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DATA EVALUATION AND METHODS RESEARCH

Methodological Aspects of a Hearing Ability Interview Survey

Development and use of a set of scale questions to measure functional hearing ability in an interview survey.

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PREFACE

The Health Interview Survey, National Center for Health Statistics, collects information by means of household interviews on illness, accidental injuries, hospitalization experience and various measures of disability, and on social and economic impact due to episodes of morbidity.

If viewed from the standpoint of clinicians or epidemiologists, the precision of diagnostic information that can be obtained from lay household respondents may leave much to be desired. However, these same respondents are the best source of information, at the present time, on the amount of disability and other forms of impact due to illness and injury. Information on the degree of severity of certain physical impairments (e.g., visual and hearing loss) present in the population are of extreme importance to persons engaged in rehabilitation and other programs of assistance to the physically handicapped. If lay respondents can describe the severity of these impairments in meaningful, functional terms and, particularly, if these functional terms can be correlated to standard clinical measures or tests, data from interview surveys can be of great value in describing the extent of the problems of the population of the United States with impaired hearing or vision.

This report describes the experience of the Health Interview Survey in the development and use of a series of items designed to serve as a functional scale of hearing loss. Gallaudet College, a federally sponsored institution and the only institution in the world that provides higher education exclusively for persons with severely impaired hearing, was asked by the Division of Health Interview Statistics of the National Center for Health Statistics to participate in this project. Under a contract with the division of Health Interview Statistics, Mr. Stanley K. Bigman, who was at that time Director of the Office of Sociological Research at Gallaudet College, developed a set of items to be used as a hearing ability scale and conducted some pretests of the scale. Dr. Jerome D. Schein succeeded Mr. Bigman at Gallaudet and conducted additional methodological studies of the scale items. Dr. Schein also provided technical assistance during all phases of the nationwide hearing ability survey in which the scale items were used, and he is a coauthor of this report. Mr. Kenneth Haase, Statistician, Survey Methods Branch, and Mr. Augustine Gentile, Chief, Survey Methods Branch, represented the Division of Health Interview Statistics and collaborated in the analysis and preparation of this report.

CONTENTS

THIS IS A REPORT on the development and use of a series of items designed to serve as a scale to measure the degree of hearing loss, in functional terms, in an interview survey of the general population.

Results of the use of the scale in several samples of persons are given. Evidence of the logic of the scale, factors affecting an individual's ability to respond to the scale logically, and the relationship of responses to the scale to other measures of hearing loss, including audiometric examinations, are discussed.

Methods used in the survey and factors affecting the general levels and quality of responses obtained in the Survey are discussed in Appendix I.

It is concluded that for general statistical purposes the hearing scale is a satisfactory instrument for measuring the degree of hearing loss of the population by means of an interview survey. Recommendations for improvements to the scale and for obtaining a higher level and better quality of response for future studies are also given in the report.

SYMBOLS

Data not available	---
Category not applicable	...
Quantity zero	-
Quantity more than 0 but less than 0.05	0.0
Figure does not meet standards of reliability or precision	*

METHODOLOGICAL ASPECTS OF A HEARING ABILITY INTERVIEW SURVEY

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INTRODUCTION

Although a sizable proportion of the population suffers impairment of hearing, there has been little current, descriptive data available about this health problem. The National Center for Health Statistics has responded to requests for more information about this problem by conducting a special hearing ability survey. This report describes some of the methodological aspects of this special nationwide survey which took place July 1962-June 1963, and it serves as a background to the substantive results of the study.

National estimates of hearing loss for earlier years have been obtained from three principal sources. From 1830 to 1930 the U.S. Bureau of the Census enumerated the number of persons with severe hearing losses of early onset (referred to as "deaf mutes"[1]). At the conclusion of the 1930 census, the Bureau announced that it would no longer attempt to collect data on persons with hearing impairments. As shown by the following quotation, this decision reflected discontent with the results of the 11 enumerations already done.

> "No high degree of accuracy is to be expected in a census of the blind and of deaf-mutes carried out by the methods which it has been necessary to use thus far in the United States. The reasons for this are that even with careful definitions of the groups to be included a large element of personal judgment enters into the decision of an enumerator as to whether a given individual should be reported as blind or as a deaf-mute; and inconsistencies follow from the varying degrees of intelligence and persistence of enumerators. Added to this, there is a tendency on the part of relatives to conceal the presence of blind persons or deaf-mutes in their families, especially in the case of children. Because of these conditions, and of changes made from time to time in definitions, as well as in the administrative methods used in taking the census, the enumeration of the blind and of deaf-mutes has doubtless always been more or less inaccurate and incomplete."[2]

The next attempt to collect national data on hearing impairments was made by the National Institute of Health in the National Health Survey

[1] Although the Bureau used the term "deaf mutes," it is likely that many of these people did have usable speech since in some years the Bureau used the term to describe persons for whom the age of onset of deafness was as late as 16 years. Persons who lose their hearing after speech has been developed can retain their ability to speak and usually do, and even those who are not able to hear at birth can usually develop some speech when properly taught.

[2] U.S. Bureau of the Census: *The Blind and Deaf-Mutes in the United States, 1930.* Washington. U.S. Government Printing Office, 1931. p. 2.

of 1935-1936.[3] This Survey avoided the narrow confines of definition used by the Bureau of the Census in the earlier decennial enumerations; and instead of concentrating exclusively on deafness of early onset, it concerned itself with the full range of hearing impairment. In addition to broadening the scope of its investigation, the Survey combined the sample survey with a clinical investigation. Samples of persons with and without hearing impairment were given audiometric tests, the results of which were compared with the survey findings. This *ad hoc* effort provided the only nationwide data on hearing impairment until the current National Health Survey was established in 1956.

In 1959 the Health Interview Survey issued a publication containing estimates for the Nation on various types of physical impairments;[4] these estimates were based on data collected in household interviews during the period July 1957-June 1958. Included in this publication were estimates that there were in the United States 109,000 totally deaf persons and 5.7 million persons with lesser degrees of hearing loss. Similar estimates of the prevalence of hearing loss have been made for succeeding years. These estimates were based on affirmative responses to the question, "Does anyone in the family have deafness or serious trouble with hearing?" No effort was made to assess the degree of hearing impairment. However, when a respondent volunteered information about the degree of hearing loss, the information was recorded and taken into consideration during the coding process. This dependence upon volunteered information to describe the hearing ability of these persons probably resulted in an underestimate of the totally deaf and provided very little information about the degree of loss for other hearing impaired persons. The principal objective of this Survey therefore was to develop a method of classifying persons with hearing problems according to the extent of hearing loss in terms that would serve a useful purpose.

