

Development of Revised Token Test in Malayalam

Lincy Mary Varghese¹ & S.P.Goswami²

Abstract

Aphasia is a multifaceted disorder. Many authors classified aphasia from different perspectives. Though mostly considered as a disorder of expression, aphasia encompasses a disorder of comprehension as an inability to understand linguistic utterances, which cannot be attributed to deficient sensory input or generalized cognitive deficits. Token test is a test which can be used to assess the subtle comprehension deficits in brain damaged individuals. It is an accurate and sensitive indicator of the presence of aphasia. The current study focused on developing Revised Token Test in Malayalam (RTT-M). Experimental participants were brain damaged adults (n=9) and controls were normal adults (n=40). Results revealed that as the complexity of the commands increased the performance decreased. Similarly older adults performed poorer compared to younger adults. Normal participants were better in comprehension as compared to the persons with aphasia on all subtests I to X. Factors such as sentence length, linguistic complexity, grammatical usage and number of critical stimulus in the commands influenced the test results.

Key words: aphasia, Revised Token Test- Malayalam

Aphasia is the loss or impairment of language function caused by brain damage (Benson & Ardila, 1996). Many authors describe the same phenomena from a different angle and in fact they rather than contradict each other (Kertesz, 1979). Different investigators classified aphasia differently. Rosenbek, La Pointe and Wertz (1989) defined disorder of comprehension as an inability to understand linguistic utterances, which cannot be attributed to deficient sensory input or generalized cognitive deficits. The most obvious aspect of a person with aphasia is the lack of oral, written or gestural output. However, the comprehension deficits in aphasia have been studied lesser than the expressive deficits. It can be possibly due to the fact that the analysis of comprehension needs to be based on observations of overt responses, which is usually confounded by the observed output deficits. Auditory comprehension can be impaired to varying degrees in each individual depending on the severity and type of the problem.

It is difficult to see an aphasic patient who can comprehend the spoken language with normal speed and accuracy. There are many factors which contribute to this comprehension difficulty and these factors are interacting. Some of these factors (speech sound and word meaning recognition) may be selectively impaired as a result of focal lesions, and may contribute to clearly defined aphasic syndromes. Other factors such as attention and short term auditory memory problems are more difficult to isolate and also they interact with the other two factors mentioned. Recent reports suggest working memory may account for language comprehension deficits in persons with aphasia (Caspari, Parkinson, LaPointe & Katz, 1998; Wright, Downey, Gravier, Love & Shapiro, 2007; Martin, Kohen & Kalinyak-

Fliszar, 2008). Situational variables such as personal relevance and emotional significance of the subject matter may also contribute to the comprehension deficits. Basso, Capitani and Laiacina (1988) and Schuell, Jenkins and Landis (1961) reported that auditory comprehension deficits exists in all the cases of aphasia. It is difficult to detect the mild deficits in conversation.

In the assessment of comprehension the stimulus material will be presented to the subject, and his ability to comprehend will be inferred based on the response. Generally, a test of comprehension consists of carefully worked out administrative procedures, and stimulus materials designed to elicit relatively simple responses.

Several tests for assessing the comprehension abilities were developed by many authors over the years. Auditory Comprehension Test for sentences (Shewan, 1980), Discourse Comprehension Test (Brookshire & Nicholas, 1997), Reading Comprehension Battery for Aphasia-2 (LaPointe & Horner, 1998), Token Test (DeRenzi & Vignolo, 1962), Revised Token Test (McNeil & Prescott, 1978) are few among them. Token test is a test which can be used to assess the subtle comprehension deficits in brain damaged individuals. Token Test is an accurate and sensitive indicator of the presence of aphasia.

Though many tests are available for the assessment of aphasia, most of them cannot be directly used in Indian population due to ethno-cultural barriers. Moreover, most of the existing tests cannot be used for the assessment of subtle deficits in auditory comprehension in persons with aphasia. Keeping this in view it was decided to adapt a test to assess the comprehension ability in Malayalam speaking persons with aphasia.

¹e-mail: lincyaslp@gmail.com; ²Reader in Speech pathology, AIISH, Mysore, goswami16@yahoo.com.

The current study aimed at developing Revised Token Test in Malayalam (RTT-M) and investigating the performances of the normal participants on the developed RTT-M. The main objectives of the study were to determine the overall performance of the normal participants in the various subtests, to examine the performances of males and females across subtests in different age groups and levels in various subtests of RTT-M in the different age groups and comparing normal population and the brain damaged individuals (persons with aphasia) on comprehension abilities on the test.

Method

Procedure: The 'adaptation' of the test was done in three phases which included listing of the test stimuli, development of test material in Malayalam, and finally administration of the test battery on normals and persons with aphasia.

Participants: The performance of a group of population on the RTT-Malayalam was the main aim. Individuals (normals and persons with aphasia) within the age range of 20-60 years were considered as the participants. The normal participants considered were native Malayalam speakers with no past/present history of any neurological, psychological problems, sensory deficits or any history of alcoholism or drug/abuse. The persons with aphasia were identified through local hospitals, neurological clinics and/or speech and hearing centers. All of them were native Malayalam speakers. No history of deterioration in cognitive abilities or sensory abilities was present.

