A COMPARATIVE STUDY ON THE EFFECT OF ANIMATED AND STATIC PICTURES ON THE NAMING ABILITIES IN CHILDREN WITH HEARING IMPAIRMENT

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CERTIFICATE

This is to certify that the dissertation entitled "**A Comparative study on the effect of animated and static pictures on the naming abilities in children with hearing impairment**" is a bonafide work submitted in part fulfillment for degree of Master of Science (Speech Language Pathology) of the student Registration Number: **18SLP009**. This has been carried out under the guidance of the faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru

July 2020

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CERTIFICATE

This is to certify that the dissertation entitled "**A Comparative study on the effect of animated and static pictures on the naming abilities in children with hearing impairment**" has been prepared under my supervision and guidance. It is also being certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that the dissertation entitled "**A Comparative study on the effect of animated and static pictures on the naming abilities in children with hearing impairment**" is the result of my own study under the guidance of Dr. Ajish K Abraham, Professor of Electronics and Acoustics**,** Department of Electronics and co-guidance of Mr. Reuben Thomas Varghese, Scientist-B, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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"Commit your work to the Lord, and your plans will be established"

(Proverbs 16:3)

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Chapter I

Introduction

Communication is an interpersonal process which involves the exchange of ideas, opinions, and emotions using verbal symbols (eg. words or sentences) and non-verbal symbols (eg. facial expressions, gestures, sign language). During the early stages of language development, children rely more on gestures (eg. pointing) to communicate their needs and later they begin to use common nouns and verbs to form simple utterances. Several studies have found that language development for children with hearing impairment (CHI) is delayed compared to normal-hearing peers. Nouns and verbs play a key role in receptive and expressive language development. Nouns are words that are used to identify people, places, or things. However, verbs indicate the occurrence or performance of an action. Among both, verbs play an important role in language development. “Verbs are more broadly defined, harder to remember, less stable in translation among languages, more prone to be changed in meaning when a conflict of meaning occurs, and slower to be acquired than nouns by children (Gentner,1981)”. Children will learn to use meaningful sentences by combining the known nouns and verbs with appropriate syntactical markers. This will be in consensus with the findings of Bloom (1991) who reported that verbs play an important role in the learning of grammar and discourse.

A lot of variability exists in the acquisition of verbs in young children, thus, less is known about the general character of verb learning (Tomasello & Akhtar, 1995). The first action categories that are understood and produced by children are primarily those associated with actions that the child actually utters (Huttenlocher et al., 1983). Studies have reported that children should be using at least 40 verbs by 24 months of age (CDI; Fenson et al., 2007). Although several clinical researchers have suggested that a limited verb usage may

indicate the grammatical weaknesses commonly observed in children with Spoken Language Impairment (SLI).

In comparing CHI and typically developing children (TDC), a striking difference exists in terms of input which they are able to process. Visual and auditory information are simultaneously processed and stored by TDC (Anderson & Bower, 1972; Paivio et al., 1968). Verbal communication system of TDC integrates information stored in auditory and visual modes. On the contrary, the dual coding in CHI would not be as automatic, as they will process majority of information (signing, pictures, reading lips, words in text, etc.) in a visual mode.

Myklebust (1954) found that individuals with hearing impairment convert a spoken message into a visual code (lip movement or other visual features) in order to process. So, for them, the visually oriented processing system is acting as the only primary storage mode. When CHI rely on auditory stimulus along with visual stimulus at a time, they have to make at least two cognitive transformations at a time. That is, they have to convert a verbal code into a visual mode for processing and again reconvert it back into a verbal code while communicating. Processing of information and communication in deaf children may be hindered by this conversion issue (Blanton et al., 1967).

Thus the above findings suggest that there may be differences in the relative efficiency of information processing in TDC and CHI depending on how the material is presented and the mode in which it must be retrieved.

Speech Language Pathologists (SLP's) are one of the core team members in the rehabilitation of children with communication difficulties. For SLP's, it is necessary to evaluate a person's underlying ability by presenting appropriate representations. Failure to use appropriate representations may inhibit the learning process and hence, prevent the

persons from deriving maximum benefit from using various intervention strategies. The color, size, amount of detail, and fidelity of the representation shows a greater impact on learning and language usage (McDougal et al., 2000; Uttal et al., 1997). In clinical context, several methods are used to elicit responses from the children which are presented either in spoken form, written form, or visual form. As one of the diagnostic tool for evaluating the speech and language abilities of children with or without disabilities, visual form such as flashcards/ pictures are the most commonly preferred. This is because pictures are processed 60,000 times faster than text in human brain, and 90 percent of information conveyed to the brain is visual. The brain also processes data from pictures all at once whereas the text is in a linear manner.

Pictures are an integral element of most Augmentative and Alternative Communication systems such as various speech generating devices and low tech communication boards, to facilitate communication and learning in nonverbal children. Even persons with intact language abilities are likely to consider pictures as a straightforward and universally-accessible method to understand the concepts. The studies done on TDC and children with cognitive deficits show that comprehending pictures is not an innate ability. It rather develops over time and with experience, as well as with the demands of the task (Ainsworth, 2006; Callaghan, 2000; DeLoache et al., 1996; Troseth, 2003). Light et al. (2003) reported that the demands involved in pictures naming task varies with the mode of presentation of the image.

Pictures can be presented mainly in two forms: static and dynamic. Static pictures are still images which do not change over time from the viewer's perspective. Examples of static images are photographs and illustrations found in print media. Dynamic pictures are also referred to as animated images or animations which do change over time from the viewer's perspective. Examples of dynamic pictures include movies and animated computer graphics.

Static pictures are very useful and effective in understanding the concepts clearly. Moreover, it has some limitations with respect to stability of the picture, cultural variability, and differences in shape, size, and ambiguity. Confusion between nouns and verbs is created when the same symbols represent a noun and a verb. Animation effect can serve to convey the functional properties and physical dynamics of the object and relationships between the objects in a scene. Hence, the recent studies moved from static pictures to animated pictures in order to convey the intended meaning. Animation in pictures involves complexity of representation, but is advantageous in terms of its interpretability. Thus the visual and spatial dynamism offered by digital graphics made a new scale of innovations in the field of speech and hearing.

Aim of the study

To study the effect of Animated Pictures on the naming accuracy and error patterns in comparison with static pictures in CHI in the age range of 4-7.11 years.

