

## Effects of Auditory Integration Training and Acoupedic Therapy on Word Recognition of Children with Hearing Impairment

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### Abstract

*This study examined the effectiveness of auditory integration training and acoupedic therapy on word recognition among children with hearing impairment. Thirty three children between five and ten years old participated in this study. All the participants had Pre-Lingual and Post-Lingual hearing impairment with degree of hearing loss ranging from mild, moderate, severe to profound. All the children had their hearing loss confirmed through audiometric test and they were fitted with hearing aids. The instruments used consisted of Macro 53 brand of audiometer calibrated on ISO-13485:2008, word recognition test adapted from Betts (1946) with reliability of 0.89 for pre and post tests and case history of the participants. Data collected were coded and analysed using Analysis of Co-variance using SPSS version 17. The results revealed that Auditory Integration Training and Acoupedic therapy had significant effects on word recognition among the participants and that Auditory Integration Training was more effective on word recognition among children with hearing impairment. Also, there were significant main effects of degree and onset of hearing loss on participants' word recognition. It was recommended that early intervention in the form of Auditory Integration Training and Acoupedic Therapy should be adopted.*

### Introduction

Hearing and speaking are very vital to a language-rich environment without which no man can adjust to a speaking and hearing community. The ability to acquire language and speak effectively are dependent on the level and degree to which the complicated hearing system can successfully process acoustic information. Obviously, verbal language development, perception and effective usage are strongly related to the pathologically free auditory sense organ (Shojaei, Jafari & Gholami, 2016). The organ of hearing is most needful for about 70% of daily activities of men. Information is gathered and adequate responses are made because one hears and can interpret all auditory signals. Children generally are born with inner capacity for language development and acquisition of vocabulary with a certain degree of variance due to level of intelligence and some environmental factors (Deaf

Children Australia, 2012). However, the development of qualitative speech rests fundamentally on good sense of hearing. Therefore, it is well-recognized that hearing is critical and important to speech and language development, communication, learning, and social activities (World Health Organization, 2015; American Speech-Learning-Hearing Association, 2015).

Sometimes, children and adults may lack the development and production of qualitative speech and language because of the degree of hearing loss and pathology to the auditory system, which impede processing of the surrounding information adequately. Hearing loss is common and can affect any age. Hearing loss, according to Majid and Saif (2011) and the World Health Organization (2016), is a loss of hearing in one or both ears ranging from mild, moderate, severe to profound, causing communication difficulty, social isolation, poor language development, low self-esteem, and academic underachievement, which leads to lower

job performance and fewer employment opportunities in later life. Therefore, the presence of hearing loss, even to a mild extent, has negative effect on speech and language development in children with hearing impairment and also delays social, academic, and emotional abilities (Shojaei, Jafari, & Gholami, 2016; Yuhan, 2013). According to the World Health Organization (2016), about 360 million people, 5% of the world population, live with substantial hearing loss and 32 million are children, with the highest prevalence in low and middle income countries. With this rate in the developing world, the multiplying effects may be catastrophic with immediate effect on economic development.

While the most obvious impact of childhood hearing loss is on language acquisition (World Health Organization, 2016), the presence of hearing loss at this critical period of language development causes disorders in speech development, acoustic processing and language synthetic representation, morphology, and pragmatic application of language (Shojaei, Jafari, & Gholami 2016; World Health Organization, 2016). Whenever occasions like these happen to adults or children, difficulties in communication may result in feelings of anger, stress, loneliness, and emotional and psychological trauma, which may have profound consequences on the total wellbeing of individuals.

Hearing loss or impairment occurs differently and in varying degrees among people. Some individuals experience hearing loss at birth. Hearing loss of this type is called congenital loss while others experience it after acquisition of meaningful speech or later in life (i.e., adventitious or acquired). These different kinds of losses occur in degrees ranging from slight, mild, moderate, and severe to profound as may be revealed by audiometric test. The occurrence and prevalence of different kinds of loss in whatever degree affect the total development and wellbeing of the affected person.

