Effect of Distance Visual Acuity Problems on the Speechreading Performance of Hearing-Impaired Adults

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The speechreading performance and distance visual acuity of 786 deaf college students were assessed. Because of the large number of persons with distance visual acuity problems among this population, a decision was made to study the effect of distance visual acuity deficits on speechreading performance. The results of this study have shown that (a) if the distance visual acuity in both eyes is 20/30 or better, students should be able to function normally within the classroom when speechreading at distances up to 22 feet, (b) as long as one eye is within normal limits (20/30 or better), speechreading performance should be comparable to that of students with normal binocular vision under similar environmental conditions, and (c) the effect of impaired binocular vision will be reflected in speechreading performance, especially when the vision in both eyes is 20/60 or poorer, or the better eye is 20/40 and the poorer eye is about 20/100 or poorer with best correction.

INTRODUCTION

A visual handicap should not, per se, be a contraindication to attempt to develop lip reading in the young child. The child with vision of 20/80, or better, may be expected to learn and perform lip reading at five feet with reasonable speed and proficiency. Nor is vision poorer then 20/80 a contraindication, although one may expect such a child to experience considerably more difficulty and achieve less proficiency. When vision is less than 20/200 training for lip reading probably will not be productive (Romano & Berlow, 1974, p. 386).

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The Romano and Berlow article is one of two major studies which have dealt directly with the effects of visual acuity on speechreading (lipreading) performance. It made a strong statement in favor of the provision of speechreading training even for those hearing-impaired persons who are known to have moderate to severe, non-correctable visual impairments.

Hardick, Oyer, and Irion (1970) also studied the effects of abnormal visual acuity on speechreading performance. They concluded that even minor deviations in distance visual acuity in either or both eyes could cause speechreading performance to be significantly reduced. In response to this article, Johnson and Caccamise (1983b) stated, "It is imperative that all hearing-impaired persons receive visual screening and corrective follow-up, if needed, prior to conducting speechreading training and research in which an intact visual channel is essential" (p. 132).

Three years of research conducted at the National Technical Institute for the Deaf (NTID) from 1976 through 1979 demonstrated a high incidence (65% of 955 students) of visual impairments and/or pathologies among the entering deaf students (Johnson, Caccamise, Rothblum, Hamilton, & Howard, 1981). Although the vision of many of these students had been corrected prior to entrance, many were in need of referral for ophthalmological examinations which they received in the NTID Eye & Ear Clinic.

The most frequent visual problems found among those students seen for ophthalmological examinations during this time period were three common, correctable refractive errors of the eye (myopia, astigmatism, and hyperopia) or combinations thereof. After 1980, primarily as a result of the rubella epidemic which occurred in the United States between 1963 and 1965, non-correctable monocular vision (only one functional eye) and binocular vision problems, in addition to the correctable refractive errors, also became more prevalent among entering students.

Visual acuity or clarity of vision is contingent, in large part, upon the appropriate length of the eyeball, the correct curvature and transparency of the cornea, the transparency and ability of the lens to change its shape, and an intact macular-foveal area (that little 3 mm in diameter area in the posterior pole of the retina into which the eye attempts to focus the incoming light waves for good clear central vision). When any one or a combination of these factors does not exist, visual acuity for near and/or distance vision may be impaired — the severity being dependent upon the combination of factors involved.

Stangler, Huber, and Routh (1980) discuss the formula (Snellen Standards) which Snellen devised to measure visual acuity. The formula is $V = d/D$ where V is visual acuity, d is the distance of the test object from the person reading it, and D is the distance at which the test object would be clearly visible to the person with normal vision. At 20 feet the person with normal distance visual acuity should be able to distinguish clearly the smallest test object (line of letters or numerals) on the standard Snellen chart. This person is said to have a visual acuity of 20/20 for the eye in question. As D becomes larger, the more severe is the loss of visual acuity for that eye. Today, in most states and for the Federal government, a central visual acuity impairment of 20/200 in both eyes with best correction represents *legal blindness* which is not to be confused with *medical blindness* which means no light perception (NLP).

Purpose

As stated above, Romano and Berlow (1974) concluded that moderate to severe visual impairments do not contraindicate training to upgrade speechreading skills. However, Hardick, Oyer, and Irion (1970) stated that even minor deviations in visual acuity in either or both eyes might cause speechreading performance to be significantly reduced. These two statements raise several questions relative to visual acuity and speechreading performance.

