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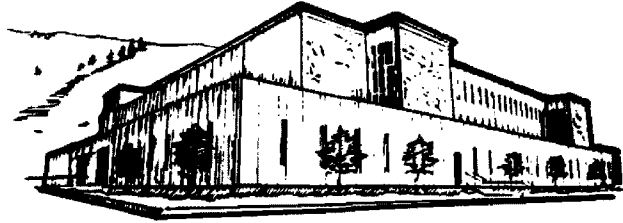
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University of
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VISION SCREENING AND ITS IMPORTANCE
FOR HEARING-IMPAIRED STUDENTS

By

Kathleen B. Thomas

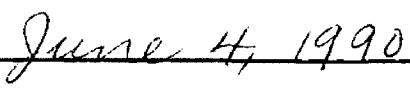
B.A., Southwest Texas State University, 1982

Presented in partial fulfillment of the requirements
for the degree of
Master of Communication Sciences and Disorders
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1990

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Acknowledgement

To my husband and daughter
in small reparation for time lost.

Preface

Though seldom considered, the screening of vision is a vital link in the comprehensive assessment and rehabilitation of the hearing-impaired population. This paper will focus on the importance of detecting vision problems in persons with hearing impairment.

The loss or impairment of hearing puts greater reliance on another distance sense, vision, especially in the areas of communication and education (Caccamise, Meath-Lang & Johnson, 1981; Hatlen & Curry, 1987 and Potenski, 1983). In addition, the prevalence of visual-impairment in hearing-impaired persons is higher than that found in normal hearing populations (Barrett, 1979; Barrett, 1981 and Hicks & Pfau, 1979). When both vision and hearing are impaired, the primary channels of communication and learning may be reduced or almost non-existent. Consequently, the visual capabilities of hearing-impaired clients should be of concern to speech, language and hearing professionals.

In addition to exploring why vision should be checked in persons with hearing loss, this paper will discuss how a vision screening program can be applied to hearing-impaired students and will review the implications of a vision screening protocol for hearing-impaired persons.

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Chapter I: Rationale for Vision
Screening of Hearing-Impaired Students

Prevalence Data

General Prevalence Figures

There is a greater prevalence of visual disorders among the hearing-impaired population than the normal hearing population. This discussion will concentrate on the prevalence of people in the United States who have both visual and hearing impairments.

Few authors cited general prevalence figures relating to the number of vision/hearing-impaired (v-h impaired) persons in the United States over the last decade (Fredericks & Baldwin, 1987; Hicks, 1979, Hicks & Pfau, 1979). In two articles in 1979, Hicks estimated that there were approximately 2.7 million persons in the United States who were dual vision and hearing impaired. In that same year, the author cited a demographic study conducted at Gallaudet University, which revealed that there were approximately 53,000 deaf students in educational programs in this country ("deaf" was not defined) and that 8%, or approximately one in twelve, of those had accompanying visual disorders. While 8% is a small percentage, each visual defect has the potential of being a handicapping condition, affecting the educability of the person. As such, each problem must be addressed to minimize its effects and maximize the person's potential. Other authors described much higher percentages of visual defects in hearing-impaired students, ranging from 38%-60% (Pollard &

Neumaier, 1974) as compared to the percentage of visual-impaired among hearing children ranging from 20%-30% (Silberman, 1981 and Suchman, 1968). The discrepancy between the 8% of visual disorders reported by Hicks and the 38%-60% of visual disorders reported by Pollard and Neumaier may have been due to differences in the sample populations (for instance, severity level of the hearing loss, etiology of the hearing loss, etc.).

Gallaudet Tabulations

Other ways to view the dual handicap of v-h impairment, shown in Tables 1 and 2, were compiled upon request by the Center for Assessment and Demographic Studies, at Gallaudet University, based on their 1987-88 Annual Survey. Table 1 shows the percentage of students with visual defects according to their hearing threshold levels. Basically, one can see there is not much of a relationship between the severity of the hearing loss and the percentage of students having secondary visual problems.

Table 2 shows the percentage of visual defects reported by etiology of the hearing loss. The survey did not delineate the category "other" causes of hearing loss, which could have provided useful information. The highest percentage of visual defects was that reported to be associated with maternal Rubella (almost 32%). The next highest reported cause of concomitant hearing and visual impairment was prematurity. The Gallaudet Survey did not define prematurity (i.e., by birthweight or term). Therefore researchers did

Table 1

Number and Percentage Distribution of Vision-Impaired Students Among Students Enrolled in Participating Special Education Programs for the Hearing-Impaired According to Hearing Threshold Levels, United States, 1987-88.*

Hearing Threshold Level dB	Number of Students Enrolled	% of Those Reporting	No. of Students with Visual Defects	% of Students with Visual Defects
Normal: <27 dB	3,290	7.2	112	3.4
Mild: 27-40 dB	3,996	8.7	129	3.2
Moderate: 41-55 dB	5,274	11.5	196	3.7
Mod. Severe: 56-70 dB	5,792	12.6	243	4.2
Severe: 71-90 dB	8,743	19.1	390	4.5
Profound: 91+ dB	18,749	40.9	887	4.7
Total	45,844	100.0	1,957	4.3

*1987-88 Annual Survey of Hearing-Impaired Children & Youth Center for Assessment & Demographic Studies, Gallaudet University.

Table 2

Number and Percent of Reported Visual Defects Among
Hearing-Impaired Students by Probable Cause of
Hearing Loss, United States 1987-88.*

Pre-Birth Causes:	Number	Percent
Maternal Rubella	477	31.8
Trauma at Birth	112	7.5
Other Complications of Pregnancy	125	8.3
Hereditiy	142	9.5
Prematuriy	219	14.6
Cytomegalovirus	20	1.3
RH Incompatibility	10	0.7
Other	167	11.1
Post-Birth Causes:		
Meningitis	75	5.0
High Fever	20	1.3
Mumps	2	0.1
Infection	20	1.3
Measles	4	0.3
Otitis Media	33	2.2
Trauma after Birth	18	1.2
Other	56	3.7
Total	1,500 *	**
Total Number of hearing-impaired students with visual problems reported	2,019	
Total Number of hearing-impaired students with information not reported on cause	1,484 (all Blanks)	
Total number of hearing-impaired students with information reported on cause	1,957	

* 1,500 is taken from the 1,957 total reported on cause.

** This does not total 100%.

*1987-88 Annual Survey of Hearing-Impaired Children and Youth, Center for Assessment & Demographic Studies, Gallaudet University

not know if one or both types of prematurity (low birthweight and/or not full term) would place the newborn at-risk. The highest post-birth cause of v-h impairment was meningitis. As can be seen, the vast majority of conditions listed as the cause of the dual sensory impairments fell under pre-birth categories. This reflects a need for screening the vision and hearing of infants who may be considered high-risk, according to Table 2's causes.

Prevalence of Specific Visual Disorders

Not many specific visual disorders were reported according to prevalence figures. Frey and Krause (1971) studied the number of hearing-impaired children having some impairment in color vision. Of 308 profoundly hearing-impaired students aged 9-18 years at an unidentified state school for the deaf, slightly over 10% showed some degree (borderline, moderate, severe) of color blindness. This was more than twice that found in the normal hearing population. These authors did control for other visual confounding variables, such as gross, uncorrected visual problems. However, this study did not address the validity of the color vision test utilized. This is significant, as the students were instructed to color an item, using a color that most represented the item, (such as coloring a heart red). Language abilities were thus a confounding variable, as the children may not have known that hearts are traditionally colored red, or the children may have decided to be creative.

Gottlieb and Allen (1985) found that 64% of the 81

children tested at the Atlanta Area School for the Deaf had visual disorders. The visual dysfunctions ranged from refractive errors and strabismus to pathologies, such as retinal detachment (see Appendix A for vision terms). The authors stated that they selected hearing-impaired students for visual examinations based on the following high-risk categories: a) congenital hearing loss, b) unknown etiology of hearing loss, c) observable visual problems and/or d) discrepant diagnoses among specialists.

Gottlieb and Allen (1985) observed that some of the students who had lost their hearing due to meningitis had visual accommodation problems. However, they did not describe any relationships between other etiologies of hearing loss and other types of vision problems and no other reviewed articles compared information that way. Revealing a correlational pattern could be of potential benefit to researchers and clinicians searching to improve the efficiency and effectiveness of a vision screening program (i.e., by helping them select which specific visual abilities, such as accommodation, to include in the detection protocol).

Gottlieb and Allen (1985) did identify congenital hearing loss as having a higher risk of concomitant vision loss but they did not speculate about the reasons for having problems with both the eyes and the ears at birth. Suchman (1968) did mention developmental similarities as a possible factor (that is, the retina and the cochlea have similar

tissue structure and timing of their embryonic development). Walters, Quintero & Perrigin (1982) theorized that the proximity of the hearing and vision organs might explain how a disease or genetic condition could affect both systems.

Interestingly, Gottlieb and Allen (1985) did not mention using a vision screening protocol to screen the entire school population. Recall that in their study, 81 children out of a school for the deaf were referred for a complete eye evaluation. The referral to an optometrist was based on a review of each student for the previously described high-risk categories. A comprehensive vision screening program could have potentially referred many other hearing-impaired students who were not classified under the four at-risk categories at the Atlanta school. For instance, with the high prevalence of visual-impairment in the hearing-impaired population, any hearing-impaired person could be considered at risk. That, of course, would then include hearing-impaired persons with some identified etiologies, without observable visual problems and without discrepant diagnoses.

Prevalence of Deaf-Blindness

Fredericks and Baldwin (1987) provided current information on the "deaf-blind." They pointed out that the term deaf-blind is actually a misnomer, because the vast majority of the people labelled "deaf-blind" have some residual hearing or vision; thus, deaf-blind traditionally refers to anyone who is visually and auditorally impaired.

Fredericks and Baldwin (1987) estimated distributions of

the different levels of sensory impairment, based on a study by Outlette (1984). Of a total number of identified persons with a dual sensory impairment, only about 6% were truly classified deaf-blind. The smallest group was that comprised of the deaf/severely vision-impaired (about 3.5%). The largest group, almost half of the entire v-h impaired population (about 48%) were blind/severely hearing-impaired. The remaining 42.5% were persons both severely hearing-impaired and severely vision-impaired.