Mild to moderate hearing loss corresponds with an average hearing loss in the range of 21-70 decibels (Delage & Tuller, 2007). According to Hillier (2012) and Delage and Tuller (2007), mild to moderate sensorineural hearing loss has been associated with deficiencies in frequency discrimination and expressive language production, which has both typical and atypical components. Sometimes children with hearing loss attend regular schools with some extra supports. This creates a

misconception concerning persons with mild to moderate hearing loss because parents, educators, and other professionals may conclude that somebody with this hearing loss may not be experiencing any major difficulties. Hence, this assumption may cause deficiencies and delays in the development of linguistic and social skills (Briscoe & Bishop, 2001; Hillier, 2012). It must be noted further that even minimal hearing loss places children or any affected person at a disadvantage of language development, learning problems, and distortion of auditory information. Overall, the adverse effect of hearing loss, whether congenital or adventitious, mild or profound, is poor language development, lack of auditory sensitivity, and speech and language disorders, which may manifest in distorted personality such as aggression and somatization.

Studies by Gilbertson and Kamhi (1995), Stelmachowicz, Pittman, Hoover and Lewis (2004) and Hansson, Forsberg, Löfqvist, Mäki-Tokko and Sahlen (2004) on language development of children with mild-moderate hearing loss on learning words revealed that a significant population of their participants exhibited significantly poor performance on most of the measures of phonological processing and novel words learning compared with those without hearing impairment. By inference, if participants with mild to moderate hearing loss demonstrated poor performance in word recognition and learning, then individuals with severe to profound hearing loss would perform abysmally poorer in language learning. Therefore, if speech and language are essential ingredients for better life, identification of hearing loss and early appropriate interventions are essential for normal language acquisition in children with hearing impairment who are lost in the world of language (Ptok, 2011; Meinzan-Derr, Wiley & Choll, 2011). Early identification of hearing loss and appropriate interventions before the awareness of language can increase the possibilities of normal speech and language development in children with hearing impairment (Olzinger, Felling & Bestel, 2011; Pimperton & Kennedy, 2012). Early intervention starts with hearing screening programmes for infants and young children with the benefit of identifying hearing loss at a very young age. Research suggests that children, whether they are born with or acquire deafness or hearing loss early in life, who receive appropriate interventions within

six months of age can perform and develop language at the same rate with their hearing counterparts (World Health Organization, 2016). With this great revelation, detection and early rehabilitation of children with hearing loss become imperative to help children with hearing impairment to enjoy the same academic and social benefits other children derive from the community.

For proper language development, reception and perception of acoustic stimuli are essential prerequisites for pre-lingual activities. This must take the dimension that will make individuals with hearing impairment to be familiar with sound and language of their environment as early as possible. In Nigeria, so many measures have been taken to reduce incidences of hearing loss and also improve language acquisition of children with hearing impairment especially among the school-going age. However, sad enough, the issues of training in language acquisition at an early age have suffered neglect. It is therefore expedient to develop or adopt interventions that will help infants and children to be familiar with sound and language to facilitate proper and adequate language acquisition and use.

According to Northern and Down (2000), an appropriate intervention programme must include assessment of degree of hearing loss, hearing aid description and fitting, auditory training, language learning, and educational strategies. Therefore, it is expedient to employ programmes or training that will aid language acquisition and auditory experience for children with hearing impairment as early as possible. Auditory Integration Training and Acoupedic Therapy would be expedient because of their potential to aid language acquisition and proficiency among children with hearing impairment. Auditory training and language development involve comprehensive programmes that may take the forms of Auditory Integration Training and Acoupedic Therapy. These intervention strategies introduce children with hearing impairment to sound and words, which aid their language initiation.

Auditory Integration Training has received popularity in advanced countries of the world especially in Canada. Auditory Integration Training is based on the concept that electronically modulated or filtered music provided through headphones reduces hypersensitivities to sound (Baranck, 2002). Auditory Integration Training as developed by French otolaryngologist, Guy Berad,

and based on the work of his predecessor, Alfred Tomatis, typically entails 20 half-hours session of listening to specially modulated music over a 10 to 20 day period. This intervention strategy has been reported to be efficacious on a number of participants with deficits in auditory processing ability and other complicated behavioural problems as documented by research.

Auditory Integration Training involves systematic procedures, which have to do with the ability of the child to recognize speech sound, environmental sounds, and ability to discriminate between and among the sounds with the use of hearing aid. This training engages the child in how to pronounce sound words. It also helps with the formation of perfect auditory discrimination. The child or groups of children under this training are active participants. Gerth, Barton, Engler, Heller, Freides, and Blalock (1994) evaluated the effectiveness of Auditory Integration Training on 10 children with auditory-based learning deficit and reported great improvement among the participants despite the absence of a control group. Also, in related studies as reported by Geffner, Lucker, Gordon and Distasio (1994), Huskey, Barnett and Cimorelli (1994), and Rudy, Morgan and Shepard (1994) on the effects of Auditory Integration Training on children with auditory processing deficit and central auditory processing dysfunction, the results revealed great improvement in word recognition and attention spans of the participants.

