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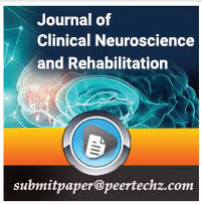

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Research Article

Exploring the Effectiveness of Cognitive Skills Training in Broca's Aphasia: A Single-Case Analysis

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Abstract

This case study explores the rehabilitation of a 34-year-old female with Broca's aphasia and right hemiplegia after tumour excision. Assessments showed moderate aphasia and mild cognitive impairment. Over 80 therapy sessions combining phonemic cueing, semantic feature analysis, and cognitive training with the Lumosity app led to improvements in speech and cognitive function. A multidisciplinary team facilitated recovery. The study suggests that integrating technology with traditional therapy can support language and cognitive recovery, though further research is needed.

Introduction

Broca's aphasia, characterized by non-fluent speech and difficulty in speech production despite preserved comprehension, is one of the most well-known and studied language disorders. Typically resulting from damage to Broca's area in the left frontal lobe, individuals with this aphasia often face significant challenges in communication, affecting their social and professional lives. Traditional treatments for Broca's aphasia have primarily focused on speech therapy and language rehabilitation, aiming to improve fluency and word retrieval. However, recent advancements in cognitive rehabilitation have begun to explore the impact of cognitive skills training, which targets underlying cognitive functions such as memory, attention, and executive functions, that may contribute to speech production. Cognitive Skills Training (CST) has emerged as a potential therapeutic approach for individuals with aphasia, aiming to enhance cognitive processes that are thought to support language production. For patients with Broca's aphasia, CST programs specifically designed to improve executive functioning, processing speed, and working memory may play a critical role in facilitating speech production and fluency. Despite promising results in broader aphasia rehabilitation, limited research exists on the specific application of CST in Broca's aphasia through single-case studies, which offer valuable insights into the individualized responses of patients to these therapies. Hickok & Poeppel [1], suggest that one pathway helps us understand speech, while another connects speech sounds to the brain's motor areas, with key differences between the left and right hemispheres. Basso, Forbes, and Boller [2] discussed various rehabilitation approaches for aphasia, including traditional methods such as stimulation, behavior modification, Luria's functional reorganization, pragmatic, and neurolinguistic approaches, as well as current approaches like the syndromic, cognitive neuropsychological, and social approaches, concluding that experimental evidence supports the efficacy of aphasia therapy. Ashori, Yazdanipour, and Pahlavani [3], examined the impact of a cognitive rehabilitation program on auditory perception and verbal intelligibility in deaf children, using the Categories of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR). The experimental group showed significant

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improvements in both areas followed by 10 sessions. The results suggest that cognitive rehabilitation can effectively enhance communication skills in deaf children. Vaezipour, Campbell, Theodoros, and Russell [4] highlight the need for more interactive and evidence-based mobile apps for speech-language therapy, focusing on user experience and patient-centered design. Improved app quality and engagement are essential for enhancing the effectiveness and long-term use of therapy for adults with communication disorders after ABI. Working memory training could enhance language therapy for persons with Aphasia [5]. A new brain-computer interface (BCI) for aphasia rehab uses EEG feedback to help patients recover language skills. A study with 10 stroke patients, aged 45-75, found that intense training boosted language abilities without impacting attention or other skills. Brain scans showed improved word processing and better brain network balance [6]. The Smartphone-assisted Language Training (SaLT) app was used on four participants aged 45–75 showing that three were motivated to use the app and found it easy to use. These results suggest that SaLT could be a valuable tool for aphasia rehabilitation and should be explored further in controlled studies [7]. This review explores the body of literature addressing cognitive skills training in Broca's aphasia, with an emphasis on single-case analyses. It aims to identify trends, challenges, and outcomes associated with CST in improving cognitive and linguistic functions in individuals with Broca's aphasia, offering critical insights for future research and therapeutic practices.

The present study focused on a 34-year-old woman with Broca's Aphasia, a condition resulting from damage to the left frontal lobe of the brain. The client's comprehension abilities are relatively intact, while her expressive abilities are affected. She is able to express her needs through single words and occasionally short phrases. To aid in her language retrieval, the author employed several methods, including Cognitive Skills Training (CST), phonemic cueing, and semantic feature analysis. Additionally, the author utilized the Lumosity app to support brain functions essential for speech and language. It is crucial for individuals with aphasia to explore diverse treatment methods. Current therapies primarily aim to improve speech and language; however, cognitive rehabilitation techniques like CST have not been extensively studied. These techniques may enhance the brain functions that support language. Given the limited research on the effectiveness of CST and digital tools in improving both cognitive and speech outcomes in individuals with Broca's Aphasia, the aim of this study is to evaluate whether the combination of CST with other methods, including digital tools, can improve both speech and cognitive skills in individuals with Broca's Aphasia.

Method

Patient information

A 34-year-old female presented with an inability to speak following tumour excision. Right hemiplegia was observed. Table 1 presents the pre-morbid and post-morbid history.

