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Effects of Cued Speech Training on Speech Discrimination of Students with Auditory Neuropathy Spectrum Disorder

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Abstract
This study examined effects of cued speech training (CST) on speech discrimination of students with auditory neuropathy spectrum disorder. The specific objectives of this study are to find the extent to which CST can improve perception of sound of students with auditory neuropathy spectrum disorder and find the extent to which CST can improve the insight into speech of students with auditory neuropathy spectrum disorder. Pretest-posttest true experimental design was used. The outcome was measured two times from experimental and control groups. The population in the study is twenty (20) students with auditory neuropathy spectrum disorder. The sample size is also twenty (20). Speech Discrimination Scale is the instrument used to obtain data in this research. To test hypotheses 1 and 2 at 0.05 level of significance, the t-test statistics was used. The results revealed that CST enhanced the speech discrimination of students with auditory neuropathy spectrum disorder in experimental group to a high extent. This study recommended that government should collaborate with experts in CST to design and implement interventions towards improving the perception of sound of students with auditory neuropathy spectrum disorder and enhancing their insight into speech.
Keywords: auditory, neuropathy, disorder, cued, speech

Introduction
Speech discrimination is the ability to understand discourse in both quiet and noisy environment; it is the aptitude to listen to communication and distinguish resemblances, besides differences between the sound quality and auditory range. Ojo (2023) accentuated that speech discrimination is the ability to detect similarities and differences between sounds, while listening to such sounds. It enables one to understand the environment and enables perception and cognitive mapping of information. Man perceives the world through sensory experience, and one of the sense organs is the ear, which facilitates communication and fosters social interaction, forges relationship and enables participation in daily activities. It also helps one to be alert to dangers and experience events and happenings around the world.

Eisenberg (2009) highlighted that speech is a sequence of consonants, vowels, non-harmonic and harmonic sounds. Discriminating speech from non-speech sounds is often complicated by the similarity of many sounds of speech, such as in vocalization.

Students with auditory neuropathy spectrum disorder often suffer as they demonstrate the ability to discriminate native language from other environmental sounds. Students with normal hearing learn how to listen naturally at a very young age; but for those with auditory neuropathy spectrum disorder, auditory training would be provided as early intervention with auditory stimuli and coaching that would help the students learn to identify and distinguish between native language and environmental sounds (Garber & Nevins, 2012). In this research the constructs of speech discrimination are perception of sound and insight into speech.

Perception of sounds in day-to-day life is of major importance for human well-being. Communication through natural sounds in school, lessons or class discussions with students living with auditory neuropathy spectrum disorder are all examples of sounds essential for school/life satisfaction in everyday life. Eisenberg (2009) drew attention to the fact that environmental sound perception serves as an important ecological function by providing students with auditory neuropathy spectrum disorder information about the immediate environment.

Insight into speech is basically the ability to perceive oral discourse and comprehend or understand what has been spoken or communicated. Babudoh (2008) alerted that insight is taking note of what someone had spoken or communicated. Insight into speech can only be gotten after listening, which is active, and the listener ruminates over the speech or communication. Abiodun (2011) avowed that hearing involves using the ear(s) to hear what is being communicated (spoken), while insight into any speech intensely involves using the mind to deliberate over what is being said or heard. Insight into speech is having the intuition or taking acumen into what has been communicated. Understanding communication is having an insight into the message being given through spoken (oral) words. Comprehending oral statement is having an insight into the message being given through spoken words.

Ali (2006) said that the life of a student with auditory neuropathy spectrum disorder, as a learner, is highly characterized with lack of insight into speech (communication); such lives are lives where messages and learnings are equally obstructed. Shaywitz (2003) and Freeman (2007) alleged that lack of insight into speech paves ways for comprehension difficulties, emotional issues, then psychological issues that reinforce auditory neuropathy spectrum disorder and concerns.