Acoupedic Therapy is a technique of teaching children with hearing impairment to speak and learn by developing intelligible speech through the maximum development of listening skills. Acoupedic Therapy teaches children to process language through amplified residual hearing and stresses an oral approach that eliminates visual cues. This approach is based on only the use of audition and early amplification with hearing aids, which is widely known as unisensory or auditory-verbal method (Osisanya, 2012). Acoupedic Therapy is anchored on the following principles namely: early detection, early fitting with binaural hearing aid, unisensory input, a normal learning environment, the use of auditory feedback mechanism, developmental language approach, parents as first models of communication, and no grouping with other children with hearing impairment. According to Moores (1996), reading and writing are discouraged in the early years because they act as

potential inhibitors to the development of oral skills. Children with hearing impairment undergoing this therapy only listen to the trainer on a one-on-one basis. Group engagement is totally discouraged in this approach. This method can only be effective in training children with usable residual hearing but may not work with children with severe to profound hearing loss (Osisanya, 2012). Based on this evidence, it appears Auditory Integration Training and Acoupedic Therapy will aid development of good listening skills and word recognition ability among children with hearing impairment in Nigeria though more research is still warranted. Therefore, this study sought to explore the effectiveness of Auditory Integration Training and Acoupedic Therapy on word integration abilities of pupils fitted with hearing aids. The study was guided by the following research questions:

1. Does Auditory Integration Training and Acoupedic Therapy have effect on word recognition of children with hearing impairment?
2. Does mild to severe hearing loss have significant effects on word recognition of children with hearing impairment?
3. Can onset of hearing loss significantly affect word recognition of children with hearing impairment?

## Method

### *Participants and Sampling*

The participants of the study consisted of 33 pupils with hearing impairment whose hearing loss ranged from mild, moderate, severe to profound hearing loss. The ages of the participants ranged from five to ten years and they were already fitted with hearing aids according to the degree of their loss. The sample was purposefully selected based on the pupils' word recognition deficiencies and the parental consent for the children to participate.

### *Design and Procedure*

This study employed Pre-test Post-test, control group quasi experimental research design. The degree and onset of hearing loss was further determined through case history and audiometric examination. The participants were assessed by an Audiologist in the department of Special Education

at the University of Ibadan using Micro 53 brand of Audiometer. The degree of loss of each participant was established. All participants were monolingual and lived with their parents who were non-hearing impaired. The brand of audiometer used for the assessment of the participants' level of hearing loss was Micro53 calibrated on ISO-13485:2008. The audiometer was in good condition before, during, and after the assessment. The case histories of the children were used to determine the actual age of the children, onset of loss, and the status of the parents. The word recognition test adapted from Betts 1946 as used by Frye 2004 was used. The test contains 10 words ranging from two to four letter words with reliability of 0.89 using cronbach alpa. Eleven children were assigned to each of the groups with two experimental and one control groups. The groups were pre-tested to ascertain the basis for their word recognition disabilities. During the study, the experimental groups were exposed to Auditory Integration Training and Acoupedic Therapy while the control group was taught with sign language and facial cue for the eight weeks of the of the duration of the study. After eight weeks of rigorous activities, the three groups were post-tested to determine the participants' word recognition abilities. Data collected were coded and analysed using analysis of covariance with SPSS17 to test significant effects of the treatments. The Duncan post hoc analysis was further done to ascertain significant difference between the treatments.

## Results

### *Research Question 1*

*Does Auditory Integration Training and Acoupedic Therapy have effect on word recognition of children with hearing impairment?* The result from Table 1 showed that there was significant main effect of treatment on participants' word recognition abilities ( $F(2, 30) = 138.59, P < 0.05, \eta^2 = 0.32$ ). This means that there was a significant difference in the mean scores of the word recognition abilities of the participants exposed to Acoupedic Therapy and Auditory Integration Training when compared with those in the control group. Hence, research question one revealed positive impact. It was therefore concluded that Acoupedic Therapy and Auditory Integration Training were effective in enhancing word

Table 1

*Summary of the Analysis of Co-Variance (ANCOVA) Posttest Word Recognition Abilities of Participants Based on Degree of Hearing and Onset of Hearing Loss*

