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Effect of Auditory Training on Sound Comprehension and Detection among the Hearing Impaired in Calabar Metropolis, Cross River State

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Abstract
The study examined the effect of auditory training on sound comprehension and detection among students with hearing impairment. The study was guided with two research questions and two hypotheses. The study adopted a pretest-posttest control group quasi-experimental design. A purposive sampling technique was used to select 20 students which is 10% of the population. The instruments used were Scene Analysis Scale (SAS) and Sound Keenness Scale (SKS). The instruments were given to Special Educators and Measurement and Evaluation experts for face validation. The reliability of the instrument was ascertained using Cronbach alpha and the coefficient of 0.82 showed that the instrument is high and can measure what it purports to measure consistently. The questionnaire was administered to the students first as a pretest and after three weeks of treatment, the post test was administered to both groups. The data was analysed using simple percentages and Analysis of Covariance (ANCOVA). The results showed that auditory training has significant effect on sound comprehension and detection among students with hearing impairment. It was recommended, among others, that parents and caregivers should ensure that children are helped at the earlier stage to comprehend sounds through regular auditory.
Keywords: auditory, training, sound, comprehension, detection, hearing, impairment

Introduction
Sound discrimination is the ability to recognize differences in phonemes (the smallest unit of sound in a language), including the ability to identify words and sounds that are similar and those that are different. Auditory discrimination tests are performed to measure a person's phonological awareness, such as the ability to focus on and manipulate phonemes within spoken words. It is a fundamental aspect for the correct production of speech sounds. Auditory training is designed to teach students skills to successfully decode words and to identify individual sounds and blends in words. Initial activities engage students in discovering the lip, tongue, and mouth actions needed to produce specific sounds. After students are able to produce, label, and organize the sounds with mouths, subsequent

activities in sequencing, reading, and spelling use the oral aspects of sounds to identify and comprehend within words.

Sound discrimination is very necessary because it helps the students to form words and make meaning out of it. A child who is unable to differentiate sound ends up becoming hearing impaired. Discrimination of environmental sounds has become a major challenge to students with hearing impairment. According to Kurita (2012), inability to perceive auditory signals and understand spoken language is a common phenomenon which affects speech and language development. Auditory training could be an effective intervention for a variety of sound discrimination problems, not only from those arising in early childhood, but also for the decline in hearing among students. Once hearing becomes impaired, incidental hearing becomes inhibited; thus, making it difficult for the individual to express and receive information effectively (Tye- Murray, 2009). This is what has been observed among student in Cross River state. They find it difficult to understand the meaning of words as well as understand other people.

The rapidity with which children acquire language is one of the mysteries of human cognition. A view held widely for the past 30 years is that children master language by means of a language-specific learning device (Gomez & Gerken, 2000). An earlier proposal which has generated renewed interest is that children make use of domain-general, associative learning mechanisms. However, current lack of knowledge of the actual learning mechanisms involved during infancy makes it difficult to determine the relative contributions of innate and acquired knowledge. A recent approach to studying this problem exposes infants to artificial languages and assesses the resulting learning.

In order to learn speech sounds, the child must present organic conditions to discriminate phonemes. The auditory neurons can be adjusted in a way that the acoustic differences found among sounds are maximized in the brain, facilitating the distinction among sounds (Cowling, 2004). Thus, alterations in the ability to discriminate sounds may contribute to speech disorders. Infants' discovery of phonetic (speech-sound) categories is impressive, particularly given the poor performance of computer systems designed to interpret spoken language. Demonstrations of infants' perceptual talents have been interpreted as showing that infants are perfectly adapted listeners, biologically predisposed to interpret the sounds of human languages. Early word-finding is an accomplishment partly because parents do not provide clear indications of word boundaries. How can children determine where one word ends and another begins? It is now known that children have several tools that help in this, including attention to changes like the pitch movements marking ends of clauses (Seidl, 2007).