Objectives of the study

- To measure and compare the naming accuracy for static pictures for CHI in the age range of 4-7.11 years.
- To measure and compare the naming accuracy for animated pictures for CHI in the age range of 4-7.11 years
- To measure and compare the error categories and no response elicitation for static pictures for CHI in the age range of 4-7.11 years.
- To measure and compare error categories and no response elicitation for animated pictures for CHI in the age range of 4-7.11 years.
- To compare the naming accuracy between static pictures and animated pictures for CHI in the age range of 4-7.11 years.

- To compare the error categories and no response elicitation between static and animated pictures for CHI in the age range of 4-7.11 years.

Chapter II

Review of Literature

Language plays an important role in a child's development. It supports the children's ability to express their feelings and ideas to the communication partner effectively. One of the primary challenging factors that disturb the language development is developmental or acquired speech and language disorders. Hearing loss is one of the developmental/ acquired causes of disability that hinders the normal speech and language development of children. A strong relationship exists between normal hearing and normal verbal language acquisition. CHI face a higher level of processing problems, both linguistically and psychologically due to their auditory deprivation. Delayed and deviant phonological development, difficulty in the discrimination of phonemes, and word order difficulties are some of the main problems seen in CHI. Previous literature found that deaf children do not impose language processing in the same hemisphere just as normal hearing children do. Deaf children are unable to perceive speech through the ears accurately, which might be compensated by using their visual modality. Hence, they may rely primarily on visual modality frequently to understand the concepts.

2.1 Speech and Language Characteristics of CHI

The factors influencing the speech and language development of children with hearing loss are the age of identification, degree, and nature of hearing loss, type of hearing aid, mode of intervention and family participation, communication mode, and their academic programs (Watkin et al., 2007). Each child's level of communication will be different from one person to another based on the degree and nature of the hearing loss. However, there are some specific characteristics in the speech and language of CHI.

Voicing errors and deletion of consonants in word-final position are the frequently reported errors in the speech of individuals with hearing impairment. Basic vowel error types include nasalization of vowels, substitutions, diphthongization of vowels, and durational distortions of vowels (Hudgins & Numbers, 1942). Consonant substitutions (frequent confusion of voiceless and voiced cognates, confusion between nasal and oral consonants, and substitution of stops for fricatives and liquids) also are some of the characteristics reported frequently. They also exhibit reduced overall speech fluency and distorted resonance particularly when linguistic complexity increases.

A child's language development can be addressed based on the vocabulary development of the child. Several studies investigated the language development of CHI. According to Spencer et al. (1998), vocabulary growth falls progressively behind for deaf children as compared with their peers. Children exhibit great difficulty in understanding and using concept words, multiple-meaning words, uses fewer lexical items, and figurative meanings of words and phrases.

The establishment of syntactic rules of language is not developed similarly in deaf and typically developing children (TDC). Finer syntactic properties of lexical items and functional knowledge of semantic information are extremely limited in deaf children. They would have mastered simple syntactic transformations such as question formation, negation, and conjunction by adulthood. Most of the syntactic structures were not established even among 18-year-old deaf individuals. Investigators found that the order of syntactic structure difficulty was similar for deaf and TDC but they are not identical. Individuals with hearing impairment frequently imposed a subject-verb-object pattern on sentences even when it is inappropriate. Example: The boy who hit the girl ran away. In the previous sentence, deaf individuals are likely to comprehend that it was the girl who ran away. Issues in

comprehension exist in both oral and written modalities and continue with age in children (Brookhouser & Moeller, 1986; Robbins, 1986).

2.2 Verb Usage in Persons with Hearing Impairment

Verbs play an important role in constructing sentences. The verb usage is significantly related to a speaker's grammatical ability. Previous research on verb acquisition suggests that deaf children had smaller vocabulary size as compared to hearing children. They also had difficulty in understanding the meaning of certain verbs, used frequently in daily life. Particularly, deaf children were shown to have difficulty in distinguishing intransitive verbs from transitive verbs. Saito et al. (1974) examined the verb usage in deaf children and TDC using pictures representing a verb (such as building a house and knitting a sweater). Both the groups of children were asked to explain the presented picture using verbs. The results indicated that deaf children in the lower grade of school used verbs that were inappropriate to the situation. They tended to use only the general verbs ('make' in both cases, instead of 'build' or 'knit'), whereas, the TDC used the more specific verbs. Sato et al. (2012) examined the verb usage by deaf children when compared to hearing children. They found that deaf children can continue to expand their usage of specific verbs accurately based on general verbs that they already know.

2.3 Picture Naming as an Indicator of Language Deficits

Naming is a common means of assessing language progress and deficits. It can act as a hallmark in identifying specific language impairments (Leonard et al., 1983). Several studies had reported that the picture naming task has been used to evaluate lexical access in children with both typical and atypical development as well as in adults. Many children with hearing loss have been identified as having lexical access problems due to their reduced exposure to new words and their slower rate of word learning. Mainly, the picture naming

task is done by assessing the accuracy and reaction time. Naming accuracy refers to the ability of a person to name a picture correctly or accurately whereas reaction time indicates the time taken for an individual to name the picture correctly.

Performance of TDC, on naming tasks enhances with age. Limitations in processing capacity and resources, including slower access to object names may result in reduced processing speed (Cook & Meyer, 2008; Miller et al., 2001). Recognition of object, retrieval of lexical information, forming lexical content and production are the four stages involved in picture naming (Miller et al., 2001; Nation et al., 2001). Deficits in any of these processes may result in inaccurate or slower picture naming.

2.4 Predictors for Accurate Picture Naming

Picture naming accuracy or speed can be dependent upon several factors such as visual, semantic, and lexical factors. Visual factors include visual complexity and image agreement. Visual complexity refers to the amount of detail or number of lines in the drawing (Snodgrass & Vanderwart, 1980), which is associated with recognition of object. Ellis and Morrison (1998) studied the effect of complex picture stimuli in picture naming task and found that it is difficult to process more complex stimuli.

Image agreement refers to the closeness of an image analogous to one's mental image of the object. It has a great influence on the level of object recognition. Barry et al. (1997) found that picture naming was fast if pictures had higher ratings of image agreement.

Semantic factors that influence the picture naming task include concept familiarity and imageability. The familiarity of the depicted picture is referred to as the concept of familiarity. Hirsh and Funnell (1995) stated that concept familiarity has an influencing link between picture representations and their semantic representations.

Imageability is a degree of the extent to which an object name evokes few or many different images for a particular object. Plaut and Shallice (1993) interpreted imageability in terms of the number of semantic features. High imageability has “richer” semantic representations than names with lower imageability.

