Development of Syntax Comprehension Test in Hindi Language for Persons with Aphasia

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Abstract

The study was carried out with the aim to develop a test of syntax comprehension in Hindi language for persons with aphasia. The present study was done in two phases. First phase included development of test material and in the second phase, the test battery was administered on neuro-typical adults and persons with aphasia. The developed material consisted of five sections, namely, prepositions, PNG markers, tenses, conjunctions and comparatives, and conditional clauses. The material was administered on 56 neuro-typical adults and 11 persons with aphasia aged 18 to 65 years. It was observed that there was a significant difference between the mean scores across the neuro-typical adults and persons with aphasia on the entire task in both the modalities. Based on this finding it is recommended that the developed test can be used for assessment of syntax comprehension for persons with aphasia.

Key words: Modality, Hindi, Task, Neuro-typical

Introduction

Aphasia is an acquired language disorder caused by brain damage. Aphasia affects expressive and receptive communication in all modes including speaking, reading, writing, understanding and gesturing. The degree to which each of these is affected depends on the location in the brain where the stroke has occurred (Longerich & Bordeaux, 1954). Aphasia affects the ability to choose words to express one's opinions and also impairs the identification of words for the comprehension of phrases and paragraphs. If comprehension is affected, reading and listening will also be affected equally (Musso, Weiller, Kiebel, Muller, Bulau, & Rijntjes, 1999).

To assess comprehension ability, the stimuli is presented to the person, and his comprehension ability will be inferred based on the responses. A test of comprehension consists of carefully worked out administrative procedures, and stimulus materials that are designed to elicit relatively simple responses. The complexity of the stimulus can be systematically varied by increasing the number of items presented (such as phonemes, morphemes, phrases and sentences) in a test. The level at which the performance is disrupted due to information overload can be determined by systematically increasing the number of items to be processed both in terms of semantic content as well as syntactic complexity. Several researchers have studied comprehension at syntax level in persons with aphasia.

Heilman and Scholes (1976) studied 34 persons with aphasia, to find out whether persons with Broca's aphasia have a comprehension deficit, which is dependent on syntactic relationships and how this comprehension deficit is different from that seen in persons with Wernicke's aphasia and conduction aphasia. The results revealed that when comprehension is dependent on syntactic relationships, persons with Broca's aphasia perform poorly.

Caplan and Evans (1990) studied the relationship between complexity of syntactic structures and comprehension of discourse in persons with aphasia. Sixteen persons with aphasia and sixteen neuro-typical adults participated in the study. The results revealed that ability to understand discourse can be relatively preserved in person with aphasia despite impaired sentence comprehension. Person with aphasia showed effects of syntactic structure in the sentence comprehension task. In addition, Caplan, Waters, and Hilderbrandt (1997) studied syntactic complexity in fifty-two persons with aphasia using sentence picture matching task. Ten examples each of ten syntactic structures were tested. All sentences were semantically reversible and were matched with a picture depicting the action orally described in the sentence and a syntactic foil. Analysis of the number of correct responses per sentence type showed effects of syntactic complexity in persons with aphasia.

Further, Goswami (2004) made use of Kannada versions of Western Aphasia Battery, Linguistic Profile Test, and Revised Token Test to investigate the comprehension abilities across different aphasias at syntactic level. Results revealed that persons with aphasia have difficulty in comprehension at syntax level.

Salis and Edwards (2009) studied ten persons with aphasia to know how sentence comprehension abilities are influenced by the nature of the assessment task. The results revealed that nature of a task can have impact on the underlying deficit, as the actual pattern of deficit differed from participant to participant depending on the task. Thus, syntactic comprehension is sensitive to task effects.

Various comprehension tests that have been used for persons with aphasia such as Minnesota Test for Differential Diagnosis of Aphasia (MTDDA) (Schuell, 1955), Boston Diagnostic Aphasia Examination (BDAE) (Goodglass & Kaplan, 1972), Reading Comprehension Battery for Aphasia (LaPointe & Horner, 1979), Auditory comprehension test for sentences (Shewan, 1980), and Western Aphasia Battery (WAB) (Kertesz, 1979, 1982, 2006).

