Hearing Handicap and Denver Scales: Applications, Categories, Interpretation

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Several hearing handicap measures are summarized and discussed. Use of these scales, especially the Hearing Handicap Scale, is described in terms of interpretation of clinical findings and counseling of aural rehabilitation clients. In this connection, the Denver Scale of Communication Function was modified to permit quantification of handicap. This Quantified Denver Scale was administered to 50 subjects and found to yield scores that were somewhat lower than for comparable subjects tested with the Hearing Handicap Scale. From these data, preliminary categories of communication dysfunction are proposed for use with the Quantified Denver Scale.

A variety of hearing handicap indexes and scales have been devised for diagnostic and rehabilitative purposes in audiology. The Social Adequacy Index (Davis, 1948) was probably the first effort along these lines, but it did not enjoy wide acceptance or long life. The medical practice of calculating percentage of hearing loss (American Medical Association, 1961) may be thought of as a handicap measure but is based only on pure-tone data and is quite different from the more recent self-assessment tools which began to emerge in the mid 1960s. The Hearing Handicap Scale (HHS) was the first of these self-evaluation instruments and was developed in America by High, Fairbanks, and Glorig (1964). Noble and Atherley (1970), from Australia, introduced the Hearing Measurement Scale a few years later, and several other scales have since been proposed. These include the Social Hearing Handicap Index which was developed in Denmark by Ewertsen and Birk-Nielsen (1973), and several American products: the Denver Scale of Communication Function (Alpiner, Chevrette, Glascoe, Metz, & Olsen, 1974), four profile questionnaires by Sanders (1975), and the Hearing Performance Inventory (Giolas, Owens, Lamb, & Schubert, 1979).

The Hearing Handicap Scale (HHS), which has 2 forms, 20 items each, and the Denver Scale, which includes one 25-item form, can probably claim the widest use based on the number of published articles and references. The Hearing Performance Inventory is indisputedly the longest, most thorough

scale since it has 158 different items. It is also the newest and, therefore, among the least used up to this time. Long or short, new or old, it seems safe to say that none of the scales have been used in an extensive way by a wide cross section of audiologists. About ten years ago, Martin and Pennington (1971) reported on a survey which showed that only 5% of this nation's audiologists were using hearing handicap measures. In a follow-up of that survey (Martin & Forbis, 1978), it was found that use of these measures had almost doubled, but of course, this still indicates limited use (i.e., apparently less than 10% of audiologists in this country are employing these handicap tools).

Use of handicap measures may be even more limited than these numbers suggest. The Idaho State University (ISU) Hearing Clinic may be used as a case in point. Hearing handicap measures are regularly used at this facility, but despite our involvement with handicap measure research and an awareness of their value, we do not use handicap tools with each adult client nor do all members of the staff use handicap measures with equal regularity. Over the past five years, for example, approximately 1000 adult clients have been seen in this practicum site, and a survey of clinic records indicates that handicap measures were used on nearly 100 persons or just about 10% of the available clients. Since a number of the clients had normal hearing, this may in fact represent 15-20% of those clients with hearing loss. Nevertheless, this experience would suggest that handicap measures are not used for every client even by those audiologists with a commitment to using these tools nor should they necessarily be employed universally. However, it is hoped that more audiologists will begin to use these scales. Our experience would suggest that these tools can be a valuable part of the audiologist's armamentarium when used appropriately.

To clarify our own use practices and to help others appreciate the value of hearing handicap tools, data were analyzed on a group of ISU clients who had been given a handicap scale. Most of these clients (52 out of 58) were advised to undergo hearing aid evaluations (HAE). In other words, they were rehabilitation or potential rehabilitation clients. Some filled out the scale prior to the audiologist's decision to recommend HAE. Scales can be a valuable resource in making such a determination. Others filled out the scale during the HAE, and still others filled it out in connection with some kind of rehabilitation therapy following the HAE. In no case did scores on these scales reflect hearing handicap while using a hearing aid.

In this group of 58, there were 35 males and 23 females. The mean age was 58.7 years. There were more of these clients in their 60s than in any other decade group, but the ages ranged from 18 to 86 years, and there were a number of clients found in each decade interval. The ISU Clinic has employed the HHS, the Denver, and the Sanders scales. Some subjects were administered more than one of these since the results can be used in a complimentary fashion. The HHS has been used at ISU more than either of

the others, and 79% of these clients had filled out that particular scale. On 10% of our subjects, a scale had also been filled out by a significant other person such as a spouse, son, or daughter as well as by the client. In 22% of the cases, we had obtained pre-/post-therapy handicap measures.

