

**RESEARCH PAPER****Cognitive Functioning of Hearing Impaired and Normally Hearing Children Studying in Integrated Settings****Harihar Sarangi**

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Email: [hsarangi@rediffmail.com](mailto:hsarangi@rediffmail.com)Received: 16<sup>th</sup> July 2017, Revised: 10<sup>th</sup> September 2017, Accepted: 15<sup>th</sup> September 2017**ABSTRACT**

*The objectives of the study were to investigate (i) the degree of hearing impairment as a determinant of the cognitive functioning of hearing impaired children as compared to normally hearing children studying in integrated settings, and (ii) age as a determinant of the cognitive functioning of hearing impaired children with different degrees of hearing impairment as compared to normally hearing children studying in integrated settings. A sample of 105 hearing impaired children years, 35 each from mild category, moderately severe category and profound category under age groups 6-7 years, 8-10 years and 11-12 years was selected randomly. Besides these, a sample of 35 normally hearing children under age groups 6-7 years, 8-10 years and 11-12 years was also selected as control group randomly. The nonverbal conservation concept development test consisting of three subtests one each on conservation of mass, weight and volume was used to collect data. The Z statistics revealed that i) the cognitive functioning of mild hearing and moderately severe hearing impaired children studying in integrated settings was similar to the cognitive functioning of normally hearing children at all ages ranging from 6 to 12 years and ii) the cognitive functioning of profound hearing impaired children studying in integrated settings lagged significantly behind the cognitive functioning of normally hearing children at all ages ranging from 6 to 12 years*

**Key words:** *cognitive functioning, integrated settings, hearing impaired, age*

**INTRODUCTION**

The area of cognitive development has received a considerable attention in the literature on hearing impairment because of the link between linguistic and cognitive development. The hearing impaired population has often served as a 'laboratory' group to test the dependence or independence of cognition and language. The results of 6 years delay of deaf children in conservation performance as compared to normally hearing children found by Ole'ron & Herren in 1961 (reported in Furth, 1966) to 1½ year delay (Furth, 1964) to no significant difference between hearing impaired and normally hearing children (Rittenhouse & Spiro, 1979) revealed that linguistic deficiency in hearing impaired children did not play significant role in influencing cognitive functioning. Watts (1979) conducted a cross-sectional study on conservation over deaf, partially hearing and normally hearing children between the ages of 10 and 16 years and found out that at the younger age (10-14), the partially hearing children performed better than the deaf children, while at the older ages (15-16), the deaf children performed better than the partially hearing children. However, the normally hearing children showed superiority over the deaf and partially hearing children for all the tasks over the whole age range. Rittenhouse, Morreau and Iran-Nejad (1981) studied six hard of hearing and eight profound deaf children ranging in age from 11 years to 16 years 9 months enrolled in a day school on conservation concepts and found out no significant results. Rittenhouse and Spiro (1979) investigated deaf children studying in state residential school along with normally hearing children on conservation tasks following Piagetian conventional and attribute specific instructions and found out a significant difference in favour of the day school deaf children as compared to residential school deaf children on conservation performance using conventional Piagetian instruction. Furthermore, using attribute specific instruction the normally hearing children and the day school deaf children performed similarly, whereas the normally hearing children performed significantly better than the residential school deaf children. A retrospective review of literature on cognitive development of hearing impaired

children revealed that there has been a little study conducted so far exploring age and degree of hearing impairment as determinants of cognitive functioning of hearing impaired children studying in integrated settings. For which the present study has been designed.

### OBJECTIVES

1. To study degree of hearing impairment as a determinant of the cognitive functioning of hearing impaired children as compared to normally hearing children studying in integrated settings.
2. To study age as a determinant of the cognitive functioning of hearing impaired children with different degrees of hearing impairment as compared to normally hearing children studying in integrated settings.

### HYPOTHESIS

1. There exists significance of difference among hearing impaired children with different degrees of hearing impairment and normally hearing impairment studying in integrated settings in cognitive functioning.
2. There exists significance of difference among hearing impaired children with different degrees of hearing impairment and normally hearing impairment studying in integrated settings at age group 6-7 years, 8-10 years and 11- 12 years in cognitive functioning.