First, what constitutes "normal" visual acuity for performing a speechreading task at a distance? Hardick, Oyer, and Irion (1970) stated that deviations in visual acuity as small as 20/20- (can read all the letters/numbers on the 20/25 line of the Snellen chart, but less than half of those on the 20/20 line), 20/25, or 20/30 in either or both eyes could affect speechreading performance. However, NTID's consulting ophthalmologists consider visual acuity of 20/30 or better in both eyes to be within normal limits. In addition, most states do not require their licensed drivers to utilize corrective lenses unless one or both eyes are 20/40 or poorer.

Second, is it necessary to have two normal eyes to assure maximum speechreading performance at a distance? If so, what are the implications for assessing speechreading skills at a distance?

Third, for those persons with abnormal binocular vision or a mild to moderate visual impairment in one eye, what are the implications for performing well during a speechreading assessment which is not conducted within the five foot limit specified by Romano and Berlow (1974)?

To address these issues, the following hypotheses were tested:

1. Subjects with distance visual acuity of 20/20, 20/25, or 20/30 in the better eye will not differ in mean speechreading performance.
2. Subjects with one normal eye (distance visual acuity of 20/30 or better) will not differ in speechreading performance regardless of distance visual acuity in the poorer eye.
3. Subjects with severely impaired distance visual acuity in the better eye will differ in mean speechreading performance from subjects with normal visual acuity (20/30 or better).
4. Mean speechreading performance will reflect the severity of a visual acuity problem in both eyes when the better eye is moderately or severely impaired.

METHOD

Subjects

The subjects were 786 students enrolled at NTID. Their mean chronological age (CA) was 19.4 years with a range of 17 to 38 years. The mean age at onset of hearing loss was seven months although most subjects (83.3%) were congenitally deaf or had lost their hearing prior to CA 3 years as a result of such pathologies as meningitis (7.2%). Maternal rubella was the reported etiology of 280 (37%) of the subjects reflecting the rubella epidemic which took place in the United States during 1963, 1964, and 1965 (Stuckless, 1980). The mean three-frequency (500, 1000, 2000 Hz) better-ear pure tone average was 94.8 dB HL (ANSI, 1969) for 785 of the subjects with a range of 53-122 dB HL. One subject with a precipitous drop-off for frequencies above 750 Hz had a better ear average of 29 dB.

Test Procedures

Visual Screening. Screening for visual acuity was conducted in two small quiet classrooms with two test positions located within each room. At each test position, the examiner and subject were seated opposite and facing each other for ease of communication. Unless the subject requested that the examiner use speech only, simultaneous communication (simultaneous use of speech, signs, and fingerspelling) was used.

An orthorater vision tester was placed slightly to the side and between the examiner and the subject. Pictures of this equipment and the test procedures were described in depth by Johnson et al. (1981). Briefly, the orthorater equipment contains 12 large squares, each containing five smaller squares. One of the smaller squares is different in design (checkerboard in appearance). The subject was instructed to indicate the location of the different square. The largest test object corresponds in size to the 20/200 line and the smallest object the 20/15 line on the standard Snellen chart.

During screening for distance visual acuity, the subject was tested first with both eyes together for practice, and then with the right eye followed by the left eye alone (test condition). Glasses or contacts were always used during the duration of the testing when the subject had them. Near visual acuity testing was performed only on those subjects who were CA 30 years or older or who had a complaint relative to near vision tasks. The test procedure was the same as that used to test for distance visual acuity with the exception that the both-eyes-together test condition was omitted.

Examiners utilized a threshold bracketing procedure similar to that used during pure tone audiometric testing. Minimally, testing continued until three threshold crossings were obtained or until the response on the smallest test object (20/15) was found to be correct. Threshold was estimated to be the last correct response followed by two incorrect responses. Subjects were always instructed to guess even when they were not sure of their responses. All subjects whose visual acuity with or without correction was 20/40 or poorer in either or both eyes were referred for an ophthalmological examination. This referral criterion has been found to yield the smallest false positive (overreferral) and false negative (underreferral) rates (Johnson et al., 1981.)

Speechreading Assessment. Since 1972, NTID-filmed or -videotaped versions of the CID Everyday Speech Sentences developed originally by the Committee on Hearing and Bio-Acoustics (CHABA) and chaired by Dr. Grant Fairbanks at the Central Institute for the Deaf in St. Louis, MO (Davis & Silverman, 1978) have been utilized at NTID to assess speechreading skills. The use of these sentence lists at NTID to assess speechreading, speech discrimination, and manual and simultaneous receptive abilities was first reported by Johnson (1975). The primary purpose in utilizing these lists at NTID is to identify those deaf students in need of various aspects of receptive communication habilitation.

