A PHONETICALLY BALANCED TEST OF SPEECH DISCRIMINATION FOR HINDI - SPEAKING ADULTS

Thesis for the Degree of M. A.

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KENNETH G. SMITH

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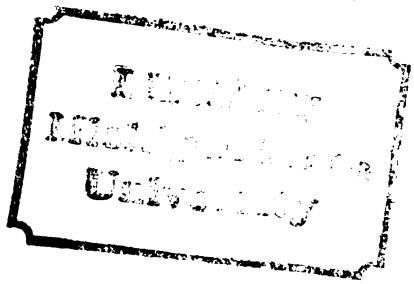
THESIS



A PHONETICALLY BALANCED TEST OF SPEECH DISCRIMINATION FOR HINDI-SPEAKING ADULTS

by

Kenneth G. Smith

A THESIS

Submitted to
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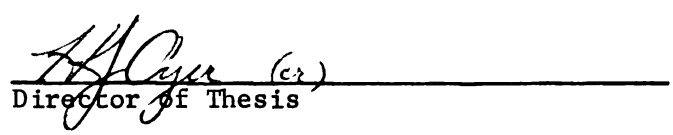
Accepted by the faculty of the Department of Audiology and Speech Sciences, College of Communication Arts, Michigan State University, in partial fulfillment of the requirements for the Master of Arts degree.



Director of Thesis

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Finally, the writer acknowledges, with deep appreciation, the understanding, cooperation and prayers of his wife, Elfriede who encouraged the study at all times.

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CHAPTER I

INTRODUCTION

In English-speaking countries, and in some other countries as well, speech and hearing clinicians have tools available that are useful in the evaluation and treatment of communication disorders. These tools are suited to the culture and language idiosyncrasies of the countries.

In the country of India, it is evident that there is a need for various kinds of materials and tests that can be used to aid the audiologist and speech pathologist in the evaluation process. Such materials and tests must, of course, be suited to the language, culture, and general frame of reference of the people for whom these materials will be produced.

In the case of India, due to great differences in language and culture, it is impossible to adapt tests and materials that were developed in another language and culture.

One such tool, which by the very nature of it, must be produced in the language indigenous to the area in which it is to be used, is a test of phonetically balanced word lists to test auditory discrimination. Since auditory

discrimination affects speech articulation, it is of value to have phonetically balanced (PB) word lists for use as part of a battery of tests administered to a subject with defective hearing.

Purpose

The purpose of this present research was to construct phonetically balanced speech discrimination word lists in the Hindi language that could be used as a test of discrimination in the evaluation of hearing problems of Indians speaking the Hindi language.

Importance of the Study

Some disciplines are of long-standing reputation and, as the result of many years of study and research, they are well established and systematized in their application in all parts of the world. In other areas of study however, which are of more recent origin as a recognized separate discipline, there is still evidence of growth in organization, acceptance and maturity. This is the case with the field of Audiology and Speech Sciences which has really made a place for itself only within the last thirty to forty years. Even at the present time, in the United States of America and Europe, where it is in its most sophisticated degree of maturity, it may still be considered as a developing discipline.

In order for a profession to gain reputation and respect from other professions, there must be certain

well-defined procedures and demonstrable results. Now, in the U.S.A. and Europe, there is a growing degree of acceptance and recognition accruing to Audiology and Speech Sciences, as is evidenced by the annual convention of the American Speech and Hearing Association which year by year attracts an increasing number of individuals connected with this field of research and practice.

Speech Pathology and Audiology in India may be described as being still in its infancy of development. Only now is it beginning to be recognized as an important discipline which can make a significant contribution to the total development of the country.

Research is being carried forward to develop procedures for evaluation of hearing disorders. But as for Hindi PB word lists for testing speech discrimination--they simply do not exist. This study then is presented as a beginning in fulfilling such a need as has been described.