Among these clients, the vast majority of ears (89%) were found to have losses which were sensorineural in nature and involved the high frequencies. Table 1 contains a summary of various aspects of the hearing losses exhibited by these clients. As indicated in the table, the mean pure-tone averages (PTAs) were in the range of slight-mild hearing loss (38-40 dB HL). The mean PTAs were 6-8 dB poorer than mean speech reception thresholds (SRTs), which were about 32 dB HL. This discrepancy resulted from the use of a strict three-frequency (500, 1000, 2000 Hz) average in figuring PTA. PTAs figured in this fashion were taken to be a better reflection of possible hearing difficulties than the SRT, though good PTA-SRT agreement is not expected in this case. Mean speech discrimination scores under earphones (at or near PB Max) were approximately 80% and are consistent with this degree of pure-tone loss. Seven clients were found to have unilateral hearing impairments, which is noteworthy since handicap measures have been found to be particularly valuable in analyzing the problems of persons with unilateral loss.

Table 1

Summary of Means, Standard Deviations (S.D.), and Ranges for ISU Clients (N = 58) with Respect to Age, Pure-Tone Average (PTA), Speech Reception Threshold (SRT), Speech Discrimination (DISC), and Hearing Handicap Scale (HHS) Scores

	AGE (Yr.)	PTA (dB)*		SRT (dB)*		DISC (%)		HHS (%)**
		RE	LE	RE	LE	RE	LE	
Mean	58.7	39.7	37.9	32.3	31.9	80.9	79.7	49.4
S. D.	17.2	21.6	18.4	19.6	19.7	15.4	16.1	22.3
Range	18-86	3-98	3-95	5-90	5-95	36-100	24-100	3-93

* Re ANSI, 1969

** N = 46 for HHS data only

For the 46 clients who were administered the HHS, the mean score was 49.4% (see Table 1). This results in approximately a 10-point difference between PTA and HHS and is consistent with several studies which have examined PTA-HHS relationships (High et al., 1964; Speaks, Jerger, & Trammell, 1970; Berkowitz & Hochberg, 1971; Schow & Tannahill, 1977). Furthermore, this HHS mean score is also in line with the categories which were suggested by Schow and Tannahill (1977) for use in interpreting HHS scores. That is, these researchers found that most candidates for hearing aid or other rehabilitation efforts will have scores of 41% or higher. Furthermore, they suggested that

HHS scores can be categorized as slight, mild-moderate, or severe based on the percentage score as shown in Table 2.

Table 2

Categories and Associated Percentage Scores for Use in Classifying HHS Performance (Schow & Tannahill, 1977)

Category	Percentage Scores
No handicap	0-20
Slight hearing handicap	21-40
Mild-moderate hearing handicap	41-70
Severe hearing handicap	71-100

The use of these categories has proven to be helpful in the application of handicap measures. Handicap categories facilitate the interpretation of scores and counseling with the client. Categories are also helpful when comparing and contrasting scores from the client and from a significant other person who may perceive the magnitude of handicap very differently. If the person's score is 41% or higher, the client is strongly encouraged to consider rehabilitation measures since they have as much difficulty as other clients who benefit from rehabilitation. Prior to use of these categories, percentage scores on HHS could be calculated, but they had little meaning to us. Differences between clients' and relatives' HHS scores were not easily interpreted. Pre- and post-therapy differences were, of course, measurable, but this was not of major interest with many of the clients tested.

The usefulness of categories in the interpretation of HHS scores has encouraged us to consider the possibility that other handicap measures may be interpreted similarly. The Denver Scale was not originally designed to be scored in a manner similar to the HHS. It was primarily recommended for pre-/post-therapy applications. In this way, questions of validity may be minimized since the client serves as her/his own control. The 25 items on the Denver Scale are designed to probe four different areas of communication function, namely family, self, social-vocational, and general communication. While the items are different than in the HHS, the general intent is similar and a quantified hearing handicap measure is, therefore, potentially feasible.

