European Summit on Interdisciplinary Research and Development - An International Research Conference
Published By Crystal Pen Publication, Perambalur, Tamil Nadu, India - www.crystalpen.in
ESIRD - 2025 Proceedings, Date: November 30, 2025, ISBN Number: 978-93-49435-80-3

BREAKING BARRIERS: COGNITIVE INSIGHTS FROM DEAF AND HARD OF HEARING STUDENTS

Madhusudhan U*, Vidya Singaravelu, Kalapana M*** & Nitin Ashok John******

* Associate Professor, Department of Physiology, AIIMS, Bibinagar, Yadadari Bhuvanagiri, Telangana, India
** Professor Paediatrics, Malla Reddy Vishwavidyapeeth (Deemed to be University), Suraram, Hyderabad, Telangana, India
*** Additional Professor, Department of Physiology, AIIMS, Bibinagar, Yadadari Bhuvanagiri, Telangana, India
**** Professor & Head, Department of Physiology, AIIMS, Bibinagar, Yadadari Bhuvanagiri, Telangana, India

Cite This Article: Madhusudhan U, Vidya Singaravelu, Kalapana M, Nitin Ashok John. (November 2025). Breaking Barriers: Cognitive Insights from Deaf and Hard of Hearing Students. In Proceedings of the European Summit on Interdisciplinary Research and Development (pp. 61-64). Perambalur, Tamil Nadu, India: Crystal Pen Publication.
ISBN: 978-93-49435-80-3
Publisher Website: www.crystalpen.in

Abstract:

Hearing and language play a vital role in children's cognitive, social, and emotional growth. However, children who are deaf or hard of hearing (DHH) often encounter barriers to cognitive and linguistic development despite having normal intelligence. This cross-sectional comparative study aimed to assess the cognitive abilities of DHH school children and compare them with their normal-hearing peers using Bhatia's Battery of Performance Tests. A total of 60 students (30 DHH and 30 normal-hearing), studying in grades 5 to 8, participated between 2022 and 2023. Data were analyzed using IBM SPSS version 21, with $p < 0.05$ considered statistically significant.

Results revealed that DHH children demonstrated significantly higher mean scores in most subtests, including Koh's Block Design, Alexander's Pass-Along, and Pattern Drawing Tests ($p < 0.05$). The Intelligence Quotient (IQ) and Performance Quotient (PQ) were also significantly higher in the DHH group (IQ: 98.53 ± 6.73; PQ: 107.23 ± 7.57) compared to controls. These findings suggest enhanced visual-spatial cognitive skills among DHH children, possibly due to compensatory neural adaptations and extensive use of sign-based communication.

The study highlights that deaf and hard of hearing children possess cognitive abilities comparable to, or even exceeding, those of hearing peers in specific domains. Promoting awareness of these strengths can help dispel social stigma, encourage inclusive educational practices, and empower DHH students to reach their full intellectual potential.

Key Words: Deaf and Hard of Hearing, Cognitive Function, Bhatia's Battery, Intelligence Quotient, Performance Quotient, Visual Cognition, Neural Plasticity.

Introduction:

Hearing and language are essential for a child's cognitive, social, and emotional development, allowing them to understand and interact with their environment. In children with hearing loss, the primary challenge lies in developing effective communication skills. Despite having normal intelligence, many deaf children face barriers to cognitive and linguistic development due to limited language exposure. [1,2] Early identification of hearing impairment through newborn screening programs can greatly enhance speech and language development, improve academic performance, and open up broader professional opportunities later in life.

Globally, approximately 466 million people (about 5% of the world's population) live with disabling hearing loss, including 34 million children. [3] In India, nearly 63 million individuals (6.3%) experience significant auditory impairment. It is estimated that four in every 1,000 children are affected by severe to profound hearing loss, and over 100,000 infants are born with hearing deficiencies each year. The prevalence of adult-onset deafness in India is around 7.6%, while childhood-onset deafness accounts for 2%. Social stigma surrounding disability often leads to underreporting of cases by families.[4-5]

Previous research evaluating cognitive abilities such as attention, memory, critical thinking, and problem-solving in deaf children has produced inconsistent findings. Some studies have reported that the intelligence quotient (IQ) of deaf individuals is comparable to that of their hearing counterparts,[6-8] whereas others have found lower IQ scores among the deaf population. [9,10-11] However, there is a notable scarcity of Indian studies exploring this area. Therefore, the present study was designed to assess cognitive skills in deaf and hard of hearing (DHH) school children using Bhatia's Battery of Performance Tests.

Methodology:

This study was a cross-sectional comparative study conducted between 2022 and 2023. The research included deaf and hard of hearing (DHH) school children from 5th to 8th grade. The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC). Assent was obtained from all participating children, and written consent was secured from the school principal prior to participation.

For the control group, normal-hearing children without any hearing or speech impairments, matched for grade level (5th to 8th), were included. Similar procedures were followed for obtaining assent and institutional consent.