Lexical factors include name agreement, frequency, and age of acquisition. Name agreement refers to the extent to which the participants agree on the name of the picture. Name agreement is estimated by assessing the number of different names given to a particular picture across participants. If participants give many different names for the same picture, it should be considered to have lower name agreement than do those that elicit a single name. Fast and accurate naming is observed in case of pictures with a single dominant response (Barry et al., 1997).

Frequency defines the number of times a word is used in a language. Picture naming can be affected based on high frequency and low-frequency words. Barry et al. (1997) reported that picture naming reaction time decreases as name frequency increases. However, name frequency often disappears or becomes limited when the age of acquisition is controlled or reaches in a regression model (Carroll & White, 1973).

Age of acquisition refers to the age at which the words are learned. Hernandez and Fiebach (2006) reported that early and late acquired words are processed in different brain areas and words acquired in younger age are named faster.

The above-discussed predictors are considered as important factors in identifying or naming a picture. However, the present study is focused on only the effect of mode of presentation (visual factors) in a picture-naming task, which has a significant role in the naming task.

2.5 Tools for Speech and Language Assessment

In a clinical context, the SLP's use different assessment tools and intervention strategies to evaluate and provide appropriate management for children with speech and language impairment. Within that, most of the tools comprise stimulus in a visual form which provides a more concrete and clear picture.

- The Edinburg Articulation Test (Ingram et al., 1971)

  It is a standardized test and qualitative assessment that evaluates the deviant or delayed speech development. It consists of 41 pictured stimuli that have to be named by the subjects and their responses were recorded for further assessment.

- Early Speech Perception Test (ESP) for Profoundly Hearing-Impaired Children (Geers & Moog, 1989)

  This test battery is used to test speech perception for profoundly deaf children at the age of 3 years. Aided (hearing aid or cochlear implant) speech perception is measured.

- The Goldman Fristoe Test of Articulation 2 (Goldman & Fristoe, 2000)

  This test assesses a child's articulation ability using both spontaneous and imitative speech production. Using pictures, it assesses the articulation and detects the types of articulation errors produced by the child.

- The Central Institute for the Deaf (CID) Picture Speech Intelligibility Evaluation (SPINE) (Monsen et al., 1993)

  Speech intelligibility of children of 6 years of age is evaluated by SPINE utilizing color pictures.

- Peabody Picture Vocabulary Test (PPVT-3) (Dunn & Dunn, 1997)

  Receptive vocabulary of children (2 years 6 months to 18 years of age) is measured using PPVT. Standard test scores percentile ranks and age equivalents are obtained from raw test scores.

The above mentioned few test materials are the common assessment tools used in CHI in the western population.

The lists of tools available in the Indian context in picture form for the assessment of CHI are as given below:

- Deep Test of Articulation (Mc Donald, 1964)

  This tool allows us to test a phoneme in a variety of phonetic contexts and analyze the correctness of the phoneme. This tool is also translated into some Indian languages. They are as follows:

  Bengali (Barman, 1991). Age: 4-7 years. (Picture form)

  Hindi (Shankar, 1998). Age: 3-7 years, (Picture form)

  Kannada (Rohini, 1989). Age: 5-9 years, (Sentence form)

  Tamil (Sangeetha, 1995). Age: 4-7 years (Picture form)

- Kannada Diagnostic Photo Articulation Test (Deepa, 2010)

  This tool was developed for children between the age range of 2-6 years. It consists of 114 words in picture form which is divided into two parts. (Part I - 52 words; Part II - 62 words).

- Computer-based Assessment of Phonological Processes in Malayalam (CAPP-M) (Sreedevi & Merin, 2011)

  It is a user- friendly, indigenous software used to assess Malayalam speaking children of 2.0- 3.6 years of age. It includes 20 picture stimuli.

- Malayalam Diagnostic Articulation Test-Revised (Sobhan et al., 2011)

  It consists of 100 target words in picture form for testing 10 vowels, 35 singleton consonants, and 30 consonant clusters. The test provides cut-off scores (combined for vowels, consonants, and clusters) for typically developing Malayalam speaking children (3- 6 years).

- Picture Speech Identification Test for Children in Hindi (Binay & Yathiraj, 2003)

  This test is useful for hearing evaluation and fitting appropriate amplification devices for Hindi speaking children above 4 years. It can also be used for central auditory tests such as dichotic monosyllabic tests, filtered speech tests, or binary fusion tests and in the evaluation and rehabilitation of children with cochlear implants.

- Odiya Diagnostic Picture Articulation Test (Stimuli Pictures) (Behera & Sreedevi, 2013)

  The test is re-standardized on TDC (urban with 2-5 years of age) with Oriya as their native language.

- Minimal Pair Based Intervention manual in Malayalam (Babin & Sreedevi, 2015)

  This intervention manual targets 31 sounds that help in assessing and treating articulation errors. It contains minimal pairs for 31 sounds with pictures and audio support.

Hence, several tools are available that use pictures as a means to elicit responses from children during speech and language assessments. All the stimuli were presented in the static form either in line drawings or in colored photographs. Due to the advancement in the

technology field, the static form of symbols was replaced by animated form of symbols for ease of use. Animation can aid in the understanding of concepts through simple exposure (ie, without any instruction). In clinical application, animation reduces the instructional burden associated with static pictures.

2.6 Positive Effects of Animated Pictures

Studies have reported that motion effects can trigger or enhance several cognitive aspects. It can capture the attention of the individual to a particular stimulus. Nealis et al. (1977) also reported that sudden changes in the stimulus properties or position can automatically elicit attention. Similarly, Franconeri (2004) stated that our perceptual system has an inbuilt ability to direct attention towards motion changes in the environment. Berney and Betrancourt (2016) explained the purposes of animation in the learning process. They found that animation can attract the learner's attention and conveys a clear picture of the information. There are several studies which support the positive effects of animation in learning mechanism. In the complex process of learning, new information is integrated with already acquired information (Schnotz, 2005). This process requires a high demand on working memory. Animation may reduce the demand for working memory to an extent.

Animation also plays a beneficial role in AAC graphic symbols. Jagaroo and Wilkinson (2008) stated that movement can add as a cue to AAC symbol. Picture of a chair might lead a child to guess the noun "chair" rather than the verb "sit"; animation might help the child identify the image as "sit". Actions such as jumping are dynamic and it involves movement, which is difficult to be represented through static pictures. Bétrancourt and Chassot (2008) stated that animations visualize temporal change and they convey dynamic information effectively. Past research has shown that animation positively impacts the child's

understanding of pictures showing action (Fujisawa et al., 2011; Mineo et al., 2008; Schlosser et al., 2011; Schlosser et al., 2012).