Recently, Kaplan, Feeley, and Brown (1978) reported on a modification of the Denver Scale wherein the items were expanded to a total of 34 and a five-point semantic differential was employed. In this case a score can be easily calculated and a percentage assigned in a manner similar to an HHS calculation. Kaplan et al., did report some undesirable individual reliability

measures both on the original Denver and on their modified version. Nevertheless, one has to remember that while handicap measures are quantifiable, they cannot be expected to have the same degree of validity or reliability which other traditional audiometric measures do since handicap measures are by nature subjective. They are dependent upon the accuracy of self-awareness as well as the honesty of the responses. This cannot be changed, but in fact, it can be an advantage since there are other methods for obtaining objective data on the hearing loss.

Recognizing these factors, it was our judgment that continued explorations of the Denver Scale are justifiable even though reliability and validity are not as ideal as they might be. It was decided to determine whether scores from a Quantified Denver Scale could be used in the same way HHS scores are used. It was also of interest to learn whether the same categories might be used with the Denver Scale as are used with the HHS. Accordingly, a study was designed to examine the Denver Scale as it relates to PTA in a manner similar to the way the HHS was analyzed by Schow and Tannahill (1977).

METHOD

Subjects

A subject group was selected which would represent a broad range of adult ages and hearing abilities from normal hearing to various degrees of hearing loss. Among the 50 subjects included in the sample were 23 males and 27 females. Ages ranged from 19-78 years with a mean age of 55.8 years. All subjects had an interest in determining their hearing status and were tested either in the ISU Hearing Clinic or in one of two community health programs (one was a community health fair and the other was a testing program conducted at the Pocatello Senior Citizens Center).

After testing, the audiograms were examined with respect to the agreement in the degree of loss between ears since sharp differences between ears may potentially influence the relationship between PTA and hearing handicap. When PTAs for the right and left ears were within 10 dB, the ears were considered symmetrical (equal in extent) for degree of loss. PTA differences greater than 10 dB were described as asymmetrical in degree unless one ear was within the normal range (0-26 dB HL) and the other was not. The latter cases were considered unilateral losses. No subject was included in the study when unilateral loss was present because of the unique communication difficulties encountered by this type of case.

At this point, the subjects were divided into three groups based on PTA in the best ear. One group of 14 subjects had extremely good best ear PTAs (0-15 dB HL). A second group of 20 had best ear PTAs in the normal range, but the hearing levels were somewhat poorer (16-26 dB HL) than in the first group. In the third group were 16 subjects with best ear PTAs that showed some degree

of hearing loss (27-40 dB HL).

Equipment

Audiological testing was completed in audiometric test booths (clinic) or quiet areas (community programs). In all cases, noise levels were monitored with a Bruel and Kjaer Model 2203 sound level meter with an associated 1613 filter set and found to be suitable for testing the thresholds involved (500, 2000, and 4000 Hz). Portable and diagnostic audiometers were used for testing purposes. All units were calibrated to current standards (ANSI S3.6-1969).

Procedure

A modified form of the Denver Scale, referred to hereafter as the Quantified Denver Scale (see Appendix), was administered to all subjects. A raw score was calculated for each Quantified Denver Scale and then converted to percent by subtracting 25 points from the raw score. In all cases, these scores reflect hearing handicap while unaided. Each subject was also tested to obtain air conduction pure-tone thresholds at 500, 1000, and 2000 Hz findings.

RESULTS AND DISCUSSION

Table 3 contains a summary of age, PTAs, and Quantified Denver data for the total group and subgroups of the study. As can be seen, the mean age for the subgroups shows an increase as the PTA increases. This is not unexpected in view of the effect which age has upon hearing sensitivity. It could be argued that age should ideally be held constant in a study which examines the relationship between PTA and hearing handicap. However, this is difficult to achieve because of the relationship between age and sensitivity. Additionally, recent investigations (Birk-Nielsen & Ewertsen, 1974; Schow & Tannahill, 1977) have found that hearing handicap measures are not strongly influenced by age for typical clinical clients. Quantified Denver scores were related to PTA, however, as indicated by a Pearson correlation of $r = .58$. This is consistent with HHS-PTA correlations which have generally ranged from .50 to .75 (Berkowitz & Hochberg, 1971; High et al., 1964; Speaks et al., 1970).

