory and/or visual background distraction

words to story materials, (b) competing noise types range from a combination of cafeteria noise mixed with multispeaker babble to quiet, (c) primary to competing noise levels range from -6 dB to >12 dB, and (d) situational cues range from auditory and/or visual background distractions to descriptive auditory and/or visual background cues. The baseline condition (M_0 N_0 SN_0 C_0) incorporates presentation of unrelated sentences (Utley Lipreading Test material) with multispeaker babble at 0 dB SN ratio. Situational cues are not provided. The resulting score is the auditory-visual speech discrimination test result. Although an acceptable level of performance is arbitrarily determined, clinical observations suggest that a score of 80% or lower is usually indicative of a need for auditory-visual training.

To determine training goals, message perception ability is probed at increasingly higher levels of message redundancy until a predetermined criterion level of performance is achieved. After baseline measures have been taken, speech perception ability may be assessed at higher levels of redundancy (levels 3, 6, and 10, for example) until a predetermined performance criterion level is achieved (see Table 4). When criterion is achieved, this is

Table 4

Auditory-Visual Communication Training Program Paradigm (revised 4-81)

AV Training Levels

(Begin at the highest level of redundancy below ceiling level performance.) ↑

(Work back toward baseline as rapidly as possible.) ↓

	11.	M_3	N_0	SN_0	C_2
	10.	M_3	N_0	SN_0	C_1
	9.	M_2	N_0	SN_0	C_2
	8.	M_2	N_0	SN_0	C_1
	7.	M_1	N_0	SN_0	C_2
	6.	M_1	N_0	SN_0	C_1
	5.	M_0	N_0	SN_0	C_2
	4.	M_0	N_0	SN_0	C_1
	3.	M_3	N_0	SN_0	C_0
	2.	M_2	N_0	SN_0	C_0
	1.	M_1	N_0	SN_0	C_0
Baseline		M_0	N_0	SN_0	C_0
	-1.	M_0	N_0	SN_0	C_{-1}
	-2.	M_{-1}	N_0	SN_0	C_0
	-3.	M_{-1}	N_0	SN_0	C_{-1}
	-4.	M_{-1}	N_0	SN_{-1}	C_0
	-5.	M_{-1}	N^0	SN_{-1}	C_{-1}
	-6.	M_{-1}	N_{-1}	SN_{-1}	C_0
	-7.	M_{-1}	N_{-1}	SN_{-1}	C_{-1}

regarded as ceiling level performance. The immediate training goal is to proceed with activities designed to develop satisfactory communication skills at each decreasing level of redundancy, progressing from ceiling back to baseline level performance. Theoretically, it is only necessary to progress below the baseline condition in unusual circumstances. However, it may be necessary to probe at redundancy levels greater than level #11 in Table 4. In these instances, the primary-to-competing noise ratio may be changed from 0 dB (SN) to successively higher ratios (SN, or SN_2, or SN_3) while continuing to modify other message parameters according to the original training program paradigm. If necessary, this process may be expanded by changing both primary-to-competing noise ratio and noise type following the stages of increasing redundancy of information listed in Table 3. This same overall procedure would also apply to an auditory-only training program (Tables 5 and 6).

Table 5

Auditory Communication Training Program Parameters (revised 4-81)

	M_5			
	M_4	N_4		
	M_3	N_3	SN_3	
	M_2	N_2	SN_2	C_2
	M_1	N_1	SN_1	C_1
Baseline Condition	M_0	N_0	SN_0	C_0
	M_{-1}	N_{-1}	SN_{-1}	C_{-1}

↑ Increase : Decrease ↓ **Redundancy**

Where: **M = Message Tips**

M_5	=	Stories
M_4	=	Paragraphs
M_3	=	Related Sentences
M_2	=	Unrelated Sentences
M_1	=	Spondees
M_0	=	Monosyllabic Words
M_{-1}	=	Syllables

N = Noise Type

N_4	=	Quiet
N_3	=	Environmental Sound
N_2	=	White Noise
N_1	=	Single-Speaker Babble
N_0	=	Multispeaker Babble
N_{-1}	=	Cafeteria/Multispeaker Babble

SN = Signal-to-Noise Ratio

SN_3	=	$>+12$dB
SN_2	=	+12 dB
SN_1	=	+6 dB
SN_0	=	0 dB
SN_{-1}	=	-6 dB

C = Situational Cue

C_2	=	Descriptive auditory and/or visual background cue
C_1	=	Related auditory and/or visual background cue
C_0	=	No background cue
C_{-1}	=	Auditory and/or visual background distraction

