A Modified Denver Scale: Test-Retest Reliability

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INTRODUCTION

The goal of aural rehabilitation is to improve the client's communication functioning in all situations. In order to achieve that goal, the professional must develop a comprehensive program for his client including speechreading, auditory training, hearing aid evaluation, hearing aid orientation, and counseling. This program, to be meaningful, must be oriented to the specific problems of the client. Therefore, prior to implementation of such a program, the audiologist must identify specific difficult listening situations and also assess attitudes of the client toward communication and toward him or herself as a hearing impaired person. Once a rehabilitation program has been developed, the audiologist needs to be able to evaluate its success in improving communicative function.

Neither the audiogram nor traditional lipreading tests identify the client's individual communicative difficulties nor do they function as evaluative tools for assessing improvement in actual everyday communication. Although traditional lipreading tests can evaluate the individual's ability to visually perceive sentence material and his improvement in that skill, they do not assess his ability to use auditory or situational clues, nor do they evaluate attitudinal factors. To one degree or another, the traditional case history explores areas of communicative difficulty, but it does not provide quantitative information about degree of difficulty in various situations, nor can it function as an evaluative tool.

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The Denver Scale of Communication Function (Alpiner, 1971) was developed by Alpiner et al in order to subjectively assess the communication function of hearing impaired adults with acquired hearing loss. It is administered by giving to the client prior to initiation of rehabilitation procedures a pencil-and-paper questionaire which allows him to judge him or herself on communication function using a seven point "semantic differential" continuum. The twenty five items comprising the scale are divided into four categories: family, self, social-vocational, and communication, in order to assess difficulties in each area so that therapy procedures can be developed to meet specific needs. For each statement on the scale, the client is instructed to respond with a 1 to 7 rating, with number 1 signifying strong agreement and number 7 signifying strong disagreement. The judgements of the client on both the pre and post-therapy scales are plotted on a graph which has an ordinate ranging from "agree" on the bottom to "disagree" on the top (Figure 1). Should improvement occur, the scores on the post-test will be closer to the top of the profile graph. A complete discussion of the Denver Scale as well as the test items and profile forms can be found in (Alpiner, 1975).

PURPOSES OF THE STUDY

The original Denver Scale was developed for young and middle-aged adults with acquired hearing loss, not for senior citizens (Alpiner, 1975). Since much aural rehabilitation is performed with the geriatric client, a need for such a scale exists for this population. One of the purposes of this study was to modify the Denver Scale in a number of ways to make it more usable for senior citizens living in retirement communities or with their families.

In order to use any scale of communication function as a measure of progress in therapy, one must be assured of the stability of the tool, that is, that high test-retest reliability exists. The second purpose of this study was to evaluate the reliability of the Modified Denver Scale with a senior citizen population using: (1) group data, (2) individual test-retest data, (3) data on each individual item, (4) pre and post-test data on each of the four item categories contained in the scale.

PROCEDURES

The original Denver Scale was modified in the following ways:

(1) In the original procedure the scale was given to the client who provided written responses. However, there are questions as to the appropriateness of a pencil-and-paper questionaire with disabled and with elderly people (Noble, 1972, Noble and Atherley, 1970). In a self-report

format, it is not certain that the client completely understands the questions or the concept of the semantic differential. Additional problems which may exist with the elderly are short attention span and visual problems which may make reading of questions difficult. Since initial attempts to use the self-report format with senior citizens proved unsuccessful, the interview procedure was developed.

