Lexical Processing Deficits in Persons with Aphasia-A Syntactic Approach

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Research Article

ABSTRACT

Individuals with aphasia commonly experience word retrieval deficits, particularly concerning nouns and verbs. This study focuses on Kannada-speaking Persons with Aphasia (PWA) and Neurotypical Individuals (NTI), employing qualitative and quantitative methods to assess word class deficits at single-word and discourse levels. Confrontation naming and picture description tasks were used, with PWA performing poorer than NTI. The statistical analysis revealed significant differences in word class usage between PWA and NTI for picture description ($p < 0.05$). Notably, deficits were more pronounced in discourse tasks, emphasizing the importance of including discourse analysis in aphasia assessments. This study advocates incorporating discourse analysis to enhance the understanding of language characteristics at the syntax level, supported by statistical outcomes, in routine diagnostic assessments of aphasia.

Keywords: Aphasia; Lexical retrieval; Word class; Discourse; Picture naming

INTRODUCTION

Aphasia, a common and debilitating language impairment, often manifests as difficulties in word retrieval, impacting lexico-semantic and phonological representations [1]. Persons with aphasia commonly struggle with naming objects and actions (anomia), affecting nouns and verbs. Some studies indicate more significant verb deficits in aphasia, potentially attributed to semantic distinctions, with verbs being semantically more complex and abstract than nouns [2-4]. Cross-linguistic differences in morphological markers and syntactic complexity also play a role. The present study focuses on the task variable, exploring how tasks involving lexical retrieval or sentence processing affect noun-verb dissociations. While many studies examine single-word tasks, a unique approach involves network lesion-symptom mapping during image description in post-stroke aphasia, revealing distinct neural correlates for action and object word production [5].

Noun and verb naming in single-word production task

Confrontational naming tests are widely used in clinical settings to assess spoken naming ability. These tasks are straightforward, providing information on the severity of naming deficits and identifying psycholinguistic variables affecting performance. Aphasia tests typically focus on single-sentence or single-picture description tasks, limiting assessment to expositional narrative [6,7]. Semantic distinctions in naming tasks involving verbs are lower in imageability than nouns, emphasizing cross-linguistic differences [8]. Picture naming tasks predominantly concentrate on nouns, making sentence production easier than in single-picture contexts.

Verb deficits in aphasia may stem from the complexity of verbs and their syntactic roles in sentences, leading to more significant difficulties in comprehension and production, particularly in non-fluent types of aphasia. These deficits extend to lexical retrieval, sentence comprehension and production, ultimately impacting discourse [9].

Noun verb naming in discourse tasks

Discourse, defined as natural language comprising utterances or phrases, involves macrostructural organization, sentence structure and lexical levels [10]. The study focuses on syntactic analysis in connected sentences and single-word production in Persons with Aphasia (PWA) compared to Neurotypical Individuals (NTI). Composite picture descriptions are commonly used for linguistic profiling but may yield more specific words than connected speech forms. Discourse tasks reveal dynamic word retrieval issues impacted by contextual factors for PWA, assessing real-life social participation challenges [11]. Discrepancies between confrontation picture naming and connected speech have been reported, emphasizing the importance of analyzing spoken discourse for microstructural and macrostructural information [12]. Associations between picture naming and dialogue/narrative suggest discourse tasks are valuable for word retrieval assessment, with structured tasks like picture description yielding specific words [13]. This study addresses word retrieval abilities in the discourse context, contributing to understanding real-life communication challenges in aphasia.

Syntactic analysis of noun-verb naming in persons with aphasia

The study by Fergadiotis analysed picture naming abilities, paraphasia, informativeness and connected discourse in 98 Persons with Aphasia (PWA) from aphasia bank [14]. Results showed that picture-naming tasks were not strong predictors of paraphasia in connected speech but were highly correlated with information content. Another study using three connected speech tasks found that picture naming scores correlated across samples, with prompted conversation less strongly associated than picture description and story retelling [15]. Boucher, et al. studied micro and macro linguistic variables, showing a strong correlation between picture naming and description on informativeness. This study recommends

automatic analysis of word-finding difficulty in connected sentences, which the present study aims to initiate for verb and noun counts in connected speech.

Fromm, et al. and Salis and DeDe highlighted discourse impairments in later recovery stages of aphasia, even in those scoring above aphasia quotient thresholds [16]. The current study includes a participant with WAB AQ scores above the cutoff, investigating discourse impairments. Difficulty in isolating and quantifying word retrieval in connected speech, especially verbs, is noted in the literature and the present study addresses this by counting appropriate nouns and verbs in Kannada-speaking PWA and Neurotypical Individuals (NTI) [17]. Kannada's linguistic complexity is considered, with the study hypothesizing task differences in performance between picture naming and connected speech tasks. The goal is to explore noun-verb performance in Kannada-speaking individuals with aphasia and neurotypical speakers.