Table 6
Auditory Communication Training Program Paradigm (revised 4-81)

Auditory Training Levels				
17.	M_5	N_0	SN_0	C_2
16.	M_5	N_0	SN_0	C_1
15.	M_4	N_0	SN_0	C_2
14.	M_4	N_0	SN_0	C_1
13.	M_3	N_0	SN_0	C_2
12.	M_3	N_0	SN_0	C_1
11.	M_2	N_0	SN_0	C_2
10.	M_2	N_0	SN_0	C_1
9.	M_1	N_0	SN_0	C_2
8.	M_1	N_0	SN_0	C_1
7.	M_0	N_0	SN_0	C_2
6.	M_0	N_0	SN_0	C_1
5.	M_5	N_0	SN_0	C_0
4.	M_4	N_0	SN_0	C_0
3.	M_3	N_0	SN_0	C_0
2.	M_2	N_0	SN_0	C_0
1.	M_1	N_0	SN_0	C_0
Baseline	M_0	N_0	SN_0	C_0
-1.	M_0	N_0	SN_0	C_{-1}
-2.	M_{-1}	N_0	SN_0	C_0
-3.	M_{-1}	N_0	SN_0	C_{-1}
-4.	M_{-1}	N_0	SN_{-1}	C_0
-5.	M_{-1}	N_0	SN_{-1}	C_{-1}
-6.	M_{-1}	N_{-1}	SN_{-1}	C_0
-7.	M_{-1}	N_{-1}	SN_{-1}	C_{-1}

Begin at the highest level of redundancy below ceiling level performance. (↑)

Work back toward baseline as rapidly as possible. (↓)

CLINICAL APPLICATION

Example 1

The following sample cases illustrate auditory-visual, training program plans for four hearing-impaired adults. The first is a 39-year-old male sales executive. He has a severe, bilateral, sensorineural hearing impairment resulting from scarlet fever at age three. He reported that his loss has gradually progressed to the point where he began wearing monaural amplification at age 17 and binaural amplification at age 20. His unaided speech reception thresholds were 85 dB and 95 dB for his right and left ears, respectively. Unaided speech discrimination scores were 36% and 28%, respectively, for right and left ears. At 60 dB HL, his aided discrimination is 60% (measured using

NU Test No. 6 stimuli presented in quiet). Interview and Hearing Performance Inventory results revealed that his greatest difficulties are in situations in which his stage-managing opportunities are restricted, such as when attending a theatrical production, lecture, or church service. He reported problems following one-on-one as well as group conversation, especially when it is difficult or impossible to ask for repetition, rephrasing, or further clarification of a misperceived message. It was clear that he wanted practical advice and immediate solutions to the everyday problems which had frustrated him to the point of seeking professional assistance.

In consideration of his poor auditory discrimination ability and his main concern for improving the success rate in auditory-visual communication situations, regular procedures for establishing baseline level performance were modified to provide an estimate of auditory-visual sentence perception under a +6 dB primary-to-competing signal condition. The result of this assessment is shown in Table 7. With a baseline score of 50%, he was

Table 7

Auditory-Visual Training Program Paradigm for Sample Case One

Auditory-Visual Training Levels					Pre-Training Score(s)	Post-Training Score(s)
11.	M_3	N_0	SN_1	C_2		
10.	M_3	N_0	SN_1	C_1	100	
9.	M_2	N_0	SN_1	C_2		
8.	M_2	N_0	SN_1	C_1		
7.	M_1	N_0	SN_1	C_2		
6.	M_1	N_0	SN_1	C_1	80	
5.	M_0	N_0	SN_1	C_2		
4.	M_0	N_0	SN_1	C_1	70	
3.	M_3	N_0	SN_1	C_0	75	
2.	M_2	N_0	SN_1	C_0		
1.	M_1	N_0	SN_1	C_0	60	
Baseline	M_0	N_0	SN_1	C_0	50	90

expected to demonstrate improved performance under conditions of greater message redundancy. He attained a score of 100% when stimulus material consisted of short paragraphs with accompanying pictures which served to provide a related visual background cue. With 100% performance under this condition, a ceiling level had been determined and remediation goals progressed from this point back toward the baseline condition with materials designed to provide a progressively decreasing amount of linguistic content and situational cues.