Source	Type III sum of squares	DF	Mean square	F	Sig.	Partial eta squared
Corrected Model	.957 <sup>a</sup>	2	0.479	9.392	0.001	0.385
Intercept	3.011	1	3.011	59.039	0.000	0.663
Protest	0.162	1	0.162	3.176	0.000	0.996
Trtgroup	14.135	2	7.068	138.588	0.001	0.321
Degree of HL	3.641	1	3.641	71.392	0.000	0.172
Onset of Loss	5.274	1	5.214	102.235	0.000	0.24
Trt group* DHL	1.52	2	0.76	14.902	0.000	0.503
Trt group* O of L	2.093	2	1.047	20.529	0.001	0.203
Error	1.528	30	0.051			
Total	32.321	40				
Corrected Total	2.485	45				

R Squared = .385 (Adjusted R Squared = .344)

Table 2

*Post-hoc Analysis Showing the Differences among the Treatment Groups*

Trtgroup	N	Subset for alpha=0.05		
		1	2	3
Aucoupedics	II	15.420		
AIT	II		18.032	
Control	II			8.200
Sig.		1.000	1.000	1.000

Table 3

*Post-hoc Analysis Table Showing the Significance Differences between the Treatment Groups*

Variable	N	DF	Mean	Std Dev	T	P
Moderate, HL	9		16.21	7.52		
		31			8.73	0.027
Severe, HL	24		14.36	6.83		

Table 4

*Post-hoc Analysis Showing the Difference in Pre and Post Ls in Response to Word Recognition Abilities*

Variable	N	DF	Mean	SD	T	p
Pre Lingual	19	31	11.87	6.99	7.56	0.042
Post Lingual	14		13.74	8.24		

recognition abilities of pupils fitted with hearing aids. However, to ascertain the direction of the differences and determine the magnitude of the mean scores of the participants in each of the experimental groups, Duncan Post-hoc analysis was calculated and the results are presented in Table 2. According to results presented in Table 2, there was a significant difference in the post-hoc test mean scores of word recognition abilities in Acoupedic Therapy and Auditory integration training between the experimental and control groups. Participants in the Auditory integration training group ( $\bar{X}$ =18.03) benefitted from the treatment better than those in the Acoupedic Therapy ( $\bar{X}$ =15.42) and control ( $\bar{X}$ =8.200) groups.

#### *Research Question 2*

*Does mild to severe hearing loss have significant effects on word recognition of children with hearing impairment?* The result from Table 1 showed that degree of hearing loss (DHL) had effect on participants' word recognition abilities ( $F(2,30)=71.39$ ,  $P < 0.05$ ,  $n^2 = 0.17$ ). This implies that there was a significant difference in the mean scores of word recognition abilities of participants with mild and severe hearing loss when compared to each other. However, to determine the magnitude of the mean scores of participants with mild hearing loss and severe hearing loss with respect to the treatment protocols, the Duncan Post-hoc analysis was calculated and the results are presented in Table 3. The results in Table 3 revealed that the mean post-hoc score of the participants with mild hearing loss was 16.21 with a Standard Deviation score of 9.52 compared to participants with severe hearing loss having the mean scores of 14.36 and a Standard Deviation value of 9.83. This implies that participants with mild hearing loss benefitted from the treatment more than those with severe hearing loss

#### *Research Question 3*

*Can onset of hearing loss significantly affect word recognition of children with hearing impairment?* The result from Table 1 showed that there was effect of onset of loss on participants' words recognition abilities ( $F(2, 30) = 102.24$ ,  $p < 0.05$ ,  $n^2= 0.24$ ). This means there was a significant difference in the mean scores of word recognition abilities of participants with Pre-lingual and post lingual hearing impairment when compared with each other. However, to determine the magnitude of the mean scores of the participants with respect to the treatment protocol, the Duncan post-hoc analysis was calculated and presented in Table 4. The result in Table 4 showed that the mean post-hoc score of the participants with Pre-Lingual hearing loss was 11.87 with a Standard Deviation score of 6.99 compared to participants with Post Lingual hearing loss, having the mean scores of 13.74 and a Standard Deviation value of 8.24. This means that participants with Post Lingual hearing loss benefitted from the treatment more than those with Pre-Lingual hearing loss.