### SAMPLE

A sample of 105 hearing impaired children, 35 each from mild category, moderately severe category and profound category under age groups 6-7 years, 8-10 years and 11-12 years was selected randomly. Besides these, a sample of 35 normally hearing children under age groups 6-7 years, 8-10 years and 11-12 years was also selected as control group randomly. The hearing impaired children selected under different categories had the impairment at any time between birth and age of 6 months. The mild hearing impaired children met the criterion of hearing threshold level between 27 and 40 dB in the better ear. The moderately severe hearing impaired children met the criterion of hearing threshold level between 56 and 70 dB in the better ear. The profound hearing impaired children met the criterion of hearing threshold level of greater than 90 dB in the better ear

### TOOLS

The nonverbal conservation concept development test consisting of three subtests one each on conservation of mass, weight and volume was developed by the investigator following the original sources of Piaget and Inhelder (1941), Elkind (1961), Furth(1964), Ole'ron and Herren(1961), Furth and Youniss (1969), Watts (1979), Rittenhouse and Spiro (1979), and Rittenhouse et al. (1981). The calculated phi coefficients of 0.80 for conservation of mass, 0.80 for conservation of weight and 0.81 for conservation of volume against Piagetian verbal test gave evidence of high construct validity for the test. The test-retest reliability coefficients calculated were 1.00 for conservation of mass, 1.00 for conservation of weight and 0.97 for conservation of volume.

### RESULTS

As it can be seen in the Table 1, the difference found between the performance of mild hearing impaired children and moderately severe hearing impaired children studying in integrated settings was not significant for the conservation of mass ( $Z=0$ ;  $p>0.05$ ), weight ( $Z=1.68$ ;  $p>0.05$ ) and volume ( $Z=0.38$ ;  $P>0.05$ ). The difference between the performance of mild hearing impaired children and normally hearing children studying in integrated settings was also not significant for the conservation of mass ( $Z=0.66$ ;  $P>0.05$ ), weight ( $Z=0.26$ ;  $p>0.05$ ) and volume ( $Z= 1.03$ ;  $p> 0.05$ ). The difference between the performance of moderately severe hearing impaired children and normally hearing children studying in integrated settings was also not significant for the conservation of mass ( $Z=0.66$ ;  $p>0.05$ ), weight ( $Z=1.93$ ;  $p>0.05$ ) and volume ( $Z =0.67$ ;  $p> 0.05$ ). However, the difference between the performances of mild hearing impaired children and profound hearing impaired children studying in integrated settings was highly significant in favour of mild hearing impaired children for the conservation of weight ( $Z=3.38$ ;  $p<0.01$ ). Similarly, the

difference between the performance of normally hearing children and profound hearing impaired children studying in integrated settings was also found highly significant in favour of normally hearing children for the conservation of weight ( $Z=3.62$ ;  $p<0.01$ ).

**Table 1:** Summary of the 'Z' ratios of conservation responses of hearing impaired children with different degrees of hearing impairment and normally hearing children studying in integrated settings (IED settings) for mass, weight and volume (N=35 for each group)

Group	Conservation of mass		Conservation of weight		Conservation of volume	
	%	'Z' ratio	%	'Z' ratio	%	'Z' ratio
Mild IED setting	86	0.00	63	1.68	11	0.38
Moderately severe IED setting	86		43		14	
Mild IED Setting	86	0.00	63	3.38**	11	0.09
Profound setting	86		23		9	
Mild IED setting	86	0.66	63	0.26	11	1.03
Normally hearing	91		66		20	
Moderately severe IED setting	86	0.00	43	1.78	14	0.66
Profound IED setting	86		23		9	
Moderately severe IED setting	86	0.66	43	1.93	14	0.67
Normally hearing	91		66		20	
Profound IED setting	86	0.66	23	3.62**	9	1.31
Normally hearing	91		66		20	

\*\*Significant at 0.01 level

As can be seen in Table 2, in integrated settings at age group 6-7 years, the performance of mild hearing impaired children did not differ significantly from the performance of moderately severe hearing impaired children for the conservation of mass ( $Z= 0.91$ ;  $p> 0.05$ ) and weight ( $Z= 0.52$ ;  $p> 0.05$ ), from the performance of profound hearing impaired children for the conservation of mass ( $Z= 0.45$ ;  $p > 0.05$ ) and weight ( $Z= 1.49$ ;  $p>0.05$ ), and from the performance of normally hearing children for the conservation of mass ( $Z= 0.91$ ;  $p>0.05$ ) and weight ( $Z= 0.98$ ;  $p >0.05$ ). Similarly, the performance of moderately severe hearing impaired children did not differ significantly from the performance of profound hearing impaired children for the conservation of mass ( $Z = 0.47$ ;  $p> 0.05$ ) and weight ( $Z= 1.88$ ;  $p > 0.05$ ), and from the performance of normally hearing children for the conservation of mass ( $Z= 0$ ;  $p>0.05$ ) and weight ( $Z = 0.47$ ;  $p> 0.05$ ).