(2) Initial attempts to administer the scale revealed that the seven point semantic differential was confusing to the elderly clients. In order to simplify the response task, the seven point scale was reduced to five points, with each point defined for the client. As with the original Denver Scale, lower numbers correspond to the "agree" end of the scale and higher numbers to the "disagree" end. Figure 1 shows a sample item. The midpoint, number 3, corresponds to "not relevant to my problem"

Figure 1

Sample Item of the Modified Denver Scale

The people I live with are annoyed with my loss of hearing.	____ 1. Definitely agree
	____ 2. Slightly agree
	____ 3. Irrelevant
Comments:	____ 4. Slightly disagree
	____ 5. Definitely disagree

(3) The four categories of statements within the original Denver Scale were modified to make them relevant to the senior citizen life style. All items concerned with vocational adjustment were removed since most senior citizens are not employed. The category "family" was changed to "peer or family attitudes" since many senior citizens do not live with families but in retirement communities. The categories "self" and "social" were combined into the single category "socialization" which was designed to probe degree of participation in social activities and feelings about such participation. The "communication" category was maintained. A fourth category entitled "specific difficult listening situations" consisting of eleven new items was added. This new category was added because to completely understand a client's communication problems it was considered important to have some assessment of his or her specific problem situations.

In the development of these items, another audiologist and a social worker experienced in working with hearing impaired senior citizens were asked to evaluate the relevance of each item.

See Appendix A for a complete description of the Modified Denver Scale.

Twelve senior citizens, ages 70 to 92, from a retirement apartment building or the surrounding community were given the Modified Denver Scale on two separate occasions approximately one week apart. All subject were members of an aural rehabilitation group and had hearing losses ranging from mild to severe in degree and sensorineural or mixed in nature. Five of the subjects used hearing aids.

The Denver Scale was administered orally by four clinicians who were well known to the subjects. Each clinician spent as much time as was considered necessary to explain the directions and interpret the statements for each client. In order to control possible interviewer bias from test to retest, the same examiner gave both the pre-test and post-test to a given subject. The hearing aid users were instructed to react to the various statements as they would while wearing their hearing aids.

Each client was given the following instructions by the interviewer:

> I am going to say some statements relating to your hearing loss. For each statement, I want you to tell me if you: (1) definitely agree, (2) slightly agree, (4) slightly disagree, or (5) definitely disagree. If you have no opinion or consider the statement to be irrelevant or not associated to your problem, please tell me.

ANALYSIS OF DATA

Test-retest reliability was evaluated by computing Pearson Product-Moment Correlation coefficients, and corresponding coefficients of determination for each correlation. The coefficient of determination (r^2) describes the percentage of variance in the post-test associated with variance in the pre-test (Guilford, 1965) and may be interpreted as the percentage of tests or test items in agreement. Correlation coefficients of 0.700 or higher were considered clinically acceptable measures of test-retest reliability (Guilford, 1965).

Individual pre-test and post-test scores were pooled, and an overall group correlation coefficient was obtained. Similarly, correlation coefficients were calculated for each of the four categories of the scale. In addition, item test-retest reliability was evaluated by correlating each item on the pre-test with its counterpart on the post-test. Perhaps most important, individual test-retest profiles were plotted for each subject.

RESULTS AND DISCUSSION

Group Reliability

When all items of the pre-test were correlated with all items of the post-test with individual scores pooled, a correlation of 0.878 was obtained,

with an r² of 77% indicating that 77% of the test-retest scores were in agreement. These scores represent high group reliability. Test-retest correlations for each of the item categories also revealed high reliability according to the 0.700 cut-off used by Guilford (see Table 1). Although the r of 0.695 obtained for the "communication" category does not exceed the 0.700 criterion, it may be considered clinically acceptable because of its closeness to the cut-off and because all of the reliability coefficients are somewhat artificially depressed due to the limited variability of the data.

In 1975, McNeill (unpublished research) performed a test-retest reliability study of the original Denver Scale. He obtained an r of 0.729 for overall test-retest comparison. Correlation coefficients for individual item categories (family, self, social-vocational, communication) all exceeded 0.700. Group reliability of the Modified Denver Scale compares favorably to comparable data of McNeill using the original Denver Scale.