2.7 Effect of Animation on Typically Developing Children

Diehm (2020) conducted a study to determine whether animated and static conditions elicit different narrative retells from typically developing children. A total of 73 children in the age range of 3 - 5 years participated in the study. The stimulus includes a classic story that was presented in two modalities. One is in the static form (books) and others in animated form (video). All children were assigned to either of two modalities randomly. The animated version of the story was selected initially and the corresponding version of the static form was created as a picture book by taking screenshots from the animated version. The static form (books) was presented with the same audio in the animations. Each child had guided through two practice narrative retells before the experimental narrative retells. Children's stories were then transcribed and coded for linguistic and narrative elements. The primary outcome measures assessed in the study were the Number of total words (NTW), Number of different words (NDW), and Mean length of utterance (MLU). The results indicated that those children assigned to animated form of story presentation had longer narrative retells (NTW), used more diverse vocabulary (NDW), and used more complex syntax (MLU) while retelling the story as compared to the static form of story presentation. Also, the children produced more action verbs in response to the animated form of presentation than static form. Thus, these findings support the positive effect of animation for children's narrative retells. The limitation of the study include static form of a story (books) which are created from the screenshots of animated videos, which may hinder the clarity of the picture presented. It was better to first select books and then develop the corresponding videos.

Harmon et al. (2014) did a study to check whether the effect of environmental sounds could further enhance the naming accuracy by using animated graphic symbols for TDC in the age group of 3 yrs. A total of 46 TDC participated in the study. All the participants were randomly assigned to one of the two conditions. That is graphic symbols of verbs with environmental sounds and without environmental sounds. The lists of verbs were taken from the MacArthur-Bates Communicative Development Inventory and corresponding graphic symbols were borrowed from ALP Animated Graphic Set. All environmental sounds were recorded using an Olympus Digital Voice Recorder VN-8100PC in a soundproof room condition. After undergoing a familiarization task, each child was assigned to either two conditions which were presented on a computer screen using PowerPoint presentation. For both conditions, children were instructed to name the graphic symbol shown on the computer screen and assessed how accurately they can name the symbol. The results of the study revealed that the addition of environmental sounds with animated symbols helped elicit the responses in these children. Thus, the study supports the previous literature (Schlosser et al., 2012) along with adding the effect of sound for the graphic symbols while naming those symbols. The limitations of the study were, the lack of standardized recorded environmental sounds which affects the consistency of stimulus. Also, there was no baseline assessment data of the actual sounds which obscure the specific contribution of sounds on naming the symbols.

Mineo et al. (2008) conducted a study to compare the accuracy of the children's identification of actions across four conditions using two formats: animated and static. The animated forms included video and line drawings. The static formats consisted of line drawings with disequilibrium and movement cues. Disequilibrium cues represent a state of instability by displaying a position that was difficult to be maintained in 3D. Movement cues aim to highlight the moving part. The participants included in the study were 93 typically

developing preschoolers in the age group of 3 year, 4 year, and 5year (31 children in each group). All the children were exposed to the four representational conditions. The target stimuli included twenty-four action words that were presented to each condition. Children were selected as participants only if they can recognize the twenty-four action words during the informal assessment. The selected children were asked to choose a picture from the four choice array by touching the computer screen after listening to the computerized target stimuli. Results indicated that words presented in pictorial form influenced the comprehension ability of children. Thus, it concluded that animated forms were better than static forms with disequilibrium cues. The first limitation of this study is, some of the stimuli presented are not included in the vocabulary of a typical three-year-old. Moreover, the number of choices in the array made the task more difficult in choosing the correct stimuli. Finally, the alternate presentation of different representations prohibited a more comprehensive analysis of each dimension to item identification.

Schlosser et al. (2012) investigated the impacts of animation on 52 TDC belonging to 3, 4 and 5 year age groups. They examined the effect of animation on transparency, name agreement, and identification of graphic symbols for verbs and prepositions from the Autism Language Program (ALP) Animated Graphics set. The stimulus set includes 114 graphic symbols representing 24 verbs and 8 prepositions. In each age group, every child received animated and static symbols for both verbs and prepositions. All the symbols were presented via a PowerPoint presentation on a computer screen. In the transparency task, children were asked to name the symbols which were shown in the screen within an allotted time interval. The responses were considered as correct only if the child says the exact symbol name or the synonyms which intended by the researcher. In the name agreement task, the children should say the exact symbol name intended by the researcher to consider it as correct. For the identification task, children were presented with four choices of graphic symbols and asked to

choose the correct symbol from it. About transparency and name agreement, the results indicated better response for animated symbols than static symbols and the responses were more pronounced for verbs than prepositions. They also found that older children identified and named the symbols more accurately than younger children. The present study does not examine the effect of animation on clinical populations which act as one of the limitations.

Takacs and Bus (2016) studied the visual processing of animated and static pictures in typically developing children within a story retelling condition. A total of 39 children participated in the study. Every child had to undergo three sessions during the study. In each session, children were instructed to listen to two stories. One is in animated format and the other in the static format. The storybooks chosen for the three conditions include 'The Little Kangaroo' in static condition, 'Imitators' which was used in animated condition, and 'Bear is in love with Butterfly' was used in the control condition (without any book reading). Both formats were presented for the same amount of time to maintain consistency across the participants. The eye movements of the children were analyzed using an eye tracker to check the visual attention of the children. Finally, the results indicated that pictures with motions received more visual attention when compared to static pictures. Also, the duration of fixations on animated pictures was longer on average than static pictures. Hence, the study concluded that motion pictures (animated pictures) attract the visual attention of children and scaffold the learning process.

2.8 Effect of Animation on Children with Developmental Disabilities

Fujisawa et al. (2011) did a study to investigate the effect of animation on persons with intellectual disability (ID). This was mainly to evaluate whether the movement in animated pictures could help persons with ID in the learning process. 16 verbal children with intellectual disabilities whose language age ranged from 3 -7 yrs participated in the study. All

the participants were divided into four groups based on their average language age. In a one week time interval, two sessions were conducted to the children to learn the targeted static pictograms and their action words. The stimuli consisted of 16 static pictogram symbols of action words and their animated symbols respectively. The 16 pictograms were divided into four blocks each consisting of four pictograms. The procedure involved two conditions with eight trials for each condition. Half of the stimuli were presented in the experimental condition and the other half in the control condition. During the first session, a static symbol representing a verb was presented to the participants to label. If wrongly labeled, the static symbol was replaced by the animated symbol. In the control condition, the static symbols were only presented even though they were naming it as wrong. The responses were scored as 0, 1, or 2 depending on how accurately the participants are naming it. After one week duration, the second session was provided to all the participants and they were asked to name the same 16 static symbols again. No animated symbols were given during the second session. Finally, the scores obtained for naming the static symbols during the first session were compared with the scores obtained during the second session. The results suggested that animation was helpful in the naming of static symbols correctly in the experimental group compared to the control group. Hence, the study concluded that animation facilitated the learning of static symbols of action words in children with ID. Also, the present study hypothesized that static symbols with arrow marks which used to indicate the movement and directionality of the targeted stimuli were difficult to be identified by younger children when compared to static symbols without arrow marks. However, the results proved that there is no significant difference between the static symbols with and without arrow marks. They also found that children with lower language age groups (< 5yrs) had performed better for animated symbols than static symbols. Thus, it concluded that children in the younger age group could be benefitted more with animated symbols as compared to the other age groups.