There are a few places in India where an interest in Speech Pathology and Audiology is being established, where research is being carried on and clinical programs are serving the needs of the people. Among these places are Vellore, Mysore, New Delhi, Bombay and Calcutta. The oldest clinical program is operating in Bombay. Until about 1955, the treatment of speech disorders was almost completely neglected.[1]

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[1]Margaret Eldridge, A History of the Treatment of Speech Disorders (Edinburgh and London: E. & S. Livingston Ltd., 1968), p. 194.

According to the 1961 population census, of the four hundred and forty million people then living in India, almost one third indicated that Hindi was either their native tongue or their preferred second language. It is probable, therefore, that more Indians understand Hindi than any of the other fourteen major languages in India.[2]

Questions

In this study, the following questions have been asked and answered as will be seen in the following pages:

1. Is it possible to construct phonetically balanced word lists in the Hindi language?
2. Are the test results obtained from the administration of each of the word lists reliable upon repeated administration?
3. Are there significant differences in scores obtained for the two word lists?

Definition of Terms

Throughout this report the following terms will be used as they are defined below:

Phoneme.--This refers to a family of closely related speech sounds, which have the same acoustic characteristics in spite of their differences. In the study of Hindi, the student learns that each character of the alphabet has only

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[2]Gordon H. Fairbanks and Bal Govind Misra, Spoken and Written Hindi (Ithaca, N. Y.: Cornell University Press, 1966), p. v.

one correct articulation. Therefore in this language it is assumed that a phoneme is synonymous with each character of the alphabet.

Phonetically balanced.--". . . the speech sounds within the list occur with the same relative frequency as they do in a representative sample of . . . speech."[3]

Speech discrimination.--Although this phrase is used by many authorities, there seems to be a scarcity of definitive discussion about this specific term. In talking about the use of speech discrimination tests in the measurement of hearing, Lafon has discussed discrimination and identification from the neurological and learning viewpoints: "The discrimination rests on an extraordinary analysis of the nervous message, but it necessarily entails the identification of the acoustic messages."[4]

The present writer favors this reference, as it seems most applicable in what is spoken of as "speech discrimination" in the context of this study.

Limitations of the Study

The subjects available for the initial testing of these PB word lists were all adults who had received a formal education at a higher level than that which the average

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[3]Ira J. Hirsch, The Measurement of Hearing (New York: McGraw-Hill Book Company, Inc., 1952), p. 147.

[4]J. C. Lafon, The Phonetic Test and Measurement of Hearing (Springfield, Ill.: Charles C. Thomas, Publisher, 1966), p. 71.

Indian in India receives. These subjects were college students, both graduate and undergraduate, instructors and some wives of these individuals. All of the subjects were connected with Michigan State University. It was expected that such a group would possess a familiarity with the Hindi vocabulary and correct articulation that might not be found generally in rural India.

The test presented in this study uses the Hindi language in the PB word lists for the following reasons:

1. Hindi is the national language of India.
2. Hindi is spoken by more people in India than any of the other thirteen major languages.
3. The present writer is more familiar with Hindi than any of the other Indian languages.

CHAPTER II

BACKGROUND

This chapter is a review of some of the literature pertinent to a study on the construction of PB word lists used in a test for speech discrimination. For the purposes of this study the literature has been divided into two categories.

Studies Related to the Construction of the Word Lists

The principles which have been used in constructing PB word lists in English have been used in this present study. James Egan[1] has given certain guidelines which have been followed in this project. He recommends using testing materials which are representative of conversational speech. This is true for most testing purposes and it is certainly true for the present purpose. The question of familiarity was also mentioned by Egan. He referred to the balance needed between the lists in terms of how difficult the words were.

If a word list is to be useful it should include, as nearly as possible, all the sounds of speech. Another

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[5]James P. Egan, "Articulation Testing Methods," The Laryngoscope, LVIII (1948), 955-91.

control to which Egan referred in his research was normal hearing for all his subjects.

Special mention should be made of the research of Hirsh et al.[6] This has been a most valuable source, since the experience of these researchers could be readily applied in the present instance.

The first question raised by Hirsh et al. was that of familiarity. The purpose of a test of speech discrimination is not to determine the extent of a person's vocabulary, but rather his ability to discriminate the various sounds of the language. Therefore, it is important to keep in mind the familiarity of the words included in the word lists, and to maintain a balance in this respect from list to list.

