The development of Malay speech audiometry

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Abstract

Speech audiometry is a method for assessing the ability of the auditory system using speech sounds as stimuli. A list of phonemically balanced bisyllabic consonant-vowel-consonant-vowel (c-v-c-v) Malay words was produced. All the bisyllabic words (c-v-c-v) thought to be commonly used in everyday conversations were listed from the Dewan Bahasa dictionary and their suitability assessed. The chosen words were divided into 25 groups containing 10 words each. The list was then recorded by a professional male newscaster in a sound proof studio. A normal speech audiometry curve was obtained by testing 60 normal hearing subjects using the prerecorded speech material. The result of the study showed that the normal Malay speech audiometry curve was comparable to those of English and Arabic speech audiometry, in which it was sigmoidal with the optimum discrimination score of 40 dB and half peak level of 17.5 dB.

Key words: Phonemically balanced, Malay speech audiometry

Introduction

Speech audiometry is a technique whereby a standardized samples of speech material are presented through a calibrated system to assess the function of hearing ability. In this test, the test subject is to repeat the words audible to him. Therefore a better picture on the subject's communication ability is obtained. Other purposes of speech audiometry include detection of inorganic hearing loss, determination of types of hearing impairment and selection of hearing aid.

In developed countries speech audiometry has been available since the 1950s. In Malaysia, where a large percentage of the population is non-English speaking, the use of the test samples in the English language is obviously impractical. Hong (1984) introduced bisyllabic Malay word lists for speech audiometry. However it is not phonemically balanced. As speech audiometry is proven to be useful in many conditions, this study was undertaken to produce phonemically balanced bisyllabic Malay word lists, so that this test will be available to the practicing local otolaryngologists.

Material and methods

i) Construction of word lists

In constructing the Malay word list for speech audiometry, bisyllabic words with consonant-vowel-consonant-vowel (c-v-c-v) structure were used. The decision was made as a great percentage of Malay words are of this type. A total of 405 bisyllabic (c-v-c-v) words which were thought to be commonly used in daily conversations were listed from the Dewan Bahasa

dictionary. The list was given to 150 adults of different races of Malaysian nationality to assess the suitability in term of familiarity. One hundred and ninety six words were rated as appropriate for use.

The phonemic system of Malay language consist of 25 consonants; b,c,d,f,g,h,j,k,l,m,n,p,q,r,s,t,w,y,z,dh,gh,kh,sh,th,ng,ny, 6 short vowels; a,e,e,i,o,u and 6 diphthongs; ai,ia,au,ua, oi and io. However in developing the word list, certain phonemes were excluded. The phonemes f,sh,z,oi and io were omitted due to the low frequency of occurrence. The phonemes dh,gh,kh and th were not included as in daily use they are very frequently pronounced as d,g,k and s respectively.

Using the one hundred and ninety six selected words, twenty five different groups of word were produced, each containing the 28 selected phonemes to form 10 c-v-c-v words.

ii) Recording procedure.

The recording of the speech material was done in a sound proof studio (Rediffusion) using The Neuman microphone connected to Studer 2 tracks recorder. The words were spoken by a professional male newscaster using standard accent at the rate of 1 word in 5 seconds. The speech was delivered at a constant loudness and steady tone. The consistency of the speech level was determined by the sound level meter Castle GA 202 placed at the same level with the microphone. At the end of the recording, correction was made by adjusting the amplifier equalization circuit so that all the words appear at the same level (± 5dB). For calibration purpose, a 1000 Hz tone of 30 seconds was recorded at the beginning of the tape at the average level of the recorded words.

iii) Interlist intelligibility difference.