Cued speech is a mode of communication of students with hearing impairment which uses hand gestures and lip reading skills. According to National Cued Speech Association (2008), Cued Speech is a visual communication system - mouth movements of speech combined with “cues” to make all the sounds or phonemes of spoken language look different. Jikukka (2021) alleged that some sounds in the English language look alike on the lips. For example, looking in the mirror and saying the

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sounds /p/, /b/, and /m/ would look the same; others are /sh/ and /ch/ which look alike on the lips and becomes difficult to lip read during cued speech. National Cued Speech Association (2008) supposed that cued speech is based on the hypothesis that if all the sounds in the spoken language looked clearly different from each other on the lips of the speaker, those hearing impaired would learn a language in much the same way as a hearing person, but through vision rather than audition. National Cued Speech Association further buttressed that cued speech uses hand gestures to supplement auditory and visual information. Hand movements are made near the speakers' face to help cue the listener about specific speech sounds and to represent the English sounds visually (Knoors & Marschark, 2012; Pepper & Weitzman, 2004).

Jikukka (2021) held that cued speech uses eight hand shapes in four different locations, known as cues, in combination with the natural mouth movements of speech to make all the sounds of spoken language look different. This approach can be used with other approaches. It has been adapted for more than 55 languages and dialects (Pepper & Weitzman, 2004). The use of cued speech focuses attention on the mouth, reinforces the sounds in a word or phrase, and integrates motor activity with the use of hearing and vision. Cued speech is another option, which Students with Auditory Neuropathy Spectrum Disorder consider to be a combined approach. It is an auditory-visual communication approach that combines a system of hand cues with natural mouth movements of speech, specifying each sound. The hand shape, which gives the consonant groups, at a location, which gives the vowel groups, cues a syllable. Cued speech is a system that supports access to speech and spoken language.

Cued Speech Training (CST) is an educational model that can be summarized as follows: The Model is traditionally based upon educational concepts, approaches and social-psychology conceptions and policies (Knoors & Marschark, 2012). The researcher adapted this treatment (CST) and centred it on speech discrimination (perception of sound and insight into speech). The researcher adapted this treatment from Edward Travis' integration model which gave rise to the Model in this study: Insight stage: insight into speech discrimination effort/problem is taken; Assessment stage: here the therapist infers the underlying causes of this problem; Treatment stage: the therapist engages the client/student in cued speech training; and Ending the process: ending the training/therapy relationship.

Auditory Neuropathy Spectrum Disorder (ANSD) is a hearing problem in which the ear(s) detects sound normally, but has problem sending the sound to the brain. Madell and Clark (2012) averred that a student with Auditory Neuropathy Spectrum Disorder may have trouble telling one sound from another; such a student may also have problem understanding speech clearly. Joint Committee on Infant Hearing (2007) also averred that a student with auditory neuropathy spectrum disorder may be characterized with deteriorated speech perception, due to problem in the transmission of sound from the inner ear to the brain. The sound may fade in and out or are "out of sync". This can be

frustrating for the student and other students around him/her. Diagnosis can sometimes be very difficult (Eisenberg, 2009). Otolaryngologists often work together with audiologists by using a combination of methods to diagnose auditory neuropathy. These include tests of auditory brainstem response (ABR) and otoacoustic emissions (OAE).

Students with Auditory Neuropathy Spectrum Disorder are learners living with ANSD. Ali (2006) opined that Auditory Neuropathy Spectrum Disorder prevents or affects the attention and concentration of students with Auditory Neuropathy Spectrum Disorder and frustrates them from receiving sounds or communicating, thus traumatizes them psychologically. This then implies that there is need to encourage students with auditory neuropathy spectrum disorder towards speech discrimination so that they cannot be affected negatively (American Academy of Pediatrics, 2015; Kentucky's Office for the Americans with Disability Act, 2015).

Other problems are, can cued speech training be used to: change the emotions of students with auditory neuropathy spectrum disorder to emotions of joy, tranquility and peace of mind? Improve the negative feelings experienced by students with auditory neuropathy spectrum disorder? The aim of this study is to study effects of cued speech training on speech discrimination of students with auditory neuropathy spectrum disorder.