Because members of the Health Interview Survey staff had a limited knowledge of the subject matter in this field, Gallaudet College[5] was asked to develop a plan for conducting a survey of persons with impaired hearing. After consultation with Gallaudet and several other interested groups and after consideration of various alternatives, it was determined that the only practical method of measuring hearing loss in an interview survey was to devise a series of items that would serve as a scale and make it possible to describe the amount of hearing loss in functional terms. Such a scale was developed and compared with audiometric examinations in three test groups. The results of these tests of the hearing ability scale and the efficacy of the scale as determined by the Hearing Ability Survey are presented in this report. A description of the methods and procedures used in the Survey and information about the quality and level of response obtained are given in Appendix I.

THE HEARING SCALE

Description of the Hearing Scale

It has been indicated that previous estimates published by the Health Interview Survey of the number of persons with impaired hearing assigned such persons to one of two categories—deaf or lesser degree of impairment. It was recognized that both the means of assessing hearing loss and the two-category limit on the degree of impairment were inadequate. To determine the degree of hearing impariment in better-defined, functional terms, the items in figure 1 were developed for this survey.

Preliminary research indicated that statements a, b, c, e, and g approximate a unidimensional scale; i.e., once a person responds negatively to any one of these items his response to succeeding items will also be negative.

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[3]National Institute of Health: *Significance, Scope and Method of a Clinical Investigation of Hearing in the General Population.* The National Health Survey, 1935-1936, preliminary report. Hearing Study Series Bulletin No. 1. Public Health Service. Washington, D.C., 1938.

[4]U.S. National Health Survey: Impairments by type, sex, and age. *Health Statistics.* PHS Pub. No. 584-B9. Public Health Service. Washington, D.C., April 1959.

[5]Gallaudet College, located in Washington, D.C., is a federally sponsored institution and is the only college in the world dedicated exclusively to the education of persons with severely impaired hearing.

SECTION A		
1. **WITHOUT** using a hearing aid, what can you hear? *(Please check the "Yes" or "No" box after each statement.)*	Yes	No
a. I can hear loud noises.		
b. Most of the time I can tell one kind of noise from another.		
c. If I hear a sound, most of the time I can tell if it is a person's voice or not.		
d. I can hear and understand a few words a person says if I can see his face and lips.		
e. I can hear and understand a few words a person says without seeing his face and lips.		
f. I can hear and understand most of the things a person says if I can see his face and lips.		
g. I can hear and understand most of the things a person says without seeing his face and lips.		
h. Most of the time I can hear and understand a discussion between several people without seeing their faces and lips.		
i. I can hear and understand a telephone conversation on an ordinary telephone (that is a telephone without an amplifier).		

Figure 1. The hearing scale as it appeared in the Hearing Ability Survey Questionnaire.

In other words, the items are in order by anticipated difficulty in hearing—ranging from merely hearing loud noises to hearing and understanding most speech.

Evaluation of the Scale

Several things have to be considered in evaluating the merits of the hearing scale. First, do the items represent a unidimensional hierarchy of hearing ability? Second, what factors other than the degree of hearing loss have an effect on responses to the scale statements; and, finally, what is the relationship between positions on the scale and other measures of hearing ability?

Evidence of Unidimensionality

With regard to the first question, a series of studies was conducted to determine whether the hearing scale (fig. 1) had the properties associated with a psychological scale. Logically, the ordering of the statements makes good sense (face validity) in that a person who answered "No" to statement a—" I can hear loud noises"—would be expected to answer "No" to all other statements about his hearing. Similarly, a "No" response to any of the statements b, c, e, or g would be expected to preclude a positive answer to the statements following it.

In the paragraphs that follow, respondents or questionnaires providing answers to the scale items which followed this logical pattern are referred to as "persons who scaled" and "scaled responses," respectively. Conversely, the terms "persons who failed to scale" or "nonscaled responses" are used to describe persons or questionnaires that did not follow this logical pattern.

Empirical tests confirm the logic of the scale. Table A summarizes the results of the use of the scale in five samples of persons with impaired hearing. Sample I consists of 214 Gallaudet College students to whom the scale question was mailed; sample II consists of 171 Gallaudet College students who were given the scale question in a group session; sample III consists of 534 Gallaudet College students who were asked the scale question in individual interviews; sample IV consists of 1,132 deaf adults from the Metropolitan Washington, D.C., area who were administered the scale question in individual interviews; and sample V consists of 4,431 persons who were given the scale question as part of the questionnaire used in the Health Interview Hearing Ability Survey. Respondents in sample V who did not complete statements a, b, c, e, and g of the scale are not included in this analysis because their responses could not contribute pertinent data on scalability.

Table A. Results of the use of the hearing scale in five samples of persons with impaired hearing

Type of administration	Number of persons in sample	Percent of persons giving scaled responses
Sample I, Gallaudet students, mail interview	214	91.6
Sample II, Gallaudet students, group interview	171	91.8
Sample III, Gallaudet students, individual interview	534	90.3
Sample IV, Deaf adults from D.C. area, individual interview	1,132	92.6
Sample V, Health Interview Hearing Ability Survey respondents	[1]4,431	88.9

[1]Includes only respondents who completed statements a, b, c, e, and g of the scale.

The measure of scaling given in table A is the percent scaled; i.e., the number of persons who gave scaled responses divided by the total number of persons who completed the scale. Regardless of the mode of administration and sample characteristics, the percentage of persons giving scaled responses (about 90 percent) is essentially the same for the five groups, ranging from 88.9 percent to 92.6 percent.

An inspection of the 10 percent of non-scaled responses showed no consistent pattern which would suggest that these persons might have some special type of hearing problem. Consideration was then given to other factors that might affect the person's ability to answer the scale items in the expected patterns.

