==========
Language in India www.languageinindia.com ISSN 1930-2940 Vol. 24:5 May 2024
==========

Phonological Impairments in Malayalam Speaking Broca's Aphasics

Mansoor Varamangalath
Medical Speech Language Pathologist, Tawam Hospital, Alain, Abu Dhabi, UAE. mansoor.karakkad@gmail.com

Dr Swapna Sebastian
Corresponding Author
Professor (Audiology and Speech Pathology), Department of Otorhinolaryngology, Christian Medical College & Hospital, Vellore, Tamilnadu, India-632004
swapnasanthoshchris@gmail.com

==========

Aphasia is an acquired language disorder due to brain damage that affects the production and comprehension of spoken and written language in varying degrees and patterns depending on the size and site of the lesion (1)

Errors in speech production have been reported among aphasics (2). Errors in production can be either phonemic, involving language-based deformations, or phonetic, involving a motor planning deficit.

The deficits can be said to be at the phonological level when the incorrect phonological form of the word is selected but is implemented correctly, and at the phonetic level when the correct sound segments are selected but articulatory implementation is impaired. Phonetic deficits are not linguistic (3). Most aphasics produce phonological errors in their speech in the form of substitution, omission, addition, or distortion (neologism), which are called "phonemic" (or "literal") paraphasias. Aphasia research on the nature of phonological breakdown as to whether the deficit is phonetic or phonemic in the different aphasia syndromes reveals contradictory results. (4)

Broca's aphasia is characterized by nonfluent, effortful speech production, semantic and phonemic paraphasias, articulatory errors, agrammatism, relatively preserved comprehension, poor repetition, reading, and writing ability(5)

Methodology

The aim of the present study was to investigate the phonological impairments in Malayalam speaking Broca's aphasics.

Procedure

The study was approved by the research ethics committee of the Institution and informed consent were taken from the patients. In-order to achieve the above goals, study was conducted on 2 groups of subjects - experimental group and control group.

Experimental Group-

Experimental group consisted of ten participants – 7 males and 3 females , who were right handed diagnosed as Broca's aphasia between the age range of 50-80 years with a mean age of 64.3 years.All the subjects were evaluated by a Neurologist and a Speech Language Pathologist.Participants with a history of single episode of stroke and no pre morbid neurological, sensory or motor problems were only included in the study.Western Aphasia Battery (WAB) was administered on all the aphasics and the Aphasia quotient were found out.

The profile of broca's aphasics were shown in the table-1

Sl. No	Age in years	Sex	WAB scores (AQ)
1	57	M	15.6
2	59	F	15.9
3	66	M	19
4	74	M	16.6
5	58	F	15.1
6	63	M	18.8
7	80	M	15.2
8	79	F	17.6
9	72	M	15.1
10	67	M	16.4

Control Group-

Control group consisted of 10 normal participants matched for age, gender , education, dexterity and language.

Both the control and experimental groups were tested using Test for Phonemic variations in Malayalam (6)

This test has two parts.

1. Minimal pair discrimination - The stimuli were presented to the subjects and the subjects were instructed to indicate 'yes' for minimal pairs and 'no' if not.
2. Minimal pair Repetition - The examiner orally presented the items and subjects were asked to repeat them.

Minimal pair discrimination Task consisted of 4 subtests -

1. Non word minimal pair
2. Word minimal pair
3. Word minimal pair requiring written selection
4. Word minimal pair requiring picture selection

For each subtest, there were five set of words. Among each set, there were four pair of words including a minimal pair.

For the 1st & 2nd subtests, pair of words were presented orally and in the 3rd subtest, stimuli were provided in the written form in a chart. In the 4th subtest, stimuli used were drawn colour pictures.