Table 1

Reliability of Overall Scale and Item Categories

Category	r	r²
Peers	0.745	55%
Socialization	0.918	84%
Communication	0.695	48%
Difficult Listening Situations	0.881	77%
Overall Scale	0.878	77%

Item Reliability

Each of the thirty four items on the pre-test was correlated with the comparable item on the post-test. Of the thirty four items in the scale, only twelve were found to have acceptable reliability. As can be seen in Table 2, for 64.7% of the test items, correlation coefficients were below 0.700. Even when the limited variability of the data is considered, these items cannot be considered acceptable in terms of stability. McNeill, using comparable analysis techniques, found over one third of the items of the original Denver Scale (nine out of twenty five) to be below 0.700.

One might speculate about reasons for the difference in item reliability between McNeill's study and this report. It is unlikely that the poorer reliability found in this study is attributable to the item content since the items are essentially the same on the two scales. It is possible that the use

of an interview procedure rather than a pencil-and-paper format negatively influenced item stability. However, it was not possible to use a self-report format with our geriatric subjects. Even if a pencil-and-paper test is inherently more reliable and this has not been established, such a procedure cannot be considered for practical reasons.

Table 2

Item Reliability

Item	r	r^2	Item	r	r^2
1.	0.100	1%	18.	0.523	27%
* 2.	0.738	54%	19.	0.133	2%
* 3.	0.834	70%	20.	0.200	4%
4.	0.573	33%	*21.	0.732	54%
5.	0.703	49%	22.	0.045	0.2%
* 6.	0.671	45%	23.	-0.153	2%
7.	0.619	38%	*24.	0.706	50%
8.	0.331	11%	25.	0.537	29%
9.	0.630	40%	26.	0.587	34%
**10.	0.000	—	27.	0.078	0.6%
11.	0.542	29%	*28.	0.852	73%
12.	0.452	20%	29.	0.220	4%
13.	-0.133	2%	*30.	0.714	51%
*14.	0.700	49%	*31.	0.947	90%
15.	0.359	13%	32.	0.604	36%
*16.	0.824	68%	33.	0.589	35%
*17.	0.726	53%	34.	0.374	14%

*Correlations above the cut-off level of 0.700.

**Test-retest agreement was extremely high but correlation coefficient was depressed because of limited variability.

The most probable explanation for the poorer item reliability found in this study compared to that of McNeill is the age difference of the subjects. In the present study each of the four clinicians administering the scale reported that all the elderly subjects found it difficult to understand the concept of the semantic differential, even with the reduction of the seven point scale to five points and the definition of each point. Some of the clients experienced problems remembering what the scale points meant and most had difficulty deciding between the five scale points for each item. Figure 2 reveals that the vast majority of responses fell at the extremes of the scale. Out of a possible 408 responses for the group, 276

(67.65%) were either 5 or 1 on the pre-test and 288 (70.58%) responses fell at the extremes on the post-test. The subjects were clearly responding in a dichotomous fashion. Figures 3 and 4 show dichotomous responses of a subject demonstrating high reliability and another demonstrating low reliability.

Individual Test-Retest Reliability

Since the Denver Scale has been developed as an evaluate tool to compare pre-therapy and post-therapy performance, it is of the utmost importance to establish individual test-retest reliability. Table 3 shows that of the twelve subjects only two showed correlations higher than 0.700. Two additional subjects showed moderate correlations of 0.660 and 0.623 which might be considered clinically acceptable since all coefficients are artificially depressed because of limited data variability. However, eight subjects demonstrated unacceptably low reliability coefficients.

McNeill performed individual test-retest correlations with eight subjects and found that only three (37%) showed acceptable stability from test to retest. When items showing low test-retest correlations were removed, 63% of the subjects showed correlations above 0.700. Apparently, individuals are not reliable, either with the original Denver Scale or the modified version.

Another way of looking at test-retest stability is shown in Table 4. The number and percentage of items showing complete test-retest agreement and the number and percentage of items varying no more than +-1 scale points are shown for each subject. Only four subjects demonstrated complete agreement and seven subjects showed variation of no more than 1 scale point on 75% or more of the items.