Sound comprehension is the ability to understand what is heard and attach meaning to it. Comprehension of spoken language requires individual processing of the linguistic components - phonology, semantics, and syntax - as well as interactive processing among them. The tone of the voice, pauses between words, emphasis used, and the rhythm and pattern of speech all impact the meaning. Comprehension of a series of sentences, such as

a paragraph or text, is often more impaired than isolated sentence comprehension for students with hearing impairment (Sheft et al., 2012). This increase in task difficulty generally stems from the greater amount of material to process and the necessity to relate the material together. Presumably, the ultimate goal of processing messages is to comprehend them; that is, to assign appropriate meaning to them. Sound comprehension encompasses the multiple processes involved in understanding and making sense of spoken language. These include recognizing speech sounds, understanding the meaning of individual words, and/or understanding the syntax of sentences in which they are presented. This can also involve the prosody with which utterances are spoken (which can change intended meaning from a statement to a question), and making relevant inferences based on context, real-world knowledge, and speaker-specific attributes (for instance, to what information the speaker has access and about what he/she is likely to be talking). For longer stretches of language or discourse, sound comprehension also involves significant memory demands to keep track of causal relationships expressed within the discourse (Mathur & Yang, 2015).

Sound detection is basically the sound discovery and finding an item based on the sound. This also involves pin pointing on an item based on the sound and discriminating a particular sound from background noise. According to Cai et al. (2006), the ability to detect important auditory signals while performing visual tasks may be further compounded by background chatter. Thus, it is important to know how task performance may interact with background chatter to hinder signal detection. Sound signal provides a great deal of information about their sound sources. However, many students with hearing impairment are unable to access this important information due to hearing impairment, leading to difficulty in sound discrimination (Janeschik et al., 2011). Detection is exactly what it sounds like, the ability to hear the presence or absence of a sound. The student is expected to express if he/she hears or does not hear a sound or speech. It is well known that knowledge facilitates higher cognitive functions, such as visual and auditory word recognition; little is known about the influence of knowledge on detection, particularly in the auditory modality.

Manchaiah et al. (2018) reserched on examination of previously published data to identify patterns in the social representation of "hearing aids" across countries. Societal factors seem to exercise a strong influence on hearing aid acceptance, use, and satisfaction. In particular, perception, and attitude of societies often have bearing towards their and others behaviour and decisions. The study aimed at conducting auditory training through the use of hearing aids. The study employed a cross-sectional design. A sample of 404 persons of about 18 years old from India, Iran, Portugal, and the United Kingdom were recruited by relying on a convenience sampling approach. The data were collected using a questionnaire and a free association task. In this method, the sample were asked to provide up to five words or phrases that come to mind when thinking about "hearing aids." The data was initially analyzed based on qualitative content analysis. This was followed by quantitative cluster analysis and chi-square analysis (the data were analyzed using various qualitative and quantitative analyses). The content analysis suggested 39 main categories

of responses related to hearing aids. Results gotten were as follows: the cluster analysis resulted in five main clusters, namely: 1) positive attitude, 2) external factors, 3) hearing aid use and satisfaction, 4) etiology, and 5) benefits and limitations of technology. The study provides unique insights into the perception of hearing aids by the general public; and additionally, the way attitude, societal factors and many other demographic variables may influence these perceptions or hearing aids acceptance. There is countless relevance of this study to the study at hand, because of the areas of interests covered. It is surprising that the literature in this area is limited, considering the importance of this topic and the issues raised in the study.