As can be seen by these data, over 90% of those classified as dual sensory impaired, have some residual hearing and/or vision. The educational implication is that the residual senses of these individuals may be tapped to facilitate the learning process.

Prevalence of Vision/Hearing-Impairment by Age

The prevalence rate of v-h impairment significantly rises with increases in age, according to Hicks and Pfau (1979). This implies that there is a continuous need for screening the two senses of hearing and vision; that is, not only from birth (because some newborns are at risk for both hearing and vision impairments) but for the elderly as well (who may have co-existing hearing-impairment and vision-impairment, as from presbycusis and presbyopia). The emphasis here will be on vision screening for hearing-impaired students, from preschool to college.

Special Visual Needs of the Hearing-Impaired Population

Both residual hearing and vision are of importance to

hearing-impaired persons in all areas of their lives, (i.e., education, communication, personal, social and vocational). Audition is the primary channel for language learning and communication (Northern & Downs, 1984). The educability and socialization of a person is dependent upon a means of communicating and interacting.

Vision, by supplementing and/or replacing audition, fulfills an important role in meaningful interactions with other persons and objects in the environment. While good vision is important to all persons, vision is crucial for hearing-impaired individuals. When the hearing mechanism is damaged, any functional vision takes on a more significant role in the person's development and learning (Johnson, Caccamise, Rothblum, Hamilton & Howard, 1981 and Hicks & Pfau, 1979).

In education and communication vision can play a supplemental or replacement role for audition (as with visually mediated sign language). For the normal sighted population, vision plays the primary role in orientation and mobility, with audition providing supplemental information (as in localization of sound sources). Information on orientation and mobility for the visual-impaired (some of which can be adapted to v-h impaired persons) was reviewed by Scholl (1986).

Given the importance of vision in a population with damaged hearing, there is a tremendous impact when visual loss is combined with hearing loss. "Impairment of both dominant modalities not only compounds the problem, but significantly changes the type of educational or

rehabilitative program required, and fosters an array of learning, methodological, social, psychological, and career implications" (Hicks & Pfau, 1979, p. 419). Emphasis will be placed on the importance of vision in the areas of education and communication.

Education

Hearing and sighted children perceive information primarily through their senses of audition and vision. According to many learning theorists, probably 99% of what is learned is acquired through sight and sound (Johnson et al., 1981). Apart from language learning, vision is reputed to account for up to 80% of the information children acquire and perceive in school (Cress, Spellman & Benson, 1984; Hatlen & Curry, 1987; Morse, Trief & Joseph, 1987 and Smith, 1969). "Vision provides a vital foundation for learning -for organizing and synthesizing the events that make up the world for sighted children" (Hatlen & Curry, 1987, p. 7). One also organizes and synthesizes information through language. In addition to formal education, most incidental learning is acquired through both vision and audition.

In order to provide the most appropriate educational services for the hearing-impaired population, it is imperative that the other primary channel for learning, vision, be assessed (i.e., screened, and as necessary, fully tested). Information provided by vision screening and/or an eye examination, can help guide vocational planning (for high school and college students) and support instructional decisions,

such as instructional methodology (at all educational levels).

Assessment of visual processing skills of hearing-impaired students must begin early. An example of such an assessment at the preschool level was described by Fitch, Sachs and Marshall (1973). These authors outlined many visual perceptual abilities required for learning to read and write including: visual-motor sequencing, figure-ground discrimination and determining spatial relationships. The hearing-impaired children in this study performed below normative levels on the Frostig Developmental Test of Visual Perception (Frostig, Maslow, Lefever, & Whittlesey, 1964). The authors then designed a program to increase the visual perceptual skills of preschool hearing-impaired children. The treatment program consisted of visual discrimination problems involving color, shape, size and position.

Bishop (1981) wrote specifically about the education of deaf-blind children. While the role of the visual channel in the education process was not directly discussed, the importance of placing deaf-blind students in appropriate educational programs was stressed. Bishop (1981) further stated that hearing professionals are "...more familiar with the problems encountered in language and communication deprivation and are, from that standpoint, better equipped than teachers of the visually impaired to teach children who have visual problems in addition to a hearing loss." (p. 655). Actually, identification of professionals most capable

of educating v-h impaired children is a complex issue. Yet, professionals in hearing-impairment should learn more about vision and visual-impairment. The vital role that vision plays in the language and communication process will be explored next.

Communication

A language or communication system is a fundamental component of any educational program. For the person with v-h impairments, a means of communication is at the core of the educational process. Without a language system or way to communicate, an educational or re/habilitative program may be meaningless. Many researchers over the last two decades have examined the role of vision in the communication process (Erber, 1979; Hack & Erber, 1982; Hardick, Oyer & Irion, 1970; Raney, Dancer & Bradley, 1984; Walden, Erdman, Montgomery, Schwartz and Prosek, 1981).

Investigations into the role of vision in communication have been conducted in many areas, including: speech perception (visual and auditory-visual modes), speechreading, manual communication, and language processing through vision and audition.

Speech perception.

Garstecki (1983) compared auditory alone, visual alone and auditory-visual combined speech perception (of words, sentences and paragraphs) in young and elderly listeners. Auditory and auditory-visual scores were higher than visual scores for all subjects, regardless of age. Further,

comparisons of auditory and auditory-visual modes indicated that young adults scored basically the same for the auditory and auditory-visual modes. The scores of the elderly subjects on the same task revealed higher auditory-visual scores than auditory only scores.

Garstecki speculated that because the elderly adults had only mild hearing losses, they experienced less impairment in their integrated auditory-visual perceptual skills than in their auditory perceptual skills. An alternative explanation is that the visual contribution itself aided the auditory-visual score. A strength of the Garstecki study was that all the subjects had normal visual acuity. A potential limitation of other research such as that provided by Binnie, Montgomery and Jackson (1974) and Walden, Prosek and Worthington (1974) was that the visual status of the subjects was not reported. If the subjects did not receive a vision screening prior to the research, any visual problems of even a minor degree may have affected the speech perception results. For instance, uncorrected, unidentified near-sightedness or far-sightedness of a mild degree could decrease visual perception of speech cues to a significant extent (Hardick et al., 1970).

Erber (1979) conducted a study on auditory-visual speech perception with subjects who had normal or corrected to normal vision. Visual acuity of 20/20 is "normal" vision (i.e., the person sees at 20 feet the same detail that other "normal" sighted individuals see at that same distance). He

then examined the effect of varying degrees of optical clarity on auditory-visual speech perception.

Erber concluded that optical and acoustic cues for speech perception are "reciprocal," (p. 221), that is, each modality can be used to compensate for the other sense. Erber determined that beyond a visual acuity of 20/200, (i.e., an individual sees at 20 feet or 6.1 m, what "normal" sighted individuals can see at 200 feet or 61 m) gross articulatory movements and shapes are visible, but these cues alone are not adequate for visual perception of words. The implication is that with vision poorer than 20/200, visual cues to speech perception are of no practical use.

Speechreading.

Jacobs (1982) examined various aspects of visual perceptual proficiency, such as visual acuity and visual memory, and how these factors affect speechreading ability. In order to see the fine movements of articulation, visual acuity must be within normal limits or corrected to within normal limits. Jacobs also listed factors that affect visual acuity (both near and far) such as distance, lighting and fatigue. He also described visual memory as being necessary for visual perception. For instance, memory for how certain sounds look on the articulators aids in decoding which sound has been produced.

Hardick et al., (1970) stated that even a mild visual acuity impairment can adversely affect speechreading performance. They studied the relationship between several visual

parameters and speechreading ability. Some of the visual abilities examined were visual acuity (near and far), binocular vision, and color vision or the ability to discriminate color differences. The results of their research indicated a relationship between the subject's far visual acuity and speechreading performance.

In discussing visual perception and speechreading ability, Parasnis (1983) reflected that little is known regarding the specific factors that either predict or contribute to speechreading skills. To date, research has not differentiated specific skills, such as visual closure or visual perceptual speed, from a general relationship between visual perceptual skills and speechreading skills.

Manual communication.

Siple, Hatfield and Caccamise (1978) described the contribution of visual perceptual skills in learning sign language. The authors examined four areas of perceptual abilities, including: closure flexibility, closure speed, perceptual speed and spatial manipulation. They compared results of tests of these perceptual abilities from hearing-impaired students with low manual receptive skills to a group of new staff members at the National Technical Institute for the Deaf (NTID). The new staff members were hearing subjects with no signing skills.

The results were interpreted to suggest that specific visual perception abilities were used in processing sign language and that perceptual strategy differences existed

between hearing-impaired and hearing people. Specifically, the results from the closure flexibility and perceptual speed tests were significantly correlated with improvements in the manual reception performance of the hearing-impaired group. On the other hand, improvement in the hearing group was significantly correlated with results on the spatial manipulation and closure speed tests.

The idea that normal hearing and hearing-impaired persons use different perceptual strategies in processing manual language is thought-provoking. However, Siple et al., (1978) did not conclusively demonstrate such a difference. One potential limitation in their study was the method of subject matching. One group of subjects did not have any signing skills, while the other group had beginning level skills. Therefore, sign language skill level may have partially or totally accounted for the different perceptual strategies used. The inability to match subjects according to sign language skill level weakened the conclusion that the two groups differed in their perceptual strategy.

Siple (1978) discussed visual constraints in communicating with sign language. This research identified several parameters of the visual system and visual environment: relative acuity, conditions of low acuity and illumination and contrast. Siple (1978) noted that signs differ from each other by hand configuration, location of the sign and motion of the sign. Therefore, sign recognition and discrimination are concluded to depend partially on the relative visual

acuity of the viewer. Perception of the visual stimulus presented in manual language is also affected by environmental factors such as illumination and contrast. When communicating in less than optimal environmental conditions, subjects must compensate when sending and receiving signs. For example, under low illumination and/or contrast, the rate of manual communication may slow down. Compensating by increasing the duration of the visual stimulus may increase the chances of communicating effectively.

Interaction of hearing and vision in coding language.

Parasnis and Samar (1982) proposed that the acquisition and processing of language by hearing-impaired people may be affected by the characteristics of their optical systems. They also suggested that a hearing impairment may put more load on the optical system and thereby change how the visual channel processes information. Understanding how vision is used by the hearing-impaired population can potentially lead to development of appropriate aural rehabilitation techniques for effectively processing linguistic information.