Factors Affecting Scaling

Use of hearing aid.—Three of the five samples of persons mentioned above—samples III, IV, and V—were used to obtain information on the use of hearing aids. Responses were obtained from each individual in the samples, and the proportion of scaled responses by use of hearing aid is shown in table B. Those persons who were at the time of the Survey users of hearing aids tended to give scaled responses less frequently than those who had never used a hearing aid and, generally, less frequently than those who had used a hearing aid but who were not using one at the time of the survey. This finding would suggest that either (a) users of hearing aids were less able to determine

Table B. Percent of respondents giving scaled responses to the hearing scale, by use of hearing aid

Respondents	Number of persons in sample	All persons in sample	Use of hearing aid		
			Uses now	Used in past	Never used
Gallaudet College students (Sample III)	534	90.3	87.0	87.3	95.5
Deaf adults in D.C. area (Sample IV)	1,132	92.6	85.1	93.6	94.6
Health Interview Survey respondents (Sample V)	[1]4,045	88.8	80.6	85.3	90.7

[1]Excludes 386 persons for whom information about use of hearing aids is unknown.

Table C. Number and percent distribution of persons with impaired hearing in Sample V who scaled and who failed to scale, according to age

Age	Total	Scaled	Failed to scale	Total	Scaled	Failed to scale
	Number of persons[1]			Percent distribution[1]		
All ages	4,431	3,939	492	100.0	88.9	11.1
Under 17 years	317	282	35	100.0	89.0	11.0
17-24 years	128	115	13	100.0	89.8	10.2
25-34 years	293	273	20	100.0	93.2	6.8
35-44 years	511	459	52	100.0	89.8	10.2
45-54 years	594	540	54	100.0	90.9	9.1
55-64 years	763	683	80	100.0	89.5	10.5
65-74 years	927	826	101	100.0	89.1	10.9
75+ years	898	761	137	100.0	84.7	15.3

[1]Based on total that responded to all of the items in the hearing scale.

the true condition of their hearing ability, (b) instructions for answering the hearing scale question did not make sufficiently clear that the statements were to be responded to as one hears without the use of a hearing aid, or (c) the use of a hearing aid significantly altered the pattern of hearing for some, though not all, users of hearing aids. It is also possible that this significant result (chi-square for each of the samples exceeds that which corresponds to a probability of 0.001) arises from a combination of all three of these factors.

Age.—The age of the person with impaired hearing is another factor that might affect scaling. Age, number, and percent of persons who scaled and of those who failed to scale are given in table C. Only two of the age groups show any marked difference in the proportion that failed to scale. Persons aged 25-34 years scaled significantly more often and persons aged 75 years and

Table D. Number and percent distribution of persons in Sample V who returned questionnaires but who failed to answer one or more of the scale questions, according to age

Age	All persons who returned questionnaires		Persons who failed to answer one or more scale questions	
	Number	Percent distribution	Number	Percent distribution
All ages	5,404	100.0	973	100.0
Under 17 years	370	6.8	53	5.4
17-24 years	151	2.8	23	2.4
25-34 years	313	5.8	20	2.1
35-44 years	566	10.5	55	5.7
45-54 years	683	12.6	89	9.1
55-64 years	940	17.4	177	18.2
65-74 years	1,220	22.6	293	30.1
75+ years	1,161	21.5	263	27.0

over scaled less often than those in other age groups.

An indication that older persons might have had some difficulty in understanding the scale or estimating their hearing ability in terms of the scale items is obtained from data in table D. Of the 5,404 persons who returned questionnaires, 2,381 (or 44.1 percent) were 65 years and over; and of the 973 who failed to answer one or more of the scale items, 556 (or 57.1 percent) were in this age group.

Unassisted and assisted respondents.—One of the items on the Hearing Ability Questionnaire is for the signature of the person who actually completed the questionnaire. In the case of children, a parent or guardian was expected to complete and sign the form. Upon examination, however, it was found that of the total persons 17 years of age and over who returned a form with a signature, 28 percent were signed by someone other than the person with impaired hearing (table E). In tables E and F persons with impaired hearing who returned questionnaires with their own name signed are called "unassisted respondents." Those who returned questionnaires with another name signed are called "assisted respondents," even though the person who assisted probably consulted the intended respondent to obtain the required answers. The term "assisted respondent" is used when any form of assistance in completing the questionnaire could be detected on the returned questionnaire. It is not known how many questionnaires signed with the name of the person with impaired hearing were in fact completed by another person. Howèver, the number of questionnaires with the names of persons other than those of the persons to whom they were addressed is known, and the magnitude is somewhat surprising. The data in table E again reflects the difficulty persons in the older age groups may have had in answering the questionnaire.

Table E. Number and percent distribution of unassisted and assisted respondents in Sample V 17+ years who returned signed questionnaires, according to age

Age	Total[1]	Unassisted respondent	Assisted respondent
	Number of respondents		
All ages-17+ years	4,676	3,352	1,324
17-24 years	144	106	38
25-34 years	301	242	59
35-44 years	537	437	100
45-54 years	645	514	131
55-64 years	880	669	211
65-74 years	1,111	816	295
75+ years	1,058	568	490
	Percent distribution		
All ages 17+ years	100.0	71.7	28.3
17-24 years	100.0	73.6	26.4
25-34 years	100.0	80.4	19.6
35-44 years	100.0	81.4	18.6
45-54 years	100.0	79.7	20.3
55-64 years	100.0	76.0	24.0
65-74 years	100.0	73.4	26.6
75+ years	100.0	53.7	46.3

[1]Excludes 358 persons who returned questionnaires without signatures.

Because of the large number of "assisted" persons, scale responses of the "assisted" and "unassisted" groups were examined. The data in table F show that generally "assisted" persons failed to scale more frequently than the "unassisted" persons and that for persons in the older age groups the failure to scale was markedly higher for "assisted" persons. The causal relationships involved here are unknown, but one might speculate that any or all of the following factors are involved:

1. The person completing the form was using his own judgment as to the afflicted person's ability to hear.
2. The fact that the afflicted person required assistance might indicate that
   a. He lacked an interest in the study and therefore was not sufficiently motivated to provide precise answers to the "assistant."
   b. He was unable to understand the questions even with assistance.
   c. He was too old or too ill to provide an accurate assessment of his hearing ability.