This study is anchored considerably on the theory of speech discrimination developed in 1968 by A. Boothroyd. This theory is also known as the speech act theory and literary criticism. This theory states that speech sound depends on intrinsic and contextual factors. The intrinsic factors are the acoustical properties of the sound and its probability of occurrences (Boothroyd, 1969). Speech discrimination can be changed via training or manipulations such as: treatment, therapy or counselling. Speech act theory is related to this study based on the fact that it involves giving teaching and therapy to students with auditory neuropathy spectrum disorder. The researcher engages the students in cognitive, emotional and intellectual exercises, following with counselling and explanations, which help students with auditory neuropathy spectrum disorder to do away with arbitrary and unreasonable acts and issues. Therefore, the students with auditory neuropathy spectrum disorder were trained to speak and act against negative feelings, emotions, speech discrimination issues and try to prevent psycho-traumas, low or bad speech discrimination issues.

Objectives of the study

The specific objectives are to:

i. find the extent to which cued speech training can improve the perception of sound of students with auditory neuropathy spectrum disorder.
ii. find the extent to which cued speech training can improve the insight into speech of students with auditory neuropathy spectrum disorder.

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Research questions

1. To what extent can cued speech training enhance the perception of sound of students with auditory neuropathy spectrum disorder?
2. To what extent can cued speech training enhance the insight into speech of students with auditory neuropathy spectrum disorder?

Hypotheses

Ho1: There is no significant difference in the posttest perception of sound mean scores of students with auditory neuropathy spectrum disorder who were exposed to cued speech training and those who were not.

Ho2: There is no significant difference in the posttest insight into speech mean scores of students with auditory neuropathy spectrum disorder who were exposed to cued speech training and those who were not.

Methodology

This study is experimental research. The researcher adopted the true experimental research design. The choice of this design is due to the fact that the nature of the study requires determining the effect of treatment on speech discrimination of students with auditory neuropathy spectrum disorder. This design provides opportunity for the researcher to determine how the independent variable interacts to influence the dependent variable as well as permits the sorting of only students with auditory neuropathy spectrum disorder and at the same time with low or without speech discrimination are picked after screening.

Awotunde and Ugodulunwa (2004) further averred that true experimental design is utilize where it is possible to carry out a random assignment of subjects into two groups. The researcher simply splits the samples into experimental and control groups (through randomization).

There are 5 secondary schools in the study area; one with a very high number of students with hearing impairment (70). To ascertain the students with auditory neuropathy spectrum disorder, first, a screening test (on speech discrimination) was administered which determined 20 students with auditory neuropathy spectrum disorder and secondly, an opinion poll was administered only on those with Auditory Neuropathy Spectrum Disorder to get their consent towards participation as sample in this study and they all agreed to participate. The experimental group consisted of ten (10) samples, while the control group also consisted of ten (10) samples. This gives the overall total of twenty (20) students with auditory neuropathy spectrum disorder as the total sample. The sampling technique is the non-probability technique (purposive sampling). The purposive sampling used was such that the students under investigation are with auditory neuropathy spectrum disorder and so were picked based on purpose; only one school with the highest population was selected and investigated, this is because the

school had a better and more accurate representation of the students with auditory neuropathy spectrum disorder in the study area.

The instrument that was used in this research for data collection, at both pre-test and post-test, was Speech Discrimination Scale (SDS). Speech Discrimination Scale was used in this research for data collection at pre-test and post-test. This scale was in two parts; Part A elicited information from the respondents about their personal data such as: sex, age, class and the like. Part B measured the respondents' speech discrimination as follows: 0 – 39 percent = Low extent; 40 – 69 percent = Moderate extent, and 70 – 100 percent = High extent. The instrument was validated by three professionals; one from the Department of Special Education and Rehabilitation Sciences, one from the Department of Educational Foundations (Test and Measurement) and then one from the Department of Ear Nose and Throat (ENT), all from the University of Jos, Jos, Nigeria. This validation was made to ensure that the instrument measures what it is intended to measure. The validity of the instrument was generated to be 0.711. The test-retest reliability was used to ascertain the suitability of the research instrument. Using Pearson product moment correlation coefficient method to ascertain the stability of the entire instrument. The reliability index was 0.723.

A letter of introduction was taken to the school authority to seek for authorization and support to carry out the study. Upon approval, the researcher was introduced to students with auditory neuropathy spectrum disorder; then, the screening processes began which also indicated the commencement of the training/therapy as planned. Earlier on, there was training of two research assistants on what to do and be familiar with the instrument (SDS), procedure and equipment that were employed in the research. The research assistants were DO (Doctor of Otolaryngology) and B.Sc. Ed. holders in the relevant areas of research; they are knowledgeable in the areas of cued speech training and speech discrimination.