MATERIALS AND METHODS

Participants

Forty individuals formed two separate groups, with twenty participants in each group included in the present study. Group I constituted the clinical group (three females and seventeen males; age range 20–71 years) (mean age=42.45 years) consisting of Persons with Aphasia (PWA) and group II comprised age-matched Neurotypical Individuals (NTI) as the control group (seven females and thirteen males; age range 20–71 years) (mean age=42.45 years). Participants in both groups were native Kannada and Kannada-English bilingual speakers with a minimum of 10 years of formal education. Participants in both groups did not report any history of neuropsychiatric disorders (and this also applied to the PWA before the onset of aphasia). Sensory issues (hearing, vision) were self-reported using a questionnaire composed by the investigator.

All PWA had sustained a left Cerebrovascular Accident (CVA) in the Middle Cerebral Artery (MCA) territory confirmed by a neurologist and were at least six months since the onset of aphasia when recruited in the study. Participants were diagnosed with aphasia by administering Western aphasia Battery in Kannada. PWA had normal to mild cognitive impairment according to the Montreal Cognitive Assessment in Kannada (MoCA), which was administered by a speech-language pathologist (Table 1). Participants in the neurotypical group scored >26 on the MoCA administered by the investigator. The types of aphasia were anomic aphasia and Broca's aphasia with varied aphasia quotients. PWA was recruited from the Department of clinical services at the All-India Institute of Speech and Hearing (AIISH), Mysuru district, Karnataka. The neurotypical individuals were residents of Mysuru district, Karnataka, who volunteered to participate in the present study. The study followed the 'ethical guidelines of bio-behavioral research involving human subjects' and was approved by the AIISH ethical committee. Written informed consent was obtained from the participants and caregivers.

Table 1. Demographic details of Participants of the study

	Persons with aphasia (group I)								Neuro-typical individuals (group II)			
S. no	Age/ gender	Years of formal education	Handedness	Neuroimaging finding	WAB -AQ	WAB naming score	MoCA scores	Diagnosis	Age/ gender	Years of formal education	MoCA scores	Handedness
P1	20 yrs/F	14 yrs	Right handedness	Infarct in left temporo parietal lobe	32.2	1.5	21	Broca's aphasia	20 yrs/F	15 yrs	26	Right handedness
P2	38 yrs/M	15 yrs	Left-handedness	Infarct in left fronto temporo parietal, occipital lobe	67.7	6.8	23	Broca's aphasia	35 yrs/M	16 yrs	28	Right handedness

P3	34.4 yrs/M	16 yrs	Right handedness	Hemorrhagic stroke in left putamen region	70.6	9.3	28	Anomic aphasia	38 yrs/M	16 yrs	27	Right handedness
P4	35 yrs/M	16 yrs	Right handedness	Infarct in left temporo parietal lobe.	89.6	7.8	28	Anomic aphasia	35 yrs/M	16 yrs	26	Right handedness
P5	47 yrs/M	14 yrs	Right handedness	Acute hemorrhage involving left basal ganglia.	89.8	8.6	19	Anomic aphasia	34 yrs/F	14 yrs	27	Right handedness
P6	50 yrs/F	16 yrs	Right handedness	Infarct in left temporo parietal lobe.	83.6	6.8	19	Anomic aphasia	50 yrs/M	16 yrs	30	Right handedness
P7	35 yrs/F	15 yrs	Right handedness	Infarct in left frontal operculum and adjacent white matter.	97	9.7	29	Anomic aphasia/Latent aphasia	47 yrs/F	14 yrs	29	Right handedness
P8	32 yrs/M	15 yrs	Right handedness	Acute recurrent CVA	75.8	6.8	20	Conduction aphasia	45 yrs/M	15 yrs	27	Right handedness
P9	31 yrs/M	12 yrs	Left-handedness	Acute non-hemorrhagic infarct in left cerebral hemisphere	80.5	8.3	21	Broca's aphasia	32 yrs/M	12 yrs	26	Right handedness
P10	69 yrs/M	10 yrs	Right handedness	Chronic infarct in right PCA	72.6	7.3	21	Broca's aphasia	39 yrs/F	10 yrs	27	Right handedness
P11	71.1 yrs/M	15 yrs	Right handedness	Acute ischemic stroke-left frontal cortical infarct	78.4	10	24	Anomic aphasia	61 yrs/M	15 yrs	28	Right handedness
P12	36.8 yrs/M	15 yrs	Right handedness	Complete thrombosis of left internal carotid artery	86.2	8.8	24	Anomic aphasia	71 yrs/F	15 yrs	29	Right handedness
P13	39.2 yrs/M	15 yrs	Right handedness	Acute infarct in left fronto-parieto-occipital lobe	97.2	9.5	26	Anomic aphasia	39 yrs/M	15 yrs	25	Right handedness
P14	43 yrs/M	12 yrs	Right handedness	Acute infarct in left basal ganglia; occlusion in left MCA	87.4	9.1	25	Anomic aphasia	39 yrs/M	12 yrs	26	Right handedness
P15	45 yrs/M	12 yrs	Left-handedness	Ischemic CVA- left MCA territory	66	7	21	Broca's aphasia	43 yrs/F	12 yrs	27	Right handedness
P16	23 yrs/M	14 yrs	Right handedness	Temepro-parietal hemorrhagic infarct	66.3	6.1	24	Conduction aphasia	45 yrs/M	14 yrs	26	Right handedness
P1	35 yrs/M	12 yrs	Right handedness	Subacute infarct in	70	8	24	Broca's aphasia	23 yrs/M	12 yrs	25	Right handedness