Scale Responses and Other Measures of Hearing Ability

Internal consistency of the hearing scale.— After answering the hearing scale question, respondents in the Survey were requested to rate their hearing ability separately for each ear. The question asked is reproduced in figure 2.

Further understanding of the hearing scale can be gained by comparing responses to the scale with self-estimates of hearing ability for each ear. This comparison yields a measure of the consistency, rather than validity, between two ways of inquiring about hearing ability. Table G compares the hearing scale responses with groupings of the estimates for the individual ears.

The contingency coefficient calculated for table G yields a value of 0.62, with the maximum possible contingency coefficient being 0.89 and the probability that the relationship does arise from chance alone being less than 0.001. Even though the contingency coefficient has limitations as a measure of correlation, the obtained relationship suggests substantial consistency between the two self-estimates of hearing ability.

Table F. Percent distribution of unassisted and assisted respondents in Sample V who scaled and who failed to scale, according to age

Age	Unassisted respondent			Assisted respondent		
	Total[1]	Scaled	Failed to scale	Total[1]	Scaled	Failed to scale
	Percent distribution					
All ages-17+ years	100.0	90.7	9.3	100.0	84.2	15.8
17-24 years	100.0	87.8	12.2	100.0	94.1	5.9
25-34 years	100.0	93.4	6.6	100.0	93.1	6.9
35-44 years	100.0	90.2	9.8	100.0	88.3	11.7
45-54 years	100.0	91.2	8.8	100.0	89.6	10.4
55-64 years	100.0	90.8	9.2	100.0	85.9	14.1
65-74 years	100.0	91.5	8.5	100.0	83.2	16.8
75+ years	100.0	88.6	11.4	100.0	79.6	20.4

[1]Excludes 358 persons who returned questionnaires without signatures.

2. Please describe how well you can hear, without using a hearing aid, by checking one of the statements below for each ear. For example, a person who is deaf in his left ear and has good hearing in his right ear would check the following: In left ear - box (d); in right ear - box (e).

In left ear

(a) ☐ My hearing is good

(b) ☐ I have a little trouble hearing

(c) ☐ I have a lot of trouble hearing

(d) ☐ I am deaf

In right ear

(e) ☐ My hearing is good

(f) ☐ I have a little trouble hearing

(g) ☐ I have a lot of trouble hearing

(h) ☐ I am deaf

Figure 2. Question 2 of the Hearing Ability Survey Questionnaire.

The estimates of hearing ability for each ear have a further use in conjunction with the hearing scale. Individuals having an impairment in only one ear should respond to the scale as they hear with *both* ears, which would mean obtaining a scale score of 5 since their hearing in general would permit good reception and understanding of speech. In fact, only 134 (9.2 percent) of the 1,462 persons who indicated a unilateral hearing loss (one ear good, other ear worse) obtained scale scores of less than 5 (table G). This finding lends some support to the contention that most respondents answered the scale in terms of the overall functioning of their hearing. For those who apparently did not respond in this way, the relation of their scale scores to their hearing estimates derived from question 2 suggests that they tended to refer the scale items to their impaired ear. Thus, by the conjoint application of questions 1 and 2, errors in estimating functional hearing impairment can be substantially reduced—i.e., those with scale scores of less than 5 who indicated on question 2 that they could hear well with one ear can be assumed to have near-normal hearing for most situations.

Table G. Comparison of hearing scale positions for those persons who scaled with combined self-estimates for each ear for the Health Interview Hearing Ability Survey Sample

Combined estimates of hearing loss for each ear	Total[1]	Hearing scale position[2]				
		0	1	2-3	4	5
		Number of persons				
Total[1]	3,728	100	99	278	441	2,810
Deaf in both ears	92	55	19	10	1	7
One ear severe loss, other ear same or worse	508	35	60	140	139	134
One ear some loss, other ear same or worse	1,329	7	14	89	209	1,010
One ear good hearing, other ear worse	1,462	3	6	34	91	1,328
Hearing good in both ears	337	-	-	5	1	331

[1] Excludes the 211 persons who failed to provide estimates of hearing loss.

[2] 0 = Unable to hear loud noises.
1 = Able to hear loud noises, but unable to distinguish between different kinds of noises.
2-3 = Able to distinguish between different kinds of sounds, including voice, but unable to hear and understand speech.
4 = Able to hear and understand a few words, but unable to hear and understnad most of what is spoken.
5 = Able to hear and understand most of the words spoken.

Audiometric equivalents of the hearing scale.—The evidence presented thus far suggests that in terms of scalability the hearing scale items might be adequate in distinguishing the degree of hearing loss for general statistical purposes. However, if it could be demonstrated that responses to these items were highly correlated with audiometric measurements for the same persons, the meaning and utility of the scale would be greatly enhanced. It was not possible to conduct audiometric examinations for the persons in the Health Interview Survey, but tests were conducted for persons in the I, II, and III samples previously described.

The mean pure-tone-average losses (better-ear average loss for the frequencies 500, 1,000, and 2,000 cycles per second) for each position on the hearing scale are given in table H. Several precautions should be taken in interpreting these data. It should be noted first that this group consists only of persons with severe hearing losses (Gallaudet College students), the smallest average loss being 56 decibels. Second, since this group is not a random sample of the total population with hearing impairment, no attempt should be made to apply these average losses to those in the Health Interview Survey sample having similar positions on the hearing scale. What the table does illustrate is an orderly progression of degree of hearing loss for each scale step, with a minimum degree of overlap between each position as illustrated by the small standard errors.

Table H. Number of persons, mean pure-tone-average loss (PTA)[1] in decibels, and standard error for steps on the hearing scale, based on scores of three samples of Gallaudet College students

Item	Scale position					
	0	1	2	3	4	5
Combined samples (872 students)						
Number	128	348	161	102	107	26
Pure-tone-average loss	98	91	83	75	66	63
Standard error	0.7	0.8	1.0	1.4	1.5	2.7
Sample I, mail interview (194 students)						
Number	30	90	48	10	12	4
Pure-tone-average loss	96	89	78	69	58	56
Standard error	1.3	0.9	1.8	4.8	3.2	7.0
Sample II, group interview (157 students)						
Number	22	74	24	12	18	7
Pure-tone-average loss	100	92	92	80	73	63
Standard error	1.8	1.1	2.3	4.2	3.2	5.8
Sample III, individual interview (521 students)						
Number	76	184	89	80	77	15
Pure-tone-average loss	98	92	83	75	65	64
Standard error	1.0	0.7	1.3	1.6	1.7	3.3

[1]Better-ear average for frequencies 500, 1,000, 2,000 cycles per second; 105 decibels assigned to nonresponse at limits of audiometer.