Hirsh and his colleagues recorded the word lists in their study on magnetic tape. This was done so that the presentation could be made the same way every time it was used. A 30-second 1000 c.p.s. calibration tone, at the loudness level of the carrier phrase, was put at the beginning of each list of words, so that individual operators could set their levels at a constant signal.

Another important question is the intensity level of the presentation of the word lists. Hirsh presented the word lists at 15, 20, 30, 40, 50, 60 and 70 db re: .0002 microbar. These intensity levels applied to the carrier

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[6] Ira J. Hirsh, H. Davis, S. R. Silverman, E. G. Reynolds, E. Eldert and R. W. Benson, "Development of Materials for Speech Audiometry," The Journal of Speech and Hearing Disorders, XVII (1952), 321-37.

phrase: "Say the word . . ." It was found by Hirsh that the scores of the subjects were consistently near 100 per cent above 50 db. That is why in this present study the presentation level has been fixed at 50 db since the main consideration is the determination of the reliability of the word lists.

Each list used by Hirsh was phonetically balanced; that is, the speech sounds in each list occurred with the same relative frequency as found in a representative sample of English speech.

Various kinds of test materials are available for testing speech discrimination. Carhart[7] has indicated the advantage of using monosyllabic words, by pointing out that they are sufficiently unpredictable for clinical subjects so that individual speech elements must be perceived relatively independently. At the same time they are superior to nonsense syllables which are apt to baffle many subjects.

Carhart also refers to the PB-Max score. By this he means that the word lists are presented at a level of sufficient intensity so that the subject is enabled to make his optimal discrimination score.

In the work of Peterson and Lehiste,[8] the importance of uniformity in word lists is stressed. It is necessary

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[7]Raymond Carhart, "Problems in the Measurement of Speech Discrimination," Archives of Otolaryngology, LXXXII (1965), 253-60.

[8]Gordon E. Peterson and Ilse Lehiste, "Revised CNC Lists for Auditory Tests," The Journal of Speech and Hearing Disorders, XXVII (1962), 62-70.

to be able to obtain the same results no matter which list is used in a test. This involves the question of familiarity of the materials used in compiling the word lists. Peterson and Lehiste found that it was necessary to review the CNC lists which they introduced in 1959. The result was that some of the words had to be eliminated because they were (1) relatively rare, (2) literary words, or (3) proper names.

Studies Regarding the Hindi Language and the Status of Audiology in India

The book by M. A. Ghatage has been invaluable in providing the groundwork for this study.[9] The basis of Ghatage's Phonemic and Morphemic Frequencies in Hindi was a corpus of 19,211 words scientifically selected from a variety of sources yielding a representative sample of Hindi as used today.

This corpus of words were painstakingly analyzed so that accurate counts were made indicating the number of times each word was used and the number of times each phoneme was used. Each of these two lists were arranged in two different ways. The words were arranged in descending order of frequency of occurrence and alphabetically, and the phonemes were arranged in the same way.

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[9]Amrit Madhav Ghatage, ed., Phonemic and Morphemic Frequencies in Hindi (Poona: Dr. S. M. Katre, for Deccan College Postgraduate and Research Institute, 1964).

The work of Professor Ghatage of Poona University is of recent publication (1964), and the present writer assumes that it represents a valid analysis of the Hindi language.

CHAPTER III

EXPERIMENTAL PROCEDURES

Information is given in this chapter regarding the selection of subjects, the equipment employed in this study, the compilation of the lists of words and a discussion of the testing procedures employed.

Subjects

The subjects were thirty young adults. To qualify, each subject had to be familiar enough with the Hindi language so that he could converse and write in Hindi. Since part of the testing required writing in Hindi, each subject had to be able to write in the Devanagari script. Each subject was also required to pass a pure-tone, air conduction audiometric test so as to ascertain whether or not he had hearing within normal limits. This was ascertained by a sweep test at 15 db (ISO).[10] The frequencies covered in this test were 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. The subjects for this study were selected from the faculty and student body of Michigan State University. In some cases the wives of some of the students were also subjects.