CONCLUSIONS

1) When the Modified Denver Scale was evaluated using group data, it was found to be a reliable tool for a senior citizen population. Test-retest correlations were found to be equally reliable for the four item categories comprising the test. However, individual test-retest stability was found to be extremely variable. Consequently, one must be cautious in using the scale as a pre and post-therapy evaluation tool. McNeill came to the same conclusion in his evaluation of the original Denver Scale and recommended that individual test-retest reliability be established prior to the administration of therapy.

2) The data suggest that one must be cautious in using the semantic differential concept with senior citizens. Perhaps the difficulty of the response task can be decreased by writing the scale point numbers and their definitions in large print and keeping them in full view of the client

to ease memory problems. Perhaps more time spent in instruction of the client in the use of the semantic differential is indicated, despite the fact that the time necessary for administration of the scale would be increased.

3) Almost two thirds of the items of the Modified Denver Scale were found to be of questionable reliability. This result is probably related to the difficulty experienced by the subjects in handling the semantic differential.

The Modified Denver Scale does not seem to be a highly reliable tool for evaluating progress in therapy of senior citizens, and should be used with caution. Since some of the problems seen with this scale may also be present with other scales of communication function, it would be desirable to carefully evaluate the individual test-retest reliability of any communication scale used with hearing impaired individuals.

Figure 2
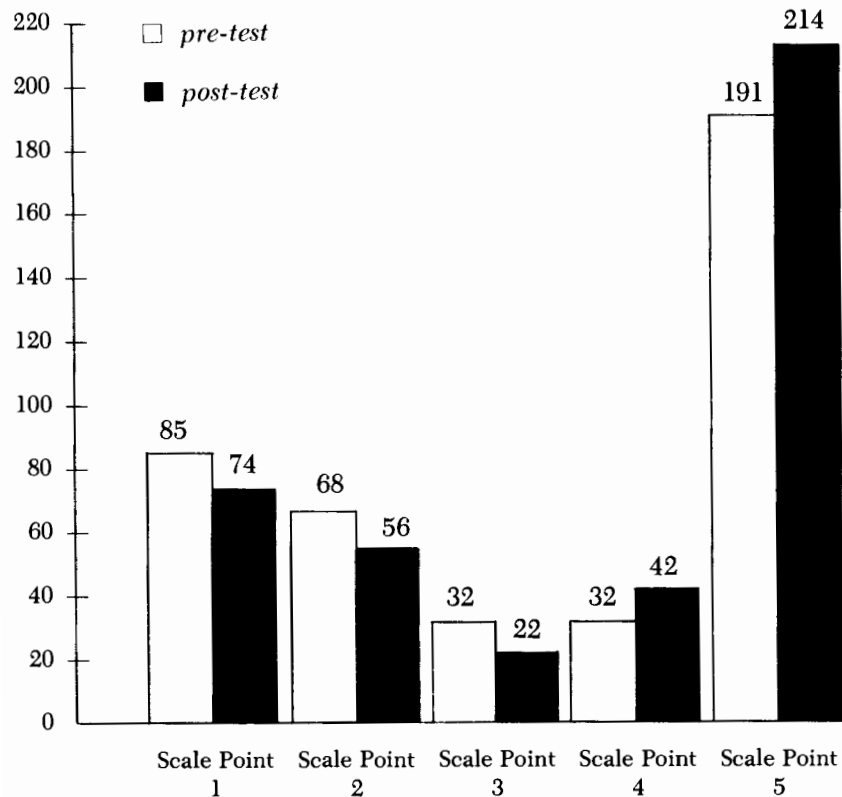### Group Responses at Each Scale Point