The study period was chosen between 2022 and 2023, as schools remained closed during 2021 due to the COVID-19 pandemic, which had delayed data collection. We included 30 deaf & hard of hearing children &30 normal children without deafness & speech impairment.

Bhatia's Battery of Performance Test:

Bhatia's Battery of Performance Test is applicable to both literate and illiterate individuals, with specific administration rules tailored to each group. The test is designed for children aged 11 to 16 years and can be administered within 45 to 60 minutes. The standardization of the five subtests was carried out over a four-year period in various rural and urban regions across India, ensuring broad applicability and cultural relevance. The test has demonstrated good validity (0.77) and shows a correlation ranging from 0.67 to 0.82 with other established measures of intelligence.

Data Analysis:

Data entry was carried out using Microsoft Excel 2019, and statistical analysis was performed with IBM SPSS Statistics version 21. The results were summarized and displayed through tables and graphical representations, including bar charts, pie charts, and frequency distributions. Descriptive statistics such as mean and standard deviation were calculated. To assess differences between groups, an independent samples t-test was applied, and a p-value < 0.05 was considered to indicate statistical significance.

Results:

The mean age of the study group was 10.9 ± 1.12 years, while that of the control group was 11.86 ± 1.22 years. Each group consisted of 16 boys and 18 girls. The scores obtained in the various subtests of Bhatia's Battery of Performance Tests are summarized in Table 1. The study group demonstrated significantly higher scores than the control group, with statistical significance at $p < 0.005$. Table 2 presents the comparison of Intelligence Quotient (IQ) and Performance Quotient (PQ) between the two groups, indicating that both IQ and PQ values were significantly higher among the study participants compared to controls.

Table 1: Comparison of Scores of Various Tests between Two Groups

Name of the Test	Scores		T Value	P Value
	Study Group	Control Group		
Koh's Block Design Test (25)	12.1±1.51	9.37±1.38	8.7162	0.0001*
Alexander's Pass-along Test (20)	9.5±2.09	7.87±2.22	3.7802	0.0003*
Pattern Drawing Test (20)	8.5±2.43	7.63±1.44	2.1779	0.03*
Immediate memory test for digits (15)	5.93±1.52	5.53±1.23	1.4465	0.1512
Picture construction Test (15)	7.2±1.30	6.90±1.14	1.2269	0.222
TOTAL (95)	43.3±2.89	37.3±4.72	7.6658	0.0001*

* Statistically Significant

Table 2: Comparison of IQ & PQ Scores between Two Groups

	Study Group	Control Group	T Value	P Value
Intelligence Quotient (IQ)	98.53±6.73	95.6±9.34	3.330	0.03*
Performance Quotient (PQ)	107.23±7.57	103.4±8.91	3.830	0.01*

* Statistically Significant

Discussion:

The study was conducted to assess cognitive functions in deaf and hard of hearing school going children using Bhatia battery of tests, calculate Performance quotient & Intelligence quotient from Bhatia battery of tests & compare it with the age matched control population without speech & hearing impairment. The following 2 points derived from the results

- The test scores were higher in deaf and hard of hearing school children, when compared with control group
- The PQ & IQ scores were also higher in deaf and hard of hearing school children, when compared with control group

Concentration & Focus in Deaf and Hard of Hearing in Comparison With Normal Children:

Concentration fatigue is frequently observed in individuals who are deaf or hard of hearing, as they must constantly focus on lip-reading, sign language, and other visual cues to understand communication. This sustained mental effort increases cognitive load, making processing information more demanding. Even those

with mild hearing impairment may experience listening fatigue, which can be mentally exhausting and, at times, overwhelming. [12]

To address this, we chose an assessment tool that minimizes the need for prolonged attention to verbal instructions. Bhatia's Battery of Performance Tests is skill-based, where the examiner demonstrates each task, and participants replicate it within a set time. This approach allows deaf and hard of hearing children to complete the tasks without excessive reliance on auditory input, providing a more accurate evaluation of their cognitive abilities.

According to the concept of compensatory plasticity, the absence of auditory input in deaf individuals is often accompanied by enhanced visual cognitive abilities. When controlling for various confounding factors, studies have shown that deafness can influence the spatial allocation of attention, shifting focus toward the peripheral visual field rather than the central field. This reorganization is reflected in neural adaptations that extend from higher association cortices to early sensory cortices. A common feature across these reorganized regions is their multimodal organization, supporting current theories that multimodal integration plays a critical role at all stages of cognitive processing.[13,14]

Certain cognitive functions, such as peripheral visual processing and motion detection, demonstrate improved performance in deaf individuals, but primarily when tasks require focused attention. For example, Neville and Lawson[15] found that deaf participants outperformed hearing controls in detecting the direction of motion of peripheral targets when attention was directed to the relevant location.