7				left fronto pareital lobe-subcortical structures								
P 1 8	60 yrs/M	12 yrs	Right handedness	Acute infarct to left MCA territory	75.3	8.3	22	Broca's aphasia	35 yrs/F	12 yrs	27	Right handedness
P 1 9	58 yrs/M	12 yrs	Left-handedness	Acute infarct in Left MCA territory, chronic lacunar infarct in left putamen	67.4	7.7	20	Broca's aphasia	60 yrs/M	12 yrs	28	Right handedness
P 2 0	32 yrs/M	15 yrs	Right handedness	Acute recurrent CVA	75.8	6.8	23	Conduction aphasia	58 yrs/M	15 yrs	27	Right handedness

Procedure

The stimuli materials were of two types. A single word (noun, verb) production task and naming at discourse task (*via* picture description). The single-word task was created using 114 target words (each word class consisted of 57 words). Items were selected from the Boston naming test and the action naming test adapted to the Kannada version. The second task was the 'Picnic spot picture' from Western aphasia battery-Kannada. Characteristics such as word imageability, frequency, familiarity, age of acquisition, length and visual complexity of the images were appraised by three speech-language pathologists [18].

The study was conducted in the (native) Kannada language across all participants. Participants were assessed in a quiet room (for example, a home, hospital, etc.). Line drawings (on A4 picture cards) of the noun and verb task were presented to the participants and participants were instructed to name each picture using a single word per item. They were asked either to name the object, if it was an object picture, or to say what was happening in it or what the person was doing if it was an action picture. Phonemic and semantic cues were provided if required. For the picture description task, participants had an average of 2 minutes to look at the picture. Then, they were instructed to describe it for 3-5 minutes. The assessment took 40-50 minutes and was completed in one sitting. For a few participants (persons with aphasia), the activities were completed in two sittings due to fatigue and low attention abilities. The reaction time to name the nouns and verbs for confrontation naming and naming on picture description was not considered for the present study.

Responses were recorded continuously with audio-video recording using Sony digital camera and Praat software. Verbatim transcription was made to check for accuracy and naming errors. The first response was considered for further analysis. Time measurements were not considered for analysis.

Scoring

Confrontation naming

The original report indicated that BNT and ANT scoring exhibited dissimilar patterns. Modifications were made based on a study to align the scoring for nouns and verbs, equalizing the scores. Consequently, scoring for the confrontation naming task involved assigning three points for the word class 'verb and noun.' A score of 2 was given for a correct response without any cue, a score of 1 for a correct response with a phonemic or semantic cue and a score of 0 for an incorrect or no response.

Picture description

The target stimuli for the picture description task followed a standard way to list the nouns and verbs used to accurately describe the picture as per the validation of three speech-language pathologists. The scoring method involved two-point rating scales developed by the investigator. Each accurate noun or verb naming corresponded to a score-1 without any cue and a score-0 for the incorrect or no response and use of parenthetical remarks was not considered for scoring. Inflectional variations of target verbs were also considered for correct scoring. This scoring was considered after the verbatim transcription of the connected speech sample. If responses were recognizable verbal productions of the target objects, they were rated as correct. Self-corrections made within 10 seconds were also acknowledged and phonological paraphasia-but not semantic paraphasia-was also considered acceptable because the present study is more interested in lexical knowledge than naming errors due to phonological processes. For verb naming, all forms were considered acceptable and equivalent for a score of 1 concerning the route word only; (for the verb /thinnu/(eat),/thinda/(ate),/thinnuthidane/(eating) and/thinnuvanu/(will eat)) were all accepted. For noun naming, the scoring did not consider using parenthetical remarks like 'this,' 'that,' and 'it.' Accurate noun naming was considered in the scoring. A total of 10% of the data was subjected to interrater reliability using Cronbach's alpha coefficient and a significant p-value>0.80 was obtained, showing good interrater reliability of PWA and NTI in both tasks.