Minimal Pair Repetition Task:
Consisted of the following subtests

1. Syllable length
2. Non words
3. Imagible & frequent words
4. Grammatical class
5. Morphological endings
6. Sentences

For the repetition task there were 5 items in each subtest. In the first subtest, there were five words including a one syllable word, two syllable word , three syllable word, four syllable word and five syllable word. In the 2nd subtest, five non words were selected. For the 3rd subtest, five Imagible and most frequently used words were used. In the 4th subtest, five words from several grammatical classes were selected. In the 5th subtest, five morphologically ending words were chosen. And in the 6th subtest, there were five sentences starting from two word sentence to six word sentence.

Procedure for minimal pair discrimination task: The stimuli were presented to the subjects and the subjects were instructed to indicate 'yes' for minimal pairs and 'no' for other stimuli.

Procedure for repetition task: The examiner orally presents the items and subjects were asked to repeat them.

Scoring

A score of 1 was given for correct responses and 0 for incorrect responses.

The total score for minimal pair task was and repetition tasks were 20 each.

Statistical Analysis

Using the SPSS software, mean and standard deviation was calculated and "t" test was done to analyse the significance of difference between the control and the experimental groups.

Results and Discussion

Mean and standard deviation were calculated for the different subtests.Brocas aphasic's had a total mean score of 72.5 with SD of 8.891 .

Eventhough the Brocas aphasics scored better in minimal pair discrimination task (total mean score of 181 and SD of 7.64 their scores were poor for the repetition tasks (total mean score of 0.16 and SD of 0.37) In the minimal pair discrimination task, for the non words a mean of 17.6 and SD 0.916 was obtained and for the words 19.4(SD= 1.2) for written selection and picture, 17.9 (SD=0.94) and 17.5 (SD=0.5) respectively .

For the repetition task, in the repetition of syllable length mean was 0.1and SD was 0.3. The mean and SD obtained for all other tasks were 0.

The normal subjects scored 20 with a standard deviation of zero for both both minimal pair discrimination task and minimal pair repetition task.

The mean and standard deviation of both the normal subjects and Broca's aphasics in the minimal pair task is shown in table 1.

	NON-WORD		WORD		WRITTEN SELECTION		PICTURE	
	Brocas Aphasics	Normal	Brocas Aphasics	Normal	Brocas Aphasics	Normal	Brocas Aphasics	Normal
MEAN	17.6	20	19.4	20	17.9	20	17.5	20
SD	0.916	0	1.2	0	0.943	0	0.5	0

TABLE 1- The mean and standard deviation of the normal subjects and Broca's aphasics in the minimal pair task