It is evident from the existing review of literature that the quoted tests vastly cover all the domains. However, there are limited tests to assess the comprehension abilities at syntax level for persons with aphasia in Indian context and the available Western assessment tests pose limitations in Indian contexts due to the linguistic and ethno-cultural diversity. Moreover, there is growing evidence that a diagnosis in terms of affected linguistic levels - semantics (word meaning), phonology (word sound), and syntax (grammatical structure) - is more useful than diagnosing aphasia type (Howard & Patterson, 1989). For the assessment of aphasia in the Indian context, it is necessary to have a culturally standardized test to identify the problem and classify the problem into various groups for the purpose of diagnosis, therapy and prognosis. Thus, the aim of the present study was to develop a test of syntax comprehension in Hindi language for persons with aphasia.

Method

This study endeavored to develop a test of syntax comprehension in Hindi language. The objective of the study was to conduct a relative study between neuro-typical adults and persons with aphasia with respect to auditory and orthographic modes. The selection of participants followed a set criteria and the data collected was analyzed with respect to auditory and orthographic mode. The following procedure was adopted for the study.

Procedure

The present study was done in two phases. First phase included development of test material and in the second phase, the test battery was administered on neuro-typical adults and persons with aphasia.

Phase- I: Development and Description of Test Material

The first phase involved the development of the test material. All the items of the test were selected on the basis of the linguistic background of the target population. The Syntax comprehension test consisted of five sections viz. prepositions, PNG markers, tenses, conjunctions and comparatives, and conditional clauses. In each section, 20 items were selected from newspaper or day to day materials. Twenty Speech Language Pathologists (SLPs), who were proficient in speaking, reading, and writing Hindi language and who had at least two years of clinical experience, were asked to rate the items for assessing Syntax comprehension in persons with aphasia. A two point rating scale was applied to rate the stimuli on the basis of inappropriate and appropriate by the SLPs. An average of minimum 90% appropriate items rated by the SLPs was selected as the final set of stimuli for the test. SLPs were also asked to arrange the items in a hierarchical manner in the order of complexity.

The finalized test, Syntax Comprehension test in Hindi Language, consists of 10 items in each section. A total of 100 stimuli (50 stimuli in auditory mode and 50 stimuli in orthographic mode) were considered for the final test. Culturally appropriate picture stimuli were provided wherever necessary which were drawn by a professional artist. The stimuli were presented in auditory and orthographic mode separately and randomly. The response sheet for the prepositions and PNG markers section contains four pictures out of which one is the target picture and other three were the distracters. Different distracters were provided for different stimuli. In Tenses section, there were three pictures present in the test however pictures were not provided for the section of conjunction and comparatives, and conditional clauses. Responses could be either verbal, gestural or pointing pictures/cards having ‘yes’ and ‘no’ written on them.

Scoring

Participants’ responses were analyzed and a score of ‘2’, ‘1’, and ‘0’ was given for every correct response without prompt, correct response with prompt, and incorrect/no response even after prompt respectively.

Phase- II: Administration of the Test

The neuro-typical participants between the age group of 18-65 years were considered for this test. The participants were seated comfortably in a quiet environment. The test materials were arranged according to the demands of the task of each section and order of mode of administration of the test. The administration of the test was recorded on a digital video camera recorder (Sony Handycam, model no. DCR-SR88).

Participants

A total of 67 participants participated in the study. The participants were divided into two groups: Group- 1 consisted of 56 neuro-typical adults and Group- 2 consisted of 11 persons with aphasia. The following Table 1 and Table 2 present the details:

Table 1

Details of the participants of the study

Participants	Age range	Male	Female
Neuro-typical adults	18-65	26	30
Persons with aphasia		7	4

Table 2

Demographic details of persons with aphasia

Sl. No.	Age/ Gender	Provisional Diagnosis	Time post onset	CT scan/fMRI report	Education
1	49 years/M	Global Aphasia	3 months	Left MCA territory	Graduate
2	65 years/M	Global Aphasia	3 months	Left MCA territory	Graduate
3	58 years/F	Global Aphasia	5 months	Left MCA territory	Graduate
4	62 years/F	Global Aphasia	3 months	Left frontotemporoprietal region	PG
5	42 years/M	Broca's Aphasia	4 months	Left MCA territory	Graduate
6	48 years/M	Broca's Aphasia	6 months	Left MCA territory	Graduate
7	43 years/F	Broca's Aphasia	4 months	Left MCA territory	PG
8	57 years/M	Broca's Aphasia	12 months	Left MCA territory	PG
9	65 years/M	Broca's Aphasia	7 months	Left MCA territory	Graduate