Animation has been considered as a novel means of enhancing emotional recognition in children with autism spectrum disorders. Golan et al. (2009) examined the effect of animation incorporated intervention in children with high functioning autism. The stimuli used in the study were animated forms of vehicles with real emotional faces. The results indicated that children had improved their emotion recognition and understanding after the intervention.

Schlosser et al. (2019) investigated the effect of animation on the identification of graphic symbols for verbs using the Autism Language Program Graphic Symbols Set in autistic children in the age range of 3-7 yrs. The stimulus set included 24 verbs and its corresponding graphic symbols both in animated and static form. A total of 27 children participated in the study. Out of 27 children, 15 children were assigned to static symbol condition and 12 children were assigned to animated symbol conditions randomly. Static symbols were chosen from the animated symbols to ensure that the static symbols were a still representation of animated symbols. The entire stimuli were presented using a PowerPoint on a computer screen. The children were asked to identify a target symbol (static/ animated) among four-choice array (which include one correct answer and three foils) after listening to the spoken label. All children had equal time intervals (30 sec) to identify the symbol. The naming accuracy performances of children were evaluated using the criteria of the American National Standards Institute set standards for the comprehensibility of the traffic signs. It includes four categories: (1) Exceptional->85%, (2) Effective->75%, (3) Adequate->50% and (4) Inadequate-<50%. The results revealed that 18 out of 24 items of animated symbols were placed in the upper two categories (ie, Effective or Exceptional) and 21 out of 24 items of static symbols were placed in the lower two categories (i.e, adequate or inadequate). The study concluded that animated symbols were more readily identified than static symbols in children with autism.

2.9 Research Gap

A review of the previous studies indicates that the research in the area of animated and static pictures on naming accuracy in the Indian context is limited. Numerous studies have reported that children with disabilities face difficulties in the picture naming task. However, no research is conducted on the effect of animation in picture naming tasks for CHI. Hence the present study compared the effect of static and animated pictures on naming abilities in CHI in the age group of 4-7years in the South Indian Malayalam speaking population.

Action verbs and prepositions are the categories that can be better illustrated through animation effects than nouns and other categories. Hence, the present study examined the usage of action verbs and error patterns in the production of CHI. Although they have difficulty in the usage of verbs, this study might help to find out whether the effect of animation can improve the naming ability of action verbs in CHI.

Chapter III

Method

Study Design

A between-group design was used to compare the effects of animated and static pictures on identification of action verbs.

Participants

Eighty CHI within the age range of 4 to 7.11 years (20 each in the age range of 4 to 4.11 years, 5 to 5.11 years, 6 to 6.11 years, and 7 to 7.11 years) were chosen as participants. The age range of 4-7.11yrs was chosen in order to rationalize the results obtained by Fujisawa et al. (2011). They found that children at lower linguistic developmental ages may benefit most from animation. Within each age group, twenty participants were selected and subdivided into 2 groups. That is, half of the children (10) were randomly assigned for tests with animated pictures, whereas the other half were assigned for tests with static pictures.

Group I consisted of 40 CHI (ie.10 children from each age group) who were assigned the static pictures and Group II consisted of other 40 CHI (ie.10 children from each age group) who were presented with the animated pictures. The participants were selected from AIISH pre-school as well as from different special schools in Kerala. Demographic details of the participants were collected as per the format given in Appendix A.

Inclusionary criteria

The participants were selected based on the following inclusionary criteria:

- Children who are diagnosed as having severe to profound bilateral sensorineural hearing loss and using hearing aid regularly.
- Children who had receptive, expressive language and cognitive skills within the age range of 4-7 years which was determined using Communication DEALL Developmental Checklist (Karanth, 2011) and Scale of early communication skills for hearing impaired children (Moog & Geers, 1975).
- They should have attended at least 6 months of regular speech therapy.
- They should pass the informal pre-assessment in order to assess the comprehension and expression of the action verbs. It involves the experimenter performing certain actions and the child was asked to label the action.
- They should have a normal/corrected vision.
- They should speak predominantly Malayalam as their primary language at home (based on preschool records and parent report)

Exclusionary Criteria

The participants with the following characteristics were excluded from the study:

- Children with a history of visual, neurological, and psychological disorders.
- Children who failed the informal pre-assessment which assesses the comprehension and expression of the action verbs.

Procedure

Prior to the testing procedure, the study and its purpose were explained to the caregivers and written consent was obtained from them. Then the clinician interacted with the

child in order to build a rapport with the child. After having the rapport, the stimuli were presented in a noise-free environment to each participant.

The study was carried out in three phases which are as follows:

Phase 1- Stimuli Selection

As a part of the stimuli selection, verbs were selected from the vocabulary checklist of Assessment of Language Development (ALD) tool (Lakkanna et al., 2007). This is because, recent studies have found that children who use more verbs at 2 years of age show proficiency in advanced grammatical skills after six months (Hadley et al., 2016). Hence, the early usage of verbs in CHI needs to be assessed in order to understand the emerging grammatical abilities. ALD is a comprehensive tool that assesses the receptive and expressive language skills of children from birth to seven years. It also consisted of a vocabulary checklist which comprises action verbs. Since the age group considered in the present study was from 4 – 7.11 years, 30 out of the 49 verbs were chosen from the actions category, based on the Indian socio-cultural context. Further, the action verbs were given to three experienced speech-language pathologists for validating (Appendix B) the stimulus. After the validation, the items were finalized and served as the stimulus set.

