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Research Article

Correlation of Auditory Comprehension Between Fluent and Non-Fluent Types of Aphasia

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Abstract

The current study was aimed to assess auditory comprehension by using the Revised Token Test (RTT) in Telugu. A total of 20 Telugu-speaking aphasics with an age range of 17 to 80 years participated. Qualitative analysis was done to get the details of the errors made by each type of aphasia while performing the test. Results revealed that the performance of all aphasics was observed to be 76% to 93% on all the subtests. Females participated better than the male aphasics. The anomic aphasia group performed well when compared to other types. Error analysis reveals that the incorrect responses were mostly observed in G3 and G4. While performing the test, various errors such as 'confusions', 'multiple attempts', 'visual interceptions', 'I don't know' and 'No response' were observed. As the complexity of the sentence occurred, 25% of participants mostly responded by saying "don't know" and "no response" was given by 15% due to the comprehension deficits. All the aphasics performed poorly on various linguistic elements such as adverb clauses, along with place prepositions, object I nouns, implied common verbs, left-right prepositions, and size II adjective sections, except for anomic, where they showed errors only in adverb clauses. Poor performance might be due to an increase in linguistic and cognitive complexity. Finally, the author found that the auditory comprehension was poor for all the types of aphasias with the increase in complexity of sentences. Anomic aphasics performed better than all the aphasics. Authors stated that detailed auditory comprehension assessments are essential in assessing aphasics and are crucial before starting management.

Keywords: Aphasics; Revised Token Test; Telugu; Auditory Comprehension; Linguistic Complexity

Introduction

Communication is successful when a person understands what the speaker is talking about. Typical individuals can engage in healthy communication without any interruptions due to their ability to understand by listening to speakers through auditory mode. The process is termed "auditory comprehension." Aphasia is defined as a loss of language due to damage to the brain. Auditory comprehension is affected in individuals with aphasia. The process of understanding what one hears through listening is called auditory comprehension[9]. Aphasia is most commonly the result of an occlusion within the middle cerebral artery (MCA) territory. After its origin from the internal carotid artery, the MCA bifurcates into a superior and an inferior branch. Occlusions involving the superior division tend to lead to similar lesion patterns, which are different than the patterns yielded by strokes resulting from occlusion of the inferior division of the MCA as stated by various authors [2,6,7,15,24]. The general pattern of speech and language impairment that results from stroke is somewhat predictable as the type of aphasia is associated with specific lesion patterns.

Authors [20,21] reported that auditory comprehension deficits exist in all cases of aphasia. Most researchers have shown that the majority of expressive problems are often associated with im-