Parasnis and Samar (1982) described visual perception as both a constructive process and a selective process. According to the constructive process theory, visual perception requires the brain to construct or place structure on information received from the senses. This involves both bottom-up and top-down processing. Bottom-up processing in visual perception involves coding information transmitted by

the eye to the cortex through a hierarchy of complex levels of analyses. Top-down processing involves higher level knowledge and how that affects the interpretation of the information received by the senses in bottom-up processing.

Both top-down and bottom-up processing interact in the perception of information. A good example was provided by Parasnis and Samar (1982) when they described the perceptual coding involved in reading. For instance, bottom-up processes include the effects of the lighting in the room, the type of print and contrast of the print on the page. In the reading example, perception is also affected by knowledge of the language and familiarity with the topic. Such knowledge and experience are classified as part of top-down processing. In reading, both types of coding interact dynamically, both influencing the perceptual experience.

Processing of auditory information has also been described in this manner. In auditory coding of speech, bottom-up processing could be influenced by background noise and reverberation, while top-down processing would involve high level functions such as linguistic knowledge, attention and motivation. Again, the two types of coding dynamically interact.

A selective process is also believed to occur in coding perceptual information. For instance, a person does not passively receive sensory information, but rather, actively selects what information to process and what information to reject. An example of this is described by Parasnis and

Samar (1982). A person can gaze straight ahead and yet ignore information present there in favor of a stimulus in the peripheral field of vision. Similarly, auditory processing can be selective. A person may be in a room with several people talking. It is possible to tune out a nearby conversation and hear a conversation elsewhere in the room.

Many variables influence constructive and selective processing of perceptual information. These include memory (short-term and long-term) and cognitive factors (familiarity and redundancy).

Samar and Sims (1983) described an information processing model for speechreading. In this model, factors affecting bottom-up perceptual processing include feature detection mechanisms and neural organization of sensory information, while top-down processes include attention and linguistic competence.

Unfortunately, research has still not fully explained how the senses of hearing and vision interact with each other. According to Parasnis and Samar (1982), some researchers have suggested that information from both senses is integrated in an overlapping fashion. They cited the research of MacDonald and McGurk in 1976, concerning intermodality integration. MacDonald and McGurk (1976) examined normal hearing subjects who received disparate auditory and visual information simultaneously and tried to identify what was presented. When subjects saw /ba/ produced, but heard /ga/ pronounced, they frequently stated

that they perceived the syllable /da/. The response /da/ has been interpreted as integrating the front sound /ba/ and the back sound /ga/ into a middle sound. The results were interpreted to mean that neither sense was ignored, but rather information from each sense was integrated into a most likely percept.

More recently, Massaro and Cohen (1983) conducted several experiments to evaluate the integration of visual and auditory information in syllable perception. They reviewed the contributions of hearing and vision to speech. They noted that while auditory information contributes to overall speech discrimination, visual information contributes mainly to place of articulation information. They presented the proposition that visual information not only supplements unclear auditory information, but is an aid even when auditory information is unambiguous. They noted that the general issue of intersensory perception has been neglected.

One question posed by Massaro and Cohen (1983) was whether or not auditory and visual features are evaluated independently of each other during syllable identification. The authors concluded that rather than detecting cues separately, syllable identification was influenced by cues from both the auditory and visual senses interacting with each other. In this conclusion, Massaro and Cohen agreed with the earlier work of MacDonald and McGurk (1978). Massaro and Cohen also stated that visual cues became more important to perception when the existing auditory cues were

somewhat ambiguous.

In contrast to the interdependent theory of information processing, Raney et al., (1984) proposed an independent theory of processing auditory and visual information. The authors conducted a study comparing auditory and visual performance on two speech reception tasks (one auditory only and the other visual only). The auditory task involved speech-in-noise discrimination of revised Central Institute for the Deaf (CID) Everyday Sentence Lists and the visual task involved a speechreading exercise also using the CID stimuli.

These authors found that their subjects' scores on the auditory and on the visual tasks were not correlated. It should be noted though, that the procedure in this study examined unimodal speech signals, rather than bimodal, as in the McGurk study. Research with a unisensory modality and research with a bisensory modality are not comparable. Also, one stimulus was degraded (the auditory signal) while the visual signal was not. Therefore, a direct comparison of the auditory and visual performance from these studies is not possible. If the auditory signal had not been presented in noise or if the visual signal had been degraded, as in the Erber 1979 study, then a comparison of the two modes of audition and vision might have been possible.

Summary

The research reviewed in this section presents a number of significant findings.

One, the combined use of audition and vision provides greater perception of speech than either audition or vision alone. Results of visual versus auditory-visual processing in the profoundly hearing-impaired population have been contradictory.

Two, visual information appears to complement auditory information, yet the amount of information provided by vision under optimal conditions has not been determined in the normal hearing or hearing-impaired populations. Visual cues provide information about place of articulation.

Three, when disparate information is provided by the two senses, hearing and vision seem to interact, rather than work independently.

Four, some minimally hearing-impaired elderly persons with normal vision show an auditory-visual advantage over audition alone as a mode of communication.

The implications of these findings directly impact the services that audiologists and speech-language pathologists provide to individuals with impairments in both auditory and visual systems. Subsequent sections will present specific suggestions for providing assessment and rehabilitative services to the hearing-impaired person who has vision problems as well.

Identifying Dual Sensory Impairment

Detection of visual problems in hearing-impaired persons is paramount, not only because of the greater prevalence of vision disorders (and perhaps greater reliance placed on the

sense of vision), but because results of vision screening can become part of the diagnostic picture and be of assistance to audiology. Detection from a screening protocol may be the first step leading to diagnosis. Identification of certain visual disorders can help determine the etiology of some congenital hearing-impairments (Campbell, Polomeno, Elder, Murray and Altosar, 1981).

Campbell et al., (1981) did not discuss vision screening, but they did stress the importance of an ophthalmologic evaluation for all children with congenital sensorineural hearing loss. These authors said that an eye examination can help in determining the etiology of congenital hearing-impairment. They argued that knowledge of the cause of hearing loss is important for: genetic counseling, diagnosis of certain diseases that are medically treatable, and appropriate treatment of progressive and/or multiple handicapping conditions. Campbell et al. (1981) distinguished congenital as well as sensorineural hearing loss from other hearing-impairments (e.g., acquired and conductive hearing losses).

Persons with acquired hearing loss and conductive hearing loss may also have concomitant visual loss and rely to varying degrees on their vision in order to supplement or replace auditory information. While a complete eye examination might not be feasible for every hearing-impaired person, informal vision screening (such as asking hearing-impaired clients if they are having any problems with their

eyes or vision) is possible. A proposal for informal vision screening (as in a visual case history) will be presented later. If hearing-impaired clients report a change in their vision or have a problem with their eyes, their speech-language and/or hearing clinicians should counsel them to consult an eye professional. See Appendix B for a sample visual case history and Appendix C for signs of possible eye or vision disorders.

Informal and formal visual screening of hearing-impaired persons may lead to diagnosis of eye or vision problems, may aid the identification of the etiology of a hearing loss, and may help spot the presence of either a syndrome or apparently unrelated dual impairments in vision and hearing as well.

Many syndromes involve impairments in both vision and audition. These oculo-auditory syndromes have been extensively researched by Konigsmark and Gorlin (1976) and Regenbogen and Coscas (1985), who detailed over one hundred diseases involving both the eyes and ears. Their classic works provide the reader with detailed information including: clinical aspects (specifically, auditory/ocular), pathological and laboratory factors, and genetic factors as well as diagnosis, treatment and prognosis of the syndromes. Complete discussion of all the oculo-auditory syndromes, diseases and classifications that have been identified and described to date is beyond the scope of this paper. However, screening vision can aid the diagnosis of an oculo-auditory syndrome and this will be discussed next.

Walters (1978) provided the example of differential diagnosis of Usher Syndrome in the early stages of the disease. In Usher Syndrome, hearing is impaired—at birth and vision slowly degenerates over a period of years. The diagnosis of an eventual dual sensory impairment can be aided by clues that may be provided by early screening. The screening process may reveal the presence of subtle problems and therefore lead to more extensive testing. Further detailed information on how vision screening can lead to the diagnosis of Usher Syndrome has been provided by various researchers (Day, 1982; Fillman, Leguire, Rogers, Bremer and Fellows, 1987; Walters, 1978 and Walters et al., 1982).

Vision screening can also help detect unrelated dual sensory impairments. In general, during the assessment and confirmation of a hearing loss, it is customary to inquire about other health or developmental problems. At this time, informal probing of the client's visual status may begin by asking, "Do you have any concerns about your or your child's vision or eyes?". Appendix B's sample of a brief visual case history includes follow-up questions to use if the initial question is answered affirmatively or if observations of the client during the hearing assessment indicate possible vision or eye problems.

Chapter II: Vision Screening

Purpose of Vision Screening

Screening as Part of the Intervention Process

There are three levels of assessment procedures: screening, diagnostic and monitoring. According to Bess and McConnell (1981), screening procedures are designed to separate disorders from normal functioning in a fast, inexpensive and simple way. Diagnostic procedures, on the other hand, provide information about the nature, severity, and/or etiology of the impairment. Diagnostic information should also include a discussion of those factors that may affect intervention, as well as recommendations and the prognosis (Meitus & Weinberg, 1983). Monitoring refers to the periodic re-evaluation of an individual's functional levels to determine if any changes have occurred or if the individual's status has remained stable. This section will discuss screening procedures, focusing on the vision screening tools that can be applied to hearing-impaired students.

Walters (1978) and Walters et al., (1982) described a vision screening program for hearing-impaired students. Walters considered screening to be a modified clinical technique in which detection is given top priority. Thus, a screening serves to separate those individuals who need additional medical and/or nonmedical attention and services from those who do not. Again, the emphasis is that screenings serve to detect, not diagnose. In other words, a

screening answers the question "Is there a problem?", whereas a diagnostic procedure answers the questions "What kind of problem is there?" and "How severe is the problem?".

Though differences exist between screening procedures and diagnostic procedures, Meitus and Weinberg (1983) emphasized the interrelationship between these two processes. They described a cyclical, dynamic interaction between the components of the intervention process. For example, based on the clinician's recommendations, the screening may lead to more extensive testing. Treatment is based on the recommendations outlined in the diagnostic report. It is important to consider that the beginning of the remediation process does not signal the end of the diagnostic process. Instead, diagnostic re-assessments are an on-going part of therapeutic services. Thus, screening is simply one component of the intervention plan.