The lists were first tested for interlist intelligibility difference to ensure that they are of the same clarity. This was assessed by testing 12 normal hearing subjects using all the 25 groups of words presented at a constant intensity. In this procedure the prerecorded test material was delivered through the Amplaid 309 audiometer equipped with Pioneer CT 111 cassette player and TDH 49 headphones. The loudness of the speech material was set at 10 dB above the subject's average hearing thresholds at 0.5, 1 and 2 KHz. The mean scores of each group were then evaluated using the test for analysis of variance.

iv) Normal speech audiometry curve.

The normal speech audiometry curve was obtained by testing 60 normal hearing adults whose Malay was good. The randomly selected word lists were delivered monoaurally through the headphones. The subjects were instructed to listen and repeat the spoken word heard. The test material was presented at 5 dB and increased stepwise by 5 dB until the subject reached the maximum score of 100 percent or very near to this value. Phonemic scoring was used, whereby a mark of 2.5% was given for each correctly repeated phoneme. The normal discrimination curve was obtained by plotting the maximum score as a function of speech level.

Results

i) Phonemically balanced bisyllabic Malay word lists.

Table I showed the 25 phonemically balanced bisyllabic word lists produced in this study. Close examination of those lists showed that almost each of them contained all the 27 selected phonemes. The lists were therefore phonemically balanced in the sense that each group contained all the selected phonemes. The frequency of occurrence of the consonants and vowels were shown in Tables II and III respectively.

Table I
The phonemically balanced bisyllabic malay (c-v-c-v) word lists

1	2	3	4	5	6	7	8	9
halia	keju	duta	bangau	roti	dawai	tanya	gusi	boria
goda	semai	hawa	cerai	pisau	yoga	singa	capai	sungai
wangi	hirau	leka	juara	kayu	semua	hawa	jiwa	teko
topi	buaya	renyai	mulia	tanya	ngeri	loya	bunyi	sunyi
cukai	nyata	sengau	nyawa	ngilu	teko	tiada	dangau	payau
risau	ngilu	bayu	topi	cukai	bunyi	beca	mulia	tuala
jemu	nota	siapa	sayu	sedia	piala	panau	nota	gema
lena	piala	guni	dosa	meja	silau	muara	ketua	dahi
sunyi	dagu	cuaca	leka	halus	canai	kedai	loya	canai
buaya	ciku	loji	hina	bagi	haji	joli	hari	soda

10	11	12	13	14	15	16	17
belia	lori	roti	dawai	belia	kacau	tauge	lena
suara	kota	pisau	teko	dahi	nyawa	kayu	gulai
jeti	wangi	kayu	ngeri	suara	semua	dawai	penyu
ramai	suami	tanya	bunyi	piatu	tunai	bunyi	bunga
yoga	hijau	ngilu	puasa	kecai	bunga	piala	kacau
punya	bagai	cukai	limau	bangau	hobi	roti	rayu
wangi	penyu	sedia	halia	nyonya	desa	semua	hobi
hina	beca	meja	juga	guni	peria	bunga	dosa
kacau	layu	halus	sayu	maju	gaya	haji	jamu
soda	dunia	bagi	canai	rayu	laju	cina	hina

18	19	20	21	22	23	24	25
beli	buaya	roti	bunga	nyata	suria	dangau	dewi
tirai	nyawa	bunyi	nyiru	singa	bena	gerai	penyu
kicau	dagu	hoki	damai	piano	loji	punya	bunga
roma	singa	sengau	petua	bola	petua	kota	kota
dungu	hijau	lena	kacau	cuti	walau	lori	suara
puasa	tupai	gadai	loya	gerai	hanya	sewa	nilai
dunia	mulia	mulia	sewa	semua	gadai	suami	hijau
nyawa	leka	cuaca	guni	hijau	kaya	biaya	mulia
gaya	nota	jawi	piatu	dewa	singa	haji	yoga
haji	cerai	paya	haji	kayu	cuma	cina	suci

ii) Interlist intelligibility difference.