For condition 1, the stimulus set in the static mode was displayed on the computer screen. For condition 2, the stimulus set was given animation effect and were presented through a computer screen. The animated and static representation was selected in consensus with the procedures used by Schlosser et al. (2012). Static pictures were derived from the developed animated pictures. The animated pictures were developed using adobe photoshop with the help of a professional well-versed in this area with the inputs given by the researcher. The stimuli were presented using a Lenovo Idea Pad 320 (80XH01DKIN) laptop computer with a 15.6-inch display, 2.4 GHz Intel Core i3-6006U processor coupled with a

4GB of RAM, in Microsoft PowerPoint along with pre-recorded voice output. This mode of stimulus presentation ensured consistency in instructions. The 'time of exposure' and 'inter-trial interval' were maintained uniform. This helped in reducing variation which might have resulted from inconsistency in human response. Integrity of procedures within and across research locations was also ensured by this mode. The order of presentation of verbs was kept consistent across all participants.

Phase 2- Familiarization Task

Familiarization trials were carried out for both the groups prior to the experimental task. In this procedure, two action verbs were chosen which were not being used in the experimental task (ie, Swim and Blow). It was presented in animated or static form to the respective groups. Figure 1 illustrates the specific procedure for familiarization task for Group I and Group II. First, the child was asked to sit in front of the laptop and the experimenter was seated next to the child. Then the experimenter had build rapport with the child and made him/ her comfortable and further oriented the child about the task which is as follows:

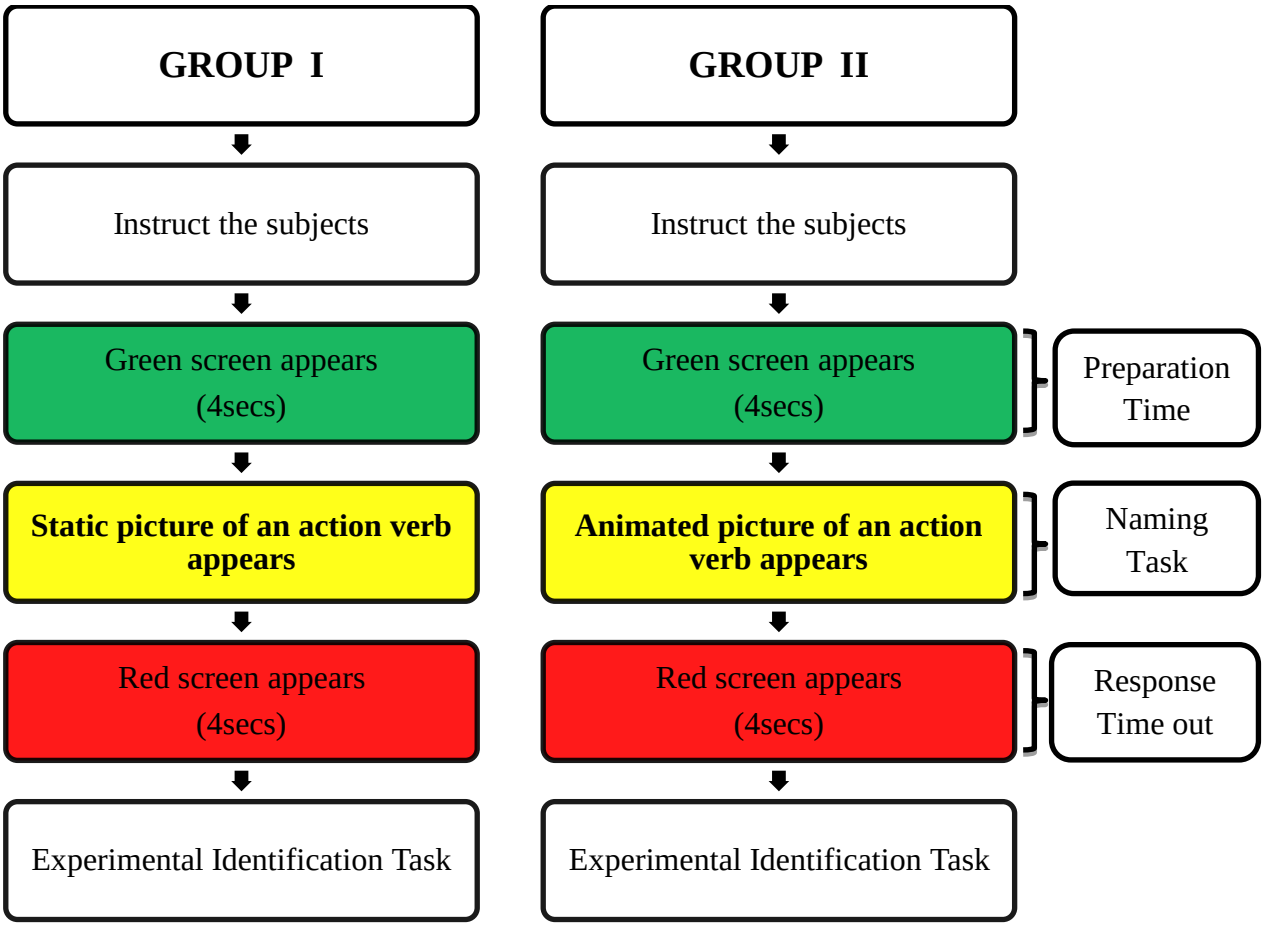
"Let's play a game on the computer. You will see a picture on the computer and the computer will ask you to guess it." Then the experimenter will tell the child, "First, I am going to show you how to play the game, while moving ahead in the PowerPoint to the green screen. After the computerized question, "What's this?" the child will be asked to make a guess."

In the familiarization trials, the experimenter acknowledged correct responses (Yes, this is ____). If the response was not correct the experimenter informed the correct response to the child (No, this is ____). The experimenter has also noted whether the child guessed before the screen color changes to red. After the second word, children were asked whether

they understood how to play the game. If the response of the child was 'No', the task for familiarization task was presented again. This was repeated till we get the response 'Yes'.

Figure 3.1.

The Specific Procedure of Familiarization Task for Group I and Group II



Experimental Identification Task

Immediately after the familiarization task, the child was presented with either one animated or static picture at a time. 4 seconds after the appearance of first green slide, the recorded speech "Get ready, Please look at the compute" was played back. The slide with the picture followed and after a time gap of 1 second, the recorded speech "What is this?" was played back. The child shall respond to this question before the appearance of red slide. The screen would turn red after displaying pictures in either condition for 30 seconds. The

animated picture was repeated several times within this period of 30 seconds. The number of repetitions varied depending on the duration of one animated picture. The criteria for selecting 30 seconds as a stimulus presentation time is because to compare the procedure used in the previous studies done by Schlosser et al. (2012) in children with autism. Compared to familiarization task, more time was given for the identification task, considering its difficulty. Between two consecutive symbols, three second time gap was given. The child was given breaks after presentation of 6 stimuli, every time.