The Role of Audiologists and Speech-Language Pathologists in Vision Screening

Walters et al. (1982) stated that hearing professionals can become directly involved in visual diagnostic testing. In his discussion on electroretinography (ERG), Walters stated, "Anyone trained in audiology should be able to administer and interpret the ERG produced by the retinitis pigmentosa or Usher Syndrome with minimal training" (Walters et al., 1982, p. 430). While audiologists and/or speech-language pathologists may become certified to screen vision, ERG testing is diagnostic, and as such, should require more

than "minimal" preparation to perform and interpret accurately. According to the American Speech-Language-Hearing Association (ASHA) scope of practice statement (1990), speech-language and hearing professionals cannot ethically diagnose problems outside their area(s) of training. An audiologist or speech-language pathologist is ethically bound to refer to another appropriate professional as necessary.

ASHA recognizes screening and diagnosing of speech, language and hearing disorders by speech-language pathologists and/or audiologists (hence, vision does not fall within the scope of practice). However, an audiologist and/or speech-language pathologist can also become certified by an appropriate agency to screen vision. For instance, in the state of Texas, successful completion of a one day seminar and practicum on vision screening certifies the participant as a vision screener. Therefore, an audiologist and/or speech-language pathologist who is Texas Department of Health (TDH) certified as a vision screener, may (according to the TDH) screen vision. With or without additional certification in vision screening, the speech-language pathologist and/or audiologist should learn to recognize the need for referring to other specialists, such as eye and/or vision specialists, as needed.

Issues Regarding Screening Tests

In order for a screening tool to be effective, it must meet certain requirements which define its validity,

reliability, sensitivity, and specificity. An ideal screening program should be accurate (valid), repeatable in the same person (reliable), sensitive, specific, inexpensive, and quickly and easily administered. The test accuracy or validity must address true diagnosis of the disease or lesion (Odom, Weinstein, Farber & Chao, 1986). The rationale for screening vision focuses primarily on the identification of persons who may need a thorough eye examination by a qualified eye specialist, such as an ophthalmologist. Thus, vision screening is designed to detect or identify potential eye problems, not actually diagnose them.

Four Possible Results of a Screening

A decision matrix can illustrate the four possible outcomes of a screening or test and its relationship to sensitivity, specificity, and referrals (see Table 3). These four possibilities include: true-positives, false-positives, true-negatives and false-negatives.

A true-positive finding results when the patient fails the screening and a disease process actually exists. A true-negative finding results when the patient passes the screening and no pathology is present. A false-positive occurs when the screening result is abnormal but no disease is present. False positive results may lead the clinician to over-refer. A false-negative finding results when the screening outcome is normal but a disease is actually present. False negative results may lead the clinician to under-refer.

False-positives and false-negatives are serious errors

Table 3
Four Possible Results of a Screening Test

TEST RESULTS	DISEASED	NOT DISEASED
Abnormal (positive)	True-positive (sensitivity)	False-positive (over-referrals)
Normal (negative)	False-negative (under-referrals)	True-negative (specificity)

and have significant consequences for the accountability of any screening program. That is, the over-referring that results from false-positives may lead to the unnecessary expense of physician visits, while the under-referring that results from false-negatives is a threat to the health of the client.

The most accurate test is the test that has the least amount of false-positives and false-negatives and the most "true" diagnoses (both positive and negative). According to Walters (1978), a "...well-done visual acuity test is one of the best procedures for evaluating visual function. Clearly, if visual acuities are abnormal, something is wrong" (pg. 401). Walters further states that some visual acuity tools, when properly administered, can effectively identify the presence of a lesion in the visual system. His remark is an example of how visual acuity tests have historically been considered accurate vision screening tools. However, Walters did not address the possibility of outcome errors, i.e., false-positives and false-negatives, which will reflect the actual effectiveness of the visual acuity tools.

Reliability and Validity

The reliability of measurement has to do with its precision or consistency (Ventry & Schiavetti, 1983). A detailed discussion of reliability is not possible within the scope of this paper. Briefly, however, three standard checks of reliability include: test-retest, parallel or equivalent form, and split-half reliability. Test-retest reliability is

consistent or stable if a screening instrument is administered a second time with essentially the same findings. A second method for examining reliability is to administer an equivalent form of the measurement and assess the consistency of the results across the parallel forms. A third check is that of split-half reliability, in which the measure is divided into equivalent parts and reviewed for consistency.

Sensitivity and Specificity

The predictive value of the screening procedure is dependent on the protocol's sensitivity and specificity. The sensitivity of an instrument is its ability to accurately identify a disease or impairment. The specificity of an instrument is its ability to accurately determine that no disease or impairment exists (Lowenstein, Palmberg, Connett & Wentworth, 1985). Thus, sensitivity refers to the ability to provide true positive findings, while the specificity refers to the ability to provide true negative findings. Predictive values are also dependent on the prevalence of the pathology in the sample population (Odem et al., 1986).

Application of Validity Concerns to Some Visual Acuity

Screening Tools

Recall that in addition to issues of reliability, the examiner should know the validity (accuracy) of the measurement tools. This kind of information may be provided in a test's manual, but may not be described in the literature. Therefore, the clinician must read a test's manual and

analyze its specific reliability and validity. For instance, when Faye (1976) reviewed picture/symbol visual acuity tests (i.e., the Tumbling E and the Lighthouse test), the reliability or validity of those tools was not discussed. Only four responses are possible on the Tumbling E test (up, down, left and right), and only three choices are provided on the Lighthouse test (a house, apple and umbrella). The ability of these limited sets to accurately assess visual acuity was not addressed. The clinician should not select an instrument solely on the basis of familiarity or exposure to the test, but rather should directly examine the test manual for reliability and validity information. Based on that information the clinician may either choose another test instrument or appropriately qualify the results of the test.

Additional Outcomes of Screening Tests

The characteristics of the target population may determine which assessment tools/techniques will be used and for what specific purposes. While the primary purpose of a screening program is to determine if a disorder exists in a target population, there are various additional outcomes of vision screening. Table 4 lists some additional outcomes which may occur by identifying visual problems in various populations, according to age. For example, for school-age children, one outcome of vision screening may be to correct learning problems, whereas for older adults an outcome may be the prevention of blindness from glaucoma. The list is not meant to be exhaustive, nor is it meant to be age-exclusive.

Table 4
Other Potential Outcomes of Vision Screening
by Target Population

POPULATION	OUTCOME
Preschool Children	to prevent abnormal visual development
School-age Children	to prevent/correct learning problems
College/Vocational Students	to aid in selection of career
Older Adults and the Elderly	to prevent blindness i.e., from glaucoma, and other diseases more common in older populations

Functional Vision Assessment

Information regarding functional vision testing or screening can be found in Cress et al., (1984) and Knowlton & Normandin (1987). These articles describe various issues relating to the assessment of visual function in a natural environment. For instance, a functional or dynamic assessment of vision can be one which simulates or is administered in an appropriate environment for the individual (i.e., in the classroom for a student). As Roessing (1980) suggested, an eye specialist's static examination should be supplemented by a functional vision evaluation. Some specific examples of functional vision assessment are described in the following discussion.

Types of Vision Screening

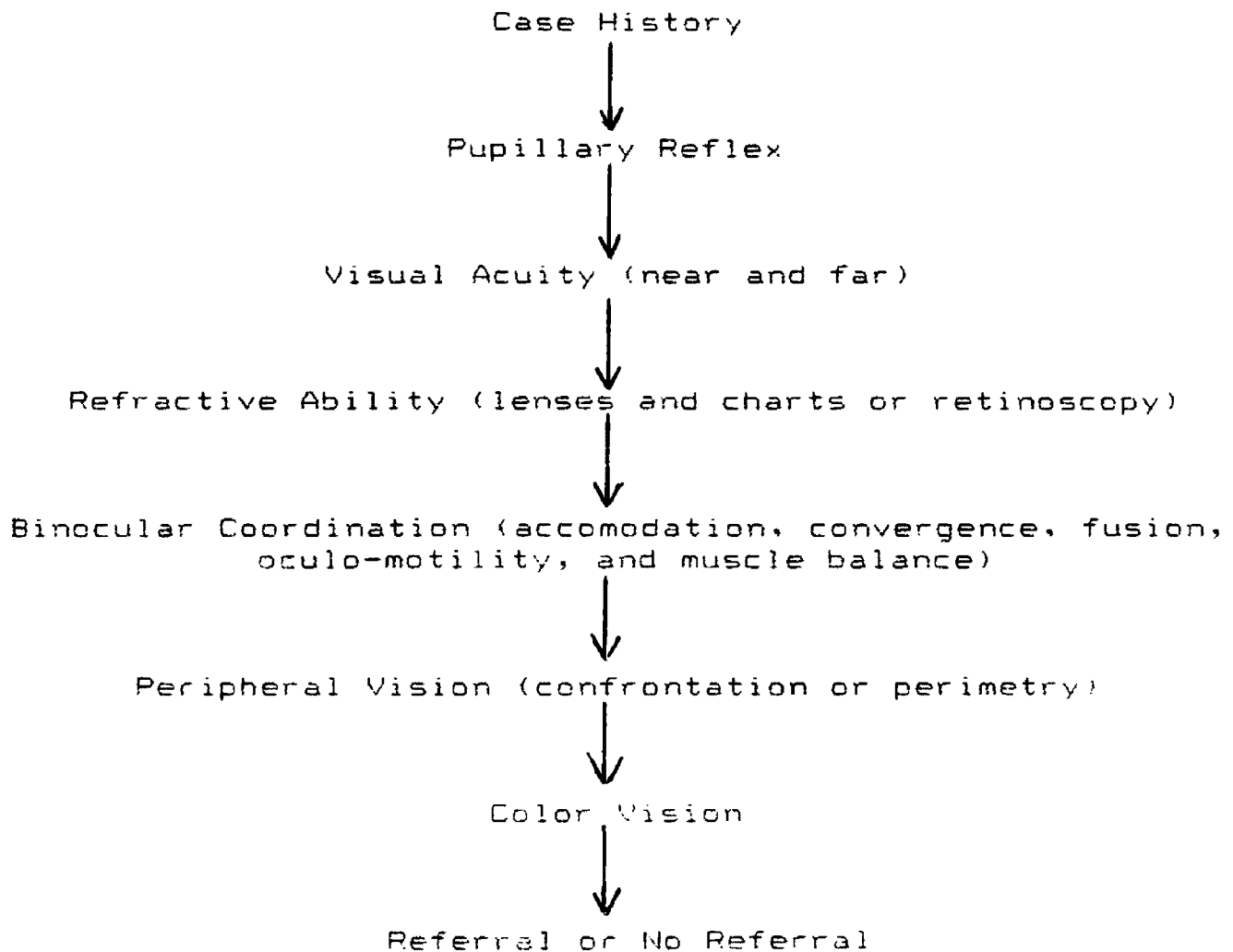
A Battery Approach to Assessment of Visual Functioning in Hearing-Impaired Students

Table 5 presents a flow chart of some types of vision screening performed with hearing-impaired students. Normal vision, in addition to referring to 20/20 visual acuity, also encompasses the ability of the two eyes to work together, the ability to discriminate colors and the ability to see peripherally as well as centrally (Wertenbaker, 1984).