Figure 3
Item Distribution of a High Reliability Subject
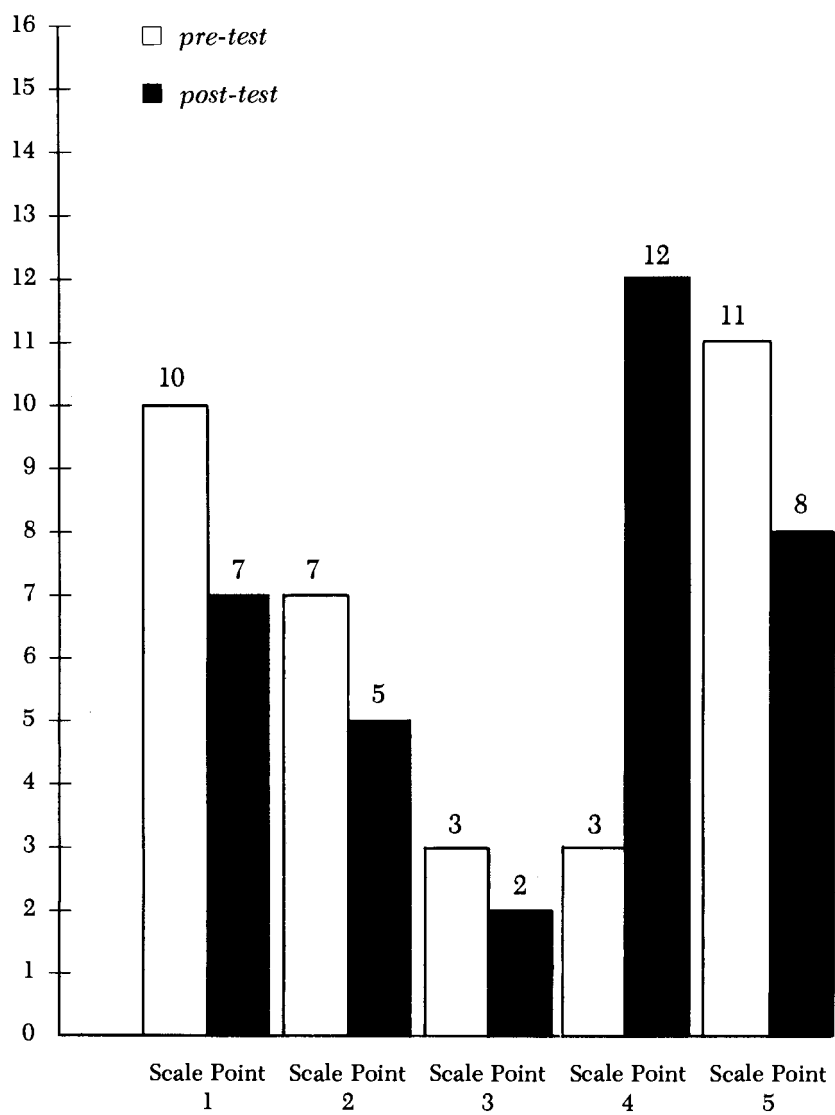
Figure 4
Item Distribution of a Low Reliability Subject
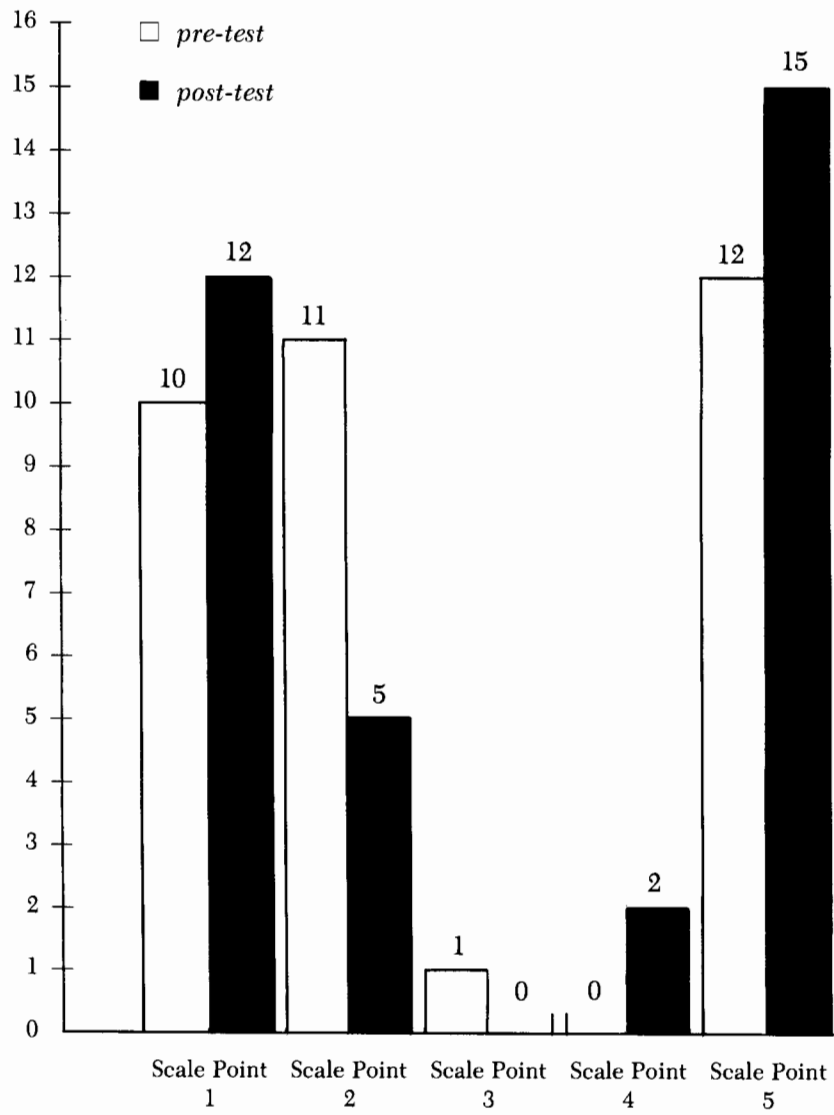
Table 3