CLASSIFICATION OF HEARING SCALE SCORES

While specific audiometric values should not be assigned to the various scale scores for reasons discussed above, the data gathered so far would justify considering that all those who occupy the same scale position have a similar degree of hearing that is distinct from that in the other five categories. Furthermore, the scale score indicates the relative degree of impairment from 0 (worst) to 5 (best). While the evidence (see, especially, table H) might support the treating of each of the six scale positions separately, a more conservative attitude is recommended for any publication of the substantive results of the Survey. The following classification is suggested:

Category I. *Unable to hear and understand speech (scores from 0 to 3 on the hearing scale).*—Persons in this group deny being able to both hear and understand speech without a hearing aid. They range in impairment from inability to even perceive loud noises to just being able to distinguish the sound of speech from other sounds.

Category II. *Limited speech perception (scale of 4).*—These persons can hear and understand only a little of what is said to them.

Category III. *Can hear and understand most speech (scale score of 5).*—This group contains persons with only slight hearing impairment.

Category IV. *Unilateral hearing loss.*—Persons in this group have one normally functioning ear and should be able to hear well, except under conditions in which the hearing of the good ear is masked by noise. Of course, spatial localization of sounds and some other aspects of hearing will be affected by a unilateral loss. For communication, however, one good-hearing ear can serve adequately; hence this group is regarded as lesser impaired.

A fifth category arises by implication—those persons for whom information was insufficient to permit classification. Persons in this group did not respond to the Hearing Ability Questionnaire or did so to such a limited extent that classification was precluded.

CONCLUSIONS

While it is believed that the evidence presented indicates that the hearing scale is a satisfactory instrument for use in morbidity surveys, certain limitations must be pointed out. It is necessary to obtain more data from a sample of the general population, including those *without* hearing impairment. Such data should include hearing tests which would permit a more precise determination of the meaning of the scale positions in terms of audiometric measures. Further consideration should be given to the fact that little is known about those who obtained the highest position on the scale. As it now stands, the hearing scale is like a measuring stick that is 72 inches long. For measurements of those over 6 feet, such a measuring stick permits no further differentiation beyond stating that the individual is "more than 6 feet tall." In the same sense, those who obtain scores of 5 on the hearing scale are inferred to have the best hearing, but this could now include those who have no hearing loss at all. It is apparent, then, that in future development of this scale attention must be given to providing increased differentiation at the better-hearing end of the scale. And, finally, some effort should be directed toward obtaining a higher rate and a better quality of response from persons in the older age groups.

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APPENDIX I

PROCEDURES USED IN THIS SURVEY AND LEVEL AND QUALITY OF RESPONSE

The basic Health Interview Survey Questionnaire seeks to obtain information on a variety of health-related topics. In order to avoid extending the length of the interview unreasonably, the number of questions that can be devoted to a given topic must be limited. One method of probing a specific topic or condition that avoids the problem of extending the length of the original interview is to have the basic interviewer screen respondents for followup interviews. By this procedure persons who are reported in the original interview as having experienced the event or as having had the condition which is to be the subject of more intensive study are selected for additional interviewing at a later time. The Hearing Ability Survey, which was conducted for a 12-month period ending June 1963, was the first attempt by the Health Interview Survey to utilize this type of procedure. A description of the procedures used, some comments on these procedures, and some data on the level and quality of response obtained in the survey are given in this appendix.

Methods Used to Obtain Respondents

During the basic interview respondents were asked to report the existence of hearing problems in one or both ears. Most of the reported cases of hearing impairment were elicited from responses to the question: Does anyone in the family have serious trouble hearing with one or both ears? A relatively few cases were picked up from responses to some of the other illness-probe questions used in the basic interview questionnaire.

Persons reported as having hearing problems were mailed a copy of the Hearing Ability Survey Questionnaire. Adults were asked to fill out the questionnaire for themselves, and a parent or guardian was asked to complete the questionnaire for children.

In order to obtain the maximum level of response to the survey, persons who failed to respond to the initial inquiry were sent a reminder letter followed by a second reminder letter and finally by a personal visit when necessary. As a result of these procedures, responses were obtained from 93 percent of the persons who were sent questionnaires. Further details about response rates follow in the section entitled Level of Response.

The Hearing Ability Questionnaire

A facsimile of the Hearing Ability Questionnaire is shown in Appendix II. In addition to the hearing ability scale (question 1) and to the estimate of hearing ability in each ear (question 2) which have been discussed previously, the questionnaire was designed to provide the following information: (a) age at onset and progression of hearing difficulty, (b) cause of hearing loss, (c) associated otological condition, (d) mode of communication to and by the person with the hearing loss, (e) special training, (f) hearing aid ownership and use, and (g) hearing tests.

Utilization of the Basic Health Interview Questionnaire as a Screening Device

An important feature of the Hearing Ability Survey was the utilization of the basic health interview questionnaire as a screening device to elicit reports of hearing problems that later were followed up to obtain more detailed information. Since followup questionnaires were sent only to persons for whom some loss of hearing had been reported in the original interview, the completeness of the followup data is limited by the accuracy of reporting in the original interview. A general discussion of the response problems in interview surveys is not feasible here.[6] However, some comments on response problems that were encountered in this survey may be pertinent.

The first type of response problem is an implicit one. It involves the failure to report in the original interview the existence of hearing loss for an unknown number of persons. Because of the need to limit the scope and objectives of this study, no effort was made to obtain additional information about persons for whom no hearing loss was reported. Such an effort might have yielded some information on the extent of underreporting of hearing impairments.