Procedure of test administration

Arrangement and Placement: For all groups of participants and all subtests, the tokens were arranged on a standard table in front of the participant, and the order of arrangement was kept the same always.

Arrangement of Seating: During testing the participant was seated in front of the table at a comfortable distance from where it was easy for the participant to reach and pick up the test material. The examiner sat to the left of the participant and slightly behind to avoid distractions that he/she might receive.

Introduction of Subtest: Instructions were given to the participants prior to each subtest. The test was administered by giving the commands. The participant's behavior was observed during the command and response was rated based on a multidimensional 15-point scoring system taken from the original Revised Token Test developed by Mc Neil and Prescott (1978).

Scoring pattern: A multidimensional 15-point scoring system (McNeil & Prescott, 1978) was used to describe performance, and quantify deficits and differences among normal and pathological groups.

Score Sheet: The participant's demographic data (name, age, and sex), handedness, diagnosis, age of onset etc. were included in the score sheet. The summarization and accessibility of the overall test time mean overall score for all subtests, and the mean for each individual subtest was included in the score sheet.

Statistical analysis: SPSS (Statistical Package for the Social Sciences, version 16.0) software was used for statistical analysis. The tabulated scores were used for obtaining the mean (M) and standard deviation (SD). Parametric tests were utilized to obtain the significant difference measures. Mixed ANOVA was used to obtain significant difference between various subtests and across various age groups. Interaction effect between the subtests and groups were compared using the repeated measures ANOVA. A Multivariate Analysis of Variance (MANOVA) was performed to compare subtest across groups.

Results and Discussion

The results obtained from the data were analyzed on various aspects. The findings of the present study have been broadly presented under the following headings.

(I) Performance of males and females across subtests in different age groups

Subtest I (SI)

The mean scores of male and female participants in S I subsection of RTT is shown in Table 1. The mean values of both male and female participants of the age group 20-30, 30-40, 40-50 and 50-60 years was 15.00. In the subtest I, the male and female participants scored a mean of 15.00. The total mean score was also found to be 15.00. It is indicated that the task on this subtest was easy and did not require enough effort from the participant's side in its comprehension. All the participants executed a complete response.

Subtest II (SII)

In the male participants the lowest value was obtained for the 30-40 age group with a mean of 14.97 (SD= 0.05), whereas the other three groups, 20-30, 40-50 and 50-60 age groups obtained a score of 15. While considering the female participants it is observed that all the age groups scored 15. All the male participants secured a mean of 14.99 (SD=0.02), parallel to which all the females obtained a mean score of 15 in all the age groups for Subtest II. Their total mean score on this subtest was 14.99 (SD=0.02). The participants were mostly complete in

their responses, with a few of them going down to the level of sub-vocal rehearsal.

Subtest III (S III)

A minimum of 14.18 (SD=0.51) and a maximum of 15.00 in the age ranges of 50-60 and 20-30 years of age was scored by the male participants and 13.81 (SD=0.70) and 14.95 (SD=0.09) in the age ranges 50-60 and 20-30 years of age were scored by the female participants. The means of other groups fell between these boundaries. A total score of 14.63 (SD=0.44) and 14.52 (SD=0.61) was obtained by male and female participants of all the age groups and they obtained a total mean score of 14.57 (SD=0.53) for the Subtest III. The responses of the male and female participants were mainly in the form of sub-vocal rehearsals and complete ones with the female participants of the oldest age group of 50- 60 years showing some delayed responses.

Subtest IV (S IV)

A score of nearly equal to 15 was obtained in all the age groups in the male participants, except for 50- 60 years, (41.11) which signifies that the responses were between sub-vocal rehearsals and complete. The female participants in the subtest scored between 13.76 (SD=0.67) to 14.65 (SD=0.24), which indicated that the responses were sub-vocal rehearsals in almost all of the participants. The male participant of all the age groups across Subtest IV (S IV) had a mean score of 14.56 (S=0.46) while for female participants mean value was 14.23 (SD=0.59). The total mean score for the participants across S IV was 14.39 (SD=0.55). The responses of the male participants were scored as sub-vocal rehearsals and those of females as sub-vocal rehearsals and delayed.

Subtest V (S V)

In S V subtest of RTT the males obtained a highest mean score of 14.74 (SD=0.26) in the age group of 20-30 years and a least of 13.87 (SD=0.51) in the age ranges of 50-60 years. Similarly, the females in the age group of 50-60 years scored poorer to the males of the same age group with a score of only 13.78 (SD=0.77). The female participants in the age group of 30-40 years scored the highest mean of 14.64 (SD=0.27). The female participants seemed to perform comparatively poorer than the male participants. The responses of the male and female participants were mainly subvocal rehearsals, whereas all the participants in the age group of 50-60 years exhibited responses which were in the form of delayed ones.