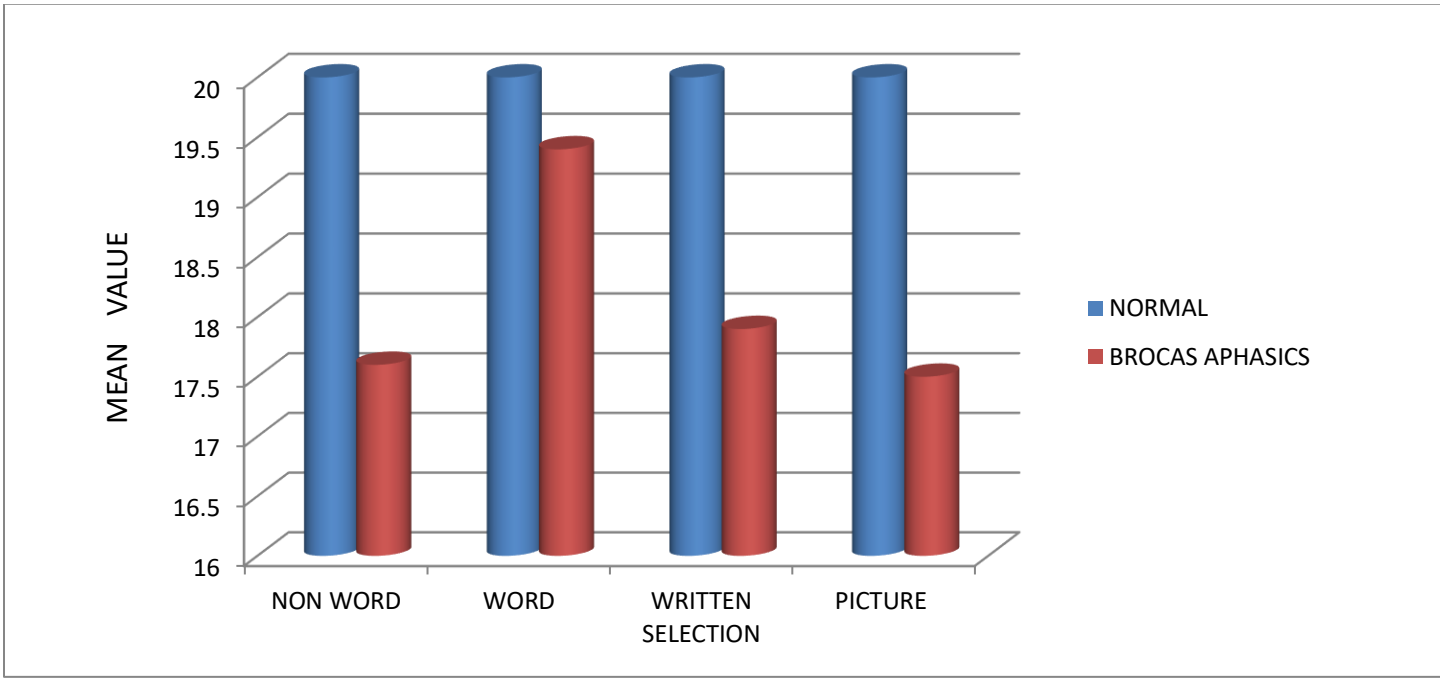

Fig 1- The mean and standard deviation of both the normal subjects and Broca's aphasics in the minimal pair task

The scores obtained by the Broca's aphasics were compared with that of age and sex matched normal. Results of t test reveals that there is a significant difference between the brocas aphasic group and normal group in all the tasks other than minimal pair word discrimination.

TABLE 2 – COMPARISON BETWEEN BROCA'S APHASICS & NORMAL GROUP ON DISCRIMINATION MINIMAL PAIR.

(In the table, S indicates significant and NS indicates not significant)

TASKS	**VARIABLE**	**'T' VALUE**	**'P' VALUE**	**S/NS**
NON-WORD	Aphasics Vs Normal	7.855	3.17	S
WORD	Aphasics Vs Normal	1.5	0.15	NS
WRITTEN SELECTION	Aphasics Vs Normal	6.677	2.89	S
PICTURE	Aphasics Vs Normal	15	1..28	S

The mean and standard deviation of both the normal group and Broca's aphasics in the repetition task were calculated and shown in table 3.

TABLE 3- THE MEAN & STANDARD DEVIATION FOR BROCA'S APHASICS & NORMAL GROUP IN REPETITION TASK.(In the table, BA indicates broca's aphasics and N indicates normal group)

	Syllable length		Non –word		Imagibility and frequency words		Grammatical class		Morphological ending		Sentence	
	BA	N	BA	N	BA	N	BA	N	BA	N	BA	N
Mean	0.1	5	0	5	0	5	0	5	0	5	0	20
SD	0.3	0	0	0	0	0	0	0	0	0	0	0

