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Original Research Article

A Comparison of Language Comprehension of Children with Hearing Loss and Their Typical Peers

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ABSTRACT

Introduction: Children with hearing impairment (HI) encounter problems related to poor comprehension at morphological, syntactical and lexical level. So, assessment of comprehension skill in HI is imperative.
Purpose: Comparison of language comprehension of children with HI including Cochlear implant (CI), Behind the ear (BTE) hearing aid users and typical peers.
Method: The Assessment of Comprehension and Expression (ACE) 6-11 Test (Adams et. al. 2001) was administered to 75 subjects of age range 9 to 12 years from integrated schools in Mumbai. Group I: - CI, Group II: - BTE users, Group III: - Typical peers.
Results: Post –hoc tests reveal that performance of group I is at par with group III while group II performed poorly on all comprehension subtests of ACE.
Conclusion: Comparable performance on ACE tests may be attributed to the advanced amplification i.e. CI with early intervention coupled with intensive auditory verbal therapy.

Keywords: HI, CI, BTE.

INTRODUCTION

The hearing is considered as the primary sensory modality through which an individual is connected with the world. In the early critical period of life, auditory input and communication are essential for the normal development of language, cognition, and behavior. Different experiences and neuronal changes in the critical period of life lead to the acquisition of new abilities which otherwise is very hard to acquire later in life (Quittner and Leibach, 2004). So, any sensory impairment may hamper language and sensory experiences which in turn results in language impairment.

Hearing loss reduces the ability to utilize maximum potential to perform well socially and academically. So, early diagnosis and intervention play a crucial role for restoration of hearing acuity. Early restoration of auditory input can be provided either via a cochlear implant or a hearing aid. These devices improve speech perception and consequently offer the potential for acquisition of speech and language skills. Padovani and Teixeira (2004) have also stressed the importance of intervention during the first years of life and its benefit in the development of auditory perception for the initial linguistic activities and speech.

The impact of hearing loss on a person's life also depends on type, severity, and age of onset of hearing loss. Investigators have also documented that children with hearing impairment have the deficient vocabulary, grammar, concepts and pragmatics (Geers and Moog, 1994) in both receptive and expressive domains. So, children with hearing impairment lagged behind their hearing counterparts in terms of

sentence, inferential, semantic, naming and non-literal comprehension.

As there are variations in performance of children with a cochlear implant (CI), behind the ear (BTE) hearing aid and their typical peers, it is important to compare the speech perception, comprehension, and performances on different comprehension task. Thus it is required to investigate and compare language comprehension of children with hearing impairment i.e. CI and BTE hearing aid users with their typical peers.

METHODOLOGY

The present study is a descriptive research focusing on comparison of language comprehension of children with hearing impairment and their typical peers. The sample comprised of 75 subjects with hearing impairment and normal hearing of both male and female in the age range of 9 to 12 years. Subjects were drawn from the integrated and special school of Mumbai. Subjects were divided into 3 groups. Group I: - CI users (15), Group II: - Behind-the-ear hearing aid user (20) Group III: - Normal hearing typical peers (40). All subjects were matched for age of identification and period of intervention.

Tools

The Assessment of Comprehension and Expression (ACE) 6-11 Test developed by Adams, Cooke, Crutchley, Hesketh, and Reeves (2001) was used to compare language comprehension of children with hearing impairment and their typical peers.

Procedure

The test (ACE 6-11) was administered to all the three groups with single repetition of instruction, coupling verbal instruction with signs and gestures, and without any repetition for the group I, II and III respectively. The average is time taken by group I and III were approximately 40 minutes whereas for the group I, it was 1hour.

All the obtained protocols were scored as per manual and subjected to statistical analysis.

RESULTS AND DISCUSSION

The present study was conducted to compare language comprehension ability of children with HI i.e. CI, BTE users and NH on a number of subtests i.e. Sentence Comprehension (SC), Inferential Comprehension (IC), Naming (N), Semantic Decisions (SD) and Non-Literal Comprehension (NLC) by using Assessment of comprehension and Expression (ACE 6-11) developed by Adams, Cooke, Crutchley, Hesketh and Reeves (2001).

The sample of 35 subjects comprised of two groups of children with hearing impairment using CI and BTE. These subjects were drawn from the integrated and special school of metropolitan cities. 40 children with hearing sensitivity within normal limits i.e. typical peers were also drawn from same school and class. All participants were in the age range of 8 to 12 years with a mean age range between 9.43 to 10.20 years.