10	65 years/M	Broca's Aphasia	9 months	Left MCA territory	Graduate
11	55 years/F	Broca's Aphasia	5 months	Left MCA territory	Graduate

Initially a total of 60 neuro-typical adults and 16 persons with aphasia were recruited for the study. But there was attrition of four neuro-typical adults and five persons with aphasia which resulted in the final count of 56 neuro-typical adults and 11 persons with aphasia for the study.

Inclusion Criteria

Ethical standards and considerations was maintained and adhered to while selecting the participants for the study. The participants (or family members/care takers in case of persons with aphasia) were explained about the purpose and procedure of the study and written consent was acquired. They were selected based on the following inclusionary criteria. The age of the participants should be between 18-65 years and ten years of formal education. All the participants under consideration should be the native speakers of Hindi and Pre-morbidly all participants have been right handed. There should not have been any known history of pre-morbid neurological illness, psychological disorders, and no other significant sensory and/or cognitive deficits. Mini-Mental State Exam (Folstein, Folstein, & McHaugh, 1975) was administered on neuro-typical adults to rule out any cognitive-linguistic deficits. The participants were diagnosed as having Ischemic stroke by a Neurologist/Physician.

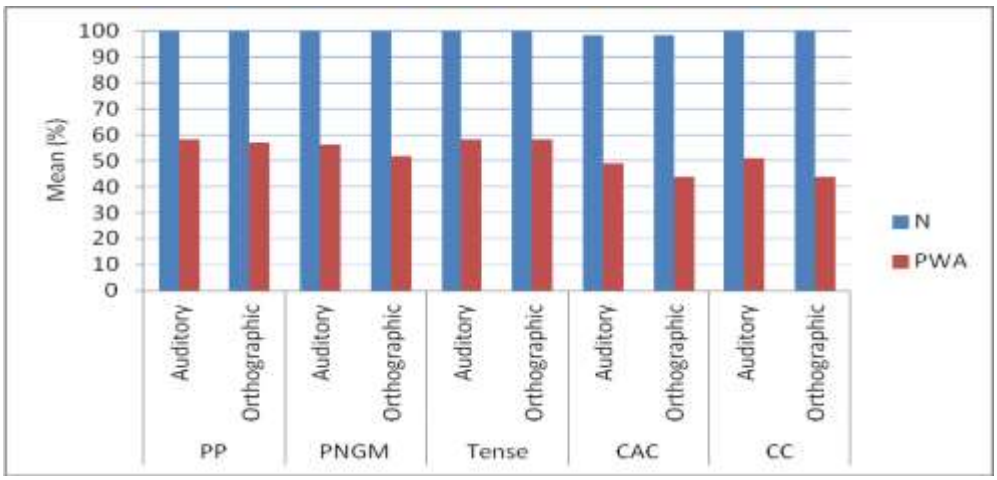
Results

This study was undertaken to investigate Syntax comprehension in persons with aphasia and neuro-typical adults. Fifty six neuro-typical adults and eleven persons with aphasia participated in the study. The responses of the participants were tabulated and statistical analysis was done using SPSS software (Statistical Package for the Social Sciences package, version 17.0). Mann-Whitney U test was executed as a part of statistical analysis of the data and the results of the analysis are presented as follows.

Table 3

Mean and SD values for neuro-typical adults and persons with aphasia in auditory and orthographic modes

Sections	Mode	Neuro-typical adults		Persons with Aphasia	
		Mean (%)	SD (%)	Mean (%)	SD (%)
Preposition	Auditory	100.00	0.00	58.18	31.88
	Orthographic	100.00	0.00	57.27	36.90
PNG marker	Auditory	100.00	0.00	56.36	36.13
	Orthographic	100.00	0.00	51.81	39.45
Tense	Auditory	100.00	0.00	58.18	37.36
	Orthographic	100.00	0.00	58.18	39.45
Conjunction and comparatives	Auditory	98.57	3.53	49.09	27.73
	Orthographic	98.57	3.53	43.63	32.64
Conditional clauses	Auditory	100.00	0.00	50.90	35.05
	Orthographic	100.00	0.00	43.63	35.57



Note. PP- Preposition, PNGM- PNG markers, CAC- Conjunction and comparatives, CC- Conditional clause, N- Neuro-typical, PWA- Persons with aphasia

Figure 1. Mean scores on different task for neuro-typical adults and persons with aphasia.