One list of 10 CID Everyday Speech Sentences, List 3 (List C in Davis & Silverman, 1978), was administered to all subjects. Exact procedure for instructions, test administration, scoring, and interpretation of results have been reported by Johnson and Caccamise (1983b). In addition, validity and reliability information have been reported by Johnson and Crandall (1982). It was predetermined that the English vocabulary level contained within this list is at the 4.3 grade level equivalent (Barley & Merchon, 1976).

Subjects wrote word for word what they thought they saw. Scoring was based on the percentage of 50 key words correctly identified regardless of the order in which they were written. Points were not deducted for words incorrectly identified.

The videotaped sentences were shown via three 19-inch television monitors located to the left, center, and right of a quiet classroom. Minimum and maximum viewing distances were 9 and 22 feet respectively. All subjects had an unimpeded view of the television monitors. If it is assumed that all subjects watched the closest of the three monitors, then viewing angles ranged from 0° to, at most, 30°. Subjects who knew or felt they might have visual problems were encouraged to seek preferential seating as near to any of the three screens as seating would allow.

Statistical Analysis

One-way analysis of variance techniques were used to explore the effects of abnormal visual acuity on speechreading performance. In cases in which a null hypothesis was rejected, Bonferroni procedures were used for pair-wise comparisons (Rosenthal & Rubin, 1984). When variances were determined unequal (Levene, 1960), appropriate test statistics (Brown & Forsythe, 1974) were used.

As the number of contrasts computed during an experiment increases, there is a greater likelihood that some of the contrasts will be declared "significant" even when the null hypothesis is true. In part, to minimize such Type I errors, summary statistics were determined for subjects grouped by visual acuity in each eye prior to testing hypotheses (2) and (3). In addition, these summary statistics were useful in determining which groups of subjects to combine for hypothesis testing because the number of subjects with abnormal vision in both eyes was small ($n = 28$).

Speechreading scores, expressed as percent correct, were arcsine transformed. Analyses were performed on both the raw and transformed data. The results were found to be equivalent.

Four potentially confounding factors, reading comprehension, chronological age, age at onset of hearing loss, and pure tone average, were examined when differences between groups were found to be significant, or nearly so.

RESULTS

Since previous investigators (Hardick et al., 1970) had concluded that very slight impairments in visual acuity of either eye could affect speechreading performance, data for 97 subjects with distance visual acuity classified as normal by conventional ophthalmological criteria (20/30 or better in both eyes) were closely examined. Of these 97 subjects, 65 had 20/20 or better visual acuity in both eyes, 12 had 20/25 or 20/30 visual acuity in both eyes, and 20 had 20/20 visual acuity in the better eye and 20/25 or 20/30 in the poorer eye as determined by ophthalmological examination. The mean speechreading scores for these groups were 36.8, 36.2, and 43.2% respectively. No relationship between very slight impairments in visual acuity and speechreading performance was found when both eyes were 20/30 or better. As shown in Table 1, the means of these three groups differ by no more than 7%, whereas the standard deviations are roughly 20-25%. Differences among these means were not statistically significant at the 0.05 level.

Table 1

Effect of Distance Visual Acuity on Speechreading Scores of Deaf Postsecondary Level Students

Speechreading Score	20/20 or Better Both Eyes	20/25 or 20/30 Both Eyes	20/20 Better Eye 20/25 or 20/30 Poorer Eye
M[a]	36.8%	36.2%	43.2%
SD	20.2	25.4	22.4
n	65	12	20

Note: Confirmed by ophthalmological examination.

[a]There are no significant differences between the means for any of the above groups ($p > .05$).

Secondly, as shown in Table 2, when visual acuity was normal (20/30 or better) in one eye, then the severity of the impairment in the poorer eye had no significant effect on speechreading performance as measured in this study.

That is, there was no systematic trend in mean speechreading performance as visual acuity in the poorer eye decreased. Note that the mean score for the group with "normal" vision in both eyes was 38.3%, comparable to the mean score of 41.6% for those students with monocular vision (20/200 or poorer in the poorer eye).