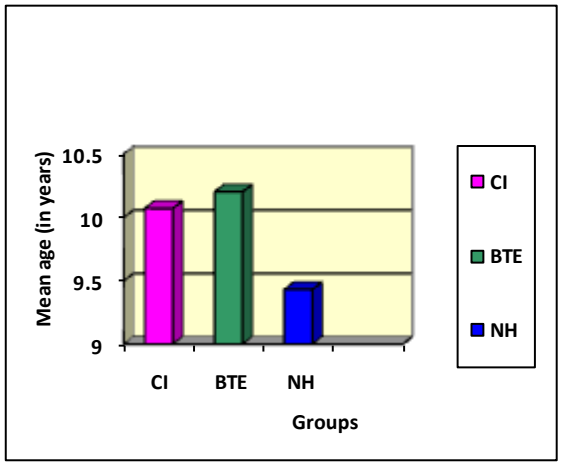

Figure 1: Mean age of children with Hearing Impairment (HI)

As shown in figure 1, mean age of children with HI are higher by about 10 months in comparison to their typical peers. Even among children with hearing impairment CI group subjects are slightly younger to BTE group.

The results for five sub-tests of ACE 6-11 are discussed in the sequence as follows:

(a) Sentence comprehension (SC) consisted of 35 items.

(b) Inferential comprehension (IC) consisted of 9 items.
(c) Naming (N) consisted of 25 items.
(d) Semantic decisions (SD) consisted of 20 items and
(e) Non-literal comprehension (NLC) consisted of 7 items.

Table 1: Mean score of Group I, II, and III on SC, IC, N and NLC subtests of ACE 6-11.

ACE6-11 Subtests	GRI (15)	SD	GR II (20)	SD	GR III (40)	SD
Sentence comprehension (SC)	21.2 (min=14, max=29)	4.64	16.50 (min=6, max=24)	5.47	21.23 (min=12, max=29)	4.66
Inferential comprehension (IC)	7.07 (min=2, max=12)	2.58	4.40 (min=0, max=8)	2.34	7.23 (min=3, max=13)	2.98
Naming (N)	12.40 (min=8, max=18)	3.18	8.65 (min=4, max= 18)	3.70	13.03 (min=2, max=22)	6.87
Non-literal comprehension (NLC)	2.80 (min=2, max=4)	0.86	1.85 (min=1, max=4)	0.93	2.80 (min=1, max=6)	1.15

Table 1 reveals that group I and III have obtained almost equal mean score on SC, IC, N and NLC tasks even though they are younger to group I by more than 6 months. The performance of group II is far below in comparison to CI and NH groups. These results suggest that cochlear implant aids in improving the perception of auditory signal hence results in enhancing their inferential comprehension. Similar performance of group I and III has been obtained on non-literal comprehension task. Hence, choice of amplification device helps in acquiring deep meaning i.e. nonliteral meaning (e.g. figurative, idioms and proverbs) along with superficial comprehension. It gives significant positive impact on speech and language development skills which in turn could make children with HI able to compete their typical peers.

It is suggested that children with HI follow the same language developmental pattern as typical peers but are slower in nature (Szagun, 1997). With the increase in age, the gap between children with hearing impairment and typical peer increases and language development of HI children reaches ceiling very fast. Research regarding the effects of cochlear implantation in children with prelingual deafness found that CI at the early age of life is an effective option for children with prelingual deafness in terms of speech perception, production, and language development (McKinley & Warren, 2000). So, in brief, we can say that overall early intervention and better amplification i.e. cochlear implant plays a crucial role in reducing the language gap normal hearing children and children with hearing impairment.

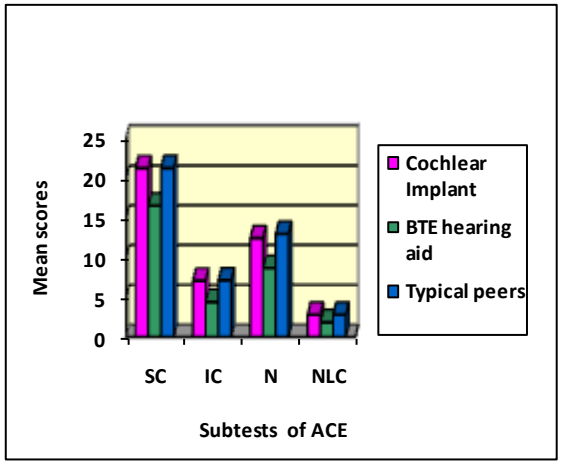

Figure 2: Mean scores of CI and BTE on ACE Subtests

Table 2: Performance of both between and within groups on Sentence comprehension (SC), Inferential comprehension (IC), Naming (N) and Non-literal comprehension (NLC).