#### **Discussion**

The results revealed that there was significant main effects of treatments on participants' word recognition abilities. This indicates that Auditory Integration Training and Aucoupedic Therapy were significantly effective on improving the word recognition abilities of children with hearing impairment. The result indicated that using Auditory Integration Training and Acoupedic Therapy as an early intervention strategy with appropriate hearing aids for children with hearing impairment will help them to develop language appropriately like their hearing counterparts. The result corroborated previous research (i.e., Gerthet et al., 1994; Geffner et al., 1994; Huskey, et al.,

1994; Rudy et al., 1994) that reported positive impact of Auditory Integration Training in improving auditory processing deficit, attention deficit, and language development difficulty experienced by children with hearing impairment. The finding of Ugwuanyi and Adaka (2015) on the effectiveness of Auditory Integration Training on reading comprehension of children with hearing impairment in Enugu State, Nigeria, is a welcome development. The finding of this current study revealed that Auditory Integration Training improved the reading comprehension of the participants within eight weeks of intensive training. The implication of this result is that locally, alternative strategies to improve language acquisition of children with hearing loss have started evolving and gaining recognition. The effectiveness of Acoupedic Therapy on word recognition abilities of children with hearing impairment as revealed by this study is also another breakthrough as its effectiveness can be highly felt by children with usable or residual hearing as noted by (Osisanya, 2012) though there is paucity of research documenting the use of Acoupedic Therapy locally. This means that if the two approaches are effectively used by specialists, language acquisition will be easy for children with congenital and most profound hearing loss in Nigeria where some of the affected children have been facing language development difficulty.

Furthermore, the post-hoc analysis reveals that Auditory Integration Training was more effective as the Auditory Integration Training group ( $\bar{X}=18.03$ ) benefitted from the treatments compared to those in Acoupedic Therapy ( $\bar{X}=15.42$ ) and control ( $\bar{X}=8.200$ ) groups. The effectiveness of Auditory Integration Training can be linked to the fact that the trainees under the instruction of Auditory Integration Training were actively involved in the process of auditory and word initiation. The result is in line with previous research (e.g., Huskey et al., 1994; Rudy et al., 1994; Yencer, 1996; Zollweg, Vance & Palm, 1997) reporting the efficacy of Auditory Integration Training in word recognition and attention span of their participants. Therefore, the popularity of Auditory Integration Training is based on the history of its effectiveness in improving language development and reducing attention deficit of pupils with hearing impairment. Therefore, it will be of immense benefit for children with hearing loss in Nigeria if this intervention

strategy is adopted early enough and implemented by professionals. Language development, which has become an onerous task for children with deafness will become an easy and attainable task and will give them the opportunity to be functional members of the society at an early age.

The results also revealed that degree of hearing loss has significant effect on word recognition of children with hearing impairment. Participants with mild and moderate hearing loss benefitted from the treatment than those with severe hearing loss as reflected in Table 3. The significant effects of treatments on participants with mild-moderate hearing loss can be attributed to the influence of residual hearing, which could have affected their word recognition abilities. This finding is in line with Hansson et al.'s (2004) study of the word learning abilities of children with mild-moderate and severe hearing loss and language impairment using Gilbertson and Kalmi's (1995) method. Their results revealed that children with mild and moderate hearing loss performed better than children with severe language impairment on word learning, sentence comprehension, and reading accuracy. This can be linked to efficient use of their residual hearing fitted with hearing aids.

Finally, the results indicated that the onset of hearing loss has significant effect (Pre and Post Lingual hearing loss) on participants' word recognition abilities with the participants having post lingual hearing loss demonstrating improvement in word recognition abilities compared to participants with pre-lingual hearing loss. The gain derived from the treatment could be a result of initial gains of language before the onset of their hearing impairment. This means that children with adventitious hearing loss of mild to moderate degree can be helped to improve their hearing and speaking well with early detection and intervention by the use of Auditory Integration Training and Acoupedics Therapy. The two interventions can be another breakthrough in language training and acquisition among children with hearing impairment in Nigeria.

### **Recommendations and Conclusion**

This study explored the effectiveness of Auditory Integration Training and Acoupedic Therapy on the word recognition abilities of children with hearing impairment. The study is

important because of language deficit experienced by children with hearing impairment though many strategies and efforts have been employed to improve language development among children with hearing impairment in Nigeria. Auditory Integration Training and Acoupedic Therapy were employed as intervention strategies for eight weeks on two experimental groups. The intervention proved very effective on word recognition among participants with hearing impairment. Therefore, early identification and intervention in form of Auditory Integration Training and Acoupedics Therapy will help children with hearing impairment to develop language efficiently if the approaches are appropriately employed.

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