Reassessment under baseline level conditions at the end of an eight-week training program resulted in a score of 90%. According to this finding, his ability to perceive unrelated sentences in noise had improved from 50% to 90%. The client attributed his success to an improvement in his "problem-solving" ability. Problems created in training were resolved through discussion and systematic, logically progressing, message perception exercises. He reportedly became more conscious of efforts to apply what he practiced in training in his everyday social and work situations. By developing successful strategies under controlled training conditions, he felt more confident in facing difficult communication situations. This remediation approach seemed to work for this client because he could understand those communication parameters over which he had control and those for which he had to compensate. The remediation plan was logically organized, and the procedures had direct bearing on his immediate communication concerns. This client's self-motivation to perform well was another important factor leading to overall program success.

Example 2

The second sample is a 39-year-old female computer science graduate student. Her loss is progressive and of unknown origin. Three years ago her unaided speech discrimination ability was 64% as measured using the Word Intelligibility by Picture Index Test (Ross & Lerman, 1970) presented in sound field at 50 dB HL. At present she is only able to auditorily comprehend spoken messages when she is able to use lipreading cues simultaneously. Her aided auditory-visual discrimination of NU Test No. 6 stimuli presented in quiet at a normal conversational speech level is 56%. She is a reserved, almost rigid, communicator. She is not willing to guess at partially perceived messages. In addition, it should be noted that English is her second language.

With this individual as with other adults experiencing either a debilitating progression of hearing loss or sudden onset of severe hearing loss, initial emphasis in auditory-visual training was directed toward counseling and reconsideration of factors influencing success in everyday communication. Efforts were directed toward: (a) developing an understanding of her hearing impairment in relation to the acoustic properties of speech signals; (b) auditory and visual language processing (e.g., auditory and visual closure) and contrasting speech movements; (c) nonverbal communication cues; (d) cues from linguistic context; and (e) knowledge of the communication set and situational cues, as well as the influence of other sender, receiver, message, and communication environment variables on successful interpersonal communication. The importance of associating message cues perceived to be relevant and related to a spoken message was emphasized.

Table 8

Auditory-Visual Training Program Paradigm for Sample Case Two

Auditory-Visual Training Levels					Pre-Training Score(s)	Post-Training Score(s)
11.	M_3	N_0	SN_0	C_2		
10.	M_3	N_0	SN_0	C_1		
9.	M_2	N_0	SN_0	C_2		
8.	M_2	N_0	SN_0	C_1		
7.	M_1	N_0	SN_0	C_2		
6.	M_1	N_0	SN_0	C_1		
5.	M_0	N_0	SN_0	C_2		
4.	M_0	N_0	SN_0	C_1		
3.	M_3	N_0	SN_0	C_0	80	
2.	M_2	N_0	SN_0	C_0		
1.	M_1	N_0	SN_0	C_0		
Baseline	M_0	N_0	SN_0	C_0	65	

Upon completion of the orientation program, auditory-visual communication baseline measures were determined, and she obtained an AV baseline score of 65%. Her performance improved to 80% through the addition of linguistic content (see Table 8). With her relatively high baseline level scores and with ceiling level performance being achieved through the addition of linguistic content only, her auditory-visual training goals were readily defined, and her prognosis for improvement appeared to be excellent. Unlike the first example, this client did not appear to be motivated by, nor interested in, the progression of steps incorporated in her auditory-visual program. The pre-program counseling and education served to heighten this client's awareness of ways in which she might improve her everyday communication skills. Her program plan served its most useful purpose by providing a guide for the clinician in preparing short-term training goals.

Example 3

The third case is a 64-year-old salesman with a long-standing, bilateral sensorineural hearing impairment due to otosclerosis. Attempts at surgical improvement had been unsuccessful. Most importantly, a recent viral infection further reduced his auditory sensitivity. His current unaided speech discrimination ability is 4% and 12% in his right and left ears, respectively. Aided discrimination of Utley sentences in quiet at 60 dB HL is 36%. He has worn binaural amplification for 27 years.

Although this man had no history of rehabilitative service other than hearing aid evaluations and fittings, the recent progression of his hearing loss left him despondent over the possibility of losing all auditory capability. He was referred for participation in an aural rehabilitation program with emphasis on counseling and education regarding management of hearing-loss related problems. After an intake interview and assessment of his communication skill, he was enrolled in a combined individual and group counseling and auditory-visual training program. Somewhat like the client in the first example, this man became highly interested in knowing what factors served to influence his communicative skill. He charted his progress in training, and in doing so, challenged himself to improve. The program plan clearly served as a motivational tool for him. Another positive feature of his program was that, by the nature of the plan, he experienced some success in communication in every session. The momentum generated by his successes helped him to meet more challenging conditions which followed. Baseline measure procedures were modified to provide an estimate of auditory-visual sentence perception under a +6 dB primary-to-competing background ratio. This resulted in a score of 50% (see Table 9). A 79% score obtained in exercises

