

Impact of Speechifi Device on Communication Skills of Children with Hearing Impairment

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Abstract

There is an increased prevalence of hearing impairment exist in recent population. This mandates a thorough hearing evaluation for every case of speech-language delay; this will help in the early diagnosis of hearing loss, allowing proper management to be instituted as early as possible. Apart from manual treatment, there is only handful of devices and mobile applications developed to assist children with hearing impairment in improving their communication skills. A general objective of the present study is to introduce an electronic device named “Speechifi” that can assist communication by persons having communication difficulties through tactile, auditory and visual modality. Another and more specific objective of the present study was to provide effectiveness of the device that is portable, battery-operated and constructed to be held in the hand of a user to improve communication skills of children with hearing impairment. In this paper the authors made an attempt to present a speech-enabled device named Speechifi. This device is found to be useful in the improving speech and communication skills of children with hearing impairment who participated in the present study. Speechifi enables rapid development of usable speech which allows the user to be hands-free when they use the multimodality of the device themselves when they want to.

Keywords: Speechifi device, Hearing Impairment, Speech training, Communication

Introduction

Hearing undoubtedly plays a primary part in the process of language acquisition. There are studies stated that approximately 80% of new words are learned by overhearing, which signifies that children learn language through exposure in their environment. They acquire words

that they hear or signs that they see from the adults communicating with one another. But for a child with hearing loss, there is an exception as they have to be the talker before they will be able to detect and/or comfortably hear what is being said. To develop spoken language, a child must be able to hear speech clearly and also hear themselves through auditory feedback. Children with very limited hearing or those who are hard of hearing but do not (consistently) wear amplification will not be able to develop language and speech at the same rate as age peers. Several investigations have attempted to determine the characteristics and intelligibility of speech of individuals with hearing impairment, but there is scarce of the research studies to determine the effectiveness or impact of such speech training devices on the children with hearing impairment. This showed an immense need to conduct a study to determine the impact of a battery operated multi-modality based speech training device.

Review of Literature

There are number of libraries that provide access to certain mobile applications; however, it has been reported that these mobile devices does not yet live up to its promise on enhancing speech and communication skills. One of the reasons reported being that the developers who are not expert speech technologists may make sub-optimal decisions regarding interaction management, choice of speech, and consistency across apps.

Philips Electronics Industries Ltd. (1970) have produced a speech training unit designed to assist children with hearing difficulty in comparing their own speech with that of their teachers. The unit consists of a two-track cassette tape recorder with microphone and headphones. It can be used several ways: the pupil can repeat or answer the teacher's amplified speech, hearing himself in the headphones as he does so, or the teacher's and pupil's speech can be recorded and played back for comparison.

There are some commercially available electronic training aids which claim to be helping in improving communication skills of the disordered population. A number of comprehensive reviews of speech training aids for the deaf have appeared over the past several years. Following are the brief review on similar aids:

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The Bolt, Beranek and Newman System: Digital Equipment Corporation PDP-8E minicomputer (1973) developed the first computer-based speech training aid which was an experimental system, and no commercial system resulted directly from its development.

The Indiana Speech Training Aid (ISTRA): developed an aid based on speaker-dependent speech recognition (1987). The ISTRA project builds on earlier work at Boys Town Institute for Communication Disorders in Children (1987).

Along with the benefits, certainly some difficulties have been reported on usage of these aids. One of the problems has been the restricted accessibility to speech training aids outside of therapy. Carryover is typically minimal, even if there is a progress during therapy session. In order to affect carryover, extensive practice is required.

Similar problem on using other speech training aid was pointed out by Osberger, Moeller, and Kroese (1973, p.146). According to these authors, "Often, a child is seen for individual speech therapy only once or twice a week for a brief session or the child receives instruction with a large group of other children". Thus, even if therapy involves a potentially effective speech training aid, its benefits are likely to be limited if that aid is available only when the therapist works with the child. Problems encountered in using speech training aids may also be the result of placing laboratory equipment in the hands of individuals who do not have specific technical expertise. Nickerson and Stevens (1973, p. 448) noted that, "Some of the devices that have been developed have been rather difficult to use because they require careful and frequent adjustment".

To overcome such hindrance, an attempt was made by Innoflaps Remedy Pvt. Ltd. who manufactured a new and improved version of speech trainer in 2014 and the name given to this device is 'Speechifi'. The device has been manufactured in India and is commercially available.