Osisanya and Afolabi (2016) conducted a study on effect of auditory training and aided language stimulation on speech perception of children with hearing loss in Ibadan, Oyo State, Nigeria. The purpose was to examine the effect of auditory training (AT) and aided language stimulation (ALS) moderated on onset and degrees of hearing loss, on the speech perception (detection, recognition and discrimination) of children fitted with hearing aid in Ibadan, Oyo state, Nigeria. A pretest-posttest control group quasi-experimental research design, using a 3x2x2 factorial matrix, was adopted for the study. A purposive sampling technique was used to select 24 children (age ranged between 4 and 7 years) with hearing loss. The participants were randomly assigned to two treatment groups (AT and ALS) with a twelve-week intervention plan and a non-treatment control group. A standardized auditory trainer, and the Peabody Picture Vocabulary Test - 4th Edition (PPVT-4, r=.80 - .84), were the instruments used for the training. The five hypotheses formulated were tested at 0.05 level of significance, and data collected were analysed using descriptive analysis, Multivariate Analysis of CoVariance (MANCOVA) and Scheffe Post Hoc Analysis.

The findings revealed a significant main effect of treatments on the speech perception of the participants; Recognition (F=71.45, η = 94), Discrimination (F = 88.11, η = .95), and Detection (F = 32.06, η = 87), with ALS being a more significant treatment (Recognition (F = 3.37, p>05); Discrimination (F = .83, p>.05), and Detection (F = .96, p>.05). Onset of hearing loss interacted with the degrees of hearing loss on Detection (F = 4.69, η = .39) but not on Recognition (F =.67, p>.05); and Discrimination (F = .53, p>.05). Treatments, onset of hearing loss and degree of hearing loss interacted on Recognition (F =4.31, df = (1, 23), p.05).

The findings also revealed that any individual with hearing loss that is exposed to auditory training in addition to aided language stimulation in the course of rehabilitation or habilitation will get maximum gain from the approach. The study has helped to see how effective the use of auditory training and aided language stimulation is to persons with hearing loss; how it can enable persons with hearing loss to be introduced or reintroduced back into the sound world. Based on these findings, it was recommended that children with hearing loss should be rehabilitated using auditory training and aided language stimulation as part of the aural rehabilitative strategies meant to maximize the use of the assistive listening device. The study concluded that irrespective of the degree of hearing

loss, with proper amplification together with an aural rehabilitative approach, noticeable improvements will occur, positively affecting children's auditory and speech perception. Findings were consistent with previous studies showing positive outcomes for auditory training and aided language stimulation but also showed that two subjective factors, pre-fitting hearing aid expectations and acceptance of hearing loss, significantly influenced hearing aid outcome. Osisanya and Afolabi mentioned that the sample consisted of Hearing Aids users; it is not clear whether the users were new users (new hearing aids users) or they are familiar with the use of hearing aids. The current researchers would prefer to use persons with hearing impairment who are old users of Hearing Aids but bought new Aids at the time of this current experiment.

Purpose of the study

The purpose of the study is to examine the effect of auditory training on sound comprehension and detection among students with hearing impairment in Calabar Metropolis. Specifically, the researchers sought to find out the:

i. Effect of auditory training on sound comprehension among students with hearing impairment.

Effect of auditory training on sound detection among students with hearing impairment.

Research questions

The following questions were raised to guide the study:

i. What is the effect of auditory training on sound comprehension among students with hearing impairment?

ii. What is the effect of auditory training on sound detection among students with hearing impairment?

Hypotheses

The hypotheses were stated as follows:

Ho1: There is no significant effect of auditory training on sound comprehension among students with hearing impairment.

Ho2: There is no significant effect of auditory training on sound detection among students with hearing impairment.

Methodology

The study adopted a pretest-posttest control group quasi-experimental design. This is because the study involves the use of intact classes. The experiment took the following pattern:

	Groups	**Pretest**	**Treatment**	**Posttest**
Random assignment of groups	Experimental	O_1	X	O_2
	Control	O_3	−	O_4

Where
O_1 = Pretest for Experimental Group
X = Treatment
O_2 = Posttest for Experimental Group
O_3 = Pretest for Control Group
− = Absence of Treatment
O_4 = Posttest for Control Group