At the preliminary stage, screening and identification of the samples formed part of the sampling procedure. Before the commencement of the treatment, there was a pre-test in the first week. The research assistants and the researcher discussed and analyzed items in the cued speech training (treatment). The pre-test was for the first week which lasted for 40 minutes each day. The experimental and control groups were subjected to this pre-test to collect the respondents' responses (data) before the experimental group was exposed to treatment.

The cued speech training (treatment) was administered on the experimental group, foremost to treat low/poor speech discrimination. The treatment consisted of speech discrimination tips, deliberations and plenary sessions; it came after pre-test and before post-test. Even though those in the control group were given the conventional treatment, they were not exposed to cued speech training. They were engaged meaningfully by

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their teachers in the conventional methods of teaching speech discrimination for the period the experimental group underwent its treatment. This is to keep them busy and avoid situations where those in the control group would come round and get exposed to cued speech training (treatment). This treatment was carried out throughout the study period, after pre-test and before post-test.

The data collected were analyzed using both descriptive and inferential statistics. The generated data were analyzed using mean and standard deviations to answer the research question. In order to test the hypotheses raised in this study, the t-test statistics was used. The researcher analysed the data with Statistical Package for Social Sciences (SPSS) version 17.00. The hypotheses were tested at $P<0.05$ or at 5% level of significance.

Presentation of results

Research question one: To what extent can cued speech training enhance the perception of sound of students with auditory neuropathy spectrum disorder?

Table 1: Extent to which Cued Speech Training enhances the perception of sound of students with Auditory Neuropathy Spectrum Disorder in experimental and control groups

Groups	n	Pretest		Post-test		Pretest Mean Score Difference	Post-test Mean Score Difference
		Mean	SD	Mean	SD		
Experimental	10	1.80	0.79	8.40	0.84	0.00	4.70
Control	10	1.80	0.92	3.70	0.82		

Table 1 shows the extent to which perception of sound mean scores of students with auditory neuropathy spectrum disorder in experimental and control groups differ before and after intervention. Students with auditory neuropathy spectrum disorder in experimental group had a pretest mean score of 1.80 and a standard deviation of 0.79, while students with auditory neuropathy spectrum disorder in the control group had a pretest mean score of 1.80 and a standard deviation of 0.92 with a pre-test mean score difference of 0.00. In addition, students with auditory neuropathy spectrum disorder had post-test mean scores of 8.40 and standard deviation of 0.84, while students with auditory neuropathy spectrum disorder in the control group had post-test mean scores of 3.70 and standard deviation of 0.82, with a post-test mean score difference of 4.70 in favour of the experimental group exposed to perception of sound.

Ho1: There is no significant difference in the posttest perception of sound mean scores of students with auditory neuropathy spectrum disorder who were exposed to cued speech training and those who were not.

Table 2: T-test analysis of post-test perception of sound mean scores of students with auditory Neuropathy Spectrum Disorder exposed to Cued Speech Training and those who are not

Groups	n	Mean	SD	df	t-calc	p-value
Experimental	10	8.30	0.84	18	12.61	0.00
Control	10	3.70	0.82			

Table 2 shows the t-test analysis of post-test perception of sound mean scores of students with auditory neuropathy spectrum disorder with cued speech training and those who were not. Students with auditory neuropathy spectrum disorder in experimental group had a mean scores of 8.30 and standard deviation of 0.84, while control group had mean scores of 3.70 and standard deviation of 0.82, with a t-value of 12.61 and p-value of 0.00. Since the p-value is less than 0.05 level of significance, the researcher rejects the null hypothesis and accepts the alternative hypothesis which states that there is a significant difference between the perception of sound mean scores of students with auditory neuropathy spectrum disorder taught with cued speech training and those who were not, in favour of the experimental group.

Research question two: To what extent can cued speech training enhance the insight into speech of students with auditory neuropathy spectrum disorder?