Table 2

Effect of Poorer Eye Distance Visual Acuity on Speechreading Scores of Deaf Postsecondary Level Students when the Acuity in the Better Eye is Normal (20/30 or Better)

	Distance Visual Acuity in Poorer Eye						
Speechreading Score	**Normal**	**20/40**	**20/60**	**20/80**	**20/100**	**20/200**	**Poorer than 20/200**
M	38.3%	29.5%	51.1%	41.0%	32.8%	39.4%	41.6%
SD	21.3	18.2	16.6	22.8	16.6	21.7	21.8
n	706	12	7	4	5	7	17

Note. The distance visual acuity of 177 of these students was ophthalmologically confirmed. The acuity of the remainder ($n = 581$) was the result of stringent visual screening with orthorater vision testers.

In Table 3, the effect of distance visual acuity in the better eye alone on speechreading performance is shown. Although the means and standard deviations are comparable, the number of subjects with 20/20, 20/25, and 20/30 vision is not the same as in Table 1. This is because each group includes subjects whose visual acuity in the poorer eye ranges from 20/20 to poorer than 20/200. Note that visual acuity in the better eye appears to have no effect when 20/30 or better. However, mean speechreading scores become progressively worse over the 20/40 to 20/80 range. This fact suggests that, over this range, lower speechreading scores are related to visual impairment.

Table 3

Effect of Distance Visual Acuity of the Better Eye on Speechreading Scores of Deaf Postsecondary Level Students

	Distance Visual Acuity in Better Eye						
Speechreading Score	**20/20**	**20/25**	**20/30**	**20/40**	**20/60**	**20/80**	**Total**
M	39.0%	34.3%	36.7%	31.2%	24.8%	24.0%	36.9%
SD	20.4	23.8	23.3	17.3	21.8	—	20.7
n	124	13	12	19	8	1	177

Note. All of the above results for distance visual acuity were ophthalmologically confirmed.

As noted above, the small number of subjects ($n = 28$) with abnormal visual acuity in both eyes (20/40 or poorer) required examination of the data in detail before further analysis. As shown in Table 4, 10 students had visual acuity of 20/40 in the better eye and 20/40 or 20/60 in the poorer eye. For this group, the mean speechreading score appears comparable to that of subjects with normal vision in both eyes (see Table 1). Only one student had a better-eye visual acuity of 20/40 with 20/100 in the poorer eye, and his score is also comparable to the mean of the normal vision group. The mean speechreading score of the remaining 17 subjects is lower.

Table 4

Effect of the Poorer Eye on Speechreading Scores of Deaf Postsecondary Level Students when the Better Eye is also Not within Normal Limits (20/30 or Better)

Poorer Eye Distance Acuity	Better Eye Distance Acuity 20/40	20/60	20/80
20/40			
M	40.8%		
SD	15.5		
n	7		
20/60			
M	36.7%	28.5%	
SD	3.1	17.8	
n	3	4	
20/80			
M		26.0%	24.0%
SD		—	—
n		1	1
20/100			
M	36.0%		
SD	—		
n	1		
Poorer than 20/100			
M	16.2%	19.3%	
SD	15.9	33.5	
n	8	3	

Note. Distance visual acuity on all students was ophthalmologically confirmed.

As shown in Table 5, when these observations were tested, they achieved statistical significance ($p < .05$). That is, when visual acuity in the better eye was 20/40, and 20/40 or 20/60 in the poorer eye, the mean speechreading score (39.6%) was not significantly different ($p > .05$) from that of subjects with normal vision (20/30 or better) in at least one eye (38.3%). However, if visual acuity in both eyes is worse than 20/40 or one is 20/40 and the other is poorer than 20/60, the mean speechreading score (23.2%) is significantly lower ($p < .05$). Note that the mean score is a little greater than half that of subjects with better vision. This group of subjects did not significantly differ from the other groups in English reading comprehension, chronological age, age at onset of hearing loss, or pure tone average.

Table 5

Effect of Distance Visual Acuity on Speechreading and Reading Scores Under Normal and Other than Normal Conditions

	Normal (20/30 or Better) Acuity in at Least One Eye	20/40 Acuity Better Eye and 20/40 or 20/60 Acuity Poorer Eye	20/40 Acuity Better Eye and Other Eye Poorer than 20/60 *OR* Both Eyes Poorer than 20/40
Speechreading			
M	38.3[a]	39.6%[a]	23.2%[b]
SD	21.2	12.9	18.4
n	758	10	18
Reading			
M	8.1	8.2	8.6
SD	1.5	1.8	1.6
n	762	10	17

Note. Speechreading scores measured by List 3 of the NTID videotaped versions of the CID Everyday Speech Sentences (CHABA), and English reading comprehension measured in grade level equivalence by Form *X* of the California Reading Test: Junior High Level.