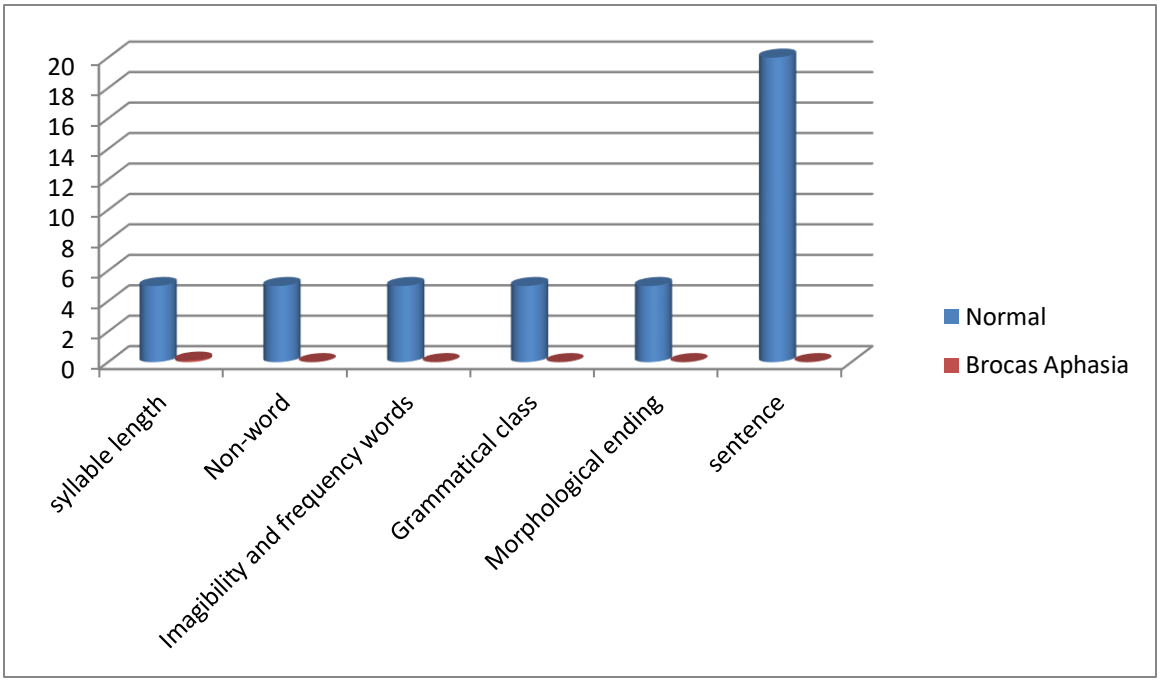

Fig 2- THE MEAN OF BROCA'S AHASICS & NORMAL GROUP ON REPETITION TASK.

The scores obtained by the Broca's aphasics were compared with that of age and sex matched normal for the repetition task. Results of t test reveals that there is a significant difference between the brocas aphasic group and normal group in all the tasks.

TABLE 4 .COMPARISON BETWEEN BROCA'S APHASICS & NORMAL GROUP ON REPETITION TASKS.

(In the table S indicates significant and NS indicates not significant)

TASKS	**VARIABLE**	**'T' VALUE**	**'P' VALUE**	**S/NS**
Syllable length	Aphasics Vs Normal	49	0	S
Non –word	Aphasics Vs	0	0	S

	Normal			
Imagibility and frequency words	Aphasics Vs Normal	0	0	S
Gramatical class	Aphasics Vs Normal	0	0	S
Morphological ending	Aphasics Vs Normal	0	0	S
Sentence	Aphasics Vs Normal	0	0	S

Qualitative analysis was also done to find out the phonemic variations in Malayalam speaking Broca's aphasics. Stretching errors were most frequent as compared to other phonemic variations. About 60% of Broca's aphasics in the present study showed stretching errors and elisions followed by assimilation errors by 40% , by liason errors by 30% and clipping errors by 20 %.

The phonemic variations evident in Broca's aphasics for the repetition task are shown in Table 5.

TABLE 5: PHONEMIC VARIATIONS IN BROCA'S APHASICS

BROCA'S APHASICS	**PHONEMIC VARIATIONS**				
SL.NO	No. of assimilations	No. of elisions	No. of liaisons	No. of clipping	No. of stretching
1	-	-	-	-	-
2	-	-	-	-	1
3	-	-	-	-	1
4	1	1	1	1	-
5	-	1	1	-	2
6	-	2	-	-	-
7	1	-	-	-	-
8	-	1	-	-	2
9	1	1	-	-	2
10	1	1	1	1	2
TOTAL	4	7	3	2	10

The following graphs show the number of phonemic variations exhibited by each patients (graph 4 to 13). The patient 1 showed no phonemic variations but shows articulatory errors like addition and substitution.