Subtest VI (S VI)

The mean scores of 20-30, 30-40, 40-50 and 50-60 years group was 14.43 (SD=0.25), 14.41 (SD=0.50), 14.56 (SD=0.26), 13.85 (SD=0.38) respectively with the least being scored by the oldest

age group. The mean scores of females in the age groups 20-30, 40-50 and 50-60 years (14.14, SD=0.24; 14.30, SD=0.57; 13.52, SD=0.74) was poorer in comparison to the males and that of the 30-40 years (14.40; SD=0.33) was better. The male and female participants of all the age groups on subtest VI pulled up an overall total mean score of 14.31 (SD=0.43) and 14.09 (SD= 0.58) respectively. They secured an overall total mean score of 14.20 with a SD of 0.52. This depicts that the responses were predominantly sub-vocal rehearsal type with few of them with a delayed response.

Subtest VII (S VII)

The male participants in the subtest scored between 13.57 (SD=0.57) to 14.56 (SD=0.46), which indicated that the responses obtained were sub-vocal rehearsals in almost all of the participants. A score of 14 was attained in all the age groups, except the older group (where the score is 13) in the female participants, which signified that the responses were between delayed responses and sub-vocal rehearsals. The male participants of all the age groups across subtest VII (S VII) had a mean score of 14.11 (S=0.58) while for female participants mean value was 14.02 (SD=0.69). The total mean score for the participants across S VII was 14.07 (SD=0.63). Most of the participants in both the genders performed sub-vocal rehearsals on this subtest which demanded left and right postpositional task that comparatively puts greater load on the participants' comprehension than that of above subtests (except subtest I and II).

Subtest VIII (S VIII)

In the S VIII subtest, the males scored a mean score of 14.24 (SD=0.38) and 14.45 (SD=0.56) in age group of 20-30 and 30- 40 years respectively and an even lower score of 13.79 (SD=0.51) and 13.19 (SD=0.42) in the higher age groups, 40- 50 and 50-60 years. Similarly in the female participants the mean score was equivalent to the score of 20-30 and 30-40 years male participants and the scores of other two age groups were 13. All the female participants of all the age groups across the subtest VIII (S VIII) scored a mean of 13.72 (SD=0.68), while the male participants obtained a mean score of 13.92 (SD=0.66). 13.82 (SD=0.67) was the total mean score of all the participants of all the age group on S VIII. The female participants seemed to perform comparatively poorer than the male participants. The responses of the male and female participants were mainly delay and subvocal rehearsals.

Subtest IX (S IX)

A score of nearly equal to 15 was obtained in the age groups of 30-40 and 40-50 years in the female participants, which signifies that the responses were between sub-vocal rehearsals and complete. The scores of male participants in the age range 50-60 years were poorer (mean=13.99;

SD=0.50) than the lower age groups. Likewise the mean values of age groups 20-30, 30-40 and 40-50 years in case of females performed with sub-vocal rehearsal to complete responses, scoring a mean ranging from 14.48 (SD=0.54) to 14.75 (SD=0.33). The female participants in the 50-60 years age groups were much lower than this (mean 11.21; SD=5.41). The male participant of all the age groups across Subtest IX (S IX) had a mean score of 14.44 (SD=0.48) while for female participants mean value was 13.75 (SD=0.92). The total mean score for the participants across S IX was 14.09 (SD=2.10). The responses of the male and female participants were mainly in the form of complete type, subvocal rehearsal and delayed with few of the older female participants (50-60 years) giving self correction responses.

Subtest X (S X)

The lowest value in the male participants was obtained for the 50-60 age group with a mean of 13.92 (SD=0.41). While the 30-40 age group scored the highest of 14.71 (SD=0.52). At the same time the female participants it was observed that the younger age groups 20-30, 30-40, and 40-50, (14.62, SD=0.28; 14.72, SD=0.34; 14.50, SD=0.42 respectively) obtained better scores than the older age group of 50-60 years (13.53, SD= 0.58) (which is a much higher score in comparison to the same age group scoring 11.21 (SD=5.41) on subtest IX. On a careful examination it was evident that the higher groups performed better on subtest X with respect to subtest IX. All the male participants secured a mean of 14.47 (SD=0.48), parallel to which all the females obtained a mean score of 14.34 (SD=0.62) in all the age groups for Subtest X. Their total mean score on this subtest was 14.40 (SD=0.55). Most of the male and female participants in the other age groups (20-30, 30-40, and 40-50 years) except 50-60 age group were scored as sub-vocal rehearsal and complete on the adverbial clauses. At the same time the male and female participants in the higher age groups were scored as delayed.

Overall

On the overall mean the male and female participants were comparable across age groups with the scores of male participants' ranging between 14.07 (SD=0.24) (50- 60 years) to 14.69 (SD= 0.37) (20- 30 years) and that of female participants ranging between 13.58 (SD=0.73) (50- 60 years) to 14.69 (SD=0.37) (20- 30 years). For the middle age groups 30- 40 and 40-50 years the scores were between these ranges (in males 14.65 (0.2); 14.53 (0.15) and in females 14.45 (0.27), 14.43 (0.27) for age groups respectively, thus revealing the fact that the performances on the auditory comprehension tasks declined as age increased. For all the subtests the overall total scores were summed up and the mean and standard deviation (SD) were calculated for all

the dependant variables i.e. subtest of RTT-M. An overall mean score of 14.48 (SD=0.34) was obtained for the male participants of all the age groups. Similarly a mean score of 14.29 (SD=0.56) was illustrated by the female participants. For both males and females a total mean score was 14.39 with a SD of 0.47 was obtained. It can be inferred from the above mean values that, on an average most of the participants obtained either a mean of 15.00 or 14.00, indicating that the responses were either complete or in the form of sub-vocal rehearsal with very few participants showing delayed or immediate responses.