pairments in comprehension. The extent of the auditory comprehension deficits associated with aphasia ranges from very severe impairments (Global aphasia) to subtle impairments (Anomic aphasia) were seen in reading, writing, speaking, and understanding. Research has shown that stroke patients with auditory comprehension impairment typically show poor comprehension of pictures, and it has been reported that comprehension-impaired stroke patients express semantic access deficits in the auditory-verbal domain as well as multimodal semantic deficits. In the most severe cases, stroke patients with auditory word comprehension impairment comprehend almost nothing that is said, failing to respond appropriately to verbal questions, commands, or single words. In more moderate cases, however, patients may be able to understand, with effort, a few words and statements. The deficit in auditory word comprehension caused by a stroke is caused by semantic (access)-level impairments rather than phonemic level impairments. Phonemic-level aspects of auditory word recognition are bi-hemispherically organised, as unilateral disruption, even in an acute stroke, does not appear to lead to profound deficits in phonemic processing in auditory word comprehension. Auditory comprehension is poor in Wernicke, transcortical sensory, and global aphasias. Mild auditory comprehension deficits are observed in Broca, transcortical motor, and anomic aphasias, whereas it is relatively good in conduction aphasia [10]. The reliability of the five-item (total 55 items) Revised Token Test for individuals with aphasia. They examined 12 adults (51 to 80 years old) with aphasia due to left-hemisphere stroke. The first five items of subtests I-VIII and X, and all the ten items in subtest IX. The results showed that overall mean scores were highly reliable, while individual subtests and linguistic element scores were moderate to highly consistent [18]. Various authors [8] have examined 19 adults (11 males and 8 females) for three conditions: traditional, pointing, and eye movement. Results revealed that the traditional RTT scores indicate normal comprehension for all participants; pointing conditions indicate good comprehension; and for eye movement conditions, for each subtest, the amount of time that fixes were allocated to target images significantly exceeds chance expectations. An item analysis of Revised Token Test in 250 healthy Spanish speaking children age ranges from (4 to 12 years). The RTT consists of 10 subtests of 10 commands each. Results revealed that the significant change in RTT scores at age 10 and shows high discrimination level at different ages, from younger children (4 to 9 years) to older children (10 to 12 years) [19]. The Revised Token Test in Telugu [11] and administered it to 100 participants of the normal population, both males and females (20-65 years). A total of 20 objects were used for the test. Results revealed that the performance of people aged 61-65 years showed a highly significant difference. There is no gender difference, whereas both males and females have performed equally well. A study was done to measure the verbal syntactic comprehension in 60 aphasic patients (Broca's and Wernicke's). The results revealed that the verbal comprehension performances of Broca's and Wernicke's aphasics were compared, although the two groups gave different quantitative results, almost no qualitative differences were found between them [17]. Inter-rater agreement in scoring the Revised Token Test in a language-normal group and 10 aphasics was studied and results reveal that the patterns of subtest characteristics and specific error types are evident across scoring disagreements; thus, these are important factors to emphasise during training to minimise scoring errors and increase reliability [16]. The Revised Token Test in Telugu was developed [11] on normal individuals. There is a dearth of research on clinical populations, especially the data on auditory comprehension, which is limited. Hence, the present study was aimed at checking auditory comprehension in different types of aphasia by using RTT-T.

Method and Procedure

Participants

The present study aimed to compare the auditory comprehension (AC) between different types of aphasias using the Revised Token Test in Telugu (RTT-T). A total of 20 Telugu-speaking aphasics with an age range of 17 to 80 years participated. All participants were divided into four groups based on age (G1: below 30 years) (G2: 31-50 years) (G3: 51-70 years) (G4: above 70 years). The criteria for the participants are that all the participants should be native Telugu with normal hearing sensitivity and should be diagnosed with aphasia. Participants who have a history of visual and auditory problems and any other comorbid conditions are excluded from the study. Groups and participant details were given in table 1.

S.no	Fluent	Non fluent
1	Wernicke (5)	Broca (5)
2	Conduction (4)	Global (4)
3	Anomic (2)	-

Table 1: Types and no. of participants.

Material used

Developed RTT-T[11], was used to assess aphasic patients.

Procedure

Each subject was seated comfortably in front of the table at a distance where it was easy to touch and pick up the test material. The objects were arranged on a table in front of each participant and they were asked to touch or place the material by the side, front, back, right, or left when the clinician said. The scores of each sub-test of each item were given individually. The test was done in a quiet and distraction-free environment. The examiner was also alert regarding the level of fatigue and discontinued the testing if there were signs of poor vigilance while performing the tasks.

Instructions

The participants were given instructions in Telugu that "I am going to administer a test on you." I'll ask you to show or touch the object on the table, and you must keep one item on top of the other, front or back, left or right. you don't understand what I have said, stop me and ask me to repeat it. I will repeat it once again. Prior to the test, pre-test instructions were given to get a concept of the test. The test was done in a quiet and distraction-free environment. The examiner was also alert regarding the level of fatigue and discontinued the testing if there were signs of poor vigilance while performing the tasks.

Testing procedure

The objects were arranged on a table according to each subtest. For 1, 3, 5, 7 and 9 subtests, only big objects were arranged, and for 2, 4, 6, 8 and 10, both big and small objects were arranged. These objects were arranged in a parallel row, one after the other. A minimum distance should be maintained throughout the test so that it will be easy to perform and place the material by the side of, front of, back, right, or left when the clinician says.

Scoring

The test consists of ten subtests. Each subtest consists of ten commands with different linguistic elements like colours, adjectives, nouns, etc. A score of 1 was given for the correct response. A score of 0 was given as an incorrect response. The total overall score is 570.