Six areas of visual function have been identified: acuity, refractive ability, binocular coordination, color vision, peripheral vision and pupillary reflex. Various battery approaches to vision screening of hearing-impaired populations have been described (Greene, 1978; Johnson, et al.,

Table 5

Flow Chart

Sample Vision Screening Protocol for Hearing-Impaired
Students

1981; Johnson & Caccamise, 1982; Levin & Erber, 1976; Morse et al., 1987; and Roessing, 1980). However, no one set of recommendations is all inclusive. Therefore, the six visual areas presented here represent combined research efforts regarding areas pertinent to the overall visual functioning of hearing-impaired individuals.

A battery approach (i.e., assessing many visual abilities) is one way to comprehensively screen the visual status of a specific population. When taken together, these tests can help describe a person's visual abilities; however, it is important to note that failure in one specific test may not represent a true or significant problem (Greene, 1978). Levin and Erber (1976) suggest that many of the areas listed in Table 5 can be administered by trained nonmedical personnel, such as the school audiologist.

Subjectivity and Objectivity of Measurement Tools

Each assessment protocol can be categorized as subjective or objective (Walters, 1978). A subjective test is one which requires a cognitive response by the client. The results from subjective procedures rely on the ability (i.e., physical, cognitive, etc.) of the client to respond to the task. In addition, a hearing-impaired person's language ability may affect the results on the subjective tests described in the sample protocol shown in Table 6. Accordingly, language abilities of hearing-impaired students must be considered in behavioral assessment of their visual capabilities. Inaccurate results can be obtained by failure to

Table 6

Vision Screening Tests for Hearing-Impaired Students

Screening Element	Definition	Purpose	Administration/ Instrumentation	Referral Criterion
Case History	-questions re:problem & related conditions	-collect data -observe behavior -one basis for dx	-interview format or written questionnaire	-vision problems reported -screen result positive
Visual Acuity	-sharpness of vision for near & far objects	-detect abnormal acuity -separate refractive error from disease	-Snellen Chart -Tumbling E -Lighthouse Flashcard Test (See text for detail)	-Near at all ages 20/30 or poorer -Far < 8 years old 20/40 or poorer -Far > 8 years old 20/30 or poorer
Refractive Ability	-ability of eye to focus light on retina	-detect refractive errors -separate hyperopia from no refractive error	-use of convex lens w/ acuity chart -retinoscopy (See text for details)	-if lens does not decrease acuity -retinoscopy determines refractive error accd to light movement

Table 6 continued

Screening Element	Definition	Purpose	Administration/ Instrumentation	Referral Criterion
Accommodation	-ability of eye to change from far to near focus or vice versa	-detect eye focusing problems	-use of card w/ tiny but legible print moved as close to eyes as possible	-not in lit. consult vision prof for population screened
Convergence	-ability to bring eyes together for close examination of objects	-detect dyplopia	-move pen close to person's nose -ask person to state when 2 objects are seen	-when s/he reports 2 objects beyond 2 inches from nose
Fusion or Stereopsis	-ability to use both eyes to perceive objects in 3-D	-detect depth percept. problems	-Titmus Stereo Fly Test -ask person to touch fly's wings (See text for details)	-if s/he touches paper rather than image "above" paper
Oculo-motility	-eye movement control -related to eye muscle balance (see next screening element)	-detects either neurological or eye muscle balance problems	-ask person to follow pen from side to side or up & down	-any inability to use eyes together to follow object

Table 6 continued

Screening Element	Definition	Purpose	Administration/ Instrumentation	Referral Criterion
Muscle Balance	-ability of extraocular muscles to work together for normal binocular vision	-detect optical alignment problems (see text for details)	-person focuses on object at near & far distances w/ eyes covered & uncovered -tester observes position of eyes when binocular vision interrupted	-any deviation of eye alignment (see text for details)
Color Vision	-ability of eye to discriminate colors	-detects abnormal color vision -may identify ocular or systemic diseases	-Ishihara Color Vision Test (see text for details)	-incorrect identification of 3 or more patterns from 16 plates
Peripheral Vision	-ability to perceive motion, color or presence of objects outside direct line of sight	-detects reduced visual field	-use pen or projection arc perimeter (see text for detail)	-approx 130° or less
Pupillary Reflexes	-response of pupil to light	-detects abnormal pupillary reflex which may indicate neurological problem	-use penlight (see text for detail)	-absence of pupillary reflex

communicate by the clinician as well as the client. Some subjective procedures in vision screening include the case history, acuity testing, color testing and visual field testing.

Objective procedures do not require a cognitive response and thus reduce, if not remove, patient subjectivity. However, as Walters (1978) pointed out, some subjectivity is still present since the examiner must interpret the responses. Examples of objective visual screening tools include retinoscopy, tonometry and ophthalmoscopy. Table 6 provides brief descriptions of a sample vision screening protocol.

Elements of a Sample Vision Screening Protocol

Case history.

As Meitus and Weinberg (1983) discussed, the case history is usually an interview based on a questionnaire that includes the following information: a) onset of the problem, b) development of the problem, c) previous diagnostic results, d) previous rehabilitation or treatment, e) general developmental history, f) current health condition, g) family history, h) family concerns and support, and i) other, such as education, social and vocational information. An example of a brief visual case history is provided in Appendix B.

Visual Acuity.

Visual acuity testing includes two types, far (distant) and near (Johnson, et al., 1981; Walters et al., 1982). Near visual acuity testing usually includes a reading or picture identification task at distances of 14-16 inches or 35.5-40.6

cm (typical close reading distance). Far visual acuity testing usually includes a letter or picture identification task at a distance of 20 feet or 6.1 m. While screening tools cannot diagnose the etiology of an abnormal acuity, they can potentially separate refractive error from disease and lead the patient to further diagnostic testing and treatment.

Letter charts and picture symbols, as in the Snellen Chart and the Tumbling E (Illiterate E) are the most commonly used tests to assess distant acuity. These tests are manufactured by Reichert Ophthalmologic Instruments, P. O. Box 123, Buffalo, New York, 14240, (716) 891-3000. The Snellen Chart is an eye chart that uses alphabetical letters that decrease in size from the top to the bottom of the chart. The tumbling E uses lines of increasingly smaller E's facing in four directions (left, right, up and down). Both these tests are mounted at a distance of 20 feet or 6.1 m from the person viewing the chart. The tumbling E or Illiterate E, is so named because it only utilizes an E and does not require knowledge of the alphabet.

The subject identifies what letters he sees on the Snellen, beginning on the top line and sequentially moving downward. On the Tumbling E, the individual shows the direction of the E either by pointing his or her hand or a picture of the E in the same direction. On the Snellen, the smallest line with the majority of the letters correctly read signifies the person's visual acuity. The visual acuity is then noted as two numbers, one over the other. The top number

refers to the distance at which the chart is read, while the bottom number refers to the distance at which a normal-seeing individual can read the same line on the chart. In the United States, a central visual acuity of 20/200 or worse, in the better eye and with the best correction, is one classification of legal blindness (Wertenbaker, 1984).

Another distance acuity test used with children is the Lighthouse Flashcard test, which uses progressively smaller pictures of an apple, house and umbrella. This Lighthouse Test is available through the New York Lighthouse Optical Aid Service, 36-02 Northern Boulevard, Long Island City, New York, 11101, (718) 937-9338 or 1-800-453-4923. As Faye (1976) stated, the Lighthouse test can be used with children of mental age 27 months and older, while the tumbling E, which requires greater neurological maturity, requires a mental age of 3-4 years.

Near visual acuity tests are not as common as distant acuity tests. Some tests that evaluate near visual acuity include miniaturized versions of the Snellen and the Lighthouse. These tests are administered at approximately 16 inches or 40.6 cm and indicate the client's ability to read print according to certain type sizes. Near vision tests will help determine the person's ability to read texts, workbooks, newspapers, and such. All of the above tests are subjective, in that they require the patient to actively respond to the stimuli presented. Visual acuity of 20/20 is typically not used for children, due to the developmental

nature of normal visual acuities. That is, for children under seven years of age, normal visual acuities range from 20/30 to 20/40 (G. L. Hemphill, M.D., personal communication, May 8, 1990).

Refractive ability.

The purpose of screening refractive ability is to detect any refractive errors and to differentiate between no refractive error and hyperopia (farsightedness). Greene (1978) included refractory screening because distance vision (far acuity ability) is usually good in hyperopia. Recall that the most common type of vision screening tests only far acuity. Since hyperopic individuals can pass a far acuity screening, significant refractive errors can be missed when only visual acuity is the basis for referral to an eye specialist (Hammond & Schmidt, 1986).

One subjective measure of refractive ability uses a convex lens in addition to charts (The Plus Lens Test for Hyperopia). The use of a convex lens (which can be provided by an optometrist or optician) to screen for hyperopia is based on the same principle as prescribing a convex lens to correct hyperopia. Light rays converge beyond the retina in the hyperopic individual. Convex lenses bring parallel rays of light together and are thus called "plus" lenses. This corrects farsightedness by drawing the rays of light together on the retina. Conversely, a concave lens spreads parallel rays of light and is called a "minus" lens. This corrects myopia by spreading the rays of light so that they no longer

converge in front of the retina.