Individual Test-Retest Correlations

Subject	r	r^2
*1	0.745	56%
*2	0.708	50%
3	0.660	43%
4	0.623	38%
5	0.560	31%
6	0.515	27%
7	0.433	18%
8	0.365	14%
9	0.302	9%
10	0.282	8%
11	0.262	6%
12	−0.120	1%

*Acceptable test-retest reliability

Table 4

Test-Retest Differences of 0 and 1 Scale Points (34 Items)

Subject	r	0 Scale Points		1 Scale Point or Less	
		No. Items	% Items	No. Item	% Items
1	0.745	26	*76.47	29	*85.29
2	0.708	19	55.88	25	73.53
3	0.660	15	44.12	28	*82.35
4	0.623	27	*79.41	32	*94.12
5	0.560	26	*76.47	30	*88.24
6	0.515	22	64.70	26	*76.47
7	0.433	23	67.65	23	67.65
8	0.365	18	52.94	21	61.76
9	0.302	21	61.76	26	*76.47
10	0.282	13	38.24	21	61.76
11	0.262	13	38.24	20	58.82
12	−0.120	24	70.58	26	*76.47

*Above 75% of the total 34 items

APPENDIX A

The Denver Scale
of Communication Function—Modified

Pre-therapy_____   Post-therapy_____

Date_____

Name_____ Age_____ Sex_____

Address _____

AUDIOGRAM   (Examination Date_____)

Pure Tone:

	250	500	1000	2000	4000	8000	Hz
RE	—	—	—	—	—	—	dB (re:
LE	—	—	—	—	—	—	ANSI)

Speech

SRT   *Discrimination Score (%)*

                          Quiet   Noise (S/N =   )

RE_____dB   RE_____   _____

LE_____dB   LE_____   _____

HEARING AID INFORMATION

Aided _____ For How Long _____ Aid Type_____

Ear_____ Satisfaction _____

Examiner:_____

INSTRUCTIONS

I am going to say some statements relating to hearing loss. For each statement, I want you to tell me if you: (1) definitely agree, (2) slightly agree, (4) slightly disagree, or (5) definitely disagree. If you consider the statement to be irrelevant or unassociated to your communication problem, please tell me.