It is clear from the responses of the participants that their performances differed qualitatively across the age groups. The younger age groups 20- 30 and 30- 40 years responded mostly in a normal manner without needing any extra information to perform the task. Most of the participants demonstrated a complete type and few of them on rare occasions showed sub-vocal rehearsals. Whereas in the older age groups (40- 50 and 50- 60 years), few of the participants even scored as poorer as delayed and immediate type of responses. In general the normal responses across the test varied between complete and subvocal rehearsal, thereby paving the idea that the Revised Token Test involves tasks that are well suited to identify an individuals' auditory comprehension levels.

A Mann-Whitney U-test was conducted within each age group for all the subtests and the overall mean to detect the differences between them. Mann-Whitney U-test revealed that there was no significant difference between the males and females on any of the subtest or on groups at $p < 0.05$ (i.e. the males and females performed equally well on all subtests). Due to this reason, males and females were combined and considered as one single set, for further analyses i.e. consideration of ten participants instead of five males and five females in each age group. Furthermore, there were only five participants of each gender in each age group (which is not a large sample to be considered). Hence gender was not regarded as an independent variable on all advanced analyses.

The test encapsulates a series of cognitive processes as well to auditory comprehension, including working memory (Lesser, 1976; Smith, Mann & Shankweiler, 1986), analysis of the whole into a series of items, or the ability to adequately ignore automatically evoked, distracting stimuli. Such factors are evidently distinct in both the gender. Parietotemporal metabolism (Karbe, Herholz, Szekely, Pawlik, Wienhard & Heiss, 1989) could have affected the performance of the participants in this test. Another factor is the measures of language production (Guthbrod, Meger, Meter & Cohen, 1985).

Hence, the present study gives evidences regarding the gender variation in normal persons that may not be a major variable in comprehension task in auditory mode only. No differences in the performances of the two groups were seen, and if present, may be subtle in nature.

(II) Overall performance of the participants in the various subtests

The performances of female and male participants were not significantly different across groups and subtests; hence the following comparisons were made using repeated measure analysis of variance:

(a) Comparison of the performance on subtests

A significant difference was observed between the subtests [$F(9, 234) = 10.937, p < 0.05$] on mixed ANOVA (repeated measures ANOVA with age as independent factor). The mean and standard deviations of age groups across each subtest are given in Table 1 and Figure 1. 30-40 years and 50-60 years age group scored the highest and the lowest respectively. The age groups 20-30 years and 40-50 years scored in between.

The results of the present study receives support from Swisher and Sarno (1969); DeRenzi and Faglioni (1978); Emery (1986); Ivnik, Malec, Smith, Tanglos and Peterson (1996). Many

researchers suggested that the differences in scores exhibited by the older individuals could be due to the difficulty in retaining the auditory stimuli for a longer duration in comparison to the younger individuals.

The deterioration in comprehension from the S I to S X subsections in a gradual fashion is due to minimal redundancy, where the participants are required to understand the significance of each word in a series of increasingly complex commands (Goswami, 2004). Moreover, the linguistic stimuli are presented only in the verbal mode on RTT; hence the participants need to rely completely on the auditory mode for comprehending the stimuli. Sub-vocal rehearsals were observed beside the complete responses in few of the normal participants, which indicate that they rely on their auditory feedback and even sub-vocal rehearsals also help in retaining the linguistic stimuli for a longer duration.

On mixed ANOVA, a significant difference was observed between the performances of various subtests [$F(9, 324) = 12.68, p < 0.05$]. Therefore, subsequent to this a post-hoc Bonferroni test for pairwise comparison was done to find out the subtests which differed significantly. This is being depicted in Table 2.

Table 1. Mean and standard deviation (SD) of groups across

Subtests		20-30 years	30-40 years	40-50 years	50-60 years	Mean
I	Mean	15.00	15.00	15.00	15.00	15.00
	SD	0.00	0.00	0.00	0.00	0.00
II	Mean	15.00	14.98	15.00	15.00	14.99
	SD	0.00	0.04	0.00	0.00	0.02
III	Mean	14.97	14.84	14.49	14.00	14.57
	SD	0.06	0.29	0.36	0.61	0.53
IV	Mean	14.63	14.67	14.35	13.93	14.39
	SD	0.36	0.40	0.54	0.59	0.55
V	Mean	14.48	14.60	14.39	13.82	14.33
	SD	0.35	0.33	0.30	0.62	0.50
VI	Mean	14.28	14.41	14.43	13.69	14.20
	SD	0.27	0.40	0.44	0.58	0.52
VII	Mean	14.23	14.57	14.08	13.39	14.07
	SD	0.29	0.36	0.56	0.62	0.63
VIII	Mean	13.93	14.40	13.84	13.10	13.82
	SD	0.49	0.45	0.57	0.47	0.67
IX	Mean	14.41	14.74	14.63	12.60	14.09
	SD	0.37	0.44	0.32	3.90	2.10
X	Mean	14.59	14.72	14.58	13.72	14.40
	SD	0.29	0.40	0.35	0.51	0.55
Overall	Mean	14.55	14.69	14.48	13.82	14.39
	SD	0.13	0.28	0.18	0.57	0.47