The total number of nouns and verbs was noted in the two tasks and was subjected to statistical analysis. Descriptive statistics were computed for each word class in the two tasks. The comparison was made between the group performance and within-group comparisons on using different word class levels in the two tasks. The Friedman test compared performances within PWA and the neurotypical group. The Mann-Whitney U test was used for between-group comparisons for total nouns, total verbs and overall total accurate words in the two tasks. The Wilcoxon Signed rank test was also used to compare within-group performance in the two tasks. Comparison between the total numbers of nouns, verbs and overall words produced by PWA and neurotypical groups in the two tasks were also studied.

RESULTS

Section A: Comparison between confrontation naming and picture description tasks in PWA and NTI (Between-group comparisons)

The total raw mean accuracy score obtained by both groups in confrontation naming and picture description tasks, irrespective of word class, was computed and subjected to statistical analysis. The percentage of raw scores in the PWA group varied highly between confrontation naming and picture description tasks. In contrast, NTI showed a minimal difference between tasks concerning the percentage of raw scores. Table 2 compares mean scores obtained between groups across tasks and word classes.

Table 2. Mean scores of nouns, verbs and total words on confrontation naming and picture description tasks obtained by PWA and NTI.

Groups	Confrontation naming			Naming on picture description			Total noun Mean (SD)	Total verb Mean (SD)
	Noun mean (SD)	Verb mean (SD)	Total mean words (SD)	Noun mean (SD)	Verb mean (SD)	Total mean words (SD)		
Persons with aphasia	95.90 (24.67)	96.50 (20.69)	192.40 (41.88)	6.20 (1.47)	4.20 (1.50)	10.40 (2.58)	102.10 (25.23)	100.70 (21.57)
Neurotypical	112.90	113.30	226.20 (2.11)	9.65	5.85	15.50 (1.05)	122.55	119.15

individuals	(1.33)	(1.45)		(0.74)	(0.36)		(1.31)	(1.66)

Friedman's analysis of variance was applied to see the effect between two tasks, task 1-confrontation naming and task II-picture description for both groups as the first instance. Results indicate a significant effect of picture description and confrontation naming task in PWA with a score of x^2 (3)=52.60, p-value<0.05 and NTI with a score of x^2 (3)=57.54, p-value<0.05. Thus, task difference is seen in both the PWA and NTI groups.

For the second instance, Friedman's analysis of variance was applied to see the effect between two-word classes, the noun and the verb. The results indicated there was a statistically significant difference between the word class with a score of x^2 (1)=20; p-value<0.05 for verb and x^2 (1)=24; p-value<0.05 for noun.

Section B: The performance of the PWA and NTI group on confrontation naming and naming on picture description (Between-group comparisons)

The performance of PWA and NTI groups in the confrontation naming and picture description task was addressed statistically, using descriptive and nonparametric methods. The results specific to the task are discussed below.

Confrontation naming: The main objective of the present study was to compare the performance of the PWA and NTI groups concerning word class deficits across both tasks. The overall raw mean score of total words for the confrontation naming task was 192.40 (SD-41.88) for the PWA group and a score of 226.20 (SD-2.11) for the NTI group.

Regarding word class (noun and verb) for both confrontation naming and picture description tasks, the raw mean scores were computed and there was a relative difference in word classes between the groups. Figure 1 represents the word class mean scores for PWA and NTI groups in confrontation naming. The mean accuracy score on two-word classes in the confrontation naming task for the PWA group was poor compared to the NTI group, as shown in Table 2.

Figure 1. Mean raw noun and verb scores in confrontation naming task by PWA and NTI.
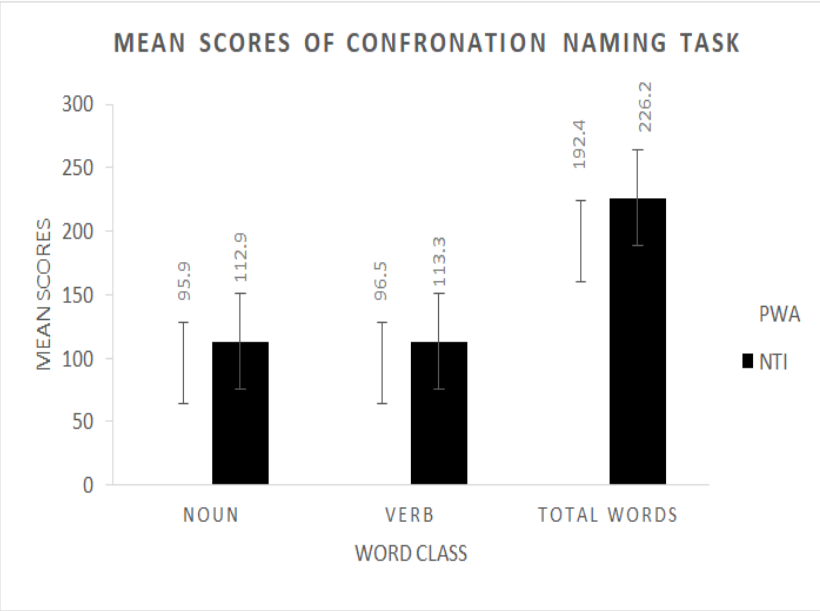
The data were subjected to extended analysis for the confrontation naming task, where the cues were provided for target response in case the participant could not name at first instances. The analysis was the 'percentages of correct naming with a phonemic cue, percentages of correct naming with a semantic cue' and the 'percentages of incorrect responses.' The