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[10]Here and throughout the study references to a certain db level are according to ISO 1964 standards.

Equipment

The following equipment was employed for the preparation and analysis of the word list tapes:

Microphone (Electro Voice Model 635A)

Dual-track tape recorder (Ampex Model 601)

Magnetic tape (MMM 201 professional)

Power Level Recorder (Bruël and Kjaer Model 2305)

The following equipment was employed for administering the pure tone and speech discrimination tests to the subjects:

Dual-track tape recorder (Ampex Model 601)

Clinical Audiometer (Beltone Model 15C)

Speech Audiometer (Grason-Stadler Model 162)

1 pair headphones (Telephonic Model TDH-39)

1 pair headphones (Grason-Stadler Model D-1)

A pre-fabricated, double walled, sound treated room (Suttle) was used in the recording of the tapes, and in playing back the tapes to the subjects.

Procedures

Compiling the Word Lists for the Test

Two considerations regarding balance were kept in mind in choosing the words to be included in the two word lists, namely, frequency of occurrence of the words in the language, and frequency of occurrence of the phonemes in the language.

Ghatage[11] placed the words of his total count of 19,211 in two lists. The second list was most pertinent for the purposes of this study, since it ranked the words in descending order of frequency. From this list all the words were taken which consisted of one syllable, and had a frequency of 10 or more. This resulted in a list of 173 words. For ease of calculation, two more words with frequencies of 9 or 8 were added so that a total of 175 words was finally selected. The characteristics of these words therefore were that they were monosyllabic, familiar and consisted of one, two, three or four phonemes.

Ghatage made a count of the frequency of occurrence of each phoneme appearing in the 19,211 words. His results show that the total number of phonemes was 507,904. This total number of phonemes was then divided by the frequency for each phoneme so that a determination could be made about the relative frequency of each phoneme in the word lists (see Appendix A).

On the basis of the foregoing calculations it was determined how many times a phoneme should occur in each of the two 50-word lists (Appendix B). With this information as a guideline for phonetic balance and the 175 monosyllabic words ranked in order of frequency, words were selected for each list so as to maintain a balance of word familiarity, and phonemic balance. As far as possible the

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[11]Ghatage, op. cit., pp. 213-14.

correct frequency of occurrence for each phoneme has been maintained for each list of words, so that if a phoneme occurs N times in list #1, it should occur N times in list #2. Where there has been a deviation from this ideal, the phoneme occurs ± one or two times from the ideal frequency of occurrence. If the word lists had been composed of nonsense syllables the ideal could have been maintained consistently, but these slight deviations have been necessary due to the use of monosyllabic words which were also familiar. The final working lists (#1 and #2) of Hindi PB words are to be found in Appendices C and D.

One final word should be given about the number of phonemes in each word list. Ghatage recognizes fifty phonemes in Hindi, some of which do not occur frequently enough to be counted even once in a 50-word list. Therefore only thirty-two different phonemes have been used (Appendix E). There is a total of 131 phonemes in list #1 and a total of 133 phonemes in list #2.

Making the Tapes for the Test

A copy of the two word lists found in Appendices C and D were made, and when ready for recording on tape, were submitted to Professor Y. P. Kapur, a Hindi-speaking faculty member of the Department of Audiology and Speech Sciences at Michigan State University, for examination. Accuracy of words and spelling was confirmed.

These word lists, fifty words in List #1 totally different from fifty words in List #2, were then read by a young female adult Indian, a graduate student in Audiology and Speech Sciences, whose mother tongue is Hindi. The recording situation was arranged so as to achieve as ideal a recording as possible. Before each PB word, a carrier phrase was spoken in Hindi, which translated into English would mean: "Please say after me . . ." The speaker monitored herself as she spoke the carrier phrase, by watching a VU meter on the tape recorder, and attempting to make the peaks at the same loudness level. The PB words on the other hand were not monitored in this way. Instead, they were spoken with equal effort rather than equal loudness.[12]

When the two tapes had been recorded, the tapes were run through the power level recorder, and a graphic recording was obtained. An average of the peaks of the carrier phrase was computed. Hirsh et al. found it necessary to do this so that they could put a half-minute of a 1000 Hz. calibration tone at the level of the carrier phrase at the inner edge of each record so that individual operators could set their levels on a constant signal.[13] The procedure used by Hirsh et al. was applied in this study, the only difference being that the storage medium was magnetic tape instead of

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[12]Hayes A. Newby, Audiology (New York: Appleton-Century-Crofts, 1964), p. 115.