What is Speechifi?

Speechifi is an empathetically designed, portable, battery operated device with intensive speech and language stimulation. Speechifi is an assertive communication device that assists and prepares parents, educators and therapists to perform effective speech therapy. Speechifi is a device for assisting communication that comprises a generally rectangular enclosure of a size constructed and adapted to be held in front of the user. A microphone is positioned within the enclosure for receiving acoustic speech sounds.

In addition to providing the developer with flexibility to experiment with different modes for speech interaction, the microphone overlay and speech control menu provided by Speechifi enable a consistent interface and interaction for the user across multiple “Speechified” applications.



Fig.1: Appearance of the Speechifi device

How It Works

The Speechifi device is meant to store and deliver high quality sound with acoustic energy which enables a person to listen properly and differentiate between two distinct sounds. The functionality of the light system enhances attention and eye-contact. The device operates to use original voice in speech stimulation, which in turn works towards faster recovery. There are mainly three principal modalities i.e. auditory, visual and tactile on which Speechifi works on.

The enhanced technology of the product makes it a device full of advantages. It caters to the need various speech complexities in the society. It culminates pre-linguistic skill by stimulating sitting attention and eye-contact. It serves the need of Linguist skill by a sense of

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understanding and expression into the minds of people. Also, it operates in providing supra-linguistic skill by enhancing the cognition level. With the range of benefit it provides, it also assists at home mingle with the main-stream.

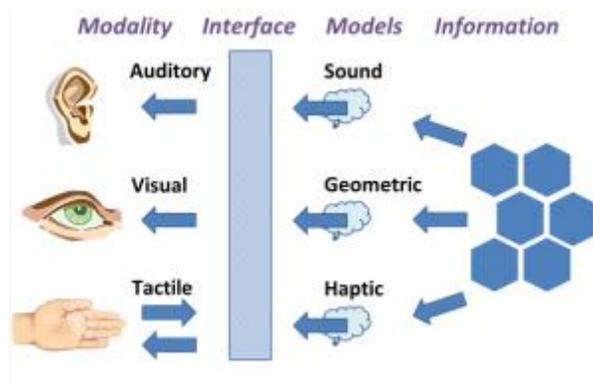


Fig 2: Functionality of the multimodality based Speechifi device

Aim of the Study

The objective of the present study was to see the effectiveness in communication skills of the children having delayed speech and language with hearing loss before and after using the Speechifi device and comparing it to pre and post therapy skills with no device condition. The present study determines whether there was any improvement in receptive skills and expressive skills in the participant. Also, the extent of comfort level by the participants on usage of the device was rated.

Method

The comprehensive study was conducted to check the improvement in receptive and expressive communication skills in children of age group 2-8 years mean age of 4.9 years using Speechifi device having visual modality along with auditory modality.

Participants

All the participants were selected on the basis of inclusion criteria. The Inclusion criteria of followed as:

- All the participants were children with age range of 2-8 year having Hindi as their native language
- Participants had delayed speech and language (DSL) with Hearing Impairment (HI) of severity range from sensor neural to propound
- No report of any positive family history
- No history of earlier therapy sessions by the participant
- All participant were digital hearing aid users bilaterally

In the present study total 40 children (20 boys and 20 girls) participated. All the participants were categorized into respective groups as per their age range.

Material

Following material was used to conduct the present study:

- Speechifi Device with Chargeable battery
- Philips headphone (SHM1900)
- Sony CyberShot Camera model no-DSCVX220 for video recording
- Clearly visible flash cards
- Scales of Early Communication Skills for Hearing Impaired Children (SECS) given by Moog and Geers in 1975. The test was done to evaluate speech and language development of the children with hearing impairment who participated in the present study.
- The comfort level of the participants was calculated through 5 point rating scale (prepared by the authors) where level 0 indicated as ‘not at all comfort’ and level 4 indicated as ‘very comfortable’.

Procedure

All individuals were subjected to speech and language and hearing assessment, pre- and post-therapy. The speech, language and hearing assessment consisted of speech and language

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evolution with using SECS test and specific assessment of hearing loss by using audiological tools. Case history, Family history, hearing complaints and general health information was collected in the interview.