Assessment

The Western Aphasia Battery (WAB) assessment revealed difficulties in naming, repetition, memory tasks, word frequency, and sentence completion, with an Aphasia Quotient of 75 and a Cortical Quotient of 60, indicating moderate Broca's aphasia. The Addenbrooke's Cognitive Examination – Revised (ACE-R) score of 80 indicates mild cognitive impairment.

MRI findings

An MRI scan conducted on 24/9/19 showed FLAIR hyperintensity in the white matter surrounding the bilateral lateral ventricles, porencephalic cysts with ex vacuo dilation of the temporal horn in the ipsilateral ventricle, and signs of small vessel ischemic changes.

Management and treatment

Management involved 80 sessions (45 minutes per session) using phonemic cueing, semantic feature analysis, and cognitive skills training with the LUMOSITY app. The Lumosity app includes games targeting various cognitive skills, such as information processing, divided and selective attention, memory, reasoning, planning, flexibility, and spatial reasoning.

Multidisciplinary approach

Professionals such as neurologists, speech-language pathologists, physiotherapists, and occupational therapists collaborated and focused on enhancing her speech-language, motor skills, and cognitive functions to support her recovery.

Therapy goals and progress

The primary goals of therapy were to improve communication skills and cognitive abilities, particularly through the use of phonemic cueing and semantic feature

Table 1: Shows pre and post-morbid history of the patient.

Category	Pre-morbid History	Post-morbid History
Communication Skills	Fluent in English and Telugu (verbal and non-verbal)	Retains comprehension in English and Telugu (names, numbers, and simple sentences)
Reading and Writing	No issues were reported with reading and writing	Affected, unable to read or write at the time of assessment
Expression	Able to communicate verbally and non-verbally with ease	Expresses needs through vocalization, gestures, pointing, and nonsensical words
Speech	Normal speech and language functioning	Difficulty in speech, particularly verbal expression (Broca's Aphasia)
Comprehension	Fully capable of understanding verbal and non-verbal cues	Retains comprehension of simple sentences, names, and numbers in both English and Telugu

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Table 2: Shows the pre and post-therapy results.

Category	Pre-Therapy	Post-Therapy
Naming ability	Difficulty with naming and word retrieval	Significant improvement in naming with the help of phonemic cues
Story narration	Limited ability to narrate a story	Able to narrate a story with assistance from phonemic cues
Logical Reasoning	Challenges in tasks involving logical reasoning	Demonstrated considerable progress in tasks requiring logical reasoning
Attention	Difficulty with divided, selective, and planned attention	Improved in tasks requiring divided, selective, and planned attention
Memory	Issues with memory recall	Successfully recalled seven tiles in a memory matrix
Communication	Primarily used gestures and simple words	Began using phrases to effectively communicate her needs
Western Aphasia Battery (WAB)	Aphasia Quotient of 75, indicating moderate Broca's aphasia	Improved speech, with better expression, comprehension, and naming ability
Addenbrooke's Cognitive Examination (ACE-R)	Score of 80, indicating mild cognitive impairment	Improvement in cognitive functioning, with better attention and memory recall

analysis. Initial progress in expressive language was slow, but ongoing sessions aimed to enhance her verbal output and cognitive processing.

Results

The patient demonstrated significant improvement in naming and was able to narrate a story with the help of phonemic cues. She showed considerable progress in activities that involved logical reasoning, as well as in tasks requiring divided, selective, and planned attention. Additionally, she successfully recalled seven tiles in a memory matrix. Furthermore, she began using phrases to effectively communicate her needs. The details of the pre and post-therapy results are given in Table 2.

Finally, the outcome of the therapy reveals that the patient demonstrated significant progress in naming, story narration, logical reasoning, attention, memory, and communication. The Western Aphasia Battery (WAB) indicated moderate Broca's aphasia pre-therapy, but there was a notable improvement in speech and expression post-therapy. Additionally, Addenbrooke's Cognitive Examination (ACE-R) reflected mild cognitive impairment pre-therapy, with improvements in attention and memory recall observed after therapy. These results suggest substantial recovery and enhancement of cognitive and communicative functions post-intervention.

Prognosis and future plans

The prognosis varies with expectations of her language and cognitive abilities over time. Ongoing therapy and periodic follow-up assessments are planned to closely monitor her development and make any necessary changes to the treatment plan.

Conclusion

The author concluded that integrating technology, such as various cognitive game apps, with traditional aphasia therapy could lead to significant improvements. These apps engage multiple cognitive functions, which may facilitate quicker language recall. While some researchers remain cautious about the effectiveness of brain games, they can offer benefits when paired with therapy especially, in games designed to enhance cognitive skills alongside conventional therapy, helping to preserve both cognitive abilities and linguistic components. Since this was a single case study, the results were only compared between pre- and post-therapy stages. To achieve more robust and consistent findings, the study should be expanded to include a larger sample size.

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