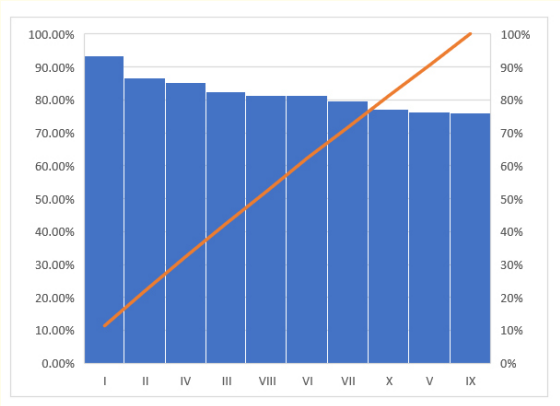
Qualitative analysis

Analysis was done by calculating percentage of performance in each subtest. Error analysis was done to know the accuracy of the tasks which are performed by the participant.

Results and Discussion

Overall performance on all the subtests

Subtest I: 93.33%, subtest II: 86.75%, subtest III: 82.41%, subtest IV: 85.31%, subtest V: 76.33%, subtest VI: 81.31%, subtest VII: 79.66%, subtest VIII: 81.43%, subtest IX: 76.12%, and subtest X: 77.12%. The overall performance in all the subtests ranges from 76 to 93%, which means that all individuals have performed well in all the subtests. The drop in performance percentage was seen as the complexity of the sentences increased. Overall, in the present study, the lowest percentage was seen in subtests V and IX (76.33% and 76.12%) respectively. All the data is depicted in Graph 1.

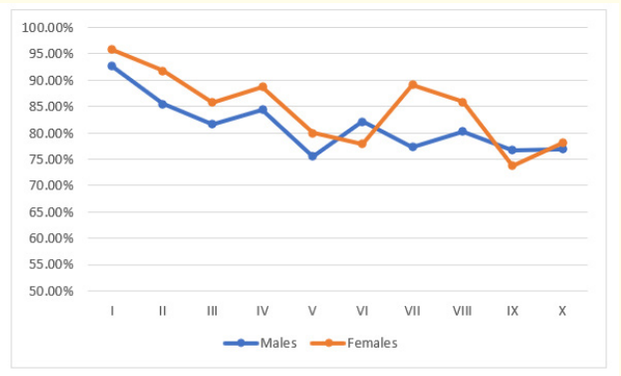


Graph 1: shows the percentage of performance on all the subtests.

Percentage of overall performance in gender

In subtest I, females with 95.83% outperformed males with 92.70%, in subtest II, females with 91.84% outperformed males with 85.46%, in subtest III, females with 88.75% outperformed males with 75.41%, in subtest VI, males with 82.18% outperformed females with 77.81%, in subtest VIII, females with 85.93% outperformed males with 80.31%, and Males outperformed than

females in subtest IX, scoring 76.71% to 73.75%. Females outperformed males in subtest X, scoring 78.12% to 76.87%. percentage of overall performance by gender in all subtests ranges between 73 and 95%. Overall results show that females performed slightly better than males. All the data is depicted in graph 2.



Graph 2: shows overall percentage of performance of gender across subtests.

Overall, the percentage of performance by gender across subtests reveals that females performed better when compared to males. The present study is in favour of [19], who found that females performed better than males when RTT scores were compared across subtests.

Types of responses

While administering the test, different type of responses was seen across gender in various age groups.

Types of Responses in Various Age Groups						
Age group	Gender	C	SVR	D	I	SC
< 30	M	✓	✓		✓	✓
31-50	F	✓	✓	✓	✓	✓
	M	✓	✓	✓	✓	✓
51-70	F	✓	✓	✓		
	M	✓		✓		
>70	M			✓		

Table 2: Shows types of responses of participants across gender in various age groups.

*Note: C - Complete, SVR - Sub-vocal Rehearsals, D - Delayed, I - Immediate, SC - Self Correction

Table 2 summarises the responses of females and males across various ages. The responses of the participants to their performances differed qualitatively across the age groups. The participants' responses were mainly in the form of complete responses. Sub-vocal rehearsals, delayed responses, immediacy, and self-corrections were noticed.