On the Plus Lens Test, if a person is not farsighted, a convex lens will decrease visual acuity. Basically, if addition of a convex lens does not decrease his or her ability to read the chart, then the person is hyperopic and should be referred for ophthalmologic testing. An objective measurement of refractive error is retinoscopy, which is typically administered by an ophthalmologist. Light from the retinoscope is projected into the eyes and the examiner then determines the refractive error according to movement of the reflected light rays.

Accommodation.

The normal-seeing person uses the eyes together to produce one image. Many visual processes are related to binocular coordination and include accommodation, convergence, fusion or stereopsis, oculomotility, and muscle balance. Some binocular coordination tests are good examples of functional vision assessment. Functional assessment of vision determines how well the person uses vision to perform specific tasks, such as tracking information. Students, for example, need to change their focus from the chalkboard to their desk and vice versa, repeatedly and accurately over long periods of time with little effort.

The degree of accommodation can be screened by moving a card with very small, but still legible print, as close to the eyes as possible. Accomodative ability can also be screened with the use of special lenses. The client looks

through the lenses and must change focus a certain number of times in a set period of time.

Convergence.

Another functional example of vision screening concerns convergence. The need to turn the eyes inward and examine objects closely, can be illustrated with an example taken from the educational setting. In school, the student's eyes are directed straight ahead to view the chalkboard, and directed inward to read and write at his/her desk.

Fusion.

Screening fusion is also educationally functional, in that a limited range of fusion ability will affect a person's ability to do sustained close work, as in reading and writing. Fusion may be screened using the Titmus Stereo Fly Test, which utilizes polaroid glasses and a picture of a fly. This Titmus test can be obtained through the Stereo Optical Co., Inc., 3539 North Kenton Ave., Chicago, Illinois, 60641. The client is asked to touch the wings of the fly. A referral may be necessary if the client attempts to touch the "three dimensional object" directly on the surface of the test, instead of above the surface. In other words, if the client views the fly as three-dimensional through the polaroid glasses, the client is not supposed to touch the paper, but will "touch" the air about an inch above the picture. The clinician must be certain that the client understands this task, as an incorrect response could be misinterpreted as a fusion problem.

Oculo-motility and muscle balance.

Oculo-motility is related to eye muscle balance.

Screening eye movement control detects either neurological or muscle balance (optical alignment) problems.

The inability to direct both eyes simultaneously to a point is referred to as strabismus. Strabismus is specifically described according to either a constant deviation, or an intermittent deviation, as well as by the direction of the deviated alignment. The prefixes eso- and exo- refer to the eyes being turned inward or outward, respectively. The early identification and treatment of eye muscle problems is imperative for the development of normal binocular vision. Normal binocular vision may not develop if muscle imbalance is not detected and treated before six years of age (Cole, 1985; Cress et al., 1984; Ehrlich, Reinecke & Simons, 1983; Trief & Morse, 1987 and Wertebaker, 1984;). Any deviation of the eye alignment is a significant element. For example, if one eye stays turned when the eyes are covered and uncovered, then strabismus is suspected.

Color vision.

Color vision may be screened using the Ishihara Color Vision Test, which is comprised of a series of colored dots. This test is published by Kanehara & Co., Ltd., P. O. Box No. 1 Hongo, Tokyo 113-91, Japan. Either a number or a winding pattern is embedded in the dots on sixteen plates. Persons with normal color vision can detect the numbers or identify the winding patterns, while abnormal color vision may prevent

identification of any numbers or patterns.

Peripheral vision.

Peripheral vision can either be assessed with the use of a hand-held object, such as a pen, or with special equipment. Gross reductions in visual fields may be observed by holding a pen in front of the individual's face, and instructing him or her to look straight ahead. While the pen is moved to the side of the head, the client is asked to state when the pen is no longer visible (this gross check is called a confrontation test). Peripheral vision may be more precisely assessed with a projection arc perimeter. The client places his chin on a support and focuses his eyes on a fixed target at the zero axis of the perimeter machine. Objects of various sizes for various visual acuities (i.e., larger diameter objects for poorer acuities) are rotated from the periphery to the center. The client notes when the object first emerges into the peripheral field. The client's field of vision is then computed in degrees of peripheral vision.

Pupillary reflex.

The pupillary reflex is the response of the pupil to a light stimulus (Wertebaker, 1984). That is, the pupil constricts in response to the presentation of a bright light and dilates in response to a reduction in light. The iris, or colored portion of the eye which surrounds the pupil, controls the changes in the size of the pupil (smaller in bright light, larger in dim light). The pupil's reaction to light

is the most reliable and simple test of visual functioning (Gardiner, 1978).

Implementation Issues

Factors to consider in planning and implementing a screening program include expense, time, location, qualified personnel to conduct the screening and appropriate support services (Barrett, 1979). Each program must determine its needs according to the population being screened (i.e., the nature of the population, size of population, etc.). The cost of implementing a vision screening program does not have to be prohibitive. Barrett (1979) cited many possible resources, including university medical schools and local medical associations (for ophthalmologists), schools of optometry, and community organizations concerned with vision care (such as local chapters of the Society for the Prevention of Blindness). These resources can be called upon for their professional and possibly financial support.

Barrett (1979) also provided suggestions for how to implement vision screening for large groups of hearing-impaired students having various levels of communicative skills, including: first, consult with persons who have experience setting up vision screening programs for the hearing-impaired population. Second, utilize school personnel to help train and prepare the students in advance for the tasks that will be required of them. For instance, to prepare for the Tumbling E, the school audiologist, speech-language pathologist, nurse and/or classroom teacher

can practice with the children on showing what direction a big "E" is pointing. In support of Barrett, Brown and Collar (1982) wrote about the impact of prior preparation on screening vision and hearing in handicapped preschoolers. They concluded that the screening of the children in their study was facilitated by prescreening preparation. Third, utilize resources of support services for those students identified with serious visual problems.

One existing rehabilitation agency is the Rehabilitative Services Administration (RSA). The Helen Keller National Center operates under the RSA and is an excellent resource for both deaf-blind children and adults. The Helen Keller National Center offers evaluations, rehabilitative training and placement. Clients there are taught how to use their residual hearing and vision (Barrett, 1979).

Summary

This discussion has concentrated on specific areas of visual functioning that have been screened in the hearing-impaired population. If audiologists or speech-language pathologists want to have a vision screening program set up for hearing-impaired persons, the protocol should utilize appropriate referrals and be based on the specific population being screened. Various eye specialists, such as ophthalmologists and teachers of the visually-impaired should be recruited to design and administer the protocol. Audiologists and speech-language pathologists should, as necessary, refer hearing-impaired students for a vision

screening or assessment and should be cognizant of how to adapt their speech, language or hearing assessment or re/habilitation protocols for students who also have vision problems. The next section will discuss what follows the screening process, namely, referrals for specific diagnostic testing and therapy or treatment.

Chapter III: Functional Implications

Evaluation of the Vision Screening Protocol

Once visual problems have been detected through a vision screening program, the following steps should be taken:

a) refer to a specialist, b) follow-up on referrals and c) follow-up on treatment. Referral to an eye specialist, such as an ophthalmologist, is done for diagnostic testing to determine the exact nature and severity of the problem.

Ideally, follow-up should include: confirmation that the person was seen for further testing, the results of any additional testing, and the nature of the treatment. Reasons for follow-up are to evaluate the screening program's effectiveness and efficiency. The ultimate goal of detecting problems is to lead to effective treatment. Following up recommendations based on screening results will help in deciding the value and worth of the referrals.

Referral

Referral to an eye professional should not be the end of the screening protocol, but rather signal the need to evaluate the success of the referral. The referral can be evaluated by following-up on the recommendations and subsequent over-referrals and under-referrals. Tracking recommendations from the screening program can include such information as how many persons were referred, for what purpose, and to what professional. Additional follow-up information can be compiled on over-referrals, so that adjustments to the screening protocol can help reduce

"false-alarms." This can be calculated by contacting those referred or their families and inquiring about the results of the doctor visits. Under-referrals on the other hand, are harder to track. The program would have to follow everyone screened (i.e., including those who passed) and determine if they had a visual problem detected some way other than by the screening program (such as directly from parent to specialist). Tracking the therapy that is eventually put into effect will provide information regarding treatment of the identified vision problems.

A major weakness of research on vision screening is a lack of evaluation on effectiveness. This is especially true in terms of determining correct referrals and non-referrals. While many researchers would contend that referrals based on vision screenings are worthwhile, more research is needed that will specifically examine the effectiveness and efficiency of vision screening programs for the hearing-impaired population.

Morse et al., (1987) provided an example of a vision screening program that did not track its success rate. Their vision screening protocol included retinoscopy, visual acuity, convergence, motility, cover and fly tests. It required seven minutes per patient, which was considered a reasonable time frame by the authors. They assessed the vision of almost 300 Head Start children and referred 21% for further evaluation. The authors stated that their referral rate was high, but still in line with the referral rate of a

more rigorous and time-consuming battery for young children performed by the New York State Optometric Association.

A concern with the research of Morse et al. (1987) was the lack of follow-up data on the referrals. Therefore, the efficacy of their screening program remains unknown. Information on over-referrals would aid in determining how to improve the existing protocol (i.e., decrease the number of "false-alarm" referrals, while continuing to refer truly positive cases).

Miller and Stern (1974) provided an example of a study that directly followed-up its referrals. Both vision and hearing were screened in the elderly. Referrals were separated into those for hearing and for vision. Referrals for hearing and/or ear problems were to an audiologist and/or otologist for audiological evaluations, aural rehabilitative evaluations, otological evaluations or both audiological and otological examinations. Eighty of 116 elderly subjects were referred for further audiological and/or otological testing and 14 of those referred returned to the audiologist. Referrals for vision and/or eye problems were to an ophthalmologist for ophthalmologic evaluations. Twenty of 119 subjects were referred for additional testing and one of those referred returned to the ophthalmologist.

The authors speculated that resistance to treatment combined with the elderly's reduced mobility contributed to the lack of follow-up visits. Another possibility was that some of the clients may not have complained of communication

difficulties and thus not desired more testing and treatment. Further, there may have been financial considerations, i.e., the elderly clients may have thought additional services would be financially prohibitive.