Mode of Skill Acquisition in Deaf and Hard of Hearing Children in Comparison With Normal Children:

Although the overall structure of the human brain is largely established during early childhood, learning and memory remain possible throughout life due to the ability of individual neurons to adapt their signaling and synaptic connections.[16]Learning primarily occurs through changes in the strength and number of synaptic connections between existing neurons, a phenomenon referred to as synaptic plasticity.[17]In most cases, frequently used connections are reinforced, while less active connections weaken, reflecting the "use it or lose it" principle of neural adaptation. Research has consistently shown that neuronal connections across various brain regions are dynamic and can be modified.[18] This synaptic plasticity underlies behavioral learning and memory formation, with memories encoded by adjusting specific synaptic connections, stored within interconnected neural ensembles, and retrieved by reactivating the same neural circuits.

Deaf and hard of hearing children's performance in the tasks was significantly better than their normal counterpart may be due to following reasons.

- Children with deafness, regardless of their etiology, have been educated and trained by sign language for many years. We assessed cognition in 5th to 8th grade children
- Research evidences show that deaf children have enhanced visual cognition in comparison with normal children, since our majority of the tasks are based on visual concentration/focus.

Conclusion:

The present study demonstrates that deaf and hard of hearing children possess IQ levels comparable to, and in some cases statistically higher than, their hearing peers. These findings may help families move beyond the social stigma associated with hearing impairment, highlighting the cognitive potential of these children. Recognizing their capabilities can provide opportunities for equitable education and skill development, enabling them to achieve outcomes comparable to their hearing counterparts and fostering a brighter, more inclusive future.

References:

1. David Werner. Disabled Village Children- A guide for community health workers, rehabilitation workers, and families. Berkeley: The Hesperian Foundation;1987
2. Foschi, Renato; Cicciola, Elisabetta (2006), "Politics and naturalism in the 20th century psychology of Alfred Binet.", History of Psychology. Nov 2006; 9 (4):267-89.
3. World Health Organization. Deafness and Hearing Impairment - Fact Sheet; April, 2010.
4. Garg S, Chadha S, Malhotra S, Agarwal AK. Deafness: Burden, prevention and control in India. Natl Med J India 2009; 22:79-81
5. Singh S, Jain S. Factors associated with deaf-mutism in children attending special schools of rural central India: A survey. J Family Med Prim Care. 2020 Jul 30; 9(7):3256-3263. doi: 10.4103/jfmpc 222_20. PMID: 33102280; PMCID: PMC7567182.
6. Bishop, H. M. The testing of deaf and hard-of-hearing children in St. Paul schools with the Arthur Performance Scale. National Education Association Proceedings.1936; 74:393-394.
7. Scyster, M , Summary of four years 'experiment with pre- school children at the Ill. School for the Deaf. American Annals of the Deaf, 1936; 81: 212-230.
8. DuToit, J. M. Measuring the IQ of deaf children. American Annals of the Deaf.1954; 99: 237-251.
9. Peterson, E. G., & Williams, J. M. Intelligence of deaf children as measured by drawings. American Annals of the Deaf.1935; 75: 273-290.

10. Meyer, M. F. The use of the Lectometer in the testing of the hearing and the deaf. American Annals of the Deaf.1932; 77:292-304.
11. MacKane, K. A comparison of the intelligence of deaf and hearing children. New York: Teacher College, Columbia University, Bureau of Publications, 1933.
12. Deafblind UK. concentration fatigue; deafblinduk.org; 2023.Availible at https://deafblind.org.uk/concentration-fatigue
13. Bavelier D, Dye MW, Hauser PC. Do deaf individuals see better? Trends Cogn Sci. 2006 Nov; 10(11):512-8. doi: 10.1016/j.tics.2006.09.006. Epub 2006 Oct 2. PMID: 17015029; PMCID: PMC2885708
14. Ghazanfar AA, Schroeder CE. Is neocortex essentially multisensory? Trends Cogn. Sci. 2006;10:278-285
15. Neville HJ, Lawson DS. Attention to central and peripheral visual space in a movement detection task: an event related potential and behavioral study. II. Congenitally deaf adults. Brain Res. 1987; 405:268-283.
16. Owens MT, Tanner KD. Teaching as Brain Changing: Exploring Connections between Neuroscience and Innovative Teaching. CBE Life Sci Educ. 2017 Summer; 16(2): fe2. doi: 10.1187/cbe.17-01-0005. PMID: 28450442; PMCID: PMC5459260.
17. Takeuchi T, Duszkiewicz AJ, Morris RGM. The synaptic plasticity and memory hypothesis: encoding, storage and persistence. Phil Trans R Soc B. 2014; 369:1-14.
18. Skowronek, J., Seifert, A. & Lindberg, S. The mere presence of a smart phone reduces basal attentional performance. Sci Rep 13, 9363 (2023). https://doi.org/10.1038/s41598-023-36256-4