



# Reading and Writing Impairment in Persons with Crossed Aphasia: A Comparative Study

Akshaya Swamy<sup>1</sup>  Deepak Puttanna<sup>1</sup> Yashaswini Channabasavegowda<sup>2</sup>

<sup>1</sup>Department of Speech and Hearing, Father Muller College, University of Mangalore, Mangalore, Karnataka, India

<sup>2</sup>Department of Speech Language Pathology, All India Institute of Speech and Hearing, University of Mysore, Mysore, Karnataka, India

**Address for correspondence** Akshaya Swamy, MSc, Department of Speech and Hearing, Father Muller College, University of Mangalore, Kankanady Road, Mangalore 575001, Karnataka, India (e-mail: akshuswamy@gmail.com).

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## Abstract

**Background** Persons with aphasia (PWAs) manifest multifaceted deficits like auditory comprehension, spoken language, reading, and writing to varying degrees. Of these, the most debilitating signs are reading and writing impairment. Of late, PWAs express greater interest to improve their reading and writing skills. The deficits in these skills along with deficits in spoken language limit their participation in the community. Reading and writing may be altered contrarily in various stroke conditions across the left and right hemisphere lesions, just like how linguistic impairments are mutually exclusive. Thus, it must be rational to reconcile the possible role of the right hemisphere to process reading and writing inversely alike spoken abilities. Additionally, investigations on reading and writing deficits in left cerebrovascular atrophy (CVA) aphasics and right CVA aphasics (crossed aphasia) are seldom reported in the literature with relevance to Indian population focusing Indian languages. The study aims to compare reading and writing abilities across PWAs with left CVA and right CVA (crossed aphasia).

**Methodology** The study recruited four native Kannada speaking PWAs (6 months poststroke) aged between 40 and 70 years with impaired linguistic abilities secondary to stroke through convenient sampling. Western Aphasia Battery-Kannada was administered to identify aphasic component, specifically to evaluate the language, reading, and writing aspects in detail and the scores were analyzed based on the scoring.

**Results** Descriptive statistics revealed both left and crossed PWAs performed equipotent on linguistics tasks. However, reading abilities were better in left CVA individuals and writing was better in crossed PWAs on comparing the mean scores. Correlation analysis revealed positive correlation between language and reading-writing abilities of left CVA PWAs. Negative correlation was evinced in crossed PWAs. Hence, reading and writing difficulties in crossed aphasia can be mostly ascribed to impairment in peripheral mechanisms involved in visual and/or kinesthetic information processing as the right hemisphere is most viable to these processes.

**Conclusion** The study highlights the unique pattern of reading and writing abilities in crossed aphasia condition. However, careful examination of dissociations in acquired spoken language and written language abilities across differential neuronal networks through larger samples in the future research is warranted.

## Keywords

- ▶ crossed aphasia
- ▶ left CVA
- ▶ reading impairment
- ▶ written impairment

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## Introduction

Aphasia is a language disorder resulting from insult to the cerebral regions that are involved in language understanding, formulation, and production. In general, persons with aphasia (PWAs) manifest pervasive, multimodal language impairments featured by deficits in auditory comprehension, spoken language, reading, and writing to varying degrees. Among the associated conditions of aphasia, the most debilitating signs are reading and writing impairments.

Reading and written mode of communication represent analogous functions for a visual language system. These two components are important in carrying out various activities of daily living and vocations. Considering the present era of technology, written mode of communication has become an integral part of living. PWAs find it taxing to perform in the society as these deficits are the most predominant in them.<sup>1,2</sup> Of late, there is an increased reliance observed among PWAs on written mode of communication (e.g., emails, messaging, social media, etc.), as majority of them are literate and own a professional background prior to stroke episode. Consequently, they express greater interest in improving their reading and writing skills. Certainly, deficits in these skills along with spoken language impairment hamper their participation in the community. However, the severity of these deficits depends on the site of lesion and pathophysiology of the aphasia syndrome.

In general, aphasia is attributable to lesions of the left hemisphere (in frontotemporal region and arcuate fasciculi), which is deemed dominant for both right- and left-handed patients. Yet, there are instances of aphasia secondary to lesions in the right hemisphere.

Aphasia occurs in approximately 30% of left-handed patients; however, very unusual in right-handed individuals.<sup>3</sup> Aphasia occurring in right-handed individuals secondary to damage to the right side of the brain is referred to as crossed aphasia (CA). Certainly, it is an extremely rare condition, reporting an average below 3%. Consecutively, the effects of right hemispheric lesions on overall communication abilities may be presumed to be exclusively deviant from that of left hemispheric lesions.

The left hemispheric lesions causing aphasia result in pervasive impairment in word retrieval skills, comprehension, expressive language, and written language impairment. On the contrary, right hemispheric cerebrovascular atrophy (CVA) marks linguistics impairments in comprehension and expression along with emotional aspects of speech/language. PWAs with symptoms of CA may also display deficits in written language.<sup>4</sup>

Certainly, the linguistic impairments are mutually exclusive across the left and right hemisphere owing to the neuroanatomical distinctions of language processing. In similar way, reading and writing may be altered contrarily in left and right hemispheric stroke conditions. Thus, if it is plausible that the right hemisphere favors in processing of spoken language, it must be rational to reconcile the possible role of the same hemisphere to process reading and written mode of language. Also, the severity or degree of insult in

either of the hemispheres also becomes crucial in understanding the traits presented by the PWAs on reading and writing impairments.