Some data on a second type of response problem, the reporting of hearing impairments in the original interview which later were not reported in the followup

[6] For results of studies related to the problems of response errors, see U.S. National Health Survey, *Health Statistics*, PHS Pub. Nos. 584-D4, -D5, and -D6, Public Health Service, U.S. Government Printing Office, 1961.

interview, is available from the survey. Of the 4,978 persons who were reported to have a hearing impairment on the basic questionnaire and who responded to question 2 on the supplement, 482 (almost 10 percent) reported that their hearing was good in both ears. Therefore, either the reporting in the original interview was incorrect for these persons or the supplementary questionnaire yielded false negatives. No procedures were used in this study to resolve these apparent inconsistencies in reporting. One source of these inconsistencies may be the use of a proxy respondent in the original interview, while the supplement was completed by the person for whom the hearing loss was reported. It is probable that many individuals relate their hearing ability to their age. Therefore, a 70-year-old person with hearing loss may consider his hearing "good" in comparision with other persons his age, whereas a younger proxy respondent who reported for him might recognize and report the hearing loss. Another source of these inconsistencies is probably the use of different terms and the interpretation of these terms by different people. In the original interview, respondents were asked to report persons who had "serious trouble" hearing; in the supplement respondents were asked to describe their hearing in the following terms:

I am deaf
I have a lot of trouble hearing
I have a little trouble hearing
My hearing is good

Aside from the type of response problems indicated above, the Hearing Ability Survey results indicate that the basic interview can be successfully used to screen conditions or events for subsequent detailed interviews.

Level of Response

One of the major problems inherent in using a mail interview instead of a direct interview is the inability to get all of the sample persons to respond. As shown in table I, 7.3 percent of the 5,830 persons who were sent a hearing ability supplement did not respond; 5.2 percent never returned the supplement; and 2.1 percent returned a blank questionnaire.

Table I. Number and percent distribution of persons who responded and who did not respond to the hearing ability supplement

Item	Number of persons	Percent distribution
Total persons to whom a supplement was sent--	5,830	100.0
Responded----------	5,404	92.7
Did not respond-------	426	7.3
No supplement returned----------	302	5.2
Blank supplement returned----------	124	2.1

Table II presents the percent responding and not responding according to age. These figures fail to reflect any relationship of age to response rates. The highest response rate is evident for the persons under 17 years of age and those between the ages of 65 and 74. The lowest response rates were reported for those persons aged 17-44 and 75 years and over.

In addition to the 5,830 persons who were sent a supplementary questionnaire, there were 172 persons reported as having a hearing loss in the basic interview with no supplement available for final analysis. This was primarily caused by a clerical failure to send a supplement to the person with the hearing loss. (These errors were essentially randomly distributed, and therefore these losses should have no effect on the data.) When the number of nonrespondents is added to the

Table II. Number of persons who were sent a hearing ability supplement and percent distribution of those who responded and who did not respond, according to age

Age	Number of persons	Total	Responded	Did not respond[1]
		Percent distribution		
All ages----------	5,830	100.0	92.7	7.3
Under 17 years----------	390	100.0	94.9	5.1
17-44 years----------	1,127	100.0	91.4	8.6
45-64 years----------	1,749	100.0	92.8	7.2
65-74 years----------	1,293	100.0	94.4	5.6
75+ years----------	1,271	100.0	91.3	8.7

[1]Includes those persons who failed to return the supplement and those who returned the supplement but did not answer any of the questions.

Table III. Number and percent distribution of responses to the hearing ability supplement, according to quality of response

Quality of response	Number of responses	Percent distribution
Total responding	5,404	100.0
No omissions or inconsistencies	1,987	36.8
A few omissions or inconsistencies	2,363	43.7
Many omissions or inconsistencies	1,054	19.5

number of persons for which no supplement was sent, supplementary information is missing for approximately 10 percent of the total 6,002 persons who were reported as having hearing impairments in the household interview.

Quality of Response

Since these data were obtained by a self-enumeration form and the questionnaire was moderately complex, coding procedures were adopted to reflect the quality of the responses. These procedures were devised to recapture most of the data as it was originally reported and also to record the various types of errors that the respondents made in filling out the form. Coding procedures of this type have several advantages: (1) in analyzing the results of the study, knowledge of the quality of response to a particular question can be valuable in determining the inferences that can be drawn from the data obtained from that question; (2) eualuation of the quality of responses will be beneficial in designing future questionnaires and in deciding the procedures to be used, e.g., direct interview or mail questionnaire.

A detailed analysis of the quality of response to the individual question is beyond the scope of this report. However, the range of acceptable responses to the individual questions varied from 70 to 98 percent.

In addition to coding the errors for each individual question, an attempt was made to evaluate the overall accuracy of responses to the entire questionnaire. Even though some basic criteria were established for rating the quality of response of each questionnaire, it should be emphasized that a substantial amount of subjective judgment entered into these decisions. Consequently, in interpreting the results of this rating procedure, which are shown in the tables that follow, much more importance should be attached to the relationships between quality of response and characteristics of the respondents than to the absolute levels of quality indicated in the tables. Even though about 20 percent of the questionnaires were categorized as having many omissions or inconsistencies, they contained clear and usable answers to many questions. Furthermore many of the errors of omission or commission occurred in sections of the questionnaire that had no effect on the primary objective of this study, i.e., to classify persons with impaired hearing according to degree of loss.

The results of this evaluation are shown in table III. Perhaps the only inference that should be drawn from these figures is that some of the questions and "skip patterns" were too complex for use in a mail question-

Table IV. Number of persons responding to the hearing ability supplement and percent distribution of the quality of response, according to age

Age	Number of persons responding	Quality of response		
		Total responding	No or few omissions or inconsistencies	Many omissions or inconsistencies
		Percent distribution		
All ages	5,404	100.0	80.5	19.5
Under 17 years	370	100.0	92.2	7.9
17-44 years	1,030	100.0	91.4	8.6
45-64 years	1,623	100.0	82.9	17.1
65-74 years	1,220	100.0	72.6	27.4
75+ years	1,161	100.0	72.0	28.0

Table V. Number of persons responding to the hearing ability questionnaire and percent distribution of the quality of response, according to type of respondent

Type of respondent	Number of persons[1]	Quality of response			
		Total	Omissions or inconsistencies		
			None	Few	Many
		Percent distribution			
Total	5,029	100.0	38.6	44.9	16.6
Unassisted respondent	3,388	100.0	33.0	47.0	20.0
Assisted respondent	1,641	100.0	50.0	40.5	9.5

[1] Excludes 375 questionnaires on which the respondent was unidentified.

naire. This may be particularly true in this study which included many persons in the older age groups. The difficulty that older persons had with this questionnaire is reflected by the data in table IV, which shows that the quality of response decreased as age increased.