However, the difference between the performance of profound hearing impaired children and normally hearing children in favour of normally hearing children was found significant for the conservation of weight ( $Z =2.23$ ;  $p< 0.01$ ).

As can be seen in Table 3, in integrated settings at age group 8-10 years, the performance of mild hearing impaired children did not differ significantly from the performance of moderately severe hearing impaired children for the conservation of mass ( $Z = 1.16$ ;  $p> 0.05$ ), from the performance of profound hearing impaired children for the conservation of mass ( $Z= 0$ ;  $p > 0.05$ ) and volume ( $Z = 1.44$ ;  $p > 0.05$ ), and from the performance of normally hearing children for the conservation of mass ( $Z =0.05$ ;  $p> 0.05$ ), weight ( $Z =1.67$ ;  $p > 0.05$ ) and volume ( $Z = 1.17$ ;  $p> 0.05$ ). The performance of the moderately severe group did not differ significantly from the performance of the profound group for the conservation of mass ( $Z =1.16$ ;  $p>0.05$ ), weight ( $Z = 1.19$ ;  $p > 0.05$ ), and volume ( $Z =1.44$ ;  $p > 0.05$ ) and from the performance of the normally hearing group for the conservation of mass ( $Z = 1.16$ ;  $p >0.05$ ), weight ( $Z = 1.89$ ;  $p > 0.05$ ) and volume ( $Z = 1.17$ ;  $p> 0.05$ ). Similarly, the performance of profound group did not differ significantly from the performance of the normally hearing group for the conservation of mass ( $Z = 0$ ;  $p > 0.05$ ), weight ( $Z$

= 0.72;  $p > 0.05$ ) and volume ( $Z = 0.55$ ;  $p > 0.05$ ). However, the difference between the performance of the mild group and the moderately severe group in favour of the mild group was found highly significant for the conservation of weight ( $Z = 3.39$ ;  $p < 0.01$ ), and the difference between the performance of the mild group and the profound group in favour of the mild group was found significant for the conservation of weight ( $Z = 2.33$ ;  $p < 0.05$ ).

**Table 2:** Summary of the 'Z' ratios of conservation responses of hearing impaired children with different degrees of hearing impairment and normally hearing children studying in integrated settings (IED Setting) at age group 6-7 years for mass, weight and volume (N = 10 for each group)

Group	Concept	Conservation of mass		Conservation of Weight		Conservation of volume	
		%	Z' ratio	%'	Z' ratio	%'	Z' ratio
Mild IED Setting 6-7 years		50		20		0	
			0.91		0.52		0.00
Moderately Severe IED Setting 6-7 years		70		30		0	
Mild IED Setting 6-7 years		50		20		0	
			0.45		1.49		0.00
Profound IED Setting 6-7 years		60		0		0	
Mild IED Setting 6-7 years		50		20		0	
			0.91		0.98		0.00
Normally Hearing 6-7 years		70		40		0	
Moderately severely IED setting 6-7 years		70		30		0	
			0.47		1.88		0.00
Profound IED Setting 6-years		60		0		0	
Moderately severe IED setting 6-7 years		70		30		0	
			0.00		0.47		0.00
Normally Hearing 6-7 years		70		40		0	
Profound IED Setting 6-7 years		60		0		0	
			0.47		2.23*		0.00
Normally Hearing 6-7 years		70		40		0	

\*Significant at 0.05 level

As can be seen in Table 4, in integrated settings at age 11-12 years, the performance of mild hearing impaired children did not differ significantly from the performance of moderately severe hearing impaired children for the conservation of mass ( $Z = 1.03$ ;  $p > 0.05$ ), weight ( $Z = 0.52$ ;  $p > 0.05$ ) and volume ( $Z = 0.45$ ;  $p > 0.05$ ), from the performance of profound hearing impaired children for the conservation of mass ( $Z = 1.03$ ;  $p > 0.05$ ) and volume ( $Z = 1.55$ ;  $p > 0.05$ ), and from the performance of normally hearing children for the conservation mass ( $Z = 0$ ;  $p > 0.05$ ), weight ( $Z = 1.88$ ;  $p > 0.05$ ), and volume ( $Z = 0.89$ ;  $p > 0.05$ ). The performance of the moderately severe group did not differ significantly from the performance of the profound group for the conservation of mass ( $Z = 0$ ;  $p > 0.05$ ), and from the performance of normally hearing group for the conservation of mass ( $Z = 1.03$ ;  $p > 0.05$ ), weight ( $Z = 1.49$ ;  $p > 0.05$ ) and volume ( $Z = 0.45$ ;  $p > 0.05$ ). However, the difference between the performance of mild hearing impaired children and profound hearing impaired children in favour of mild hearing impaired children was found highly significant for the conservation of weight ( $Z = 2.73$ ;  $p > 0.01$ ) and volume ( $Z = 1.96$ ;  $p > 0.05$ ), and the difference between the performance of