investigator provided two cues: Semantic and phonemic. The cueing percentage was higher in the PWA group with both cues (semantic and phonemic cues) than in the NTI group. Cueing was required for the NTI group for the confrontation naming task, which could be due to the non-frequent noun and verb category stimuli considered for the confrontation naming task. However, the NTI participants had an excellent semantic expansion of the target stimuli considered for confrontation naming. Participants from both groups responded more to phonemic cues than semantic cues when nouns were the target word class. Like verb naming, phonemic cues had an advantage over semantic cues for PWA, whereas both cues were equivalent for NTI. The observation is that both groups preferred phonemic cueing strategy in both word classes. In PWA and NTI, phonemic cueing was higher for nouns than verbs. The percentage of cues obtained for confrontation naming by both groups is given in Table 3.

Table 3. Cue received by PWA and NTI in confrontation naming task.

Word class	Persons with aphasia		Neurotypical individual	
	Semantic cue (%)	Phonemic cue (%)	Semantic cue (%)	Phonemic cue (%)
Nouns	3.55	2.58	2.54	2.23
Verbs	2.85	3.64	1.78	2.67

Mann Whitney U, a non-parametric test, was performed to compare the mean accuracy scores of nouns and verbs as word class in the confrontation naming task between PWA and NTI. There were statistically significant differences between PWA and NTI for the word class under the confrontation naming task; the same is summarized in Table 4.

Table 4. Results of Mann Whitney for word class comparison of confrontation naming and picture description task-between PWA and NTI.

The task with word class	/Z/	p-value
Confrontation naming-noun	4.619	0
Confrontation naming-verb	4.258	0
Picture description-noun	5.374	0*
Picture description-verb	3.802	0*
Note: *$p<0.05$ indicates significant difference.		

Naming through picture description: Persons with aphasia and neurotypical individuals performed poorer in picture description tasks than confrontation naming tasks due to various contributing factors of language processing. The overall mean score of total word usage in the picture description task was 10.40 (SD-2.58) and 15.50 (SD-1.05) in the PWA and NTI groups, respectively.

Specifically, for nouns and verbs as word class in the picture description task, the raw mean score of the verb was lesser than that of the noun for the PWA and NTI group. Figure 2 below represents the mean raw score obtained for noun and verb classes on both groups' picture description tasks.

Figure 2. Mean raw scores of nouns and verbs in picture description task by PWA and NTI.
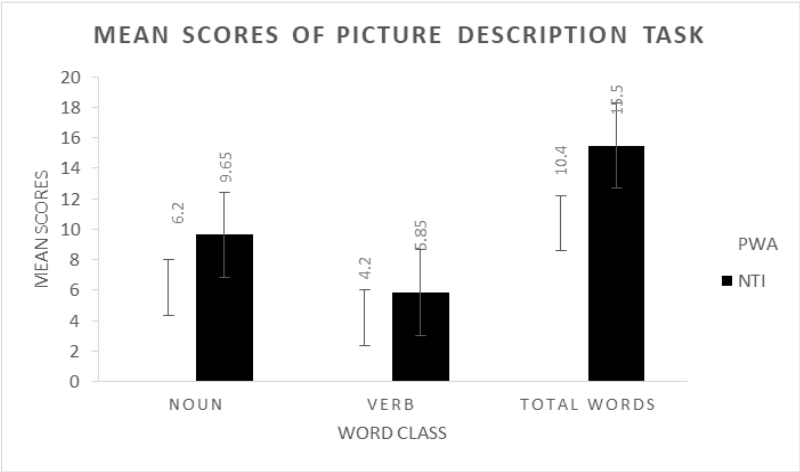
On the Mann-Whitney U test, statistically significant differences were seen for the word class of nouns and verbs for picture description. The same is summarized in Table 4. On descriptive analysis, the observable differences in the sentence structure of the picture description were seen in both groups. PWA used more simple sentences, with poor subject-object-verb agreement and used more active sentences. Meanwhile, NTI used better sentence structures, with increased morphological inflections, passive sentences and mean length of utterances.