On a pairwise comparison between subtests the following results were evident. The scores of:-

1. S I was significantly different from S III, S IV, S V, S VI, S VII, S VIII and SX;
2. S II from S III, S IV, S V, S VI, S VII, S VIII and SX;
3. S III from S V, S VI, S VII, and S VIII;
4. S IV from S VII and S VIII;
5. S V from S VIII;
6. S VI from S VIII;
7. S VII from S VIII, and S X;
8. S VIII from S X; and vice versa.

The obvious differences could be ascribed to the fact that, the increasing complexity of the tasks in terms of grammaticality brings about a difference in the overall scores.

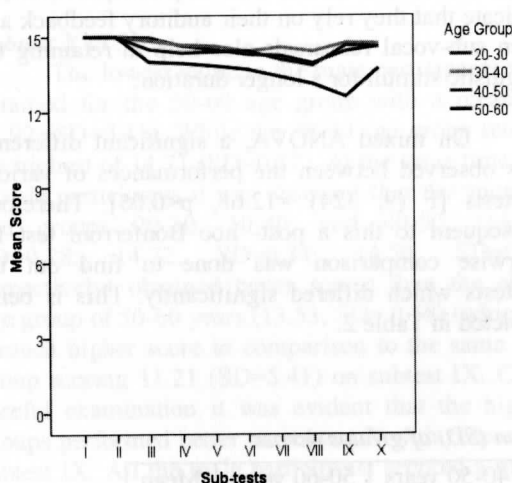


Figure 1. Mean scores of the different age groups on various subtests.

It is evident from the table that the adjacent subtests are not significantly different from each other except for S VII and S VIII. The difference in the complexity of tasks, increase in sentence length are some of the very reasons the scores of the pair of odd and even subtests are not differing, except for S VII and S VIII, which means that the commands of S VII (which involve left-right postpositional phrase) demands the participant to comprehend only six critical items, while S VIII involves eight critical items. The level thus becomes the toughest of all these subtests.

Several studies have reported that auditory comprehension in individuals is affected by factors such as effect of sentence length (Levy & Holland, 1971; Brookshire, 1974; Pierce & Wagner, 1985) and grammatical complexity (Lasky, Weidner & Johnson, 1976). Goswami (2004) even puts down the fact that the more complex a sentence is grammatically, the more difficult is its comprehension.

(b) Comparison of the performance on age groups

A significant difference on Mixed ANOVA was observed between the performances of various age groups for [$F(3, 36)=12.71, p<0.05$] as the participants of the various age groups exhibited comprehension deficits to varying degrees of severity. Post-hoc Duncan's mean range test elaborated on the differences between the various age groups. Figure 2 depicts the difference in the overall scores between the age groups.

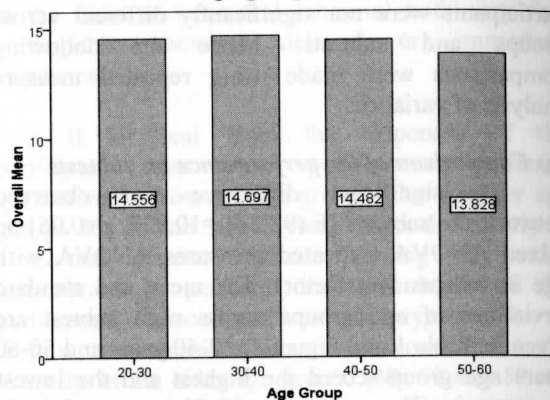


Figure 2. Overall mean on all the subtests as produced by the different age groups.

On the post hoc test the age groups 20-30, 30-40, and 40-50 years performed similarly on the test (no significant difference in all the three age groups) whereas they differ significantly from the older age group of 50-60 years.

Older adults show a greater reliance on target word activation for word selection while in younger adults, activation and inhibition mechanisms are tightly linked during auditory word comprehension in a dual mechanism context. It appears that inhibitory mechanisms become less involved in auditory comprehension with aging. Age-related effects were reported as few in a series of papers on Token Test and its versions (Swisher & Sarno, 1969; DeRenzi & Faglioni, 1978; Ivnik et al., 1996).

(c) *Interaction of the subtests and groups* Interaction effect between the subtests and groups on repeated measures ANOVA, was evident. Results revealed that a significant interaction was present between them at [$F(27, 324)=1.96$ for $p<0.05$].

(III) Levels in various subtests of RTT-M in the different age groups

Repeated measures ANOVA revealed a significant interaction effect between age groups and subtests, hence comparisons were made to determine the age group differences varying in magnitude across the subtests and vice versa.