Group 1 (G1; 30 years) shows that two male participants participated and responded well by completing the tasks. Subvocal rehearsals, immediate and self-corrections were observed without any delay in the performance. Group 2 (G2; 31-50 years) shows that there are seven participants (2 females, 5 males), among whom one female and two male participants showed delayed responses and self-correction was observed, and the responses of the other participants were mostly immediate, complete, and showed sub-vocal rehearsals. Group 3 (G3; 51-70 years) shows that there were 10 participants (2 females and 8 males). Here, 2 females and 2 males haven't completed the task. Delayed responses were observed. Whereas SVR, immediate, and self-corrections were not observed, the remaining six participants completed the tasks with a delay in duration. Group 4 (G4; > 71 years) shows that only one participant was there and the types of responses were not complete and delayed responses were observed. In G3 and G4, no self-correction and immediate responses were observed. Overall responses to the test vary between complete, sub-vocal rehearsals, and immediate. This might be due to the increase in the average age and the complexity of sentences in various tasks.

Error analysis

Incorrect responses

While administering the test, a few incorrect responses were observed. The incorrect responses are as follows: Incorrect responses were mostly observed in G3 and G4. 35% showed confusion was observed due to the different sizes of the objects. Multiple attempts by 50% This might be due to the increasing complexity of sentences. This visual interceptions by 30% might be due to the increase in age and different sizes of the objects. I don't know by 25%, which was observed in higher subtests like subtests 8, 9, and 10 as the complexity increased and there was no response by 15% due to the comprehension deficits. The overall incorrect responses were seen from 15% to 50%. Most of the responses were "multiple attempts". Various incorrect responses and percentages were given in table 3.

Type	Number	Percentage
Confusion	7	35%
Multiple attempts	10	50%
Visual interaction	6	30%
Don't know	5	25%
No response	3	15%

Table 3: Incorrect responses for the given items.

Analysis of linguistic elements based on types of aphasia

Fluent aphasias

- **Conduction Aphasia:** Poor performance was observed on place prepositions, adverb clauses, object nouns, and implied common verbs. There was an average of 47.5% responses were seen in the linguistic aspects among all the conduction aphasics. The average time taken to complete the test was 55 minutes.

- **Wernicke's aphasia:** Poor performance was observed on adverb clauses, place prepositions, and implied common verbs. There was an average of 41% responses observed in the linguistic aspects among all the Wernicke aphasics. The average time taken to complete the test was 56 minutes. Various errors like confusions, multiple attempts, visual interceptions, don't know, no response were also observed.

- **Anomic Aphasia:** Poor performance was observed only on adverb clauses. The remaining elements were performed well by all the anomic participants. There was an average of 47.5% responses observed in the linguistic aspects among all the anomic aphasics. The average time taken to complete the test was 60 minutes.

Non fluent aphasias

- **Broca's aphasia**: Poor performance was observed on left-right prepositions, place prepositions, and adverb clauses. There was an average of 45% of responses observed in the linguistic aspects among all the Broca's aphasics. The average time taken to complete the test was 45 minutes.

- **Global aphasia**: Poor performance was observed on left-right prepositions, size II adjectives, place prepositions, and object I nouns. There was an average of 42.5% of responses observed in the linguistic aspects among all the global aphasics. The average time taken to complete the test was 57.5 minutes. Various errors like confusions, multiple attempts, visual interceptions, don't know, no response were also observed.

Overall, the linguistic elements analysis found that in all the types of aphasias, there are various linguistic problems similar in each type except for anomic, where limited performance was seen only on adverb clauses. The non-fluent aphasia mostly showed errors on tasks related to the size, direction, and placement of objects. Fluent aphasics showed poor performance in place prepositions, adverb clauses, object nouns, and implied common verbs. Table 4 shows the overall linguistic element performance of various aphasics.

S. No	Types of Aphasias	Linguistic Elements	Average % of responses	Average time to complete test
1.	Conduction	Place prepositions, Adverb clause, Object I noun, Implied common verbs	47.5 %	55mins
2.	Wernicke's	Adverb clause, Place prepositions, Implied common verbs	41%	56mins
3.	Anomic	Adverb clauses	47.5%	60mins
4.	Broca's	Left-right prepositions, Place prepositions and Adverb clause	45%	45mins
5.	Global	Left-right prepositions, Size II adjectives, Place prepositions and Object I noun	42.5%	57.5mins

Table 4: Whole linguistic elements performance by various aphasics.