Section C: Within-group comparison of noun and verb naming in PWA and NTI on confrontation naming and naming on picture description

Neurotypical individuals: Neurotypical individuals' accuracy scores of nouns and verbs in confrontation naming and naming on picture description tasks were addressed using the raw data of the individual participant. The majority of the participants scored a hundred percent accuracy score in both tasks. In the confrontation naming task, the accuracy scores of nouns and verbs were near the total score of 114, while in picture descriptions, noun scores were better than verbs. Both groups displayed a similar performance pattern in which nouns were used more frequently than verbs in picture descriptions.

Wilcoxon signed rank test was administered to compare the difference between nouns and verbs as word class for both the tasks in PWA. Considering significance level <0.05 as a p-value, the NTI group showed no significant difference in the confrontation naming task and there was a significant difference for the picture description task in the production of nouns and verbs, as shown in Table 5.

Persons with aphasia: Persons with aphasia performed poorly on mean accuracy scores in both tasks compared to neurotypical individuals, while a statistically significant difference was seen only in the picture description task. Further analysis concerning individualistic performance on confrontation naming and picture description for both groups was attempted. Accuracy scores of nouns and verbs in confrontation naming and naming on picture description task for PWA were addressed using the raw data of the individual participant. The majority of the participants had more than fifty percent accuracy scores in both tasks, revealing that Anomic Aphasics have a higher score in accuracy than Broca's aphasia. Wilcoxon signed rank test was administered and PWA showed no significant difference in noun and verb production for confrontation naming. However, a significant difference was seen in the picture description, as shown in Table 5.

To summarize the results of the present study, the performance of PWA was poorer compared to NTI on confrontation naming and picture description tasks. The difference in the use of word class (number of nouns and verbs) between the PWA and NTI was statistically seen for picture description. Also, there was a statistically significant difference in word class

use in PWA and NTI for picture description only. Irrespective of the PWA and NTI groups, there was a statistically significant difference between the tasks (confrontation naming versus picture description) and the word classes (nouns versus verbs). In the further sections, the present study discusses the importance of tasks used to assess naming different word classes in NTI and PWA about the general naming process, lexical access specific to nouns-verb category, lexical-semantic access, non-lexical semantic access, linguistic processes and aphasia symptoms, etc.

Table 5. Results of Wilcoxon's signed rank test for noun and verb word class in NTI and PWA.

Groups	Parameters	Tasks	/z/	P value
NTI	Noun word class versus Verb word class	Confrontation naming task	1.101	0.271
		Naming on picture description task	4.233	0*
PWA	Noun word class versus Verb word class	Confrontation naming task	0.959	0.338
		Naming on picture description task	3.655	0*
Note: *p <0.05 indicates a significant difference.				

DISCUSSION

The present study aimed to evaluate word class deficits in persons with aphasia at single-word production and discourse levels. The findings revealed that individuals with aphasia exhibited better noun-verb retrieval during the picture naming task compared to the picture description task. Picture naming, commonly used for assessing lexical access, engages multiple stages of lexical processing, including visual recognition, matching to stored memory, selecting lexical referents, retrieving phonological codes and verbalizing the word. Participants in the study showed impairments, particularly at the encoding and retrieval stages. The simplified mechanism of picture naming, using simple line-drawing pictures, facilitates the study of lexical-semantic processing in persons with aphasia. It is considered an efficient way to assess word retrieval abilities, emphasizing the significance of the picture naming task in studying lexical-semantic processing in aphasia.

In addition to the line drawing feature, both linguistic and non-linguistic factors influence naming abilities in picture tasks. Linguistic factors, such as linguistic complexity, imageability and target word frequency, play a role, while non-linguistic factors include picture ambiguity and the sensory-motor schema involved in recognizing the word's referent [19]. In the present study, difficulty in naming nouns may be attributed to linguistic factors like frequency of occurrence and imageability. Challenges in verb naming could stem from a combination of linguistic and non-linguistic factors involving mental schema and picture ambiguity.

The misinterpretation of the mental schema for the target picture, leading to accurate noun but inaccurate verb naming, suggests the influence of both linguistic and non-linguistic factors. Some participants misinterpreted the coherence of the picture (depicting a picnic spot) as a village scene, possibly influenced by syntactic and lexical deficits in discourse. These deficits resulted in paragrammatical structures and impaired microlinguistic structures, leading to semantic paraphasias and neologistic utterances. This contributed to incoherent verbalizations of the target picture (picnic spot) [20].

In the current study, naming performance in the picture description task exhibited significant discrepancies, consistent with the dual route model, specifically at the word-level semantic processing. According to the dual route model, the semantic route takes precedence over lexical access. The lexical account posits that nouns and verbs are stored separately in the mental lexicon and dissociation between nouns and verbs arises from selective damage in accessing either the noun or verb lexicon during the lexical stage of word production. The findings in the present study align with research showing that individuals with anomic aphasia tend to perform better in noun retrieval than in verb retrieval, although contrasting patterns have also been reported.