[a]Means having the same superscript are not significantly different ($p > .05$).

[b]Means with a different superscript are significantly different ($p < .05$).

These results may be summarized as follows:

1. The conventional ophthalmological definition of normal distance visual acuity (20/30 or better in both eyes) was found to be an appropriate criterion when describing the effect of impaired vision on speechreading performance for these young adult deaf subjects (Table 1).
2. When distance visual acuity in one eye was normal (20/30 or better), regardless of the severity of the visual impairment in the other eye, mean speechreading scores were comparable to those of subjects with 20/20 vision in both eyes (Table 2).
3. When the better eye was 20/40 and the poorer eye was 20/40 or 20/60, mean speechreading scores were not significantly different from those of subjects with normal distance visual acuity in either eye (Tables 2 and 4).
4. When both eyes were 20/60 or poorer *or* if the better eye was 20/40 to 20/60 and the poorer eye was worse than 20/100, mean speechreading performance (as measured in this study) was significantly poorer ($p < .05$).

Mean scores for students with these severe binocular visual impairments were a little greater than half those of subjects with better vision.

DISCUSSION

Comparison with Previous Studies

Discrepancies between our conclusions and those of the Hardick et al. (1970) study may reflect differences in subjects (normal hearing vs. hearing-impaired), test instrument (Utley Test vs. CID Everyday Speech Sentences, List 3), data analysis techniques, and sample size. While it is possible that speechreading performance by subjects with hearing impairments may be affected to a lesser degree by slight visual impairments, the authors can think of no reasons why this should be the case. The test instruments upon which conclusions were based were also similar in that they were both taped sentence tests. The authors of this paper believe, therefore, that data analysis techniques and sample size account for most of the discrepancies.

Although Hardick et al. (1970) administered the Utley Test to 53 subjects, only the eight highest and eight lowest scoring subjects were examined optometrically. Of these 16 subjects, only seven had poorer than 20/20 vision in either eye. Of these seven, six had a visual acuity of 20/30 or better in at least one eye. Recall that, in contrast to the medical criterion of 20/30 or better, Hardick et al. (1970) defined normal visual acuity as no worse than 20/20. Of those subjects with impaired vision as defined by Hardick et al., all met the medical criterion for normal visual acuity in at least one eye. The 37 speechreaders at neither extreme, that is, the average speechreaders, were excluded from the data analysis. Inclusion of these subjects would have produced results applicable not just to excellent and poor speechreaders and, thus, would have addressed the issue of the relationship between acuity and speechreading in the average speechreader.

The Hardick et al. (1970) study also demonstrated conflicting results from the three subtests (words, sentences, and stories) of the Utley Test. This might have been resolved if a larger sample size had been used. No significant differences in mean speechreading scores between the nine subjects with normal vision and the seven subjects with impaired vision (as defined by Hardick et al.) could be demonstrated on two of the three subtests (words and stories) administered. Without a priori predictions of the relative validity of the three subtests, the results from all three subtests might have been considered in deriving conclusions. Certainly it would have been appropriate to stress the relatively small sample size, and the failure to attain statistical significance of 2 of the 3 test measures.

To enable a more direct comparison between studies, the subjects in the current study were also ranked by speechreading scores. Only those subjects examined by an opthalmologist ($n = 177$) were included in this analysis. The subjects obtaining the 25 highest and 25 lowest scores were identified with the following results.

Scores ranged between 60% and 82% correct in the high-scoring group and 0% and 12% correct in the low-scoring group. In both groups of 25 subjects respectively, seven and eight had binocular 20/20 vision and 17 and 18 had 20/20- or poorer in one or both eyes. That is, roughly equal numbers of subjects with normal and impaired vision (using the Hardick et al., 1970, definition) fell into the top and bottom groups of speechreaders. Of the 25 lowest scorers, seven subjects had severe binocular impairments (20/40 and 20/80 or worse *or* both eyes 20/60 or worse). Of the top 25 scorers, none had severe binocular impairments. The hypothesis that the two groups of subjects (normal visual acuity vs. impaired visual acuity) did not differ with respect to the proportion of cases which fell into the top and bottom 25 cases was tested with the χ^2 test for independent samples and was rejected [$\chi^2(1, n = 50) = 8.14, p < .01$]. It was thus concluded that (a) there is no relationship between mild visual impairments and speechreading performance, and (b) severe binocular impairments, as defined in this study, are associated with significantly poorer speechreading performance.