Performance of Participants on Preposition Task

It can be observed from Table 3 and Fig. 1 that the mean score of preposition task for persons with aphasia as 58.18 (S.D=31.88) and 57.27 (S.D=36.90) in auditory and

orthographic mode respectively. Persons with aphasia have performed better in auditory mode than in orthographic mode for preposition task, which is comparatively less than their neuro-typical adults counter parts whose mean score for preposition task were 100.00 (S.D=0.00) in both modes. For statistical significance, Mann-Whitney U test was carried out and the results reveal a significant difference in auditory ($Z=-8.08$, $p < 0.01$) and orthographic modes ($Z=-8.08$, $p< 0.01$) across the neuro-typical adults and persons with aphasia.

Performance of Participants on PNG Marker Task

Mean and standard deviation of PNG marker task for persons with aphasia and neuro-typical adults are shown in Table 3. It can be observed from Table 3 and Fig. 1 that the mean score of PNG marker task in auditory and orthographic mode for persons with aphasia as 56.36 (S.D=36.13) and 51.81 (S.D=39.45) respectively. It also shows that performance of neuro-typical adults on PNG marker task is higher than the performance of persons with aphasia in both modalities. Comprehension of PNG marker is better in auditory mode than the orthographic mode for persons with aphasia whereas neuro-typical adults have comprehended well in both modes. A Mann-Whitney U test was carried out to examine for statistical significance and the results reveal a significant difference in auditory ($Z=-8.08$, $p < 0.01$) and orthographic ($Z=-8.09$, $p< 0.01$) modes across the neuro-typical adults and persons with aphasia.

Performance of Participants on Tense Task

It is indicated from Table 3 and Fig. 1 that the mean score of tense task in auditory and orthographic mode for persons with aphasia as 58.18 (S.D=37.36) and 58.18 (S.D=39.45) respectively, which is comparatively less than their neuro-typical counter parts whose mean score of tense task were 100.00 (S.D=0.00) in both modes. Persons with aphasia have performed equally on tense task in both modes. To know the statistical significance, Mann-Whitney U test was carried out and the results revealed a significant difference in auditory ($Z=-8.08$, $p < 0.01$) and orthographic ($Z=-8.09$, $p< 0.01$) modes across the neuro-typical adults and persons with aphasia.

Performance of Participants on Conjunction and Comparatives Task

The performance of persons with aphasia and neuro-typical adults on conjunction and comparatives task is represented in Table 3. Table 3 and Fig. 1 indicate the mean score and standard deviation for conjunction and comparatives task in auditory and orthographic mode

for persons with aphasia as 49.09 (S.D=27.73) and 43.63 (S.D=32.64) respectively, which is comparatively less than their neuro-typical counter parts whose mean score of conjunction and comparatives task were 98.57 (S.D=3.53) in both modes. Persons with aphasia have performed better in auditory mode than orthographic mode on conjunction and comparatives task. The performances of Person with aphasia on conjunction and comparatives task were comparatively lesser than neuro-typical adults in both modalities. To examine for statistical significance, Mann-Whitney U test was carried out and the results reveal a significant difference in auditory ($Z=-6.57$, $p < 0.01$) and orthographic ($Z=-6.57$, $p< 0.01$) modes across the neuro-typical adults and persons with aphasia.

Performance of Participants on Conditional Clause Task

It can be observed from Table 3 and Fig. 1 that the mean score standard deviation for conditional clause task in auditory and orthographic mode for persons with aphasia as 50.90 (S.D=35.05) and 43.63 (S.D=35.57) respectively. It also shows that performance of neuro-typical adults on conditional clause task is higher than the performance of persons with aphasia in both modalities. Comprehension of conditional clause is better in auditory mode than orthographic mode for persons with aphasia whereas neuro-typical adults have comprehended well in both modes. Mann-Whitney U test was carried out and the results reveal a significant difference in auditory ($Z=-8.08$, $p < 0.01$) and orthographic ($Z=-8.08$, $p< 0.01$) modes across the neuro-typical adults and persons with aphasia.