[13]Hirsh et al., op. cit.

a disc. Since the two PB word lists were recorded on separate tapes, the calibration tone for each list was computed separately.

The tape on which the calibration tone was recorded, was spliced to the beginning of each test tape. To facilitate the procedure in administrating the test, the second list was spliced to the end of the first list.

Thus, the completed tape consisted of material in the following order: a calibration tone of a half-minute at 1000 Hz. representing the average of the carrier phrase in Hindi PB word list #1, word list #1, the calibration tone for list #2, and word list #2.

Testing the Subjects

Subjects were contacted by telephone, at which time it was explained to them that they would be needed for two sessions (a test and retest), that would be separated by at least two weeks. The gap of two weeks between the two sessions was a precaution to preclude any possible learning of words of sequence of words from the first session to the next.

Each subject was seated in the Suttle pre-fabricated, double walled, sound treated room, and as a check on his hearing acuity, a sweep check audiometric test at 15 db at the frequencies 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. was administered to each ear separately. Those subjects who passed this test were kept in the room, and the first Hindi word list was presented to them. Preceding

the presentation of the first word list, the subject was instructed that he was required to make both oral and written responses to what he heard. So, when he heard the voice on the tape say, "Please say after me: 'jay'," for example, he would have to say the word "jay" and also write it down on a response form that was given to him. The form contained fifty numbered spaces for the answers to each stimulus from the tape. The oral responses were picked up by a microphone in the listener's room and relayed to the operator so that he could monitor the test and make sure the subject was understanding the task. A visual check was maintained through the window of the listener's room also to make sure that each word was written down in the appropriate space. The reason for the written response was to provide the tester with a permanent, objective record of each subject's responses. After list #1 had been presented, the same procedure was followed for list #2. Two weeks or more later the subjects were called in again and the word lists presented to them in the same way as at the first time. The second time, however, involved only the administration of the word lists, and the hearing test was not repeated since it was assumed that there would be no appreciable difference in the acuity of the subjects' hearing during a period of two weeks.

The responses of each subject were scored against the two master lists of Hindi words from which the tapes were made. These scores are presented in Appendix F.

CHAPTER IV

RESULTS

This chapter presents the major results obtained by the procedures described in Chapter III. It includes a discussion of validity and reliability, including the statistical procedures employed, and a discussion of the implications of these results in terms of the original questions posed in this study.

The analysis of the Hindi language reported in the Ghatage source already referred to, reveals such a systematic and scientific approach that it can be relied upon as presenting a contemporary and accurate picture of the Hindi language. Because of the assumed validity of this work by Dr. Ghatage, it was felt that this could be an adequate basis on which to build this test of speech discrimination.

The scores obtained from the administration of these two PB word lists, show a very close relationship. One would predict this, since all subjects had normal hearing, and the two lists of words were supposed to be balanced in terms of familiarity, number of phonemes used and frequency with which each phoneme was used in each word list.

The range of scores was from 47 to 50 out of a possible maximum score of 50. In order to determine the test-retest reliability for each of the two lists, a Pearson product moment technique was employed. The test-retest reliability for list #1 was calculated to be .89 which was significant at the .05 level of confidence. The test-retest reliability for list #2 was calculated to be .87, which was also significant at the .05 level.

In order to determine if the subjects differed in the scores between the lists, a student t technique was employed in the difference scores (list #1--list #2) for each testing session. For session #1 the t was calculated to be 1.00 which was not significant at the .05 level. For session #2 the t was calculated to be .52 which was not significant at the .05 level.