CONCLUSIONS

The results of the present study have shown that distance visual acuity of 20/30 or better in both eyes is within normal limits for speechreading within a typical classroom where student seating is within the range of 9 to 22 feet with an unimpeded view of the source. When vision in the better eye is 20/40 and the worse eye is 20/60 or poorer, there is a trend for speechreading performance to diminish — especially when vision in both eyes is poorer than 20/40 or the better eye is 20/40 and the poorer eye is worse than 20/100.

Considering the importance of vision to the hearing-impaired person, visual screening programs conducted under stringently controlled conditions such as those described by Johnson and Caccamise (1983b) and Johnson et al. (1981) should be carried out by all programs/agencies providing services to the hearing impaired.

Relative to these visual screening programs, it is not necessary that expensive equipment be employed to conduct the visual screening. For example, Johnson and Caccamise (1983a) were able to demonstrate that "... a rear-illuminated Snellen chart is an acceptable alternative to the Orthorater (Vision Tester) for screening postsecondary, hearing-impaired students' far visual acuity" (p. 402). The false positive (overreferral) and false negative (underreferral) rates will be comparable when a pass-fail referral criterion of 20/40 in either or both eyes is utilized and clients are tested with glasses or contact lenses when they have these. In addition to the prescribed referral criterion, test conditions relative to lighting, test distances, test administration, and interpretation of test results have been exactly specified by these authors and are an important aspect of the visual screening program.

Concerning monocular vision, it was shown in this study that, under those conditions specified, the speechreading performance of persons with only one normal functional eye (20/30 or better) was comparable to that of persons with normal binocular vision. This fact does not preclude the use of preferential seating for these clients/students. The normal eye has a total visual field of approximately 150° without correction, with peripheral vision of about 90° temporally and 50° to 60° nasally (depending upon the size of the nose), while normal binocular peripheral vision is approximately 170° to 180°. Recommended preferential seating for these persons should take into consideration that, in the classroom, the functional eye should have an unimpeded view toward the activities taking place within the environment with few or no activities taking place on the side of the non-functional eye.

Another problem of persons with monocular vision is that they lack stereopsis; that is, they have poor depth perception and three-dimensional vision. Many of these persons have developed compensatory strategies which they utilize well while driving or in other activities. However, care should be taken when selecting careers which require high levels of skill with depth perception and three-dimensional vision.

Finally, all persons with monocular vision (especially hearing-impaired persons) should utilize safety glasses at all times to protect their one good eye. Especially recommended are polycarbonate, shatterproof, plastic glasses which are no thicker than regular glasses and can be placed within the regular assortment of frames available at the local optician to persons with corrected binocular vision.

For those hearing-impaired persons with abnormal binocular vision where one or both eyes are not normal, these persons may very well experience multiple difficulties within the classroom and other environments. The needs of these persons are very individual in nature. Moreover, reduced visual efficiency may require consideration of the following:

1. Strategic location of either the instructor or interpreter.
2. A trained notetaker to record instructor-related information.
3. Larger print classroom materials.
4. "Hard copy" of all transparencies.
5. Availability of slides for individual use.
6. Reduction of movement of the instructor around the classroom.
7. Use of black lettering on a matte or non-glare surface.
8. Use of yellow or very pale blue acetate to reduce glare from transparencies. (*Note:* It is only necessary to have one piece of colored acetate to place over the regular black-on-clear acetate when using transparencies for instructional materials. Green and red are especially poor colors of acetate for visually-impaired students.)
9. Dimmer switches to control lighting. Students with dark adaptation problems such as those with retinitis pigmentosa (RP) and glaucoma

may not be able to function in a dark room. These same students may also encounter glare problems if they have early developmental cataracts and, for these students, the use of whiteboards in place of blackboards is especially inappropriate.

SUMMARY

In summary, this study has shown that adult hearing-impaired students with 20/30 or better vision in both eyes should be able to function like speechreaders with 20/20 vision within the classroom when speechreading at distances up to 22 feet. Moreover, as long as the student has one normal eye of 20/30 or better, speechreading performance should be comparable to that of students with normal binocular vision under similar environmental conditions.

Finally, the effect of impaired binocular distance visual acuity is likely to be reflected in speechreading performance. This is especially true when vision in both eyes is 20/60 or poorer or the better eye is 20/40 and the poorer eye is 20/100 or poorer with best correction.

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