The research delves into the word retrieval abilities of Persons with Aphasia (PWA) at the discourse level, revealing that word retrieval challenges are more pronounced during discourse formation due to the influential role of context. The study suggests that verbs are less frequently employed than nouns in discourse production tasks, contributing to naming difficulties in PWA. The naming performance in aphasia is explained by various linguistic factors, including word frequency, imageability and the abstract and semantic representation of the target stimulus. In confrontation naming tasks, these factors work individually to facilitate naming responses, while in picture description tasks, they interact at a higher level, causing distraction and interference and ultimately resulting in poorer naming responses.

The semantic account posits that verbs are more challenging due to their greater semantic complexity, lower imageability and fewer perceptual features compared to nouns. In the present study, naming performance at the discourse level in the picture description task may be influenced by the types of aphasia considered, specifically Anomic and Broca's aphasia. Poorer naming performance in connected discourse was observed, characterized by a higher usage of nouns than verbs. This manifested through excessive use of simple active sentences, verb inflections and plausible sentences. The non-fluent type of aphasia, particularly Broca's aphasia, often involves impairments in grammatical systems, affecting syntactic processing.

The syntactic processing concerning linguistic information embedded in sentences involves specific processes concerning the order in which words are perceived and the rules that govern the order. Concerning the Kannada language, the Subject-Object-Verb (SOV) order is rule-governed in the given sentence. However, in the Kannada language, the verb stands alone without following any rule of the sentence structure. From the Illustration of P2 (Table 6), diagnosed as Broca's aphasia, the production of verbs and nouns was considered for a sentence that did not follow the rule and this participant obtained a score of 1 under the picture description genre. Concerning NTI participants, the use of inflections (root word+suffix/prefix) at the level of verbs was noticed to be at a greater extent than PWA participants (Illustration P5-diagnosed with Anomic aphasia) (Table 6) in picture description genre and the same was noticed in confrontation naming task. The rationale for the morphosyntactic problems in PWA is that the verbs are hard to understand because they are morphologically more complicated and carry more inflectional morphemes than other parts of speech.

Table 6. Errors analysis of sentences used by PWA in discourse sample.

Illustration of participants	Sentence type	Participant's response (in Kannada and translation in English)	No. of nouns and verb
Illustration from P 2	Word order	/ appa odu /	Noun-1
(Broca's aphasia)		Father read	Verb-1
Illustration from P 5	Verb inflections	/ata/- /aduthidane/	Verb-1
(Anomic aphasia)		Play-playing	
Illustration from P 2	Simpler sentences and verb inflections	/huduga idane/, /pata adthidane/	Noun-2
(Broca's aphasia)		Boy is there. Flying kite	Verb-1
Illustration from P 3 (Anomic aphasia)	Active sentences	/amma coffe madtale/	Noun-2
		Mother made coffee	Verb-1
Illustration from P5 (Anomic aphasia)	Plausive and implausive sentences	/amma, appa mathe magu mane inda horage bandidare/	Noun- 5
		Mother, Father and Kid have come out of house.	Verb- 1
Illustration from P 5	Verb inflections	/ata/- /aduthidane/	Verb-1
(Anomic aphasia)		Play-playing	
Note: Remark: Accurate score (1) for noun and verb naming for the sentences produced with poor morphosyntactic rules by the participant with aphasia.			

In morphosyntactic processes, proponents of the syntactic account argue that syntactic structures associated with verbs are engaged even when the verb is produced in isolation. However, the morphosyntactic rule becomes essential for producing single-word or sentence-level verbs. In the discourse of Persons with Aphasia (PWA), adherence to morphosyntactic rules is not mandatory, allowing for greater flexibility in linguistic analysis. This flexibility is highlighted in the present study and recommended for individuals with minimal speech output in PWA. The investigator correctly considered responses that deviated from morpho-syntactic rules in the study.

In this study, two tasks were employed to assess word class deficits, involving language processing at lexical-semantic, phonological and syntactic levels. Picture naming focused on semantic and phonological processing, while the picture description task emphasized syntactic processing. Lexical-semantic processing encompasses accessing the mental lexicon and semantic system, involving storing and accessing lexical items with information on sound, spelling, grammatical properties, morphology and meaning. Aphasia can selectively or collectively impair lexical-semantic storage, organization, access and word production.

In the present study, lexical semantic processing of verbs and nouns showed similarity in both groups during the picture naming task. The observed noun-verb dissociation during single-word production is challenging to explain, as they are considered to be stored in different mental lexicons and the neural foundations for verb and noun processing only partially overlap. The study suggests that lexical access for verbs and nouns remains consistent in Persons with Aphasia (PWA) and Neurotypical Individuals (NTI). Therefore, assessing both single-word production and discourse is crucial to observe discrepancies between nouns and verbs as word classes. The results support the use of these tasks together for a comprehensive assessment of word class deficits in PWA.