Overall Performance of Participants on Syntax Task

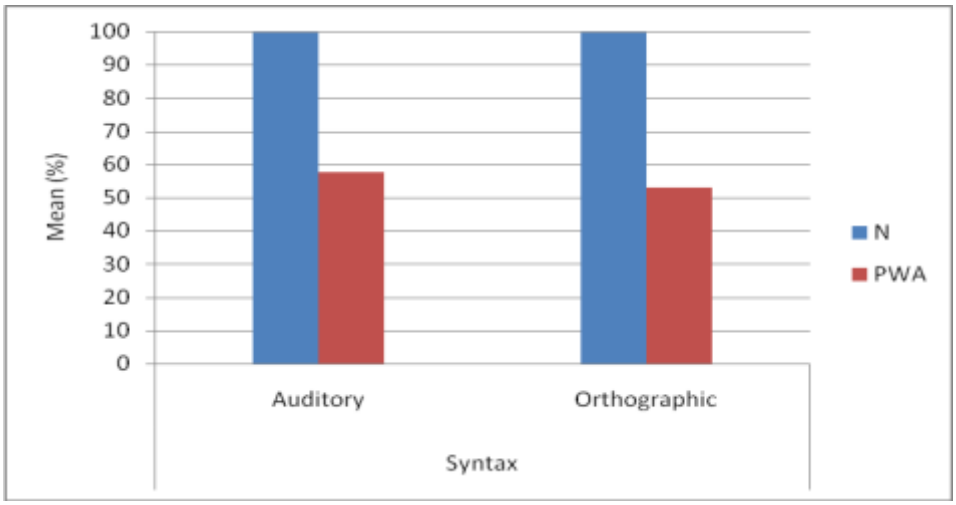
The overall total scores for Syntax comprehension were summed up for both modalities separately. The mean and standard deviation for auditory and orthographic mode were calculated. From Table 4 and Fig. 2, it can be seen that the persons with aphasia scored an overall mean of 57.79 (S.D=30.35) and 52.85 (S.D=35.84) in auditory and orthographic modes respectively.

Table 4

Mean and SD values for comprehension of Syntax for neuro-typical adults and persons with aphasia in auditory and orthographic modes

Modes	Neuro-typical adults		Persons with Aphasia	
	Mean(%)	SD(%)	Mean(%)	SD(%)

Syntax	Auditory	99.80	0.50	57.79	30.35
	Orthographic	99.80	0.50	52.85	35.84



Note. N- Neuro-typical adults, PWA- Persons with aphasia.

Figure 2. Mean values for comprehension of Syntax for neuro-typical adults and persons with aphasia.

Performance of persons with aphasia for overall Syntax task was better in auditory mode than in orthographic mode. This was comparatively lesser than the performance of neuro-typical adults whose scored an overall mean of 99.80 (S.D=0.50) in both modalities. A Mann-Whitney U test was carried out to examine for statistical significance and the results reveal a significant difference in auditory ($Z=-6.56$, $p < 0.01$) and orthographic ($Z=-6.56$, $p< 0.01$) modes across the neuro-typical adults and persons with aphasia. Result showed that there was a difference in the performances in Syntax task between neuro-typical adults and persons with aphasia across the both modalities.

Discussion

In present study, an attempt was made to investigate the syntax comprehension in persons with aphasia and neuro-typical adults in auditory and orthographic mode. Results reveal that brain damage can cause deficits in comprehension of preposition, PNG marker, tense, conjunction and comparatives, and conditional clauses in auditory and orthographic modes in persons with aphasia. Comprehensions of preposition, PNG marker, conjunction and comparatives, and conditional clauses were better in auditory mode than orthographic mode for Persons with aphasia. In auditory mode, comprehension of preposition was better

than tense followed by PNG marker, conditional clauses, and conjunction and comparatives. In orthographic mode, comprehension of tense was better than preposition followed by PNG marker, conditional clauses, and conjunction and comparatives. Persons with aphasia have performed equally in both modes (auditory and orthographic) on tense task. The poorer comprehension of the persons with aphasia for conditional clause, and conjunction and comparatives may be due to less familiarity, less frequent use in everyday communication, and increase in sentence length as compared to other tasks whereas neuro-typical adults have comprehended syntax well and equally in both modes.