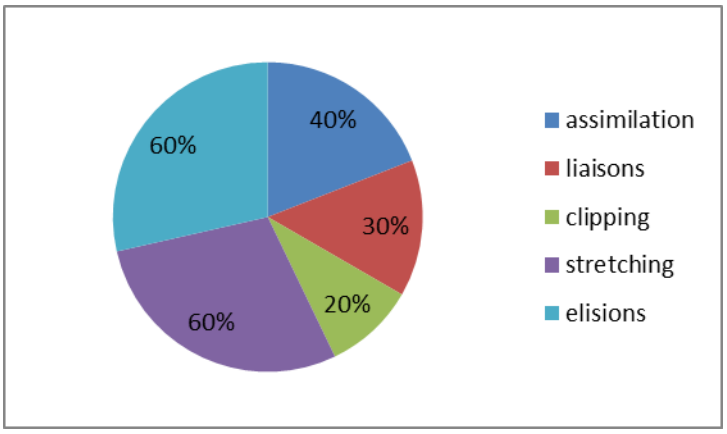

Fig 3- PERCENTAGE OF BROCA'S APHASICS SHOWING PHONEMIC VARIATIONS.

The following table shows the examples of phonemic variations shown by the broca's aphasics in the present study.

TABLE 5- PHONEMIC VARIATIONS SHOWN BY THE BROCA'S APHASICS.

CLIPPING	
Target response	***Obtained response***
ʈaʈʈa	ʈəʈʈa
pa:lum	pa:ɤə pələ
STRETCHING	
a:geja:l	a:ɖə
aɖukala	a:la
aɖukala	a:ɖə ʈa:ma
a:na	a:ɤə poɤə
aɖukala	a:lə
ʈala	a:lə
a:na	a:pə pa:pa
ammajuɖe	a: mə pa:ʈə ʈa:l
ʈaʈʈa	a: ʈappəɤə
ammajuɖe	a: mə pəɤə
ELISION	
a:na	a:
mulagəpoɖi	pə ppu:ʈə
mulagəpoɖi	məpa:ɤə
a:geja:l	a:l

puːvə	pə pə
mulagəpoḍi	ma ma ma poḍi
ṭala	ṭa
ASSIMILATION	
puːvə	pu pə pə pu pə piɤe
puːvə	pu pə pə
saʃʌm	ʃʌ ʃʌ
puːʧa	puːṭa
LIAISION	
aːna	aːɤə
aːna	aːɤəpə
aːna	aːpəɤənə

Discussion

The results reveal that the Brocas aphasics performed in par with their normal controls in minimal pair discrimination task but **showed significantly poorer performance in production of the phonemes**.The results points that there is no direct relation between difficulty in producing phonemes and auditory discrimination. Hence the phonological errors does not seem to be related to a difficulty in a perceptual level of phonemic discrimination.

Responses on repetition task by the Brocas aphasics revealed assimilation, clipping, liaison, stretching, and elisions which suggests that phonemic variations are also seen in the speech output of Broca's Aphasics, along with phonetic (dysarthric)errors. The fact that our patients showed both phonetic and phonemic errors in the speech output is indicative of both a linguistic as well as articulatory impairment . Phonological errors have been reported in Broca's aphasia by earlier researchers (7). The phonetic errors can be attributed to an impairment of motor control, and the phonemic errors can be attributed to impairment of the mental representation of the phoneme within the lexicon which could be related to the verbal and working memory deficits. Studies have pointed towards the role of verbal and working memory in the access to phonological representations.(8).The results are indicative of the role of cognition in language .It is important to assess the cognitive skills related to language processing and use cognitive rehabilitation strategies in the management of Aphasia.

Summary and Conclusion

There is no direct relation between difficulty in producing phonemes and auditory discrimination in Brocas aphasics. The fact that our patients showed both phonetic and phonemic errors in the speech output is indicative of both a linguistic as well as articulatory impairment . The phonetic errors can be attributed to an impairment of motor control, and the phonemic errors can be attributed to impairment of the mental representation of the phoneme within the lexicon .