Table 9

Auditory-Visual Training Program Paradigm for Sample Case Three

Auditory-Visual Training Levels					Pre-Training Score(s)	Post-Training Score(s)
11.	M_3	N_0	SN_1	C_2		
10.	M_3	N_0	SN_1	C_1		
9.	M_2	N_0	SN_1	C_2		
8.	M_2	N_0	SN_1	C_1		
7.	M_1	N_0	SN_1	C_2		
6.	M_1	N_0	SN_1	C_1	79	
5.	M_0	N_0	SN_1	C_2		
4.	M_0	N_0	SN_1	C_1		55
3.	M_3	N_0	SN_1	C_0		
2.	M_2	N_0	SN_1	C_0		
1.	M_1	N_0	SN_1	C_0		
Baseline	M_0	N_0	SN_1	C_0	50	

using series of related sentences presented with relevant background cues determined a ceiling level. The present plan is to continue to assist him in advancing his skills. He has requested continued enrollment and extended sessions to help him meet his goals.

Example 4

The final sample is a 40-year-old woman suffering a severe-to-profound, bilateral, sensorineural hearing loss resulting from meningitis at age six; further complicated by Meniere's Disease in 1976. She demonstrated a speech awareness threshold of 100 dB in her left ear; no response in the right ear. Aided testing yielded a 68 dB HL speech reception threshold using selected spondees. Auditory speech discrimination ability was negligible. She was self-referred for "lipreading lessons." Her auditory-visual sentence perception baseline score was 52%, with a ceiling score of 75% for understanding related sentences presented with situational cues (see Table 10).

Table 10

Auditory-Visual Training Program Paradigm for Sample Case Four

Auditory-Visual Training Levels					Pre-Training Score(s)	Post-Training Score(s)
11.	M_3	N_0	SN_0	C_2	______	______
10.	M_3	N_0	SN_0	C_1	______	______
9.	M_2	N_0	SN_0	C_2	______	______
8.	M_2	N_0	SN_0	C_1	______	______
7.	M_1	N_0	SN_0	C_2	______	______
6.	M_1	N_0	SN_0	C_1	75	______
5.	M_0	N_0	SN_0	C_2	______	______
4.	M_0	N_0	SN_0	C_1	______	______
3.	M_3	N_0	SN_0	C_0	______	______
2.	M_2	N_0	SN_0	C_0	______	______
1.	M_1	N_0	SN_0	C_0	______	______
Baseline	M_0	N_0	SN_0	C_0	52	______

Although baseline and ceiling measures were determined using background noise, she reported experiencing greater competition from her constant tinnitus. As a result, most of her AV training exercises were conducted in quiet. In this case, the program plan served to define the limits of the client's communicative ability, but because of the nature of her hearing problem, it was not necessary to maintain all test conditions in the training exercises.

CONCLUSION

In conclusion, there is a clinical population that is interested in, and able to benefit from, training to improve combined auditory-visual communication skills. Preliminary observations suggest the need for development of versatile and reliable auditory-visual communication assessment procedures. Development of these procedures should take into consideration the combined purposes for which auditory discrimination tests and speechreading tests have been developed in the past. They should be able to be used by hearing-impaired people with a wide range of experiential background and language facility. They also should be representative of everyday communication conditions which vary in acoustic and visual, linguistic and extra-linguistic redundancy. Finally, and most importantly, they should incorporate assessment of a client's ability to process isolated message components and also the ability to select and combine all available and relevant components into meaningful message comprehension.

Work with the individuals cited, and similarly hearing-impaired adults, has demonstrated the advantages of employing a systematic, logically progressing, training program paradigm. The clinician is able to use such a plan in designing a training program which taps the client's critical needs. Time is neither wasted on superfluous exercises nor on exercises that are outside the realm of capabilities of the hearing-impaired individual. Training goals are circumscribed by baseline and ceiling level measures. The client understands the direction of her/his training program and becomes self-motivated to succeed when s/he is able to compare her/his performance across exercise conditions and over time.

Use of this program paradigm and its prototype suggests that, although the redundancy continuum employed in systematically varying each message parameter is logically progressing, there is a need for further investigation of the relative differences within parameter conditions. For example, it is important to determine the absolute differences in speech perception across each message type, noise type, noise level, and type of situational cue. It is important to know if these differences change as parameters are isolated and combined. It is also important to determine how much of the process of message perception is dependent on the way in which various message parameters are combined. A considerable amount of experimental verification of this plan remains to be accomplished. However, preliminary findings suggest that such an undertaking is not only necessary but feasible.

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