The subjects with extremely sensitive hearing (Subgroup 1) had a Quantified Denver Scale mean score of 6.5%. Those with intermediate hearing sensitivity (Subgroup 2) had a Quantified Denver Scale mean score of 21.3%. The hearing loss subgroup had a Quantified Denver Scale mean score of 37.7%. This is the same general trend noted in the Schow and Tannahill (1977) study on HHS. In that study the respective HHS scores for Subgroups 1, 2, and 3 were 7.8%, 25.6%, and 54.3%.

There were small differences in the hearing characteristics for the three subgroups in these two studies. Nevertheless, those differences were not

Table 3

Summary of Means, Standard Deviations (S.D.), and Ranges for Various Groups of the Study with Respect to Age, Pure-Tone Average (PTA), and Quantified Denver Scores

Groups	(N)	Age (Yr.)			PTA (dB)*				Quan. Denver (%)		
					RE		LE				
		Mean	S.D.	Range	Mean	S.D.	Mean	S.D.	Mean	S.D.	Range
Subgroup 1 Extremely sensitive hearing (0-15 dB HL)	14	43.5	20.3	19-74	10.8	4.3	14.1	5.8	6.5	8.4	0-25
Subgroup 2 Intermediate hearing sensitivity (16-26 dB HL)	20	59.9	13.6	32-78	22.3	4.4	23.0	4.5	21.3	24.2	0-77
Subgroup 3 Hearing impaired (27-40 dB HL)	16	61.6	12.2	28-73	41.3	19.9	34.6	5.2	37.7	20.3	5-69
Total Group	50	55.8	16.9	19-78	25.1	16.8	24.2	9.5	22.4	22.8	0-77

* Re ANSI, 1969

judged to be extremely important, and the two hearing loss subgroups had mean PTAs for all ears which were almost identical (39.8 dB HL in the previous study compared to 37.9 dB HL in the present study). Thus, the generally lower scores seen for the Quantified Denver Scale (1% lower in Subgroup 1, 4% lower in Subgroup 2, and almost 17% lower in Subgroup 3) are thought to reflect a difference between HHS and Quantified Denver scales. Whereas HHS scores for persons with hearing loss have generally been found to be about 10 points higher than PTA in dB, the Quantified Denver scores appear to be about equal to PTA. The HHS-Quantified Denver differences are not entirely unexpected since completely different sets of items are involved. Furthermore, the HHS specifically probes hearing handicap while the Denver Scale deals with a related topic, communication function.

Just as Schow and Tannahill (1977) did with the HHS, a preliminary set of categories has been developed which may be useful in interpreting the results from the Quantified Denver. As can be seen in Table 4, three separate categories have been designated. The first category, labeled no communication dysfunction, ranges from 0-15%. The second category represents slight communication dysfunction and ranges from 16-30%. This should be considered to be a borderline area in terms of communication problems. The mild-moderate category includes scores from 31% and up. This last category is closely associated with those cases where substantial dysfunction exists.

The Quantified Denver categories are somewhat different from the HHS. Specifically, the cutoff for the no-handicap category was changed from 20%

Table 4

Preliminary Categories and Associated Percentage Scores for Use in Classifying Quantified Denver Scale Performance

Category	Percentage Scores
No communication dysfunction	0-15
Slight communication dysfunction	16-30
Mild-moderate communication dysfunction	31+

to 15%. The 0-15% range was derived with reference to the mean and standard deviation data on Subgroup 1 ($\bar{x}$ = 6.5; S.D. = 8.4). The cutoff for the borderline category was changed from 40% to 30%. This alteration stems from consideration of the reduced scores observed for the Quantified Denver Scale when compared to the HHS. This 30% cutoff would correspond to a PTA of 30 dB HL the same way an HHS score of 40% corresponds to a PTA of approximately 30 dB HL. Of course, it must be kept in mind that these cutoffs should not be applied in an absolute fashion. That is, these numbers provide us with a guideline, but two clients with scores of 29% and 31% should receive much the same consideration on the basis of these scores despite the location of the cutoff. Obviously, further study is needed to more thoroughly compare the Quantified Denver with the HHS. Nevertheless, we intend to continue using this modification of the Denver Scale and these preliminary categories until more extensive data are available.