Overall, among all the aphasics, the anomic aphasia group performed well on all linguistic elements except for adverb clauses. Interestingly, all other types of aphasics also performed poorly on adverb clauses along with place prepositions, object I nouns, implied common verbs, left-right prepositions, and size II adjective sections. Poor performance might be due to the increase in linguistic and cognitive complexity.

The findings of this study agree with those of [12], who stated that the errors showed an unsimilar pattern and grammatical aspects such as "left and right preposition" and "temporal order of events" were relatively sensitive to aphasic deficits.

The findings of this study agree with those of [16], who stated that RTT scoring training programmes should include more prominent practise with (a) subtests containing a greater number of elements, (b) patients producing a greater variety of error types, and (c) errors that cause the most disagreements (delays, immediacy, errors, and self-corrections). By giving attention to and highlighting each of these criteria during score training and RTT administration, the probability of poor rater agreement can be minimized and scoring accuracy improved. The present study results are in consensus with [12], that the test performance was not able to discriminate among aphasic groups.

Conclusion

The findings of this study revealed a few remarkable aspects of aphasic individuals' auditory comprehension abilities. All the individuals have performed slightly better in all the subtests, and the percentage of overall performance in all the subtests ranges between 76% and 93%. There is a gender difference. Whereas females performed better in all the subtests, the percentage of overall performance in each gender ranges between 73% to 93% of types of responses in various age groups across genders.

In G1 (30 years), two male participants participated and responded well by completing the tasks. Subvocal rehearsals, immediate and self-corrections were observed without any delay in the performance. In G2 (31-50 years), there are seven participants (2 females, 5 males), among whom one female and two male participants showed delayed responses and self-correction, while the responses of the other participants were mostly immediate, complete, and showed sub-vocal rehearsals. In G3 (51-70 years), there were 10 participants (2 females, 8 males). Here, 2 females and 2 males hadn't completed the task. Delayed responses were observed. Whereas SVR, immediate, and self-corrections were not observed, the remaining six participants completed the tasks with a delay in duration. In G4 (> 71 years), only one participant was present, and the types of responses were not complete and delayed responses were observed. In G3 and G4, no self-correction and immediate responses were observed. Overall responses to the test vary between complete, sub-vocal rehearsals, and immediate. Because several types of aphasic patients participated in the study, qualitative analysis was done depending on the type of aphasia, and the findings indicated that anomic aphasics performed better than other types of aphasics. Broca's and Conduction aphasics have outperformed Wernicke's and Global aphasics. In error analysis, the incorrect responses were mostly observed in G3 and G4. 35% showed confusion was observed due to the different sizes of the objects. Multiple attempts by 50%. This might be due to the increasing complexity of sentences. visual interceptions by 30% might be due to the increase in age and different sizes of the objects. I don't know by 25%, which was observed in higher subtests like subtests 8, 9, and 10 as the complexity increased and no response by 15% due to the comprehension deficits. Overall, among all the aphasics, the anomic aphasia group performed well on all linguistic elements except for adverb clauses. Interestingly, all other types of aphasics also performed poorly on adverb clauses along with place prepositions, object I nouns, implied common verbs, left-right prepositions, and size II adjective sections. Poor performance might be due to the increase in linguistic and cognitive complexity. There was no significant difference found when Wernicke's and Broca's aphasias were compared. The current study results can serve as reference data to understand various aphasia while assessing and treating auditory comprehension.

Limitations and future suggestions

The present study is limited to 20 aphasics, limited types of aphasias, and restricted to monolingual and adults. All the subjects are in a rehabilitation period for 3 months. The study can be extended to transcortical sensory and transcortical motor aphasias, pre and post therapy aphasics, can be extended to bilingual populations, and can be extended to large clinical populations.

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Declaration of Competing Interest

The authors solely declare that there are no competing commercial or personal relationships which could influence the present paper.