profound group and normally hearing group in favour of normally hearing group was also found highly significant for the conservation of weight (  $Z = 54.09$ ;  $P > 0.01$ ) and volume (  $Z = 2.35$ ;  $p > 0.05$ ).

**Table 3:** Summary of the 'Z' ratios of conservation responses of hearing impaired children with different degrees of hearing impairment and normally hearing children studying in integrated settings (IED Setting) at age group 8-10 years for mass, weight and volume (N = 15 for each group)

Concept Group	Conservation of Mass		Conservation of Weight		Conservation of Volume	
	%	'Z' ratio	%	'Z' ratio	%	'Z' ratio
Mild IED Setting 8-10 years	100	1.16	87	3.39**	0	0.00
Moderately Severe IED Setting 8-10 years	93		26		0	
Mild IED Setting 8-10 years	100	0.00	87	2.33*	0	1.44
Profound IED Setting 8-10 years	100		47		13	
Mild IED Setting 8-10 years	100	0.00	87	1.67	0	1.17
Normally Hearing 8-10 years	100		60		7	
Moderately severe IED setting 8-10 years	93	1.16	26	1.19	0	1.44
Profound IED Setting 8-10 years	100		47		13	
Moderately severe IED setting 8-10 years	93	1.16	26	1.89	0	1.17
Normally Hearing 8-10 years	100		40		7	
Profound IED Setting 8-10 years	100	0.00	47	0.72	13	0.55
Normally Hearing 8-10 years	100		60		7	

\*Significant at 0.05 level

\*\* Significant at 0.01 level

### MAJOR FINDINGS

1. The cognitive functioning of mild hearing and moderately severe hearing impaired children studying in integrated settings was similar to the cognitive functioning of normally hearing children at all ages ranging from 6 to 12 years.
2. The cognitive functioning of profound hearing impaired children studying in integrated settings lagged significantly behind the cognitive functioning of normally hearing children at all ages ranging from 6 to 12 years.

**Table 4:** Summary of the 'Z' ratios of conservation responses of hearing impaired children with different degrees of hearing impairment and normally hearing children studying in integrated settings (IED setting) at age group 11-12 years for mass, weight and volume (N = 10 for each group)

Group	Conservation of Mass		Conservation of Weight		Conservation of Volume	
	%	'Z' ratio	%	'Z' ratio	%	'Z' ratio
Mild IED Setting 11-12 years	100		70		40	
Moderately Severe IED Setting 11-12 years	90	1.03	80	0.52	50	0.45
Mild IED Setting 11-12 years	100		70		40	
Profound IED Setting 11-12 years	90	1.03	10	2.73**	10	1.55
Mild IED Setting 11-12 years	100		70		40	
Normally Hearing 11-12 years	100	0.00	100	1.88	60	0.89
Moderately severe IED setting 11-12 years	90		80		50	
Profound IED Setting 11-12 years	90	0.00	10	3.15**	10	1.96*
Moderately severe IED setting 11-12 years	90		80		50	
Normally Hearing 11-12 years	100	1.03	100	1.49	60	0.45
Profound IED Setting 11-12 years	90		10		10	
Normally Hearing 11-12 years	100	1.03	100	4.09**	60	2.35**

\*Significant at 0.05 level

\*\* Significant at 0.01 level

## DISCUSSION

Mild hearing impaired and moderately severe hearing impaired children showed superiority over profound hearing impaired children in cognitive functioning at integrated settings can be interpreted that total absence of linguistic ability retards cognitive functioning significantly. Further, it has been made clear that language is not the necessary condition for the cognitive functioning. In integrated settings, mild hearing impaired children and moderately severe hearing impaired children with minimal linguistic ability possibly try to exploit that ability for the successful interaction with the environment leading to effective cognitive functioning comparably at par with normally hearing children. Further, it has also been made clear that the integrated setting environment plays significant role in marginalizing the retarding effects of language deficiency for which mild hearing impaired and moderately severe hearing impaired children behaved like normally hearing children in performing cognitive related tasks.

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