Based on the analysis it was assumed that the subjects did not differ significantly on either list for either session.

CHAPTER V

SUMMARY

The purpose of the present study was to examine the Hindi language with a view to developing phonetically balanced word lists which could be used in a test of speech discrimination.

From the analysis of the Hindi language as presented by Ghatage,[14] two lists of PB monosyllabic words were constructed and administered to thirty subjects. These subjects were selected from the Hindi-speaking population on the campus of Michigan State University. A sweep check audiometric test at 15 db ISO of the frequencies 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. was administered to the listener subjects. This level of intensity was considered appropriate to determine if the subject's hearing was within normal limits.

The word lists were administered in two sessions separated by at least two weeks for each subject. The loudness level when presenting the word lists was set at a hearing level of 50 db. Since 0 db on the speech audiometer is equal to 20 db SPL, this loudness level could also be referred to as 70 db SPL.

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[14] Ghatage, op. cit.

The results of the study have answered the questions which were posed at the outset, namely:

1. Is it possible to construct phonetically balanced word lists in the Hindi language?
2. Are the test results obtained from the administration of each of the word lists reliable upon repeated administration?
3. Are there significant differences in scores obtained for the two word lists?

Conclusions

Within the confines of this study, the following conclusions appear to be warranted:

1. It is possible to construct phonetically balanced word lists in the Hindi language, and these word lists may be used as a basis for constructing a speech discrimination test.
2. From the high correlations obtained from the repeated administration of the word lists, it has been demonstrated that they are reliable as tests of speech discrimination.
3. There are no significant differences between scores obtained on the two word lists, therefore one could assume that the two word lists were equally difficult.

Implications for Future Research

Much work remains to be done in order to develop a test of speech discrimination in the Hindi language. The work represented in this study is only a beginning to what may become a fully developed, tested and standardized speech discrimination test of functional use to audiologists who need a measure of a Hindi-speaking person's speech discrimination score.

As has been noted the word lists in this study were presented at only one loudness level. In order to obtain an articulation curve, they should be presented at various levels from perhaps 15 db to 60 db.

A further test of the suitability of this test would involve presenting the word lists to a cross-section of Hindi-speaking people, rather than only an academic oriented population.

An item analysis of components of both lists should be made.

Since there are other major languages in India, perhaps similar tests could be developed in these languages to be of service to the millions of people living in India who do not speak Hindi.

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APPENDIX A

On the basis of Ghatage's findings, the following list indicates the frequency with which each phoneme occurs in modern Hindi. For example: on the average every eighth phoneme in modern Hindi is /ʌ/.

अ	ʌ	8	द	d	53
आ	ɑ	11	ज	dʒ	65
क	k	14	श	ʃ	66
र	r	15	ग	g	85
ए	e	16	◌	ɑɪ	98
न	n	20	ब	b	98
त	t	24	◌ं	ɑ̃	98
ि	ɪ	24	च	tʃ	101
ी	i	25	थ	th	109
ा	s	29	भ	bh	111
म	m	32	◌ै	ɑʊ	133
ह	h	33	ध	dh	141
प	p	36	◌ु	u	161
य	j	42	ख	kh	168
ल	l	43	ड	ḍ	171
उ	ʊ	45	ट	ṭ	177
ो	o	52	ण	ṇ	200
व	v	53	छ	tʃh	342

APPENDIX B

The total number of words from which the PB word lists have been compiled is 175. These words contain 488 phonemes. Therefore each word list of 50 words should contain about 139 phonemes. On the basis of the list detailing the frequency with which each phoneme occurs in Hindi, the following table indicates the frequency with which each phoneme should occur, ideally, in each list of PB words.