The informal speech and language assessment was carried out to check the simulative environment at home and speech and language level of child by play activities. The activities with Speechifi device using six sound cards and different lexical flash cards was placed in Speechifi Device and check out the level of understanding and verbal and nonverbal expression of children for particular flash cards was recorded pre and post therapy in camera (Sony CyberShot DSCVX220) and transcribed for assessment. Both Pre and post speech and language evaluation was carried out by using SECS and sample was recorded for the assessment (see material section for details).

All the participants were divided into two groups G1 and G2 and following steps were carried out:

Step 1

Participants in G1 were given auditory training on how to use the electronic device Speechifi which gave a clear audio output through headphone along with visual feedback (clearly visible flash cards along with blowing LED lights over the flash cards. Auditory and visual feedback simultaneously were given to the participants. Participants in the G2 were provided with auditory training without using Speechifi Device.

Step 2

Children with hearing impairment attended 4 sessions of 45 minutes each for 2 months. During the session, the children were made to sit comfortably on the small chair at 1 meter distance facing the therapist. The Speechifi device was kept on the table and therapist switched on the device by pressing ON key. (Then LCD screen in speechifi showed a welcome message) after that therapist removed both hearing aid and put headphone over the ear and it was assured that the headphone should cover full ear. The therapist kept the Speechifi device at Live Mode by Pressing LIVE mode key and kept the volume set on 9 (90 dB) by pressing Volume key.

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Step 3

Therapist plugged in headphone and Microphone in the jack of Speechifi device. The therapist had to hold the mic and kept away mic from his/her mouth at least 3 inch distance. Therapist had put ling 6 sound cards and other lexical category flash cards (according to the participant's REELS evaluation) on Speechifi Device. Therapist pressed the Front Red Key (just below the respective flash cards) and light glows on the flash cards after that therapist uttered in the mic about distinguishing flash cards.

Step 4

The participant child needed to hear about the presented flash cards through headphones and was supposed to look at the picture as well and point the particular flash card which he heard in headphone and also tried to speak the same which was spoken by the therapist.

Step 5

Once the participant child acted at Live Mode, the therapist recorded her speech where she was gave the description of the presented flash card. Therapist selected Single Key in Speechifi then she pressed recording Key in device and then pressed front Red key (of respective flash cards) afterwards a beep came and the therapist checked whether mic is ON or not. After that, she started speaking about the presented flash card. Once the message got completed, therapist turned off the mic and after 3 sec again a beep came out from Speechifi Device. Therapist pressed the Recorded/Play Key again. Also the spoken message was saved. To play back again the recorded message, she pressed front Red key (below respective flash card) and the message was retrieve. For respective play of message, therapist pressed the Repeat key and Front red key, on which the massage started playing. To stop the message, therapist again pressed the Repeat Key. On which the front red light key turned on and played the message. To stop the message, respective Mode key (Single, Repeat, and Live) was pressed. From Back Panel; message started playing in head phone which was already recorded in therapist's voice. The participant child listened through the headphones and pointed toward the flash card about which he was listening.

Step 6

Once the participant child responded by headphone, the therapist plugged out the headphone wire from Speechifi device; fitted the hearing aid to the child and then played previously recorded message via speaker out inbuilt in speechifi Speaker. Child heard through hearing aid from speaker output of Speechifi device and then pointed the respective flash card.

Step 7

After learning through Speechifi device, the therapist presented same stimulus through hearing aid to the participants without using Speechifi device then again child pointed the right flash card.

Step 8

Same procedure was followed for learning most of the pictures in card by the device and it was observed that learning goes fast and there was improvement in receptive and expressive skills.

This procedure was followed for 2 month (4 sessions a week). Pre and post therapy evaluation was done by using SECS. Other group G2 underwent the same auditory training without Speechifi device and same therapy was conducted for the same number of sessions for all the participants.

Results and Discussion

The present study was done to determine whether there was any improvement in receptive and expressive communication skills of the participant after using the Speechifi device. Also, the extent of comfort level on usage of the device by participants was assessed using a 5 point scale.