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Bibliography

1. Aram DM and Ekelman BL. "Unilateral brain lesions in childhood: Performance on the Revised Token Test". *Brain and Language* 32.1 (1987): 137-158.

2. Amunts K., *et al.* "Broca's region revisited: cytoarchitecture and intersubject variability". *The Journal of Comparative Neurology* 412.2 (1999): 319-341.

3. Bakhtiar M., *et al.* "Development of the English Listening and Reading Computerized Revised Token Test into Cantonese: Validity, Reliability, and Sensitivity/Specificity in People with Aphasia and Healthy Controls". *Journal of Speech, Language, and Hearing Research* 63.11 (2020): 3743-3759.

4. De Renzi A and Vignolo LA. "Token test: A sensitive disturbances in aphasics". *Brain: A Journal of Neurology* (1962).

5. Fridriksson J., *et al.* "Anatomy of Aphasia Revisited". *Brain* 141.3 (2018): 848-862.

6. Fischl B., *et al.* "Cortical folding patterns and predicting cytoarchitecture". *Cerebral cortex (New York, N.Y.: 1991)* 18.8 (2008): 1973-1980.

7. Fedorenko E., *et al.* "New method for fMRI investigations of language: Defining ROIs functionally in individual subjects". *Journal of Neurophysiology* 104 (2010): 1177-1194.

8. Hallowell B., *et al.* "Using eye movement responses to index auditory comprehension: An adaptation of the Revised Token Test". *Aphasiology* 16.4-6 (2002): 587-594.

9. Helm-Estabrooks N., *et al.* "Treating attention to improve auditory comprehension in aphasia". *Brain and Language* 74 (2000): 469-472.

10. Hickok G and Poeppel D. "Dorsal and ventral streams: A framework for understanding aspects of the functional anatomy of language". *Cognition* 92 (2004): 67-99.

11. Kavya R and Lakshmi Prasanna P. "Revised Token Test in Telugu. Unpublished dissertation. Osmania University (2020).

12. Kamei T and Tsukuda I. "Revised Token Test and Linguistic Errors Made by Aphasic Subjects". *Sound Voice Word Medicine* 24 (1983): 235-247.

13. Murray LL., *et al.* "Auditory Processing in Individuals with Mild Aphasia". *Journal of Speech Language and Hearing Research* 40.4 (1997): 792.

14. Noll JD and Randolph SR. "Auditory semantic, syntactic, and retention errors made by aphasic subjects on the token test". *Journal of Communication Disorders* 11.6 (1978): 543-553.

15. Ojemann G and Whitaker HA. "The Bilingual Brain". *Archives of Neurology* 35 (1978): 409-412.

16. Odekar A and Hallowell B. "Exploring inter-rater agreement in scoring of the Revised Token Test". *Journal of Medical Speech-Language Pathology* 14 (2005): 123-131.

17. Parisi D and Pizzamiglio L. "Syntactic Comprehension in Aphasia". *Cortex* 6.2 (1970): 204-215.

18. Park GH., *et al.* "Reliability of the Five-Item Revised Token Test for individuals with aphasia". *Aphasiology* 4.5-6 (2000): 577-585.

19. Quintana M., *et al.* "An Item Response Theory analysis of the Revised Token Test in normally developing native Spanish speaking children". *Anuario de Psicologia* 45.2 (2015): 147-160.

20. Schuell H and Jenkins J. "Relationship between auditory comprehension and word frequency in aphasia". *Journal of Speech and Hearing Research* 4.1 (1961): 30-36.

21. Smith A. "Objective indices of severity of chronic aphasia in stroke patients". *Journal of Speech and Hearing Disorders* 36.2 (1971): 167-207.

22. Wiener D., *et al.* "Inhibition and auditory comprehension in Wernicke's aphasia". *Aphasiology* 18.5-7 (2004): 599-609.

23. Whitaker HA and Noll JD. "Some linguistic parameters Token Test". *Neuropsychologia* 10.4 (1972): 395404.

24. Yourganov G., *et al.* "Predicting aphasia type from brain damage measured with structural MRI". *Cortex: A Journal Devoted to the Study of the Nervous System and Behavior* 73 (2015): 203-215.