Subtests of ACE 6-11	Between Groups			Within Groups			F	Sig.
	Sum of Square	df	mean square	Sum of Square	df	mean square		
Sentence comprehension (SC)	326.505	2	163.25	1716.37	72	23.83	6.84	0.002
Inferential comprehension (IC)	113.772	2	56.88	544.708	72	7.57	7.51	0.001
Naming (N)	263.54	2	131.78	2241.12	72	31.12	4.23	0.018
Non-literal comprehension (NLC)	13.23	2	6.61	79.35	72	1.10	6.005	0.004

Figure 2 indicates the pattern of performance of all three groups is same on SC, IC, N and NLC task. All have performed good for SC and poorer for IC.

To observe the performance of HI and NH on all subtests of ACE 6-11, one-way ANOVA was utilized.

The result suggests that obtained F ratio for SC (F= 6.84), IC (F=7.519), N (F= 4.233) and NLC (F=6.005) is highly significant at 0.002, 0.001, 0.018, and 0.004 respectively. The combined mean scores (CIm & BTEm) of children with HI for SC (m= 18.85), IC (m=5.733), N (m= 11.05) and NLC (m= m=2.3) is less than their typical peers SC (m=21.23), IC (m=7.066), N (m= 12.94) and NLC (m=2.8). This group has performed poorly than their typical peers on sentence comprehension, inferential comprehension, naming and nonliteral comprehension tasks.

Davis and Blasdell (1975) have compared children with normal hearing (NH) and hearing impairment (HI) for comprehension abilities of spoken sentences and suggested that various sources of ambiguity affect the strategies used by the hearing impaired children and cause them to be less stable than those employed by normal hearing children. Similar findings have been reported by Shabeena (2000) on Proverb comprehension tasks, where HI group performed poorly relative to their control group.

Among HI group significant mean difference between CI and BTE reflects the wide gap between their performances on all subtest. The performance of the children with CI was better than hearing aid users on all subtest but some BTE users have performed as par to CI group. These conditions may be due to intelligence, very early intervention and enriched language input. Friedmann and Szterman (2006) also reported that individual performance strongly correlates with the age of intervention. Only children who received hearing aids before the age of 8 months can perform well in the comprehension task.

Table 3: Mean performance difference of all groups on Sentence Comprehension (SC) Subtest, Inferential comprehension (IC), Naming (N) and Non-literal comprehension (NLC). (Multiple Comparisons, Bonferroni).

Dependent Variable	(I) Group CI	(J) Group BTE		(I) Group BTE	(J) Group NH		(I) Group NH	(J) Group CI	
	Mean Difference (I-J)	Std. Error	Sig.	Mean Difference (I-J)	Std. Error	Sig.	Mean Difference (I-J)	Std. Error	Sig.
Total Sentences	4.70	1.67	0.019	-4.73	1.33	0.002	0.03	1.48	1.00
Total Inferential comprehension	2.66	0.94	0.018	-2.82	0.75	0.001	0.16	0.83	1.00
Total naming	3.75	1.90	0.16	-4.37	1.53	.016	0.63	1.69	1.00
Total Non Literal Comprehension	0.95	0.36	0.03	-0.95	0.29	0.004	0.00	0.32	1.00

Although the performance of the NH is significantly better than that of the children with HI, their performance, on the whole, suggests less than expected levels of comprehension. The post-Hoc test was utilized to facilitate multiple comparisons among groups on SC, IC, N and NLC tasks and it suggested that performance of children with CI was better than hearing aid users. It could be due to the limitation in amplification. Here, it is interesting to note that the children who got early intervened and fitted with hearing aids and speech-language therapy by the age of eight months are better on the sentence comprehension task. Early intervention appears to be an important factor in determining syntactic comprehension even 9 years later.

The mean performance difference i.e. 0.158 of NH (m=7.066) and CI (m=7.102) group on IC task is not significant. It favors the idea about CI as a better amplification device accompanied by intensive auditory-verbal therapy results better outcome in the development of language. During naming task, mean difference for CI (m= 12.40) and NH (m= 13.025) is negligible (i.e. 0.625). Even

group mean difference for CI and BTE was statistically not significant. A point to be noted is that all subjects of the three groups have been drawn from English medium schools in an attempt to ensure a similar exposure to the test vocabulary and to minimize the effect of linguistic diversity. It was observed that children with HI as well as typical peers both have not given appropriate responses related to certain item on the naming task (e.g. "syringe" as "injection", "lobster" as "crab", "flask" as "bottle" / "thermos" and "barrel" as "drum"). It can be assumed that these responses are not only due to a limited vocabulary but rather a type of language input given by school teachers and parents in the school and home setup. In other words, though these responses may be inappropriate given their widespread usage, they have been considered as acceptable cultural variants used in the Indian context.