(a) Comparison of subtest across groups

Multivariate Analysis of Variance (MANOVA) was performed across all subtests. The

Table 2. Pairwise comparison between subtests

Subtests										
	S I	S II	S III	S IV	S V	S VI	S VII	S VIII	S IX	S-X
S I		-	+	+	+	+	+	+	-	+
S II	-		+	+	+	+	+	+	-	+
S III	+	+		-	+	+	+	+	-	-
S IV	+	+	-		-	-	+	+	-	-
S V	+	+	+	-		-	-	+	-	-
S VI	+	+	+	-	-		-	+	-	-
S VII	+	+	+	+	-	-		+	-	+
S VIII	+	+	+	+	+	+	+		-	+
S IX	-	-	-	-	-	-	-	-		-
S-X	+	+	-	-	-	-	+	+	-	

Note: Cells marked with a "+" indicate a condition in which significant difference was obtained on a given subtest from the corresponding subtest. Cells marked with a "-" indicate a condition in which significant difference was not obtained on pairwise comparisons.

MANOVA revealed statistically significant differences on subtests. Table 4 lists the ten subtests for which a significant difference was found for the total scores. It is clear from Table 4 that all the subtests and the overall mean, except subtest II and IX present with a statistically significant difference at $p < 0.05$ (with age as independent variable and dependent variables as subtests S I to S X and overall mean). The distributions of grammatical complexity suggest that all the subtests except I and II, have a slightly different complexity in their grammatical structure, which could have possibly contributed to the significant difference in scores in comparison to the others.

Further post- hoc Duncan Mean Range test elaborated on the differences between the age groups on each of the significant difference of the RTT. It can be summarized as follows:

On Subtest III, age groups 20-30 years and 30-40 years and age groups 30-40 and 40-50 years performed similarly whereas the performance of higher age group 50-60 years, varied from the lower age groups significantly i.e. the adjacent age groups were similar in their performance. Age groups 20-30 years, 30-40 years and 40-50 years performed comparably with no significant difference in scores among them, on subtest IV. The scores of age groups 40-50 and 50-60 also did not differ significantly at 0.05 levels. The scores of all the age groups except the higher age group (50-60 years) performed similarly with a statistically significant score than the 50-60 age group on subtest V and subtest VI.

Participants in the 20-30 and 30-40 years age groups and 20-30 and 40-50 years age groups performed similarly. While the scores obtained for the older age group (50-60 years) differed significantly from the

Table 3. Tests of between subjects effects others

Subtests	F (3,36)	Sig.
S I	-	-
S II	1.00	0.40
S III	12.57	0.00*
S IV	4.77	0.00*
S V	6.76	0.00*
S VI	6.24	0.00*
S VII	10.62	0.00*
S VIII	11.40	0.00*
S IX	2.58	0.06
S X	13.02	0.00*
Overall Mean	12.71	0.00*

* $p < 0.05$

younger age groups on subtest VII. On subtest VIII, the performance of 20-30 and 40-50 years age groups were comparable with no significant difference among them. The scores obtained for 30-40 years age group was significantly different from the other age groups. The scores of the age group 50-60 years was not comparable to the younger age groups i.e. the scores of 50-60 years were significantly different from the younger age groups on subtest X as well as on overall mean.

(b) Comparison of groups across subtests

Repeated measure of ANOVA was conducted for each of the age groups to determine the difference in subtest scores, if any:

1. Tests of within-subjects effects for 20-30 years age group revealed that the scores across subtests differed at 0.05 level of significance. Hence, post-hoc pairwise comparison on Bonferroni test was performed to find out the differences between the subtests. The scores on various subtests in 20-30 years age group:

- 1. S I was significantly different from S VI, S VII, S VIII, and S IX;
- 2. S II from S VI, S VII, S VIII, and S IX;
- 3. S III from S VI, S VII, S VIII, and S IX;
- 4. S IV from S VII; and vice versa.

2. A test of within-subjects effects for 30-40 years was done in order to find out the difference within the subtests at 0.05 level of significance. The scores were statistically significant [F (9, 81) = 9.36 at p<0.05]. In order to find out the differences between the subtests in the 30-40 years age group, the data was subjected to Bonferroni test. The scores on various subtests in 30-40 years age group:

- 1. S III was significantly different from S VI;
- 2. S VIII from S IX and S X; and vice versa.
- 3. A significant difference was identified within the subtests in the age group of 40-50 years on the repeated measure ANOVA [F (9, 81) =9.14, p<0.05]. Differences in the scores were identified on Post hoc Bonferroni test.

- 1. S I was significantly different from S V, S VII and S VIII.

- 2. S II from S V, S VII and S VIII; and vice versa.

- 4. In the age group of 50-60 years a significant difference was identified within the subtests on the repeated measure ANOVA [F (9, 81) = 3.52, p<0.05]. Subsequently a Post hoc Bonferroni test was done and identified significant differences in the scores, which is shown in Table 3.

- 1. S I was significantly different from S III, S IV, S V, S VI, S VII, S VIII, and S-X;

- 2. S II from S III, S IV, S V, S VI, S VII, S VIII, and S-X;

- 3. S IV from S VII, and S VIII;

- 4. S VII from S III;

- 5. S VII from S III; and vice versa.