Another interesting related factor is shown in table V. The quality of response appears to be better when some other person assisted in completing the questionnaire. Twenty percent of the unassisted respondents returned questionnaires with many omissions, while less than 10 percent of the assisted respondents returned questionnaires with frequent errors.

These findings are different from the comparison of the assisted and unassisted respondents in relation to the hearing ability scale that was discussed previously in this report. The ability of the assisted respondent to provide a better overall quality of response to the supplementary questionnaire while having a poorer

Table VI. Number of persons responding to the hearing ability supplement and percent distribution of the quality of response, according to type of respondent and age

Type of respondent and age	Number of persons[1]	Quality of response			
		Total	Omissions or inconsistencies		
			None	Few	Many
		Percent distribution			
Unassisted respondent					
All ages	3,388	100.0	33.0	47.0	20.0
Under 17 years	36	100.0	36.1	61.1	2.8
17-44 years	785	100.0	49.6	43.1	7.4
45-64 years	1,183	100.0	34.2	49.0	16.7
65-74 years	816	100.0	25.0	47.1	27.9
75+ years	568	100.0	18.8	47.4	33.8
Assisted respondent					
All ages	1,641	100.0	50.0	40.5	9.5
Under 17 years	317	100.0	45.7	48.3	6.0
17-44 years	197	100.0	58.9	34.5	6.6
45-64 years	342	100.0	58.2	34.2	7.6
65-74 years	295	100.0	46.8	41.0	12.2
75+ years	490	100.0	45.5	41.8	12.7

[1] Excludes the 375 questionnaires on which the respondent was unidentified.

ability to respond to the scale statements in question 1 may be explained as follows: Since a person is called upon to assist in completing the supplement, he could be expected to be more competent in following the questionnaire instructions and providing the answers to the factual questions. However, the ability to interpret the subjective impressions required for completing the scale in question 1 may be more difficult for the person who is lending his assistance.

Table VI shows the relationship between age, the need for assistance to complete the questionnaire, and the quality of response. It is readily evident that the older unassisted respondents experienced considerable difficulty in trying to answer the survey questionnaire.

The data presented here on quality of response points up the need for exercising considerable caution in using complex mail questionnaires, especially if the study involves many persons in the older age brackets. Furthermore, these data indicate that the quality of the data may be improved if assistance in preparing the questionnaire is available or given to elderly respondents.

APPENDIX II

HEARING ABILITY SURVEY QUESTIONNAIRE

CONFIDENTIAL - This information is collected for the U.S. Public Health Service under authority of Public Law 652 of the 84th Congress (70 Stat 489; 42 U.S.C. 305). All information which would permit identification of the individual will be held strictly confidential, will be used only by persons engaged in and for the purposes of the survey and will not be disclosed or released to others for any other purposes (22 FR 1687).

FORM NHS-D-1
(5-28-62)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
ACTING AS COLLECTING AGENT FOR THE
U.S. PUBLIC HEALTH SERVICE

NATIONAL HEALTH SURVEY
(Hearing Ability)

Name of person for whom this form should be filled out

GENERAL INSTRUCTIONS

Please answer all of the questions in this form that apply to you. Most of the questions can be answered by checking one of the boxes, like this: ☑ In some of the questions, more than one box may be checked for your answer. In a few questions, a number (such as age) is asked for. In a few others, a written description or explanation is required.

If the person for whom the information is requested is a child, a parent or guardian should answer the questions for him or her.

SECTION A

(Please do not omit any part of Questions 1 and 2 even though one or more of the statements may not appear to be directly related to your present ability to hear.)

1. **WITHOUT using a hearing aid, what can you hear** *(Please check the "Yes" or "No" box after each statement.)*	Yes	No
I can hear loud noises.		
Most of the time I can tell one kind of noise from another.		
If I hear a sound, most of the time I can tell if it is a person's voice or not.		
I can **hear and understand** a few words a person says if I can see his face and lips.		
I can **hear and understand** a few words a person says without seeing his face and lips.		
I can **hear and understand** most of the things a person says if I can see his face and lips.		
I can **hear and understand** most of the things a person says without seeing his face and lips.		
Most of the time I can **hear and understand** a discussion between several people without seeing their faces and lips.		
I can **hear and understand** a telephone conversation on an ordinary telephone (that is a telephone without an amplifier).		

2. Please describe how well you can hear, **without using a hearing aid,** by checking **one** of the statements below for **each** ear. For example, a person who is deaf in his left ear and has good hearing in his right ear would check the following: In left ear - box (d); In right ear - box (e).

In left ear	**In right ear**
(a) ☐ My hearing is good	(e) ☐ My hearing is good
(b) ☐ I have a little trouble hearing	(f) ☐ I have a little trouble hearing
(c) ☐ I have a lot of trouble hearing	(g) ☐ I have a lot of trouble hearing
(d) ☐ I am deaf	(h) ☐ I am deaf

If you have checked that your hearing is **good** in **both** ears—(a) and (e) checked, skip the questions on Pages 2 and 3 and turn to Section D on Page 4.

If you have any trouble hearing at all, please go on and answer the questions that follow on Pages 2 and 3.

SECTION B

3. How old were you when you began to have hearing trouble or grow deaf?
(Please check the first box that applies and *enter year as appropriate.)*

- ☐ At birth
- ☐ I was less than one year old.
- ☐ I was about _____ years old
- ☐ I am not sure, but I know it was before I was _____ years old.

4. (a) Since your hearing trouble began, has your hearing gotten WORSE, has it improved, or is it just about the same? *(Please check one box.)*

- ☐ My hearing is now **worse** than when I first began to have hearing trouble.
- ☐ My hearing is now **better** than when I first began to have hearing trouble.
- ☐ My hearing is just **about the same** as when I first began to have hearing trouble.