The overall population of students with hearing impairment at Special Education Secondary School, Ibom Layout, is 200. A purposive sampling technique was used to select 10% of the study population. A total of 20 students were selected and assigned to the experimental and control group. The instruments used were Scene Analysis Scale (SAS) and Sound Keenness Scale (SKS). The instruments were given to Special Educators and Measurement and Evaluation experts for face validation. The reliability of the instrument was obtained using Cronbach's Alpha Coefficient index. The reliability of the instruments obtained using Cronbach's Alpha coefficient index was 0.82, which showed that the instrument is high and can measure what it purports to measure consistently. The questionnaire was administered to the students first as a pretest and after three weeks of treatment, post-test was administered to both groups. The treatment consisted of Speech Therapy Tips using: picture motion; film/movies; tape recorders; flute; whistle and the likes; Audio Dance using: keyboard; talking drum; drum and more; and discussions and plenary sessions using: flashcards with mono syllabic words, disyllabic words, three letter words and simple phrases; story books; chalkboard; film/tv set, motion pictures. The participants were encouraged to imitate three syllable words, simple phrase and participate in repeating keywords in phrases and tenses. The auditory training tools were used to demonstrate how the sounds of words are made by striking them to produce different sounds and the participants were led to vocalize the sounds. The data generated was analysed using simple percentages and Analysis of Covariance (ANCOVA).

Presentation of results

Research question one: What is the effect of auditory training on sound comprehension among students with hearing impairment?

Table 1: Sound comprehension level of students with hearing impairment before and after being exposed to auditory training and those not exposed

Level	Experimental Group		Control Group	
	Pre-Test (%)	Post-Test (%)	Pre-Test (%)	Post-Test (%)
Low	10(100.00)	0	10(100.00)	8(80.00)
Moderate	0	8(80.00)	0	2(20.00)
High	0	2(20.00)	0	0
Total	10(100)	10 (100)	10(100)	10 (100)

To answer this research question, simple percentages were used and the result, as presented in table 1, showed the extent of sound comprehension amongst students with hearing impairment before and after exposure to auditory training and those not exposed. Before intervention, 100% of the students in experimental and control groups had low scores in sound comprehension. The experimental group, after intervention had 80% of the students moved from low to moderate extent and 20% moved to a high extent. On the other hand, students in the control group, which had low extent of sound comprehension, still had 80% with low sound comprehension while only 20% moved to moderate sound comprehension. This implies that auditory training enhances the sound comprehension of students with hearing impairment to a high extent after intervention.

Ho1: There is no significant effect of auditory training on sound comprehension among students with hearing impairment.

Table 2: Summary of Analysis of Covariance (ANCOVA) of sound comprehension post-test mean scores between students with hearing impairment in experimental and control groups

Source	Type III Sum of Squares	df	Mean Square	F	P-value	Partial Eta Squared
Corrected Model	273.800[a]	1	273.800	46.759	.000	.722
Intercept	2784.800	1	2784.800	475.583	.000	.964
Groups	273.800	1	273.800	46.759	.000	.722
Error	105.400	18	5.856			
Total	3164.000	20				
Corrected Total	379.200	19				

a. R Squared = .722 (Adjusted R Squared = .707)

The independent variable is auditory training while the dependent variable is sound comprehension. To test this hypothesis, analysis of covariance (ANCOVA) was used and

the result as presented in table 2 showed the post-test mean and standard deviation of students with hearing impairment in experimental group to be 15.50±3.27 and control group had 8.10±0.99; in addition, F=46.76 , and p<.05. Since the p-value (0.00) is less than 0.05, this implies that there is a significant mean score difference between students with hearing impairment in experimental and control groups on sound comprehension after intervention. Thus, the null hypothesis is rejected.

Research question two: What is the effect of auditory training on sound detection among students with hearing impairment?