Treatment or Re/Habilitation

Re/habilitation may take many forms, such as the prescription of visual aids (i.e., glasses or magnifying lenses), medical intervention (i.e., surgery or medication), visual therapy (i.e., training on visual perceptual skills), or the provision of support services (i.e., counseling on adjustment to vision loss). Re/habilitative strategies can be classified in many specialized areas such as medical, educational, personal/social and vocational. The emphasis of this discussion will be on education.

Caccamise, Meath-Lang and Johnson (1981) described some support services for identified v-h impaired students, offered through the Office of Special Student Services (SSS). At Gallaudet, the SSS provides several support services for students identified as v-h impaired, as well as for the hearing-impaired. Direct services include tutors, notetakers and interpreters. SSS also provides inservice training for other students and staff who interact with v-h impaired students. Additional services include making other Gallaudet offices and departments accessible to the v-h impaired students.

Besides various support services, many forms of visual correction and treatment exist, such as with prescriptive

lenses and/or visual training (Greene, 1978). Visual training or ocular rehabilitation is the corollary to aural rehabilitation or auditory training. Just as the provision of amplification to a hearing-impaired person does not necessarily provide instantaneous functional hearing, providing glasses or other optical aids (such as magnifying lenses) to a person does not automatically signal functional use of vision. Greene recommended devising visual tasks tailored to the individual client's problem and needs in order to help the client work toward his potential, or highest level of functioning.

Silberman (1981) stated that visual training increases the effectiveness of the use of vision. She recommended including visual stimulation in the individualized educational programs (IEP) of hearing-impaired students identified with visual problems. Visual stimulation could include visual tasks, related to academic lessons, performed at different focal distances.

Besides the use of prescription lenses and visual training, Barrett (1981) also described surgical and medical treatment for vision loss. For instance, surgical intervention might include removal of cataracts and corrective surgery for strabismus. Medical treatment might include drug therapy for chronic glaucoma to prevent complications leading to blindness.

Despite the many ways in which visual pathologies can be corrected or improved, this is not always possible. There

are visual pathologies for which there is no known treatment or correction, as in Usher Syndrome. However, emphasis should still be placed on early detection. Uncorrectable problems can still be dealt with by counseling and other support services. The need for screening and appropriate follow-up, was relayed by Barrett (1981) and pertained to vocational rehabilitation. He discussed the lack of comprehensive screening and diagnostic services and the subsequent tragic consequences for severely v-h impaired vocational clients. Many rehabilitation agencies have had to retrain older v-h impaired adults who, not knowing they were losing their vision, had already devoted years to inappropriate vocational training.

In addition to uncorrectable visual disorders, there exist uncorrected visual problems. The problem of both determining and treating visual-impairment in the hearing-impaired population remains to be resolved satisfactorily. In the seventies and early eighties, Barrett (1981) discussed the continuing problem of untreated visual problems in hearing-impaired persons. His discussion agreed with the previous research of Suchman (1968) from more than a decade earlier. Suchman (1968) reported that uncorrected visual disorders, especially refractive errors, were a persistent deficiency in providing visual services and care for the hearing-impaired population.

Need for Screening

Are screening and referral worth the time, money and

effort? Greene (1978) admitted that "...the identification of children who can benefit best from in-depth evaluation can be difficult" (p. 475). He contended that visual screening and referral are definitely worth the effort for any student whose educational performance does not meet expectations or who cannot follow instructions or complete tasks. Silberman (1981) also stated that failing to provide the best visual correction possible can interfere with social and educational development.

The effectiveness of remediation of visual impairments is dependent on several factors, including the age of the client, how early the disease or problem is detected, if the diagnosis is accurate and factors of the intervention itself (i.e., methodology, timing, client/clinician interaction, client motivation, and so on). Hicks and Pfau (1979) indicated the importance of screening and referral and noted an early diagnosis usually increases the chances that treatment will be effective. As applied to the hearing-impaired population, early identification and rehabilitation increases the chances that treatment will be efficacious. Early identification and treatment of visual-impairment may also have that effect. Early screening can greatly aid early diagnosis.

A comprehensive vision screening protocol in programs for the hearing-impaired has advantages and benefits that outweigh the effort, time and cost of implementing visual services (Barrett, 1981). Benefits include: (a) detection

of visual-impairment that leads to diagnosis of treatable visual problems and then leads to provision of appropriate treatment, (b) counseling and other support services (such as vocational rehabilitation) for those persons having progressive or non-correctable visual problems and (c) detection of those persons who have essentially normal vision (Barrett, 1981). Besides referral to a specialist and treatment, having a vision screening program and providing inservice to other professionals (such as school personnel) may help increase awareness of the importance of vision in the hearing-impaired population (Hicks & Pfau, 1979). Heightened awareness of vision problems (i.e., the possibility of, signs of, etc.) might lead to referrals for screening or testing and thus, identification and treatment of more v-h impaired students.

Chapter IV: Assessment and Rehabilitative Applications
to Vision-Impaired/Hearing-Impaired Persons
Vision and Hearing Assessment Considerations

Nepilovich and Naegele (1985) addressed various diagnostic and rehabilitative processes for deaf-blind persons. The assessment of this population includes determining which sensory modality is dominant or preferred. For instance, the individual with a dual sensory impairment may be considered deaf-blind in the traditional sense (profoundly hearing-impaired with very low vision) or vision-impaired/hearing-impaired (any degree of visual and auditory impairment). Knowing the sensory strengths and weaknesses of the handicapped individual is helpful in designing appropriate rehabilitative services.

Low vision assessment should be performed by vision specialists, such as optometrists or ophthalmologists, and be supplemented as necessary by other certified professionals (for example, teachers of the visually handicapped). The visual report should include the type of information similar to audiological reports, such as the nature and severity of the vision loss, the possible benefits of magnification, the type and specific characteristics of the vision aids appropriate to the client's needs, the notation of a trial period, orientation protocols and the client's reactions to the diagnosis and treatment. See Appendix D for an educationally-oriented vision report.

The audiological evaluation and report should describe

fully the nature and extent of the hearing loss in the vision-impaired individual. Immittance audiometry and speech audiometry results should be included, as well as any fitted or recommended amplification systems. If hearing aids are recommended, the following minimal information should be reported in the hearing aid evaluation and report: a) which ear(s) will be fit, b) the type of hearing aid, c) the specific characteristics of the hearing aid appropriate for that particular client, d) the possible benefits of amplification, e) information obtained during a trial period (if provided) and f) notation that a hearing aid orientation session has been provided. In addition, the client's subjective response to the hearing aid should be noted. For both the audiological and visual assessments, the client's current and potential visual and auditory functioning should be discussed.

A thorough assessment should also include how the hearing status fits into the overall functioning of the person. The audiologist or speech-language pathologist should refer the client to other professionals as needed (for instance, psychologists).

An example of how hearing and visual status may interact is provided by an elderly client who wears glasses and is recommended for aural rehabilitation. The hearing or speech professional should inquire about the vision status (i.e., results of latest eye exam, when conducted, etc.). This may be done during the case history part of the assessment. If

the client has not had an eye exam within the last year, he should be referred to a vision specialist prior to beginning aural rehabilitation. Johnson and Caccamise (1983) stressed the importance of a visual assessment for hearing-impaired persons, prior to beginning an aural rehabilitation program.

Visual and Aural Rehabilitation Considerations

General Considerations

After interdisciplinary evaluations have identified the needs, strengths, deficits and interests of an individual, the rehabilitative program can be designed and implemented. The rehabilitative program should include a broad range of learning experiences that lead to different goals for different clients. Some individuals may be able to become independent and self-sufficient (i.e., communicate, work and take care of themselves with minimal assistance) while others may learn limited use of communication skills and require extensive assistance with basic living skills. However, for virtually all clients, regardless of the severity of their dual sensory impairment, the ultimate goal is to reach their maximum potential or highest possible level of functioning in all areas of life (i.e., communication, daily life skills, vocational skills, etc.).

Example of Visual Therapy

Fitch et al., (1973) described a visual training program for hearing-impaired preschool children. Low scores on the Frostig Developmental Test of Visual Perception by fifty-one children in preschool classes for the hearing-impaired, led

Fitch et al., (1973) to state that hearing-impaired pre-schoolers are often deprived of opportunities to develop visual perception. Obtaining lower than expected scores does not, however, explain why the scores were deficient. For instance, the hearing-impaired children may have had adequate visual learning opportunities but visual perception problems could have changed their performance. The authors recommended teaching young hearing-impaired children tasks to improve such skills as eye-motor coordination and determining spatial relationships. Their rationale was that certain visual perceptual skills are necessary for learning to read, write and spell. Hearing-impaired children's academic performance in those areas may improve if they are taught specific visual perceptual skills.

Speechreading

Speechreading is another rehabilitative tool for the hearing-impaired child and adult. Speechreading can emphasize the use of vision or the combined use of the auditory-visual channel for both the hearing-impaired and some dually-impaired individuals. Some clients with low vision may also communicate with sign language. Their ability to see the signs may be affected by a central visual defect such as a scotoma. Hand movements should be slowed down and formed in the usable portion of the client's field of vision (Karp, 1983; Siple, 1978).

Karp (1983) also discussed other strategies for the aural rehabilitation of the v-h impaired client.

Speechreading and signing should be adapted to the special needs of the individual with dual sensory impairments. She discussed rehabilitation strategies designed specifically for persons with central vision deficits, for those persons with peripheral field deficits, and for those persons who are considered legally blind.

For a person with hearing loss and a central scotoma, speechreading may prove difficult. The scotoma may interfere with the ability to see the mouth or face of the speaker. If a lipreading screening test or informal probing of speechreading ability indicates that a trial period of training might show improvement, proper positioning and illumination in the therapy area is an important consideration.

Unlike clients with central vision problems, those with peripheral visual problems can often use speechreading cues to supplement their audition. For instance, some clients with tunnel vision have adequate central vision. Manual communication should be adapted to the constricted field (for example, signs should be made closer to the body and more slowly).

Karp (1983) emphasized that clients with no usable vision will depend on their sense of hearing not only for communication, but for orientation and mobility purposes as well. For a basic discussion of re/habilitation for these individuals, see Scholl (1986).