(If you have checked that your hearing has gotten **worse**, *please answer the following question.)*

(b) How old were you when it got as poor as it is now?
(Please check the first box that applies and *enter year as appropriate.)*

- ☐ I was about _____ years old.
- ☐ I am not sure, but I know it was before I was _____ years old.
- ☐ Neither of the above applies--it is getting worse all the time.

5. What was the cause of your hearing trouble or deafness?

- ☐ It was caused by a sickness, illness or disease.
  What illness? _____
- ☐ It was caused by an accident or injury.
  What kind of injury was it? _____
  How did it happen? _____
- ☐ I was born deaf or with poor hearing
- ☐ Something else caused it.
  (Please describe it) _____
- ☐ I don't know what caused it.

6. Besides your hearing trouble or deafness, do you have any other trouble with your ears?

☐ Yes ☐ No

If "Yes,"
What kind of trouble? *(Please check as many boxes as apply.)*

- ☐ Noises or ringing in the head or ear
- ☐ Earaches or pains in the ear
- ☐ Running ears
- ☐ Dizziness
- ☐ Any other trouble. **What kind?** _____

7. (a) At work or school and at home, what are all the ways you use to tell other people what you want?
(Please check each way that you use.)

- ☐ I talk to them
- ☐ I write notes.
- ☐ I spell with my fingers
- ☐ I use sign language.
- ☐ Some other way. **How?** _____

(b) Please put a circle around the way you use the most.

8. (a) At work or school and at home, what are all the ways other people use to tell you what they want?
(Please check each way that they use.)

- ☐ They talk to me.
- ☐ They write notes.
- ☐ They spell with their fingers.
- ☐ They use sign language.
- ☐ Some other way. **How?** _____

(b) Please put a circle around the way they use the most.

9. Have you ever attended a school or class for those with poor hearing or a school or class for the deaf? ☐ Yes ☐ No

10. Have you ever had any training in lip reading (speech reading)? ☐ Yes ☐ No

11. Have you ever had any training in speech or speech correction because of your poor hearing or deafness? ☐ Yes ☐ No

12. Have you ever had any training in hearing (lessons to help you understand better what you hear)? ☐ Yes ☐ No

SECTION C

(The questions in this section refer to the use of hearing aids.)

13. **Have you ever tried a hearing aid?** ☐ Yes ☐ No *(If "No," skip to Section D on Page 4)*

14. **Have you ever had a hearing aid for your own use?** ☐ Yes ☐ No *(If "No," skip to Section D on Page 4)*

15. **(a) If you have a hearing aid NOW, please check here** ⟶ ☐
AND check one of the boxes below to indicate when you got it.

If you do NOT have a hearing aid NOW, please check here ⟶ ☐
AND check one of the boxes below to indicate when you got the last one you had.

When did you get it?

☐ This year (1962)
☐ Last year (1961)
☐ 2-5 years ago
☐ 6-10 years ago
☐ More than 10 years ago

The remaining parts of Question 15 apply to your present hearing aid if you have one now. If you do not have a hearing aid now, they apply to the **last** hearing aid you had.

(b) What kind of hearing aid is (was) it? *(Please check one box)*

Air conduction
- ☐ Fits into one ear
- ☐ Fits into both ears at the same time

Bone conduction
- ☐ Fits against one side of the head
- ☐ Fits against both sides of the head at the same time

(c) Where are (were) the amplifier and batteries worn when you use (used) the hearing aid? *(Please check one box)*

☐ Above the neck
☐ Below the neck

(d) Why did you choose this (that) particular kind of hearing aid? *(Please check one box)*

☐ It was prescribed by a medical doctor
☐ It was prescribed by a hearing clinic
☐ A friend or relative told me about it
☐ I saw it advertised
☐ It was advised by a hearing aid dealer
☐ Some other reason *(Please explain)* _____

(e) About how long did it take to get used to it? *(Please check one box)*

☐ Less than one month
☐ One to six months
☐ More than six months
☐ Never have gotten used to it

16. **(a) Do you use a hearing aid now?** ☐ Yes ☐ No *(If "No," skip to Section D on page 4)*

(b) How much do you use it? *(Please check one box on each line)* *(If you do not work, go to school, etc., check the "Does not apply" column.)*

	Does not apply	Most of the time	Once in a while	Never
At work?				
At school?				
At church?				
At the movies?				
Listening to radio or TV?				
At home?				

(c) How well satisfied are you with the hearing aid you are now using? *(Please check one box)*

☐ Very well satisfied ☐ Fairly well satisfied ☐ Not satisfied at all

Question 17 of Section C on Page 4

SECTION C — Continued

17 **WITH your hearing aid, what can you hear?** *(Please check the "Yes" or "No" box after each statement)*	Yes	No
I can hear loud noises.		
Most of the time I can tell one kind of noise from another.		
If I hear a sound, most of the time I can tell if it is a person's voice or not.		
I can **hear and understand** a few words a person says if I can see his face and lips.		
I can **hear and understand** a few words a person says without seeing his face and lips.		
I can **hear and understand** most of the things a person says if I can see his face and lips.		
I can **hear and understand** most of the things a person says without seeing his face and lips.		
Most of the time I can **hear and understand** a discussion between several people without seeing their faces and lips.		
I can **hear and understand** a telephone conversation on any telephone.		

SECTION D

18. Has your hearing ever been tested by a medical doctor? Yes ☐ No *(If "No," go to Question 19)*

(a) About how long ago was your hearing LAST tested by a medical doctor? *(Please check one box)*

☐ This year (1962)
☐ Last year (1961)
☐ 2 - 3 years ago
☐ 4 - 5 years ago
☐ 6 - 10 years ago
☐ More than 10 years ago

(b) Was the doctor who last tested your hearing an ear specialist or was he a general family doctor? *(Please check one box)*

☐ Doctor who was an ear specialist
☐ General family doctor
☐ I don't know

(c) About how old were you when your hearing was FIRST tested by a medical doctor?

I was about _____ years old

I don't know, but it was before I was _____ years old.

19. Is your hearing tested regularly, for example, once or twice a year? ☐ Yes ☐ No

20. Has your hearing ever been tested with an audiometer (with earphones)? ☐ Yes ☐ No

Comments - *(Please use this space or attach an additional sheet of paper for any additional remarks you may have about your hearing.)*

Name of person who filled out this form	Telephone No.

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