CONCLUSION

Recent attention in aphasia research has focused on noun-verb disassociation, revealing that Persons with Aphasia (PWA) tend to make fewer errors in noun production than verbs. Including discourse tasks in assessing word class impairments and planning rehabilitation is essential, as it yields significant statistical outcomes and reveals notable differences compared to picture naming tasks. Verb deficits are more pronounced in discourse tasks, highlighting their utility in analyzing lexical, syntactic and morphological processing levels.

LIMITATIONS AND FUTURE DIRECTIONS

This study's findings may not generalize across different aphasia types. However, focusing on a homogenous aphasia group can enhance understanding and generalizability. Future research should explore discourse analysis using core lexicons and other genres to better understand lexical processing in both PWA and NTI, integrating such analysis with standardized language assessment batteries to develop norms for naming assessment at the discourse level.

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STATEMENT OF ETHICS

Participants/caregivers had given their written informed consent. The ethical clearance according to the declaration of Helsinki was obtained from the institutional review board, AIISH Ethics Committee (AEC), Approval Number. No. DOR.9.1/Ph.D/YBC/929/2021-2022 DT 10.02.2023.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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AUTHOR CONTRIBUTIONS

YBC and HN: Conceptualizing and designing the research study, seeking ethical approval, analyzing the data and drafting the manuscript in whole or in part. All the authors approved the final manuscript.

DATA AVAILABILITY STATEMENT

All data generated or analysed during the study are included in the article. Further inquiries can be directed to the corresponding author.

REFERENCES

1. Dell GS, et al. Connectionist models of language production: Lexical access and grammatical encoding. Cogn Sci. 1999;23:517-542.

2. Matzig S, et al. Noun and verb differences in picture naming: Past studies and new evidence. Cortex. 2009;45:738-758.

3. Vigliocco G, et al. Nouns and verbs in the brain: A review of behavioural, electrophysiological, neuropsychological and imaging studies. Neurosci Biobehav Rev. 2011;35:407-426.

4. Alyahya RS, et al. Noun and verb processing in aphasia: Behavioural profiles and neural correlates. NeuroImage Clin. 2018;18:215-230.

5. Gleichgerrcht E, et al. Separate neural systems support representations for actions and objects during narrative speech in post-stroke aphasia. NeuroImage Clin. 2016;10:140-145.

6. Stark BC, et al. A comparison of three discourse elicitation methods in aphasia and age-matched adults: Implications for language assessment and outcome. Am J Speech Lang Pathol. 2019;28:1067-1083.

7. Westerveld MF, et al. Clinician survey of language sampling practices in Australia. Int J Speech Lang Pathol. 2014;16:242-249.

8. Kemmerer D, et al. Word classes in the brain: Implications of linguistic typology for cognitive neuroscience. Cortex. 2014;58:27-51.

9. Feng S, et al. Neural correlates for nouns and verbs in phrases during syntactic and semantic processing: An fMRI study. J Neurolinguistics. 2020;53:100860.

10. Armstrong E, et al. Aphasic discourse analysis: The story so far. Aphasiology. 2000;14:875-892.

11. Wilshire CE, et al. Evidence for a context-sensitive word retrieval disorder in a case of nonfluent aphasia. Cogn Neuropsychol. 2002;19:165-186.

12. Stark BC, et al. Standardizing assessment of spoken discourse in aphasia: A working group with deliverables. Am J Speech Lang Pathol. 2021;30:491-502.

13. Pashek GV, et al. Context and word class influences on lexical retrieval in aphasia. Aphasiology. 2002;16:261-286.

14. Fergadiotis G, et al. Item response theory modeling of the philadelphia naming test. J Speech Lang Hear Res. 2015;58:865-877.

15. Fergadiotis G, et al. Modeling confrontation naming and discourse informativeness using structural equation modeling. Aphasiology. 2019;33:544-560.

16. Salis C, et al. Sentence production in a discourse context in latent aphasia: A real-time study. Am J Speech Lang Pathol. 2022;31:1284-1296.

17. Mason C, et al. Are single-word picture naming assessments a valid measure of word retrieval in connected speech?. Int J Speech Lang Pathol. 2022;24:97-109.

18. Goswami SP, Shanbal JC, Samasthitha S, Navitha U. Field testing of manual for adult: Non-fluent aphasia therapy in Kannada (MANAT-K). J India Inst Speech Hearing. 2012;31:97-108. [Google Scholar]

19. Williams SE, et al. Factors influencing naming performance in aphasia: A review of the literature. J Commun Disord. 1983;16:357-372.

20. Pallickal M, et al. Discourse in Wernicke's aphasia. Aphasiology. 2020;34:1138-1163.