Hearing Aids

Hearing aids and/or other amplification devices (assistive listening devices) are a major re/habilitation tool for the v-h impaired person. Hearing aid selection for the deaf-blind person was discussed by Karp (1983). Karp (1983) stated that eyeglass hearing aids should be recommended rarely, and then only with caution. Even though the individual with dual sensory impairments may wear eyeglasses, these individuals may require more than one optical aid for various visual tasks and it simply would be too impractical to mount hearing aids on more than one optical device. Additionally, the repair of either aid (hearing or optical) may require the person to be without the entire device while it is being serviced. Finally, when the clients are not wearing eyeglasses they could not benefit from amplification.

Eyeglass hearing aids may in some circumstances however, present advantages. According to Pollack (1980), eyeglass style hearing aids: (a) are well suited to CROS type aids, (b) have enough distance from the microphone to the ear to permit more gain without feedback problems, and (c) provide a volume control wheel which is easy to manipulate. Many hearing aid manufacturers offer an adapter to couple the arm of the person's eyeglasses to the behind-the-ear hearing aid. Presenting the advantages and disadvantages of the eyeglass style aid enables the client to make an informed decision about the style of amplification device suitable for his needs.

The clinician should also know whether or not the client uses low vision aids (such as special lenses or magnifiers). This information is useful during both hearing aid orientation and management, as the individual with a dual sensory impairment may need these low vision devices to see the fine detail on the hearing aid and its parts. Appropriate hearing aid evaluations and fittings should always consider the following types of information: binaural versus monaural fitting, type of hearing aid, maximum power output, frequency response, tone control, and soundfield test results.

Tactile Cues

The use of tactile cues is another area of consideration with v-h impaired clients. Karp (1983) mentioned using the sense of touch in familiarizing clients with their hearing aids. She also recommended the use of plastic models as well as enlarged drawings for teaching handling and care of the hearing aids.

Chapter V: Conclusion

The detection of vision problems is crucial for the hearing-impaired population. Persons with impaired hearing have a tendency to rely on their vision to either partially compensate for or replace their hearing. Compared to the hearing population, hearing-impaired persons, especially those with congenital sensorineural and/or conductive hearing loss, are more likely to have impaired vision. The combined loss or reduction of hearing and vision can have major implications for communication and education of the affected individual. The likelihood of having an additional impairment in the other primary sense underscores the need for visual assessment of hearing-impaired persons.

Vision plays a vital role in the language and communication process. A means of communication is fundamental to an education or rehabilitation program. How vision contributes to communication was addressed in the review of visual perception of speech (oral language) and sign (manual language). In general, the combined use of audition and vision provides greater perception of speech than either vision or audition alone. Contradictory results have been obtained concerning visual versus auditory-visual processing of speech by the profoundly hearing-impaired population. As hearing loss increases, the amount of information provided by vision may vary.

Generally, visual information seems to complement auditory information, but how much information is provided by

vision for the hearing-impaired population has not been determined. Hearing and vision appear to work together in decoding ambiguous or contradictory information. Communication in elderly, mildly hearing-impaired persons is facilitated by the combined use of their vision and their remaining hearing.

Vision screening can detect the presence of other handicapping conditions that may or may not be part of a syndrome. All syndromes involving the two primary senses should be identified as early as possible and early detection can be accomplished through vision screening.

A vision screening protocol was presented. Visual skills that should be sampled in the hearing-impaired student population include: (a) history of eye or vision problems, (b) visual acuity, (c) refractive ability, (d) binocular coordination, (e) color vision, (f) peripheral vision and (g) pupillary reflex. Informal as well as formal screening measures were described.

The implications of a vision screening protocol applied to the hearing-impaired population were discussed. When visual problems are suspected or identified, a referral to an eye specialist should be made. Keeping track of information regarding the referrals and treatment (i.e., how many referred, for what, to whom and how treated) helps determine the worth of the referral and remediation and thus, the value of the screening itself.

Some suggestions for audiological management (assessment

and rehabilitation) of v-h impaired persons were presented. These included diagnosis of the dominant sense (by thorough examination of the hearing mechanism and consultation with a vision professional) and development of an individualized rehabilitation plan.

Finally, research in vision and its importance for hearing-impaired students has been scarce. The following areas are recommended for further research in the hearing-impaired population: a) the value of a vision screening program in terms of obtaining professional eye and/or vision evaluations, b) the number of those identified v-h impaired students who obtain treatment and c) the effects of visual disorders on hearing-impaired students' academic and career choices.

Appendix A

Glossary of Eye and Vision Terms

accomodation- The ability of the eye to change from a distant focus to a near focus.

binocular vision- The ability of the eyes to work together to create a single image.

choroid- The vascular coat which provides nourishment to the eye. This is located between the sclera and the retina.

confrontation- An assessment procedure in which the visual fields of the examiner are compared to those of the client.

color vision- The ability to discriminate colors.

convergence- The ability to bring the eyes together to closely examine objects.

dark adaptation- The ability to see in dim light or in darkness.

dyplopia- Double vision.

electroretinography- Measurement of the retina's electrical responses to flashes of light.

fusion- The ability to use both eyes to perceive objects in all three dimensions.

glaucoma- An abnormal accumulation of fluid inside the eye, which causes increased pressure and loss of vision. This condition may be of a temporary nature or progressive.

hyperopia- Farsightedness. This occurs when parallel rays of light focus behind, instead of directly on, the retina.

iris- The colored circular portion of the eye which controls changes in the size of the pupil.

lens- The transparent disc suspended in the middle of the eye, which brings rays of light to focus on the retina.

low vision- Partial sight. This refers to visual field loss or reduced central acuity which results in visual impairment even with the best correction.

myopia- Nearsightedness. This occurs when parallel rays of light focus in front of, instead of directly on the

retina.

ocular- Pertaining to the eye.

oculo-motility- Eye movement control.

ophthalmologist- A physician who specializes in the eye and treatment of its disorders and diseases.

ophthalmoscopy- The examination of the eye's interior.

optician- A specialist who makes optical equipment.

optometrist- A vision specialist who is trained to examine the eye, perform tests of visual acuity and prescribe corrective lenses or provide other nonmedical and nonsurgical ocular treatment.

peripheral vision- Vision outside the direct line of sight, that is, in the periphery.

presbyopia- Loss of vision (usually accommodation) due to the aging process.

pupil- The opening at the center of the iris which appears black. The pupil changes in size to regulate the amount of light that reaches the retina.

refractive error- A condition in which the eye does not properly focus light on the retina. This causes blurred vision.

retina- The innermost coat of the eye which contains nerve fibers that are light sensitive. The retina receives the image formed by the lens.

retinal detachment- The condition in which the retina is separated from the choroid.

retinitis pigmentosa- The progressive loss of vision due to degeneration of the retina.

retinoscopy- A means of judging refractive error by projecting light into the eyes and examining the movement of the reflected rays of light.

sclera- The outer tough, protective layer of the eyeball which is normally white.

scotoma- A blind gap in the visual field.

stereopsis- The ability to perceive three dimensions of objects.

strabismus- An inability of one eye to work with the other eye for binocular vision, due to muscle imbalance.

tonometry- A method of assessing intraocular pressure.

tunnel vision- Constriction of the field of vision.

visual acuity- The ability of the eye to discriminate detail.

visual field- The area in which objects may be seen when the eyes are stationary.

Adapted from Taber's Cyclopedic Medical Dictionary, 14th Edition, Philadelphia: F. A. Davis Co., 1981.

Appendix B

Visual Case History

1. Do you have any vision problems? If so, what kind?
2. Has your doctor determined the cause of your vision problem?
3. When did you last have your vision tested?
4. Do you wear contact lenses or glasses? If so, do you see normally with your contacts/glasses?
5. How long have you had your contacts/glasses?
6. How often do you wear your contacts/glasses? If not all the time, when do you wear them? (i. e., reading, driving, other).
7. Do you use any other optical aids? (i. e., magnifying lenses, etc.).
8. Do you have trouble seeing in the dark (i. e., at night or in dim lighting?).
9. Do you have a tendency to bump into obstacles?
10. Does anyone else in your family have the same eye problems or a serious eye problem?

If any answers indicate the possibility of an eye or vision problem, then the clinician should refer the person to an ophthalmologist. The above questions have been adapted from Caccamise, Johnson, Hamilton, Rothblum and Howard (1980)

1983).

Appendix C

Signs of Possible Eye or Vision TroubleBEHAVIOR

Frequent eye rubbing

Difficulty in reading or other close work

Blinks more than usual

Tears excessively

Unable to see distant things clearly

Squints eyelids together

Shuts or covers one eye

Tilts head or thrusts head forward

Holds reading material at unusual angle or distance

Lack of interest in anything that involves critical seeing

APPEARANCE

Red-rimmed, crusted or swollen eyelids

Recurring styes

Crossed eyes

Inflamed or watery eyes

COMPLAINT

Eyes burn, itch or feel scratchy

Cannot see well

Blurred or double vision

Dizziness, headaches or nausea following close eye work

Adapted from the National Society for The Prevention of
Blindness and the Bureau of Maternal and Child Health,
Texas Department of Health.

Appendix D

Educationally-Oriented Vision Report

1. What is the cause of the visual impairment?
2. Is any special treatment required? If so, what is the general nature of the treatment?
3. Is the visual impairment likely to get worse, better, or stay the same?
4. Should the teacher be alert to any particular symptoms (such as eye rubbing, etc.) that would signal the need for professional attention?
5. What restrictions, if any, should be placed on the student's activities?
6. Should the student wear glasses or contact lenses? If so, under what circumstances?
7. Were you able to determine an accurate visual acuity measure? If so, please give acuity and type of target used.
8. If a visual acuity measure was not possible, what is your opinion regarding what the student sees?
9. Is the student's focusing ability and eye muscle balance adequate? If not, please describe.
10. Were you able to determine the field of vision? If so, were there areas of no vision in the field? Where?
11. Was the student able to follow visually a moving object? Were there directions in which s/he could not track moving objects? Which directions?

12. Will the student work better with large or with small objects and pictures? At what distances?
13. What lighting conditions would be optimal for his/her visual functioning?
14. What are your specific recommendations concerning this student's use of vision in learning situations?
15. When should this student be examined again?

Adapted from: Efron, M., & DuBoff, B. (1975). A Vision Guide for Teachers of Deaf-Blind Children. Raleigh: North Carolina Department of Public Instruction.

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