The test for analysis of variance done on the mean maximum score of each group (delivered at constant level) showed that there was no significant intelligibility difference between them ($p > 0.05$). The influence of the list factor over the test result was therefore negligible. The mean maximum scores and standard deviations of mean of each group obtained by testing the 12 normal hearing subjects were presented in Table IV.

iii) Normal speech discrimination curve.

The mean scores and the standard deviations of mean as a function of intensity for the speech audiometry done on 60 normal hearing subjects were shown in Table V. The normal speech audiometry curve, as shown in Figure 1 was sigmoidal. The optimum discrimination score was

Table II
The frequency of occurrence of the consonants in the Malay word lists

Consonant	Frequency (%)
b	6
c	5.4
d	5.6
g	4.6
h	5.2
j	5
k	5.6
l	8.2
m	4.8
n	4.8
p	5
r	6.2
s	7.6
t	6.8
w	4
y	5
ny	5.2
ng	5
Total	**100**

Table III
The frequency of occurrence of the vowel system in the Malay word lists

Vowel	Frequency (%)
a	3.6
i	15.4
u	13.4
e	6
e	4.4
o	7.6
ia	5
ai	5.8
ua	4.6
au	5.2
Total	**100**

Table IV
The mean score and standard deviation for the 25 groups of words presented at a constant level

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Mean score	85	86.4	85	84.6	85	84.6	85.8	86.4	86.7	86	85.8	86	84.8	83.5	84.6	85.8	87.7	87.9	84.6	84.6	85.8	86.2	85	85.6	85.8
Std deviation	8.8	6.6	9.4	8.4	8.7	8.5	9.2	9.3	7.6	9.1	9.2	6.8	9.7	8.3	7.9	7.8	6.2	7.5	10.2	10.3	8.3	8.1	7.2	9.5	8.1

at 40 dB speech level and the speech discrimination threshold which is the speech level for the 50% score is 17.5 dB.

Discussion

This study shows that Malay speech audiometry is comparable with those of English (A.Boothroyd 1967), and Arabic (Ashoor & Prochazka 1982). The use of phonemically balanced word list is essential in assessing speech discrimination problem due to frequency specificity of phoneme system. Phonemic scoring is generally preferred over word scoring as it helps in increasing the number of test items and thus reducing the test score variability.

A close examination of Table V shows that the standard deviation for speech discrimination threshold (50% score) is disturbingly high i.e 22.3%. However it should be remembered that the gradient of the speech curve at that point is 4% per dB. Therefore, a standard deviation of 22.3% is equivalent to 5.5 dB. This is comparable with the inter test difference for pure tone audiometry which is 5 dB.

Table V
Mean score and standard deviation as a function of speech level (N 60)

Intensity (db)	Mean score (%)	Standard deviation
0	0	0
5	0	0
10	7.1	11.5
15	34.4	22.3
20	64.6	21.2
25	86	18.2
30	94.5	2.2
35	98.2	2.3
40	99.8	0.9
45	99.9	0.7

Although this test can be considered accurate in the assessment of hearing ability, it is by no mean an ideal test. In addition to the hearing status, the test results are influenced by many factors, namely speech problems, memory and knowledge on the language used. Therefor, all the above mentioned factors must be considered before any conclusion on the test result can be made.

Another point to remember is that, like in pure tone audiometry it is possible that the non-test ear can respond to speech signal due to cross over of information. The inter-aural attenuation for speech is approximately 50 dB (Liden et al., 1959; Smith and Markides, 1981). Masking using wide band noise is therefore indicated when the speech level exceed the bone conduction threshold of the non-test ear by 50 dB or more. As stated by Tucker and Nolan (1984) the effective masking level for speech audiometry is determined by the formula;

$X = Y - (50 + Z) + 20$ dB

where, X = masking signal level

Z = bone conduction threshold of the non-test ear

50 = transcranial attenuation for speech

20 = correction factor to ensure effective masking.

Conclusion

A list of phonemically balanced bisyllabic Malay words were produced and tested. Given that its limitations were recognized, speech audiometry was found to be an accurate test for hearing assessment.