Comprehension deficits in persons with aphasia at syntactical level have been well documented in literature (Law & Leung, 1998; Law, 2000). However, this study attempted to elaborate on the syntactically comprehension deficits in persons with aphasia in auditory and orthographic mode.

From the Table 3 it is evident that, the neuro-typical participants exhibited significantly better comprehension as compared to the persons with aphasia on the entire task which assessed syntax comprehension. From the scores of persons with aphasia, it is observed that highest mean scores were observed in preposition and tense task and the lowest were in conjunction and comparatives task. The mean scores of other tasks fell within this range.

The performances of the persons with aphasia, however, were not similar across the various sections on syntax. They exhibited better comprehension on action verb compared with preposition, PNG marker, tense, Wh-question, conjunction and comparatives, and conditional clauses. The better comprehension on tense and preposition task could be attributed to the relative simplicity and familiarity of the stimuli as compared to the PNG marker, conjunction and comparatives, and conditional clauses. Moreover, the latter mentioned sections also require intact reasoning skills which may get compromised due to brain damage as reported by (Martin & Romani, 1994; Freedman & Martin, 2001).

However, the performance of persons with aphasia differs with different modality stimuli presentation for all the sections. This highlights an important observation that, the benefits of different modality stimuli presentation are also commensurate on the degree of a

person's comprehension difficulty on a particular task. Syntax comprehension may be influenced by factors such as familiarity, semanticity, speech rate, and stimulus modality.
The influence of stimulus length on comprehension has also been reported by Curtiss, Jackson, Kempler, Hanson, & Metter, 1986; Goswami, 2004. These authors reported that other factors held constant, the sentence comprehension tends to decrease as length increases. The deterioration of comprehension with increase in sentence length is indicative of retention deficits in persons with aphasia. Effect of sentence length (Caplan & Evans, 1990; Cannito, Hough, Vogel, & Pierce, 1996; Caplan, Waters, & Hilderbrandt, 1997) and grammatical complexity (Law & Leung, 1998; Law, 2000) has been addressed by several studies. Generally, the more grammatically complex a sentence is, the more difficult is its comprehension for persons with aphasia.

Comprehension of grammatical elements such as preposition, PNG marker, tense, conjunction and comparatives, and conditional clauses requires intact reasoning skills and good attention and memory span (as the length and complexity of the stimuli increases), and deficits in all of these cognitive processes are implicated in persons with aphasia (Papagno & Genoni, 2003; Wright & Newhoff, 2004).

Deficits in comprehension of linguistic stimuli in persons with aphasia can be attributed to extent and nature of brain damage sustained by the person (Caramazza & Zurif, 1976). Similar findings of impaired syntax comprehension in persons with aphasia as compared to the neuro-typical adults have also been reported by Burchert, Friedmann, and De Blesser (2003); Goswami, 2004; Wright and Newhoff, 2004.

The present test has proved to be a useful test for persons with aphasia as implicated by the result. The facts indicate that syntax comprehension test to be one of the most elaborate clinical tools that help in terms of assessing an individual's auditory and orthographic mode comprehension and thereby identifying the syntax comprehension deficits in persons with aphasia, which would serve as a necessary baseline for aphasia management decisions. The particular responses of the person would also guide the clinician in the selection of linguistic timing, and contextual and other facilitators of comprehension. Thus, this study underscores the importance of a thorough assessment of syntax comprehension in different modalities.

Conclusion

The present study intended to investigate comprehension deficits in Hindi speaking persons with aphasia at syntax level in different modalities. Review of relevant literature revealed the existence of syntax comprehension deficits in persons with aphasia. Result showed that there was a significant difference in the performances on syntax task between neuro-typical adults and persons with aphasia across the both (auditory and orthographic) modalities. The neuro-typical adults exhibited significantly better comprehension as compared to the persons with aphasia in auditory and orthographic modes on Syntax comprehension test in Hindi language.

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