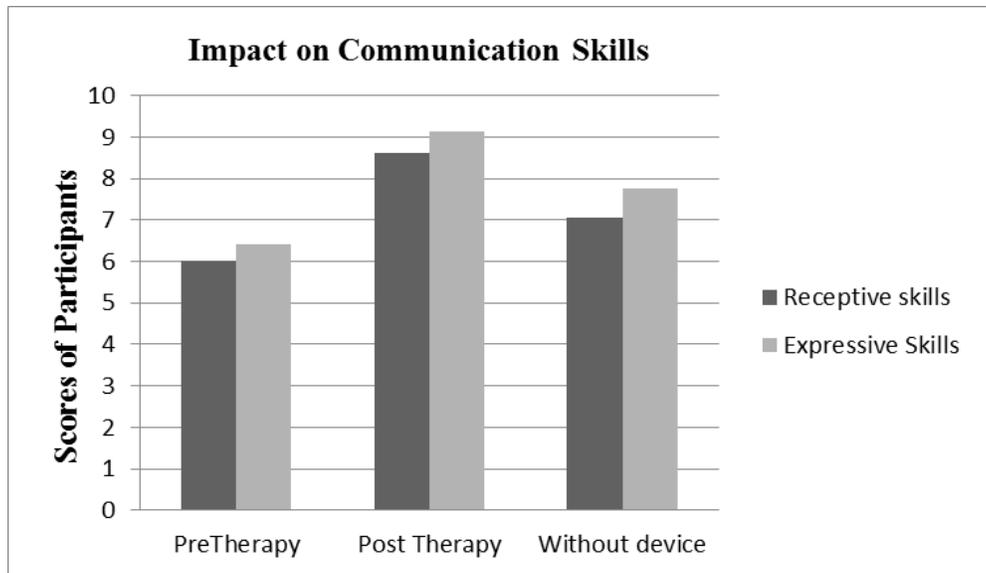
The objective of this study was to see the effectiveness in communication skills of the children having delayed speech and language with hearing loss using the Speechifi device and comparing it to pre and post therapy skills with no device condition.

Statistics

For quantitative analysis the mean, median and standard deviation were calculated using SPSS Software version 16.0 for comparing the level of the participants by grouping them with and without device as pre- and post-therapy. The t-test was used for comparison of groups with and without the device from the pretherapy. The comparison was done to see whether there is any significant difference between pre therapy and post therapy-with device; and difference between pre therapy and post therapy-without device.

Combined scores of Receptive and Expressive Language skills				
Conditions	Receptive Skills		Expressive Skills	
	Mean	SD	Mean	SD
PreTherapy	6.02	1.58	6.41	1.60
PostTherapy-with device	8.62	1.53	9.14	1.59
PostTherapy Without Device	7.05	1.60	7.77	1.86

Table 1: Mean and SD of the combined scores of participants on three different conditions



Graph 1: Combined receptive and expressive language skills on three conditions

The t-test was used for comparison of groups with and without the device from the pre-therapy. The comparison was done to see whether there is any significant difference between pre

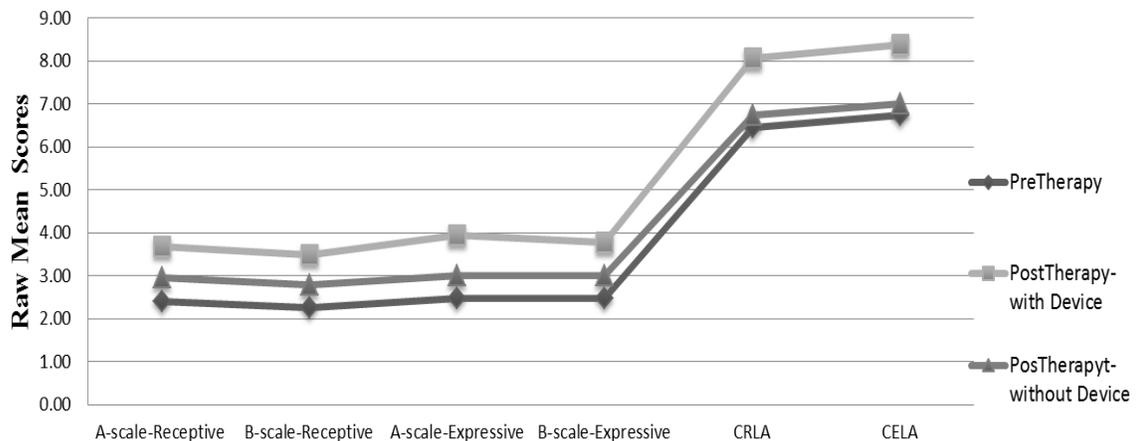
therapy and post therapy-with device; and difference between pre therapy and post therapy-without device.