Written language impairments (reading and writing) are very noticeable aspect poststroke, with an estimated prevalence of 68% of PWAs.<sup>5,6</sup> Despite the prevalence being high, majority of the studies focused on the repercussions on spoken language impairment and the remediation of the same in depth. However, with the growing need and reliance on written mode of communication via emails, text messages, letters, social media, and so on, there arises the need to understand the influence of insult on written language impairments (reading and writing). Very scarce literature presents the variance in hemispheric-specific impairments among the PWAs. Additionally, description of reading and writing deficits in left CVA aphasics and CA is seldom reported in the literature with relevance to Indian population focusing Indian languages. Thus, the study assumes that there could be obvious deviations in reading and writing impairments across PWAs with left CVA and CA.

The study aimed to compare reading and writing abilities across PWAs with left CVA and CA, and also analyze the relationship between language performance with reading and writing abilities between PWAs with left CVA and CA in isolation.

## Method

The study recruited four native Kannada speaking PWAs aged between 40 and 70 years (mean age = 52.75, standard deviation = 1.4) with impaired linguistic abilities secondary to stroke (6 months post) through convenient sampling. Of these four PWAs, two had left hemispheric CVA and two had right hemispheric CVA (or CA). All were native speakers of Kannada residing in Mysuru district. All were right handed with minimum qualification of undergraduation. Individuals with visual field defects, cognitive deficits, and apraxia of speech were excluded from the study. Apraxia of speech and other neurocognitive deficits were ruled out through screening assessments, namely, apraxia section of Western Aphasia Battery-Kannada (WAB-K)<sup>7</sup> and Mini-Mental State Examination,<sup>8</sup> respectively. No visual and auditory sensory deficits were observed among these individuals.

All the four participants were administered WAB-K<sup>7</sup> to identify aphasic component. Only PWAs scoring above five on auditory comprehension section of WAB-K<sup>7</sup> were recruited. Further, the four PWAs were grouped into two PWAs with left CVA and two PWAs with CA (right CVA). The study administered WAB-K on all four PWAs to evaluate the language, reading, and writing aspects in detail and the scores were analyzed based on scoring of the manual.

## Result and Discussion

The raw scores of two left CVA PWAs and two CAs were subjected to qualitative and quantitative analysis. The descriptive statistics for the measures of language performance, reading, and writing scores were computed for

**Table 1** Descriptive statistics of left CVA and crossed aphasia individuals on various domains

Groups domains	Left CVA		Right CVA (crossed aphasia)	
	Mean	SD	Mean	SD
Language	84.49	7.76	83.45	8.32
Reading	90	5.65	75.50	16.26
Writing	55.75	21.56	39	38.89

Abbreviations: CVA, cerebrovascularatrophy; SD, standard deviation.

both the groups. The overall language performance mean scores across left CVA PWAs and CA PWAs were equivalent. Further, the mean scores computed for reading and writing domain discerned elevated performance among left CVA PWAs compared with CA. Results are as shown in **Table 1**. Interestingly, both left CVA and CA individuals showed equipotent abilities in language on administering WAB (**Table 1**). In the study, both the left CVA individuals had milder variant of aphasia which very well coincided with the nature of the CA individuals. Few authors have reported cases of CA showing good recovery rates, with period of rapid improvement 1 to 2 months post-onset. Also, in CA cases, bilateral dominance for language results in a mild transient aphasia, as the uninjured hemisphere will be controlling the language function.

Correlation analysis was performed through Karl Pearson's (in SPSS-18) correlation to understand the relationship between the language performance with reading and writing domains in isolation exclusively among PWAs with left CVA and CA. The results revealed negative correlation between language abilities and reading domain,  $r(\text{degrees of freedom [df]}) = -1.00$ ,  $p < 0.01$ , and positive correlation evinced between language and writing domain,  $r(\text{df}) = +1.00$ ,  $p < 0.01$ , among left CVA PWAs. However, both reading and writing were negatively correlated ( $r(\text{df}) = -1.00$ ,  $p < 0.01$ ) between language performance and reading and writing in CA.

The above results signified elevated performance in reading and writing abilities among both left CVA PWAs compared with CA individuals, which may be attributable to unified involvement of language bases in both spoken and written forms of language in left CVA condition.

In case of CA, the results manifested contrasting relationship, wherein despite language being better preserved, reading and writing domains were disproportionately compromised. Even previously, studies have reported a discrepancy between written and oral language is a frequent characteristic of CA.<sup>9</sup> This finding can be quite predictable that reading and writing difficulties in CA is mostly ascribed to impairment in peripheral mechanisms involved in visual and/or kinesthetic information processing as the right hemisphere is most viable to these processes. These discrepancies are in part related to the fact that confounding variables (age, etiology, lesion size and location, educational background of the patients, and previous medical, neurological, and linguistic history) have not always been adequately controlled.

## Conclusion

PWA with acquired reading and writing impairments show interests to improve decoding written text, especially in everyday situations.<sup>10,11</sup> Mostly, they desired to read even if they were not avid readers before their stroke. They intend to seek information on the current affairs, connect with friends and family through social media, and participate maximum in their society.<sup>11,12</sup> The study highlights the unique pattern of reading and writing abilities in CA condition. The study suggests that reading and writing involves central mechanism in left CVA aphasia as compared with peripheral mechanism in CA. The unique findings may aid speech language pathologists (SLPs) to assess specifically reading and writing abilities in CA, tapping these deficits in intervention may further obviate language impairment.<sup>13</sup> It also suggests SLPs may be cautious while assessing the CA versus left CVA, as the clinical features vary among CA individuals. However, careful examination of dissociations in acquired spoken language and written language abilities in differential neuronal networks is necessary through larger samples in the future research. Also, varied and diverse performances would be evinced if a much severe left CVA aphasia individuals were compared with CA individuals in larger sample. Perhaps, a more effective approach to studying CA would be focused in future studies to identify specific types of aphasias and compare left hemisphere-damaged aphasics with this population.

## Conflict of Interest

None declared.

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