SUMMARY AND CONCLUSIONS

Various self-assessment hearing handicap measures have been available since the mid-1960s, but these have enjoyed limited use. Our use of such measures, principally the HHS, over the past five years has been described. Reference was also made to hearing handicap categories used with the HHS and the advantage of such categories in interpretation of clinical findings and counseling of aural rehabilitation clients. A modified version of the Denver Scale was administered to 50 subjects and found to yield somewhat lower scores than the HHS. From these data, preliminary categories of communication dysfunction were proposed for use with the Quantified Denver Scale.

There are several aspects of this research which suggest the need for further exploration. Best ear PTA is a convenient way to describe hearing sensitivity but may ignore important aspects of the hearing loss; such as (a) ear-to-ear degree of loss symmetry and (b) configuration of loss. If hearing loss is too narrowly defined, the general applicability of the findings may be hampered, so the approach here has been to use a broad cross section of clinical patients. Nevertheless, further analysis on the effects of symmetry and configuration

would be of interest. A follow-up study is now planned to administer HHS and the Quantified Denver Scale to a group of clients so that correlations, as well as other direct comparisons between these two, can be explored.

Finally, the present work on these tools should be viewed in the context of the broader issues involved. Researchers and clinicians should continue to focus on the development of a comprehensive protocol for measuring all the key aspects involved in hearing handicap and communication function. Scales like the HHS and the Denver will probably play some part in such a protocol, which ultimately should give us an accurate, valid, and reliable profile of overall hearing handicap. The value of the present scaling tools is not and probably will never be in terms of providing this total measure of handicap. What they do best is to tell us how the client feels about her/his loss, and this is indeed valuable information. Hearing handicap scores provide a personal perspective on a client's difficulties and may not correlate highly with more objective data like PTA and speech discrimination scores. Nevertheless, the information gathered with these measures still has tremendous utility.

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APPENDIX

QUANTIFIED DENVER SCALE*

Name _____ Score:

Age _____ Raw score _____

Date _____

	Strongly disagree				Strongly agree
1. The members of my family are annoyed with my loss of hearing.	1	2	3	4	5
2. The members of my family sometimes leave me out of conversations or discussions.	1	2	3	4	5
3. Sometimes my family makes decisions for me because I have a hard time following discussions.	1	2	3	4	5
4. My family becomes annoyed when I ask them to repeat what was said because I did not hear them.	1	2	3	4	5
5. I am not an "outgoing" person because I have a hearing loss.	1	2	3	4	5
6. I now take less of an interest in many things as compared to when I did not have a hearing problem.	1	2	3	4	5
7. Other people do not realize how frustrated I get when I cannot hear or understand.	1	2	3	4	5
8. People sometimes avoid me because of my hearing loss.	1	2	3	4	5
9. I am not a calm person because of my hearing loss.	1	2	3	4	5
10. I tend to be negative about life in general because of my hearing loss.	1	2	3	4	5
11. I do not socialize as much as I did before I began to lose my hearing.	1	2	3	4	5

	Strongly disagree				Strongly agree
12. Since I have trouble hearing, I do not like to go places with friends.	1	2	3	4	5
13. Since I have trouble hearing, I hesitate to meet new people.	1	2	3	4	5
14. I do not enjoy my job as much as I did before I began to lose my hearing.	1	2	3	4	5
15. Other people do not understand what it is like to have a hearing loss.	1	2	3	4	5
16. Because I have difficulty understanding what is said to me, I sometimes answer questions wrong.	1	2	3	4	5
17. I do not feel relaxed in a communicative situation.	1	2	3	4	5
18. I don't feel comfortable in most communication situations.	1	2	3	4	5
19. Conversations in a noisy room prevent me from attempting to communicate with others.	1	2	3	4	5
20. I am not comfortable having to speak in a group situation.	1	2	3	4	5
21. In general, I do not find listening relaxing.	1	2	3	4	5
22. I feel threatened by many communication situations due to difficulty hearing.	1	2	3	4	5
23. I seldom watch other people's facial expressions when talking to them.	1	2	3	4	5
24. I hesitate to ask people to repeat if I do not understand them the first time they speak.	1	2	3	4	5

	Strongly disagree				Strongly agree
25. Because I have difficulty understanding what is said to me, I sometimes make comments that do not fit into the conversation.	1	2	3	4	5

*Modified from Denver Scale of Communication Function (Alpiner et al., 1974).