ʌ	17	ʊ	3
ɑ	13	o	3
k	10	v	3
r	9	d	3
e	9	dʒ	2
n	7	ʃ	2
t	6	g	2
ɪ	6	aɪ	1
i	6	b	1
s	5	o	1
m	4	tʃ	1
h	4	th	1
p	4	bh	1
j	3	aʊ	1
l	3	dh	1

APPENDIX C

Hindi PB Word List #1

है	**haɪ**	दे	**deɪ**
था	**tha**	क्या	**kja**
कि	**kɪ**	लग	**lʌg**
थे	**theɪ**	याद	**jad**
वह	**vʌhe**	भाग	**bhag**
हो	**hoʊ**	कह	**kʌhe**
जो	**dʒoʊ**	दस	**dʌs**
कर	**kɔ**	रख	**rʌkh**
इस	**ɪs**	मन	**mʌn**
एक	**eɪk**	मर	**mʌr**
तब	**tʌk**	तीस	**tɪs**
अब	**ʌb**	बीच	**bɪtʃ**
श्री	**ʃrɪ**	जिन	**dʒɪn**
जाय	**dʒaɪ**	धन	**dhʌn**
आ	**a**	नै	**naɪ**
पास	**pas**	कौन	**kaʊn**
वे	**veɪ**	हर	**hʌr**
और	**ɔr**	पेश	**peɪʃ**
ले	**leɪ**	रस	**rʌs**
तीन	**tɪn**	प्रेम	**preɪm**
साथ	**sath**	छूट	**tʃhut**
तुम	**tʊm**	कुल	**kʊl**
मिल	**mɪl**	पद	**pʌd**
नाम	**nam**	तार	**tar**
दी	**dɪ**	सन	**sʌn**

APPENDIX D

Hindi PB Word List #2

और	ɐʊr	उन	ʊn
थी	thi	हम	hʌm
तो	toʊ	देश	deɪʃ
भी	bhi	चार	tʃar
न	nʌ	कम	kʌm
कुछ	kʊtʃh	देख	deɪkh
यह	jʌhe	काल	kʌl
ही	hi	किस	kɪs
मै	maɪ	जान	dʒan
जब	dʒʌb	भाव	bhʌv
जा	dʒa	बीस	bis
उस	ʊs	हाथ	hath
आप	ap	रह	rʌhe
या	ja	गत	gʌt
लोग	loʊg	सिर	sɪr
पर	pʌr	कब	kʌb
इन	ɪn	मान	man
काम	kam	स्त्री	stʃi
दिन	dɪn	तेल	teɪl
आज	adʒ	सात	sat
दो	doʊ	पार	par
की	ki	काल	kal
ये	jeɪ	धूप	dhup
व	vʌ	शेष	ʃeɪʃ
चल	tʃʌl	अन्त	ʌnt

APPENDIX E

This table indicates the actual frequency each phoneme occurs in each PB word list.

Phoneme	List 1	List 2	Phoneme	List 1	List 2
ʌ	14	17	o	3	3
a	10	13	v	3	2
k	8	10	d	5	3
r	8	9	dʒ	3	2
e	7	9	ʃ	2	2
n	8	7	g	2	2
t	7	6	p	4	4
ɪ	6	4	aɪ	1	1
i	5	6	b	2	1
s	5	7	o	0	1
m	4	5	tʃ	1	1
h	4	5	th	3	1
j	3	3	bh	1	1
l	4	3	aʊ	2	1
ʊ	3	2	dh	1	1
u	0	1	tʃh	1	1
			kh	1	1

APPENDIX F

Following are the scores representing the correct results of the two administrations of the Hindi PB word lists, given at least two weeks apart.

	Session 1		Session 2	
Subjects	List 1	List 2	List 1	List 2
1	49	48	49	48
2	47	48	47	49
3	49	49	49	49
4	47	48	47	48
5	49	49	49	49
6	49	49	50	50
7	50	50	50	50
8	50	49	50	49
9	49	49	49	49
10	50	50	50	50
11	47	48	48	48
12	48	48	48	48
13	47	48	48	48
14	48	48	49	48
15	50	49	50	49
16	48	48	48	48
17	48	48	49	48
18	49	48	49	49
19	49	49	50	49
20	48	48	48	48
21	47	49	48	49
22	49	49	49	49
23	49	48	49	49
24	48	47	48	48
25	47	47	48	47
26	50	50	50	50
27	47	47	47	47
28	49	49	50	49
29	48	47	49	48
30	47	48	48	49