Limititations

Sample size was small and the intratester and intertester reliabilities were not assessed

==========

References

1. Salis C, Edwards S. Aphasia. Oxford Bibliographies: Linguistics. 2015.

2. Ash S, McMillan C, Gunawardena D, Avants B, Morgan B, Khan A, Moore P, Gee J, Grossman M. Speech errors in progressive non-fluent aphasia. Brain Lang. 2010 Apr;113(1):13-20. doi: 10.1016/j.bandl.2009.12.001. Epub 2010 Jan 13. PMID: 20074786; PMCID: PMC2839014.

3. Blumstein SE. Impairments of speech production and speech perception in aphasia. Philos Trans R Soc Lond B Biol Sci. 1994;346(1315):29–36.

4. Kohn SE. Phonological production deficits in aphasia. In: Phonological processes and brain mechanisms. Springer; 1988. p. 93–117.

5. Lada A. Kemenoff, Bruce L. Miller, Joel H. Kramer, Frontal Lobe, Editor(s): V.S. Ramachandran,Encyclopedia of the Human Brain, Academic Press, 2002, Pages 317-325, ISBN 9780122272103, https://doi.org/10.1016/B0-12-227210-2/00148-5. In.

6. Mansoor V, Swapna Sebastian (2013). Test for Phonemic variations in Malayalam, An unpublished Masters Dissertation,Kerala University of Health Sciences.

7. Wardana IK, Suparwa IN, Budiarsa M. Phonological Errors on Impaired Language Modality Produced by Individuals with Broca's Aphasia. Int J Linguist. 2018;10(6).

8. Grigol C, Bauer M, Brandão L. Expressive Aphasia: Reporting a Phonological Retrieval Hypothesis for Auditory Verbal Memory Deficits. J Neurol Stroke. 2017;7(3):00241.

==========

Acknowledgement

The authors would like to thank The Tamil Nadu Dr. M.G.R. Medical University for the support.

==========

APPENDIX 1

A) Morphophonemic structure

1) /ɲa:n pʊsɵagaɵɪl no:kɪ vajɪtʃʊ/
2) /kʊtti kasærajil ɪrɪkʊnnʊ/
3) /avaɭ pʊɜaɵil ɪraŋɪ/
4) /Pu:və ɵæn ʊndə/
5) /ra:mʊ paʂʊvɪtɛ kajarɪl pɪdɪtʃʊ/
6) /avaɭ vi:ttɪl po:jɪ/
7) /pakʃɪkaɭ ku:ttil ʊndə/
8) /kʊtti pʊsɵagaɵɪl ɛɜʊðʊnnʊ/
9) / kʊttigaɭ pu:kkaɭ parɪkkʊnnʊ/
10) /kʊttajil ma:ŋagal undə/
11) /mi:n veɭaɵɪl ni:ðʊnnu/
12) /kʊtti basil kajarʊnnʊ/

B) Plurals

13) / kʊttigaɭ pu:kaɭ parikkʊnnʊ/
14) /ammagaɭ ɵʊɳigaɭ alakkʊnnʊ/
15) /ɲaŋaɭma:r ɪnnalɛ po:jɪ/
16) /avar maraŋaɭ vɛttʊnnʊ/
17) /niŋaɭgaɭ na:ɭɛ varaɳam/
18) /pʊrʊʃanma:r paɳɪ ɛdʊkkʊnnʊ/
19) /kʊttɪgaɭ pa:ttə pa:dʊnnʊ/
20) /kuttigaɭ karajʊnnʊ/
21) /a:ɭʊgaɭ bakʃaɳam kaɜɪkkʊnnʊ/
22) /vandikaɭ ro:dɪlu:dɛ po:gʊnnʊ/
23) /pakʃɪkaɭ parakkʊnnʊ/
24) /mi:nʊgaɭ ni:ðʊnnʊ/