Thus, children should be introduced with nominals on the basis of functions of that object in different contexts and alternate names should be introduced to children on and when appropriate.

A variety of studies have examined the non-literal language abilities to hear children; relatively few, however, have involved deaf children. In so far as deaf children generally lack both experiential diversity and language syntactic and semantic skills (Quigley et al., 1974), it would not be surprising to find that they have little skill in understanding the many non-literal aspects of language. In a similar study, Shulman et al., (1989) found significant performance differences between severe-to-profound hearing-impaired school-age children's and control group on comprehension of figurative language task. It was also assumed that figurative language is compact in nature so, it reduces the need for the speaker to provide all details of an intended message and allows communication of ideas that otherwise might be inexpressible.

Thus, such constructions should reduce both the processing load and the time required for linguistic production and comprehension relative to exact literal transmission and they should be of particular utility to deaf children, who typically have smaller vocabularies than hearing peers (Marschark, 1987).

Table 4: Performance of both between and within groups on Semantic Decision tasks as Synonyms, Antonyms, phonology/visually related and thematically related task.

Semantic task of ACE 6-11	Between Groups			Within Groups			F	Sig.
	Sum of Square	df	mean square	Sum of Square	df	mean square		
Semantics Synonyms	182.81	2	91.40	781.50	72	10.85	8.42	.001
Semantic antonyms	21.95	2	10.97	265.17	72	3.68	2.98	.057
Semantic phonology/ visually related	4.297	2	2.148	152.99	72	2.13	1.01	.369
Semantics Thematically Related	33.313	2	16.66	282.23	72	3.92	4.25	.018

Table 4, shows the comparison of performance between children with hearing impairment (HI) and normal hearing (NH). The obtained F ratio i.e. 8.421, 2.98 and 4.25 for synonyms, antonyms, and thematically related semantic tasks are significant at 0.001, .057 and .018 respectively. This suggests that the performance of the children with HI on all semantic decision tasks was poorer than typical peers excluding Phonological/Visually related (P/V) responses were no statistically significant difference was found between NH and HI. It signifies that due to the imprecise concept of HI, they have responded to most thematically related words. It is likely that their limited vocabularies may be compelling them to search for alternatives that are not even weakly related to the target word.

Further, it is interesting to note that when CI are considered separately, their performance is at par with typical peers on

semantic tasks but when BTE and CI groups are considered together as a hearing impaired (HI) group, their mean score declines and significant differences between HI and NH group was observed. So, to estimate incorrect performance ability of each group, Post Hoc Test has been done to compare each group separately to each other.

Post Hoc test shows that there was a significant difference between NH and BTE hearing aid users on semantic tasks i.e. Synonyms and Thematically related response at 0.001 and 0.045. Although there is no significant difference between BTE hearing aid users and Cochlear implant and even CI and NH group in terms of any types of responses i.e. synonyms, antonyms, phonological/visually related and thematically related responses. In a nutshell, it can be said that the performance of CI on these linguistic tasks is substantially better than that BTE hearing aid users and at par with their typical hearing counterparts.

CONCLUSION

Hearing impairment inhibits the child's ability to derive linguistic input and information, which is essential for normal language acquisition and for cognitive development. The usage of recent technological advancement i.e. cochlear implant reduces the progressive disparity between child's chronological age and language age. Closer inspection of responses and its pattern suggests qualitative differences i.e., children with CI performing superior to BTE hearing aid users. Thus, Cochlear implantation accompanied by intensive auditory verbal therapy and appropriate language stimulating family environment almost invariably reduces the deleterious impact of hearing loss on the lives of children and leads to good verbal outcome and quality of life.

Implication of the Study

1. It establishes that children with hearing impairment require special attention and emphasis for the development of inferential comprehension and non-literal comprehension.
2. Modification of texts containing metaphors and non-literal meaning done by special educators do not conform to standards. It restricts the comprehension of the same word, phrase or sentence in different contexts. Thus, especially for the early years, modifications of texts should be based on empirical evidence and should conform to a certain standard.

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