SCORING

(1) Definitely agree;   (2) Slightly agree;   (3) Irrevelevant;
       (4) Slightly disagree;   (5) Definitely disagree

ATTITUDE TOWARD PEERS

1. The people I live with are annoyed with my loss of hearing.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

2. The people I live with sometimes leave me out of conversations or discussions.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

3. Sometimes people I live with make decisions for me because I have a hard time following discussions.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

4. People I live with become annoyed when I ask them to repeat what was said because I did not hear them.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

5. Other people do not realize how frustrated I get when I cannot hear or understand.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

6. People sometimes avoid me because of my hearing loss.
   Comments:

   ____ 1. Definitely agree
   ____ 2. Slightly agree
   ____ 3. Irrelevant
   ____ 4. Slightly disagree
   ____ 5. Definitely disagree

SOCIALIZATION

7. I am not an "outgoing" person
because I have a hearing loss.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

8. I now take less of an interest in
many things as compared to when I
did not have a hearing problem.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

9. I am not a calm person because of
my hearing loss.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

10. I tend to be negative about life
in general because of my hearing loss.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

11. I do not socialize as much as I
did before I began to lose my hearing.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

12. Since I have trouble hearing, I
do not like to participate in activities.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

13. Since I have trouble hearing, I
hesitate to meet new people.
Comments:

 ____ 1. Definitely agree
 ____ 2. Slightly agree
 ____ 3. Irrelevant
 ____ 4. Slightly disagree
 ____ 5. Definitely disagree

14. Other people do not understand what it is like to have a hearing loss.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

15. I do not feel relaxed or comfortable in a communicative situation.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

COMMUNICATION

16. Because I have difficulty understanding what is said to me, I sometimes answer questions wrong.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

17. Conversations in a noisy room prevent me from attempting to communicate with others.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

18. I am not comfortable having to communicate in a group situation.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

19. I seldom watch other people's facial expressions when talking to them.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

20. Most people do not know how to talk to a hearing impaired person.
Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

21. I hesitate to ask people to repeat
    if I do not understand them the first
    time they speak.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

22. Because I have difficulty under-
    standing what is said to me, I some-
    times make comments that do not fit
    the conversation.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

23. I do not like to admit that I
    have a hearing problem.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

SPECIFIC DIFFICULTY LISTENING SITUATIONS

24. I have trouble hearing the radio
    or the television unless I turn the
    volume on very loud.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

25. If someone calls me when my back
    is turned, I do not always hear him.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

26. If someone calls me from another
    room I have much trouble hearing.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

27. When I sit talking with friends
    in a quiet room, I have a great deal
    of difficulty hearing.
    Comments:

    ____ 1. Definitely agree
    ____ 2. Slightly agree
    ____ 3. Irrelevant
    ____ 4. Slightly disagree
    ____ 5. Definitely disagree

28. When I use the phone, I have much difficulty hearing.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

29. When I play cards, understanding my partner gives me much difficulty.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

30. At lectures or discussions I have much difficulty hearing the speaker.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

31. In church, when the minister gives the sermon, I have much difficulty.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

32. When a movie is shown, I have much difficulty hearing what is said.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

33. I have difficulty understanding. announcements sent through the loudspeaker even when the speaker is in the same room as me.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

34. I have trouble understanding messages sent over the intercom.
    Comments:

     ____ 1. Definitely agree
     ____ 2. Slightly agree
     ____ 3. Irrelevant
     ____ 4. Slightly disagree
     ____ 5. Definitely disagree

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