It can be summarized that there was a significant difference between the subtests in all the our age groups. It can be reasoned that the linguistic complexity and sentence length increases gradually from S I to S X. As discussed above, another

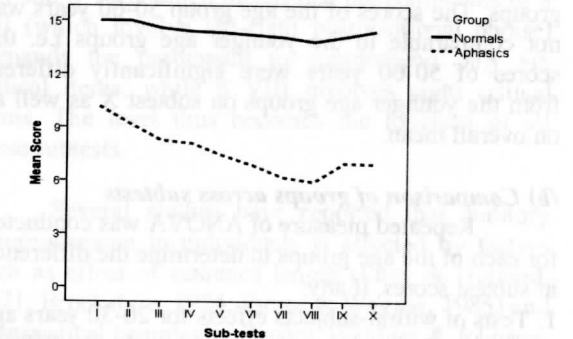


Figure 3. Mean scores of normals and persons with aphasia.

attributable factor to this result is that the subtests I (and II) contribute to lesser comprehension demand on the participants in comparison to the other subtests

in terms of the sentence length, complexity (Goswami, 2004) and number of critical stimulus units.

(IV) Comparison of normal population and the brain damaged individuals (persons with aphasia) on comprehension abilities

The overall mean scores on all the subtests by the normals and aphasics and their individual scores on the subtests is depicted in Figure 3. Normal participants were better in comprehension as compared to the persons with aphasia on all subtests I to X. The mean scores in each subtest in the normal participants' decreased with complexity of tasks. The mean scores in subtest I and subtest VIII were 15.00 and 13.82 and 10.16 and 5.92 respectively in normal and brain damaged participants. From the scores of both the groups of participants (the normals and brain damaged), it was observed that highest mean scores were observed in subtest I and lowest in subtest VIII.

Table 4. Results of Mann Whitney- U test (Comparison of normals and aphasics)

Subtests	Z	Sig.
S I	6.88	0.00*
S II	6.60	0.00*
S III	4.70	0.00*
S IV	4.65	0.00*
S V	4.64	0.00*
S VI	4.64	0.00*
S VII	4.64	0.00*
S VIII	4.65	0.00*
S IX	4.42	0.00*
S-X	4.65	0.00*
Overall Mean	4.64	0.00*

*p<0.05

Geschwind (1965) and Caramazza and Zurif (1976) have attributed reasons to the brain damage in aphasics, which causes a deficit in individual's ability to comprehend linguistic stimuli. Mann-Whitney U-test (Table 4) showed that RTT scores for the persons with aphasia were significantly poorer than those of the normal participants.

The sentence comprehension tends to decrease as length increases (Goswami, 2004). Improvements in sentence comprehension of aphasics following training to improve verbal memory span was reported by Francis, Clark & Humphreys (2003). Deficits in all of these cognitive processes in comprehending grammatical elements have been implicated in persons with aphasia (Schuell, Jenkins & Jimenez-Pabon, 1964; Brookshire, 1974). The repetition of linguistic command also improved the performance of these persons in the form of sub-vocal rehearsals, Goswami (2004).

Conclusions

The results of the study can be summarized in the following manner. There was no difference in performances of males and females across subtests. It was evident that all the subtests except Subtest II and IX differed significantly from the other subtests on the RTT-M. The age groups 20-30, 30-40, and 40-50 years (younger age groups) performed almost similarly and were different in their scores from the 50-60 years (older age group). A reduction in the performance of the participants was observed as the linguistic complexity and sentence length increased. Normal participants showed better comprehension as compared to the aphasics (persons with aphasia) on all the subtests (subtests I to X).

The RTT proves to be one of the most useful clinical tools that help in terms of assessing an individual's auditory comprehension. It also assesses the comprehension on stimuli of gradual complexity. Adaptation of RTT in Malayalam, thus, put-forth the importance of a thorough assessment of comprehension abilities and its implication in assessing comprehension among the different aphasic types.

It can be concluded that the performance of the males and females was similar across all the subtests on RTT-M. The gender of a person seems not a crucial factor in the comprehension of spoken messages to any significant extent. The deficits in auditory comprehension varied to different degrees, depending on the linguistic length and complexity on the RTT-M. Qualitative differences in the responses of the normal participants were also observed. The responses of normal participants on the RTT-M were mostly complete (score of 15) or vocal-sub vocal rehearsals (score of 14). It can be inferred that on assessment, if a scores 14 or 15 on commands for a native normal participant, mean values and/or subtests, his performance is in a normal manner. A score less than 14 indicate a deficit in the auditory comprehension skills of the person. Factors such as sentence length, linguistic complexity, grammatical usage and number of critical stimulus in the commands contributed to the test results. All the scores except for subtest II and subtest IX were evidenced to differ from that of subtest I. Aging, memory, and attention span of the participant also influence the responses. The younger age groups were better in their performances in comparison to the older age groups. The performances of aphasic participants were relatively poorer than the normal participants. Cognitive and/or auditory processing deficits have been implicated from the responses of most of the aphasics.

It can be concluded from the results of RTT-M that the difference in performances within normals and within aphasics points to the effectiveness of the

test in fulfilling its purpose of assessing auditory comprehension. The linguistic competence in normals as well as in persons with aphasia can be assessed using the test.