Scoring on SECS	PreTherapy	PostTherapy-with device		PostTherapy-without device	
	Mean	Mean	P value	Mean	P value
A-scale-Receptive	2.40	3.68	0.00**	2.95	0.02*
B-scale-Receptive	2.25	3.50	0.00**	2.80	0.01*
A-scale- Receptive	2.48	3.95	0.00**	3.00	0.01*
B-scale-Expressive	2.48	3.78	0.00**	3.00	0.07
Combined Receptive Language Age (CRLA)	6.45	8.08	0.00**	6.75	0.59
Combined Expressive Language Age (CELA)	6.75	8.40	0.00**	7.00	0.60

**Significance at <0.01; *Significance at <0.05

Table 2: Results of the t-test

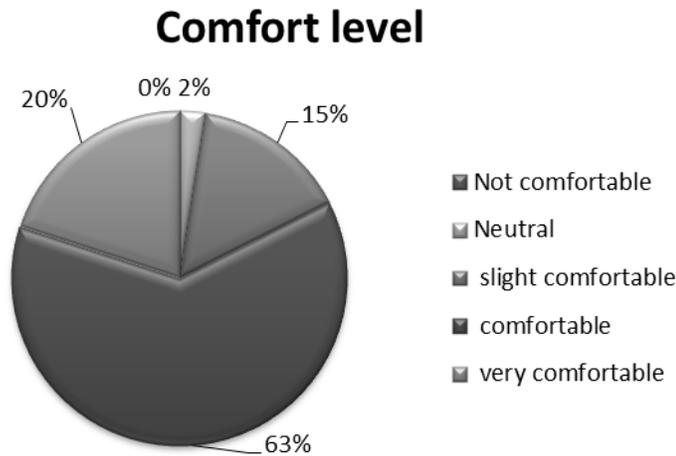
Impact on communication skills



Graph 2: Impact on communication skills of the participants on three different conditions

As shown in the Table 1 and 2, also in Graph 1 and 2, a clear difference is observed from pre to post therapy condition using the Speechifi device. A slight difference has been observed between pre therapy and without device condition. The communication skills were shown to be highest using the Speechifi device. This indicates a marked improvement in the communication

skills of the participants using Speechifi device. Expressive skills were observed to be more improved than the receptive language skills. A statistically significant difference was observed between expressive skills of pre-therapy and post therapy-using device conditions.



Graph 3: Rating on Comfort level scale

The scale was used to see the comfort level on usage of the device by the therapist. It is observed from the graph that the therapist rated 'very comfortable' level with majority (63%) of the participants on usage of the device. All the participants co-operated for the study and hence the therapist showed the most comfortable level with maximum numbers of the participants. This indicates that the Speechifi device is easy and comfortable to be implementing on children with hearing impairment.

Conclusion

The present paper has been focused on the capabilities of multi-modality based speech training device named Speechifi. However, engineering efforts alone are unlikely to result in intelligible speech by individuals with hearing impairment. It is anticipated that if the device is to be effective, they must be used along with a therapist working within a curriculum. A carefully planned and executed clinical investigation is required for the development of curricula. Thus, the currently prescribed technologically made device must be regarded as only the necessary, but not sufficient, context for development of speech training method for those who have hard of hearing. Introduction of training aids that use sophisticated signal analyses based on knowledge of acoustic phonetics and/or speech physiology implies the need for therapists with adequate

understanding of acoustic phonetics and speech physiology for speech of hearing impaired. Introduction of such aids also implies the need for education of those who are in a position to purchase training aids for clinics and school systems. Yoshinaga-Itano, et al. (1999) stated that identified language-facilitating factors of early identification of hearing impairment and early educational intervention alone may not be sufficient for developing spoken language competence in profoundly deaf children by the preschool years. Similarly, authors of the present study strongly recommend that these needs cannot be addressed adequately in the clinics and in professional community alone but must be addressed by the parents in home situations as well.

Future Directions

The Speechifi device is meant to be used for different communication disorders such as delayed speech and language in children with Autism Spectrum disorder, mental retardation, attention deficit hyperactive disorder etc. Hence, it would be valuable to research on the communication skills of different variety of speech and communication disorders using Speechifi device. Hence, an exhaustive research work is strongly recommended to be conducted on large sample of participants for assessing their improvement in communication skills.

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