Phase 3 - Analysis

Analysis of the experimental identification task for both group I and group II was done in two ways: 1) Naming Accuracy 2) Type of errors.

In order to assess the naming accuracy, firstly the responses were classified into whether it is correct or incorrect. If the child named the meaning of the symbol correctly, it was counted as correct. If the child was naming the symbol unrelated to the context or not able to name the symbol, it was counted as incorrect. From the correctly named symbols, the naming accuracy was assessed in terms of Transparency.

Transparency depicts how a person is able to correctly interpret a symbol. For transparency, a response was considered as correct if the child was able to exactly name the symbol shown by the experimenter, in a different form (such as climbing for climb), or an acceptable synonym (e.g. hop for jump) and a phrase or sentence that contained the target verb in its acceptable forms (eg. “The boy is climbing up the hill”). Percentage of transparent symbols was calculated by multiplying with 100, the ratio of the number of symbols correctly named to the total number of symbols.

The type of errors produced by CHI in naming task for both static and animated condition was analyzed by using the error categories defined by Masterson et al. (2008) in their work on naming of object and verb. It includes visual, semantic, and other errors. Visual errors (VE) consist of 'frank visual errors' which have no semantic relationship between target and response (Example: laughing for coughing) and 'misinterpretation of symbol errors' which includes actions that present in the visual but did not constitute the target response (Example: Jumping for dancing).

Semantic errors (SE) consist of three kinds of errors (1) 'Coordinate errors' which are semantically closer to the target response (Example: Weaving for Knitting), (2) 'Super ordinate errors' which are considered as over general response (Example: Gardening for planting), and (3) 'Associative errors' which has a similarity in context of the target and error (Example: Knocking for opening). The next type of errors is categorized as other errors (OE) which consist of 'Verb to noun error' which occurs when the object involved in the actions are named instead of the target action (Example: Typewriter for typing), 'Verb to adjective error' which occurs when the adjective related to the verb was named instead of the verb.

The present study also accounted for the frequency of 'No responses' (NR) for both static and animated groups across the four age groups. The responses from the participants and their demographic details were recorded in the format given in Appendix. Naming accuracy and type of errors for each of the 30 action verbs were also recorded in this form.

Inter-rater Reliability

All the participants' responses were recorded with a digital voice recorder. The responses were carefully assessed by the researcher. Further for inter-rater reliability, the recorded responses were given to an experienced speech-language pathologist to decide on whether the responses are assessed correctly or not.

Chapter IV

Results & Discussion

The present study investigated the effect of animated pictures on the naming accuracy and error patterns in comparison with static pictures in CHI in the age range of 4-7.11 years. Eighty CHI have participated in the study. Group I consisted of 40 CHI (ie.10 children from each age group) who were assigned the static pictures and Group II consisted of 40 CHI (ie.10 children from each age group) who were presented with the animated pictures. All the participants were instructed to name the static or animated picture shown on the laptop.

The analysis of the experimental identification task was done in two ways:

(i) Naming accuracy: The naming accuracy of both static and animated pictures was assessed in terms of Transparency. Transparency refers to the ability of the person to correctly interpret a symbol. In the present study, the transparent symbols were calculated in terms of percentage which was stated by Schlosser et al. (2012).

$$\text{Transparent symbols (\%)} = \frac{\text{No. of symbols that correctly named}}{\text{Total no. of symbols}} \times 100$$

(ii) Type of errors: The type of errors were analyzed according to the error categories of Masterson et al. (2008). It includes visual errors (VE), semantic errors (SE), and other errors (OE) that were derived in terms of percentage.

The present study also accounted for the frequency of 'No responses' (NR) for both Group I and Group II across the four age groups. The responses of the children were transcribed verbatim and further subjected to the statistical analysis using SPSS version 20.0.

Test of Normality

Shapiro Wilk's test was done to determine the normality across the data. The results revealed that naming accuracy followed assumptions of normality at 0.05 level of significance ($p > 0.05$). Hence, parametric test were carried out for both Group I and Group II conditions. In terms of error categories, the results did not followed assumptions of normality at 0.05 level of significance ($p < 0.05$). Hence, non parametric test were carried out in both Group I and Group II conditions for further statistical analysis.

The findings of the study will be broadly presented under each of the objectives:

Objective I: To Measure and Compare the Naming Accuracy for Static Pictures for CHI (4 - 7.11 years of age)

The descriptive scores of naming accuracy were analysed for the Group I across the age groups. The descriptive scores are indicated in Table 4.1 below.

Table 4.1

Mean, Standard Deviation, and Median Values of Naming Accuracy for Group I

Age	N	Mean	Std. Deviation	Median
4.0-4.11	10	16.23	2.312	16.00
5.0-5.11	10	17.30	3.302	16.00
6.0-6.11	10	22.10	2.234	22.00
7.0-7.11	10	22.20	2.898	23.00
Overall	40	19.48	3.782	20.00

Since differences were noticed in the descriptive scores, one-way ANOVA was performed to find out whether there was a significant difference across the age groups on the naming accuracy in Group I. The results showed that there was a statistically significant

difference between the age group in Group I, F (3,36) =13.106, p = .000. Further, to identify significant difference between each age groups, Turkey's test was carried out.

The results revealed that there was a significant difference for naming accuracy for the following age groups (4.0 – 4.11 years vs 6.0 - 6.11 years; 4.0 - 4.11 years vs 7.0 – 7.11 years; 5.0 - 5.11 years vs 6.0 - 6.11 years; 5.0 - 5.11 years vs 7.0 - 7.11 years). However, there was no significant difference observed for naming accuracy between the nearer age groups. The results of the descriptive scores also revealed similar scores between the nearer groups. The poor naming accuracy scores seen in Group I might be due to the reduced interval gap between the expressive language age of CHI in the nearer age groups. In addition, it was also observed that naming accuracy for Group I improved with age. However, there was no significant improvement in naming accuracy between two consecutive age groups, for example, between 4.0 to 4.11 years and 5.0 to 5.11 years.

Objective II: To Measure and Compare the Naming Accuracy for Animated Pictures for CHI (4 - 7.11 years of age)

The descriptive scores for naming accuracy were analysed for Group II across the age groups. The descriptive scores are indicated in Table 4.2 below.