C) Tenses

25)/ɲaːŋ naːlɛ poːgʊm/
26)/ɲaːŋl naːlɛ vannʊ/
27)/ɪnnalɛ skuːl næraɵɛ vɪdʊm/
28)/ɪnnə ɲaːn sinimakʊ poːkʊm/
29)/ɲaːn ɪnnalɛ paditʃʊ/
30)/avar mattannaːl kandʊ/
31)/kʊtti bakʃaɳam kaɜɪkkʊnnʊ/
32)/suːrjan ʊðɪkkʊnnʊ/
33)/kʊttɪ ʊrakkaɵɵɪl nɪnnʊ ɛɜʊnælkkʊnnʊ/
34)/kʊttɪ tɪvɪ kaɳʊnnʊ/
35)/avan mʌram vɛttɪ/
36)/pɛɳkʊtti pʊsɵagam vajikkʊnnʊ/

D) Agreement

37)/paːbə avanɛ kaditʃʊ/
38)/kʊttɪ pattijɛ kadɪtʃʊ/
39)/avan miːn pɪditʃʊ/
40)/pʊɜa siːðajɪl ɪraŋɪ/
41)/kʊda kʊttɪjɪl nɪnnʊ/
42)/ramanɛ vandɪ ɪdɪtʃʊ/
43)/kʊttɪ kʊda pɪdɪtʃʊ nɪlkʊnnʊ/
44)/ajaɭ seikkɪɭ oːdɪkkʊnnʊ/
45)/avan maɜa nanajʊnnʊ/
46)/ajaɭ kaɵə poːst tʃɛjʊnnʊ/
47)/ɪðə roːsaːppʊːvɪntɛ tʃɪɵaraːɳə/
48)/puːtʃa mæṣajʊdɛ mʊgaɭɭɪl ɪrɪkkʊnnʊ/

E) Case markers

49)/pʊsɵagaɵɪntɛ tʃattajʊdɛ nɪram karʊppaɳə/

50)/ɪðə ra:mʊ tʃɛrɪppaɳə/

51)/pʊsɵagaɵɪl maɜavɪlɪntɛ tʃɪɵramʊndə/

52)/pa:mbə ra:mana:l kɔllappɛttʊ/

53)/pʊllə paʂʊ ɵɪnnappɛttʊ/

54)/avarʊdɛ pakkal ʊndə/

55)/ a:ɳkʊttɪjʊdɛ kajɪl va:tʃə kɛttɪjittʊdə/

56)/avan pʊsɵagaɵɪl ɛɜʊðʊnnʊ/

57)/pæna pʊsɵagaɵɪntɛ mʊgaɭɪl ʊndə/

58)/vi:dɪntɛ mʊnpɪl pu:kkaɭʊdə/

59)/kʊttajɪl a:ppɪɭʊgaɭ ʊndə/

60)/kʊttɪ maraɵɪl kajarʊnnʊ/

F) Conjunctives & Quotatives

61)/kʊtʃælanʊm ra:manʊm ku:ttʊka:ra:ɳə/

62)/ɛlla:varæjʊm ku:dɪ kalja:ɳaɵɪnnʊ varaɳam/

63)/si:ðajʊm ra:manʊm samma:nam kɪttɪ/

64)/ɲa:n avaɭlæjʊm ku:ttɪ vara:m/

65)/ɪnnə ʊtʃajo:də ku:ttɪ parɪpa:dɪ samapɪkkʊm/

66)/ɪnnə ra:vɪlæ a:rə mʊðal vaiki:ttə a:rə varɛja:ɳə samaram/

67)/a:ɳkuttɪɪjʊm pɛɳkʊttɪjʊm pʊsɵagam va:jɪkkʊnnʊ/

68)/atʃanʊm kʊttijʊm patʃakkarɪ vaŋʊnnʊ/

69)/kʊttajɪl o:radɜʊm a:ppɪɭʊm ʊndə/

70)/atʃanʊm kʊttijʊm seikkɪɭ tʃavɪttʊnnʊ/

71)/ammajʊm kʊttijʊm ʊraŋʊnnʊ/

72)/pattijʊm pu:tʃajʊm ɵallə ku:dʊnnʊ/