Table 3: Extent of sound detection among students with hearing impairment before and after exposure to auditory training and those not exposed

Extent	Experimental Group		Control Group	
	Pre-Test (%)	Post-Test (%)	Pre-Test (%)	Post-Test (%)
Low	10(100.00)	0	10(100.00)	7(70.00)
Moderate	0	8(80.00)	0	3(30.00)
High	0	2(20.00)	0	0
Total	10(100)	10 (100)	10(100)	10 (100)

To answer this question, simple percentages were used and the result as presented in table 3 showed the extent of sound detection among students with hearing impairment before and after exposure to auditory training and those not exposed. Before intervention, 100% of the students in experimental and control groups had low scores in sound detection. The experimental group, after intervention, had 80% of the students moved to moderate extent of sound detection and 20% moved to a high extent of sound detection. Students in the control group which had 100% in low sound detection, had 70% with low sound detection and 30% with moderate sound detection. This implies that auditory training enhances the sound detection of students with hearing impairment to a moderate extent after intervention.

Ho2: There is no significant effect of auditory training on sound detection among students with hearing impairment.

Table 4: Summary of Analysis of Covariance (ANCOVA) of sound detection post-test mean scores between students with hearing impairment in experimental and control groups

Source	Type III Sum of Squares	df	Mean Square	F	P-value	Partial Eta Squared
Corrected Model	238.050[a]	1	238.050	91.362	.000	.835
Intercept	3100.050	1	3100.050	1189.785	.000	.985
Group	238.050	1	238.050	91.362	.000	.835
Error	46.900	18	2.606			
Total	3385.000	20				
Corrected Total	284.950	19				

a. R Squared = .835 (Adjusted R Squared = .826)

The independent variable is auditory training while the dependent variable is sound detection. To test this hypothesis, analysis of covariance (ANCOVA) was used and the result as presented in table 4 showed the post-test mean and standard deviation of students with hearing impairment in experimental group as15.90±1.60 and control group as 9.00±1.63; in addition, $F = 91.36$, $p<.05$. Since the p-value (.000) is less than .05, this implies that there is a significant mean score difference between students with hearing impairment in experimental and control groups on sound detection after intervention. Thus the null hypothesis is rejected.

Discussion of findings

Hypothesis one that stated that there is no significant effect of auditory training on sound comprehension among students with hearing impairment was rejected. This implies that there is a significant effect of auditory training on sound comprehension among hearing impaired students. Before intervention, students in experimental and control groups had low scores in sound comprehension. After intervention the experimental group moved from low extent to a moderate extent of sound comprehension, while students in the control group which had low extent of sound comprehension, still remained at low sound comprehension. This discovery affirmed the view of Kurita (2012) which posited that the development of sound comprehension skill through auditory training helps learners to succeed in language learning and increase their comprehensible input. Since students' self-confidence in sound comprehension can be increased, they are motivated to have access to spoken English like conversations with native speakers.

Hypothesis two that stated that there is no significant effect of auditory training on sound detection among students with hearing impairment was rejected. This implies that there is a significant effect of auditory training on sound detection among hearing impaired

students. Before intervention, students in experimental and control groups had low scores in sound detection. After intervention majority of members of the experimental group had moderate extent of sound detection while a few moved to a high extent of sound detection. Majority of students in the control group still had low sound detection. This implies that auditory training enhances sound detection of students with hearing impairment to a moderate extent after intervention. This confirms the position of Tye-Murray (2009) who avowed that auditory training (AT) is of great importance in sound detection skills. The reason is that if properly and timely performed, it will not only increase the auditory detection level in the hearing-impaired students but will also have a positive and accelerating effect on other trainings such as speech and language therapies.

Conclusion

Based on the findings of the study, it is concluded that auditory training has significant effect on sound comprehension and sound detection as it will help students with hearing impairment have a proper understanding of sound and develop language and communication skills, marvel at the sounds of the bustling world, learn to read, appreciate music and are warned of approaching danger.

Recommendations

Based on the findings and conclusion of the study, it is recommended that:

i. Parents and caregivers should ensure that children are helped at the earlier stage to comprehend sounds through regular auditory training.

ii. Medical personnel and other health practitioners should ensure that the child is helped at the early stage of development.

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