Table 3: Extent of insight into speech mean scores of students with Auditory Neuropathy Spectrum Disorder in experimental and control groups

Groups	n	Pretest		Post-test		Pretest Mean Score Difference	Post-test Mean Score Difference
		Mean	SD	Mean	SD		
Experimental	10	1.70	0.95	8.30	1.34	0.1	4.60
Control	10	1.80	0.92	3.70	0.82		

Table 3 shows the extent to which insight into speech mean scores of students with auditory neuropathy spectrum disorder in experimental and control groups differ, before and after intervention. Students with auditory neuropathy spectrum disorder in experimental group had a pretest mean score of 1.70 and a standard deviation of 0.95 while students with auditory neuropathy spectrum disorder in the control group had a pretest mean score of 1.80 and a standard deviation of 0.92 with a pre-test mean score difference of 0.1. In addition, students with auditory neuropathy spectrum disorder in experimental group had post-test mean score of 8.30 and standard deviation of 1.34, while students with auditory neuropathy spectrum disorder in the control group had post-test mean score of 3.70 and standard deviation of 0.82, with a post-test mean score difference of 4.60 in favour of the experimental group after being exposed to cued speech training.

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Ho2: There is no significant difference in the posttest insight into speech mean scores of students with auditory neuropathy spectrum disorder who were exposure to cued speech training and those who were not.

Table 4: T-test analysis of post-test insight into speech mean scores of students with auditory neuropathy spectrum disorder exposed to cued speech training and those who were not.

Groups	n	Mean	SD	df	t-calc	p-value
Experimental	10	8.30	1.34	18	9.262	0.000
Control	10	3.70	0.82			

Table 4 shows the t-test analysis of post-test insight into speech mean scores of students with auditory neuropathy spectrum disorder taught using cued speech training and those who were not. Students with auditory neuropathy spectrum disorder in experimental group had mean scores of 8.30 and standard deviation of 1.34, while control group had mean score of 3.70 and standard deviation of 0.82, with a t-value of 9.262 and p-value of 0.000. Since the p-value is less than 0.05 level of significance, the researcher rejects the null hypothesis and accepts the alternative hypothesis which states that there is a significant difference in the posttest insight into speech mean scores of students with auditory neuropathy spectrum disorder who are exposed to cued speech training and those who were not.

Discussion of findings

The findings of this study are discussed based on the research questions and hypotheses. The finding of research question one shows the extent to which perception of sound mean scores of students with auditory neuropathy spectrum disorder differ before and after intervention. Students with auditory neuropathy spectrum disorder had their perception of sound increased to a high extent. Finding of hypothesis one shows the t-test analysis of post-test perception of sound mean scores of students with auditory neuropathy spectrum disorder taught with cued speech training and those not. The researcher rejects the null hypothesis and accepts the alternative hypothesis. Students with auditory neuropathy spectrum disorder in experimental group had higher mean scores after treatment, compared to control group.

Finding of research question two shows the extent to which insight into speech mean score of students with auditory neuropathy spectrum disorder in experimental group increased to a high extent. Findings of hypothesis two show the t-test analysis of post-test insight of sound mean scores of students with auditory neuropathy spectrum disorder taught with cued speech training and those not. The researcher rejects the null hypothesis and accepts the alternative hypothesis. Students with auditory neuropathy spectrum disorder in experimental group had higher insight mean scores after treatment, compared to control group.

After the analysis the following findings were arrived at: Cued Speech Training improve the perception of sound of students with auditory neuropathy spectrum disorder in experimental than control group to a high extent after intervention. Cued Speech Training also enhances the insight into speech of students with auditory neuropathy spectrum disorder in experimental than control group to a high extent after intervention.

Conclusion

This study indicated that Cued Speech Training effectively improves the perception of sound of students with auditory neuropathy spectrum disorder. Similarly, Cued Speech Training enhances the insight into speech of students with auditory neuropathy spectrum disorder in experimental than control group to a high extent after intervention.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Government should collaborate with experts in Cued Speech Training to design and implement such interventions towards improving the perception of sound of students with auditory neuropathy spectrum disorder and enhancing their insight into speech.
2. Educators, speech therapists, and parents should collaborate to design and implement Cued Speech Training interventions that are age-appropriate, engaging, and specifically tailored to target students with auditory neuropathy spectrum disorder.

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