References

- Basso, A., Capitani, E., & Laiacina, M. C. (1988). Progressive language impairment without dementia: A case of isolated category specific naming defect. *Journal of Neurology, Neurosurgery and Psychiatry*, 51, 1201-1207.
- Benson, F. D., & Ardila, A. (1996). *Aphasia: a clinical perspective*. New York, Oxford University Press.
- Brookshire, R. H. (1974). Differences in responding to auditory verbal materials among aphasic patients. *Acta Symbolica*, 1, 1-18.
- Caramazza, A., & Zurif, E. B. (1976). Denunciation of algorithmic and heuristic processes in language comprehension: Evidence from aphasia. *Brain and Language*, 3, 572-582.
- Caspari, I., Parkinson, S. R., LaPointe, L. L., & Katz, R. C. (1998). Working memory and aphasia. *Brain and Cognition*, 37, 205-223.
- DeRenzi, E., & Faglioni, P. (1978). Development of a shortened version of the Token test. *Cortex*, 14, 41-49.
- Emery, O. B. (1986). Linguistic decrement in normal aging. *Language and Communication*, 6, 47-64.
- Francis, R. D., Clark, N., & Humphreys, W. H. (2003). The treatment of an auditory working memory deficits and the implications for sentence comprehension abilities in mild "receptive" aphasia. *Aphasiology*, 17 (8), 723-750.
- Geschwind, N. (1965). Disconnexion syndromes in animals and man. *Brain*, 88, 585-644.
- Geschwind, N., & Fusillo, M. (1966). Colour naming deficits in association with alexia. *Archives of Neurology*, 15, 137-146.
- Goswami, S. P. (2004). Comprehension deficits in aphasics. Unpublished Doctoral Thesis, University of Mysore, Mysore, India.
- Gutbrod, K., Meger, B., Meter, E., & Cohen, R. (1985). Cognitive processing of tokens and their description in aphasia. *Brain and Language*, 25, 37-51.
- Ivnik, R. J., Malec, J. F., Smith, G. E., Tangalos, E. G., & Petersen, R. C. (1996). Neuropsychological tests norms above age 55: COWAT, BNT, MAE Token, WRAT-R, Reading, AMNART, Stroop, TMT, and JLO. *The Clinical Neuropsychologist*, 10, 262-278.
- Karbe, H., Herholz, K., Szeliess, B., Pawlik, G., Wienhard, K. K., & Heiss, W. D. (1989). Regional metabolic correlates of Token test results in cortical and sub-cortical left hemisphere infarction. *Neurology*, 39, 1083-1088.
- Kertesz, A. (1979). *Aphasia and associated disorders: Taxonomy, localization and recovery*. New York: Grune and Stratton.
- LaPointe, L. L., & Horner, J. (1998). *Reading comprehension battery for aphasia* (2nd Ed.). Austin, TX: Pro-Ed.
- Lasky, E. Z., Weidner, W. E., & Johnson, J. P. (1976). Influence of linguistic complexity, rate of presentation and inter-phrase pause time on auditory verbal comprehension of adult aphasic patients. *Brain and Language*, 3, 386-395.

Lesser, R. (1976). Verbal and non-verbal memory components in the Token test. *Neuropsychologia*, 14, 79-85.

Levy, C., & Holland, A. (1971). Influence of grammatical complexity and sentence length on comprehension with adult aphasics. In A. Holland (Ed.), *Psycholinguistics and behavioural variables in recovery from aphasia*. Final report submitted to Social and Rehabilitative Service, DHEW, 1-26.

Martin, N., Kohen, F., & Kalinyak-Fliszar, M. (2008). A diagnostic battery to assess language and shortterm memory deficits in aphasia. Poster presentation at Clinical Aphasiology Conference, Teton Village, WY.

McNeil, M., & Prescott, T. (1978). *Revised Token Test*. Austin, TX: ProEd.

Pierce, R. S., & Wagner, C. (1985). The role of context in facilitating syntactic decoding in aphasia. *Journal of Communication Disorders*, 18, 203-213.

Rosenbek, J. E., LaPointe, L., & Wertz, T. R. (1989). *Aphasia: a clinical approach*, Austin, Texas: Pro-ed.

Schuell, H. M., Jenkins, J. J., & Jimenez-Pabon, E. (1964). *Aphasia in adults*. New York: Harper & Row.

Schuell, H., Jenkins, J. J., & Landis, L. (1961). Relationship between auditory comprehension and word frequency in aphasia. *Journal of Speech and Hearing Research*, 4, 30-36.

Shewan, C.M. (1980). *Auditory comprehension test for sentences*. Chicago, Biolinguistics Clinical Institutes.

Smith, S. T., Mann, V. A., & Shankweiler, D. (1986). Spoken sentence comprehension by good and poor readers: A study with the Token test. *Cortex*, 22, 627-632.

Swisher L. P., & Sarno M. T. (1969). Token test scores on three matched patient groups: Left brain-damaged with aphasia; right brain-damaged without aphasia; non brain-damaged. *Cortex*, 5, 264-273.

Wright, H. H., Downey, R. A., Gravier, M., Love, T., & Shapiro, L. P. (2007). Processing distinct linguistic information types in working memory in aphasia. *Aphasiology*, 21, 802-813.