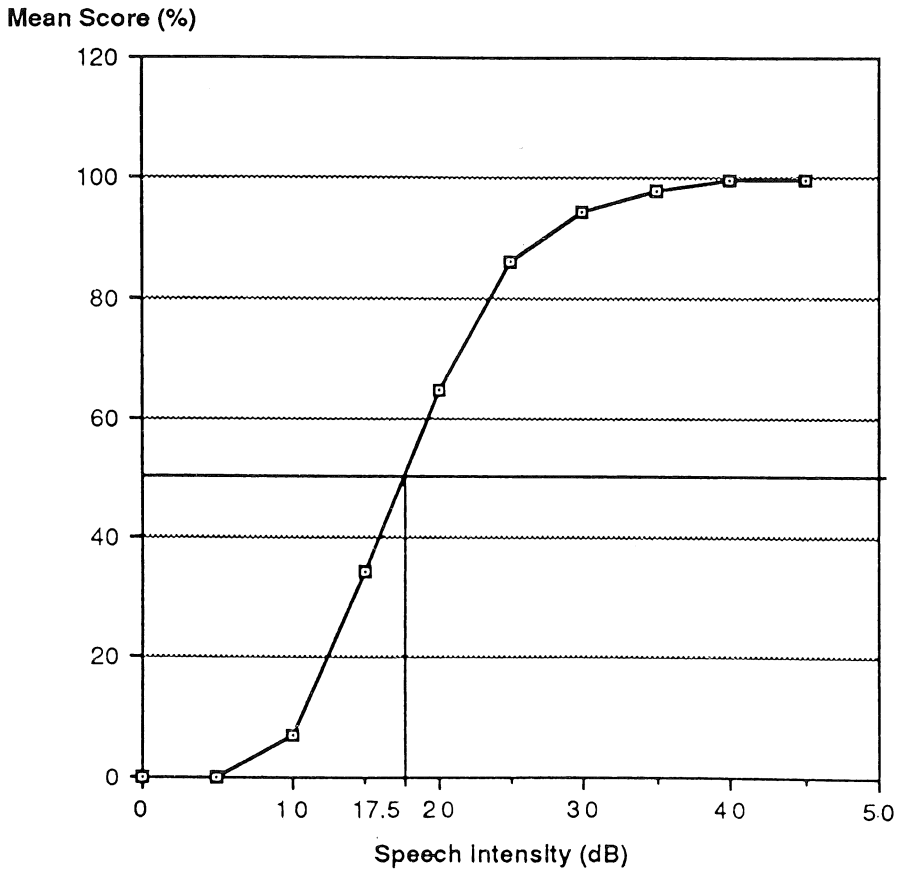

Fig. 1 : The normal Malay speech audiometry curve

Note:

The copy of the speech material is obtainable from the Department of Otorhinolaryngology, Faculty of Medicine, University Kebangsaan Malaysia at $50.00 each. Payment should be made by money order/cheque payable to the Bendahari of UKM.

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References

1. Ashoor, A. & Prochazka, t. (1982). Saudi Arabic Speech Audiometry; Audiology 21 (493-508).
2. Hong, C. (1984). Bisyllabic Malay Word Lists for Speech Audiometry; Medical Journal of Malaysia 39:3 (197-204)
3. Hong, C. (1984). Bisyllabic Malay word Lists for Speech Audiometry; Medical Journal of Malaysia 39:3 (197–204).
4. Liden, G., Nilsson, G. and Anderson,H. (1959). Masking in Clinical Audiometry; Acta Otolaryngology 50 (125-129).
5. Smith, B.L. and Markides, A. (1981). Interaural attenuation for puretones and speech; British Journal of Audiology 15, 49-54.
6. Tucker,I. and Nolan,M. (1984). Diagnosis of Hearing Impairment. Educational Audiology. Crom Helm. London.