Since the difference noticed in the descriptive scores, one-way ANOVA was performed to find out the significant difference across the age groups on the naming accuracy of Group II. The results revealed that there was a statistically significant difference among the age group, F (3,36) = 5.056, p < .005. Further, Turkey's test results revealed a significant difference in naming accuracy between all the age groups. Hence, the results showed that the naming accuracy for Group II (animated condition) improved as age increases even for nearer age groups. This is in agreement with the findings of Schlosser et.al (2012) who have also

reported that animation can enhance the naming accuracy of symbols of verbs in typically developing children.

Table 4.2

Mean, Standard Deviation, and Median Values of Naming Accuracy for Group II

Age	N	Mean	Std. Deviation	Median
4.0-4.11	10	20.80	3.824	22.00
5.0-5.11	10	22.80	3.765	23.00
6.0-6.11	10	23.40	1.430	24.00
7.0-7.11	10	26.10	2.644	26.00
Overall	40	23.28	3.523	24.00

Objective III: To Measure and Compare the Error Categories and No Response Elicitation for Static Pictures for CHI (4 - 7.11 years of age)

The descriptive scores for the type of errors were analysed for Group I across the age groups. Table 4.3 provides the overall summary of the error categories for Group 1. The mean scores (in percentage) for the error categories across the four age groups are depicted in Figure 4.1.

Table 4.3

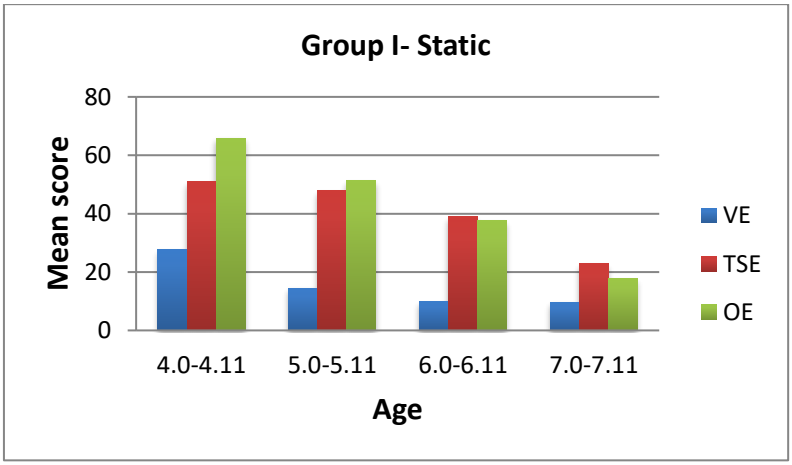
The Mean, Standard Deviation, and Median Values of Error Categories for Group 1

Error Categories	Age	N	Mean	Std. Deviation	Median
VE Frank Visual Error	4.0-4.11	10	27.60	9.9	25.00
	5.0-5.11	10	14.50	6.3	17.00
	6.0-6.11	10	10.00	4.5	10.00
	7.0-7.11	10	9.70	3.4	11.00
	Overall	40	15.45	6.02	17.00
TSE (Superordinate errors and Associative errors)	4.0-4.11	10	51.10	17.85	45.00
	5.0-5.11	10	47.90	20.12	53.50
	6.0-6.11	10	38.90	16.16	34.50
	7.0-7.11	10	22.90	10.25	22.50
	Overall	40	40.20	16.09	37.00
OE (Verb-noun errors)	4.0-4.11	10	65.90	10.33	66.50
	5.0-5.11	10	51.50	19.057	56.00
	6.0-6.11	10	37.80	17.25	32.50
	7.0-7.11	10	17.80	7.35	12.50
	Overall	40	43.25	13.49	47.00

Note: VE- Visual Errors (Frank visual error), TSE-Total Semantic Errors (Superordinate error and Associative), OE- Other Errors (Verb-noun errors)

Figure 4.1

The Mean Scores (in Percentage) Obtained for Each Error Categories across the Four Age Groups in Group I



Since differences were observed in the descriptive scores in type of error patterns, the Kruskal Wallis test was done to determine whether there was a significant difference across the four age groups. The test results revealed that a significant difference between the type of errors in Group I condition across the age groups as depicted in Table 4.4.

Table 4.4

Results of Kruskal Wallis Test of Group I

Type of Errors	Chi-Square	$\|p\|$ value
VE	12.449	.006
SE	12.466	.006
OE	15.113	.002

Further, the Mann Whitney U test was carried out between the each age groups. Results revealed a significant difference for all error categories (visual errors, semantic errors, other errors) between 4.0 - 4.11 years vs 7.0 – 7.11 years; 5.0 - 5.11 years vs 7.0 - 7.11 years.

It was noticed that other errors are found to be the largest category of error in Group I followed by semantic errors and visual errors. In the other errors category, verb-noun error and verb–adjective errors were the error patterns considered during the assessment. Among them, verb-noun errors are the commonly reported error pattern in all the age groups. No children had produced a verb-adjective error pattern during the assessment.

In the semantic type, coordinate, superordinate and associative error patterns were analysed during the assessment. Among them, super ordinate errors' and 'associative errors' were found to be frequently reported across all the age groups. Whereas, coordinate errors are not reported in any of the age groups.

In visual errors, ‘frank visual errors’ and ‘misinterpretation of symbol errors’ were considered during the assessment. However, ‘frank visual errors’ were found to be the most common error in CHI. No CHI had reported ‘misinterpretation of symbol errors’ during the assessment.

The results of the study are in consensus with the previous studies of Jagaroo and Wilkinson (2008), who have reported that static symbols create more confusion between the noun and verb agreement while naming the pictures of action verbs. The increased frequency of other errors (verb-noun error) in CHI of Group I might be due to the above reason. The second-largest error category in Group I was found as semantic errors. Previous studies have reported that CHI particularly uses general verbs in terms of specific verbs in picture naming task of action verbs (Saito et al., 1974). For instance, CHI may use the word ‘make’ instead of words like ‘build’ and ‘cook’. They may also exhibit difficulty in distinguishing between intransitive (actions without object) and transitive verbs (action with object). Among the three error categories, visual errors are found to be the least error category in Group I. Visual errors are produced mainly due to the distraction from the environment during the testing. Rothpletz et al. (2003) stated that CHI have greater inhibition in the presence of distracting stimuli. These individuals use their vision as a compensatory function to monitor their environments. Hence, distractions can create inattentiveness in CHI while attending to the target stimulus. The total errors obtained for each age group in Group I is depicted in Table 4.5.

Thus, the results revealed that total errors are reducing gradually as the age increases, as expected to be in typically developing children. Even in CHI, it can be noticed that older CHI tends to produce fewer errors when compared to younger CHI in the Group. This is in consensus with the findings of Brown (1978) that support the reduction in naming errors as age increases.

Table 4.5

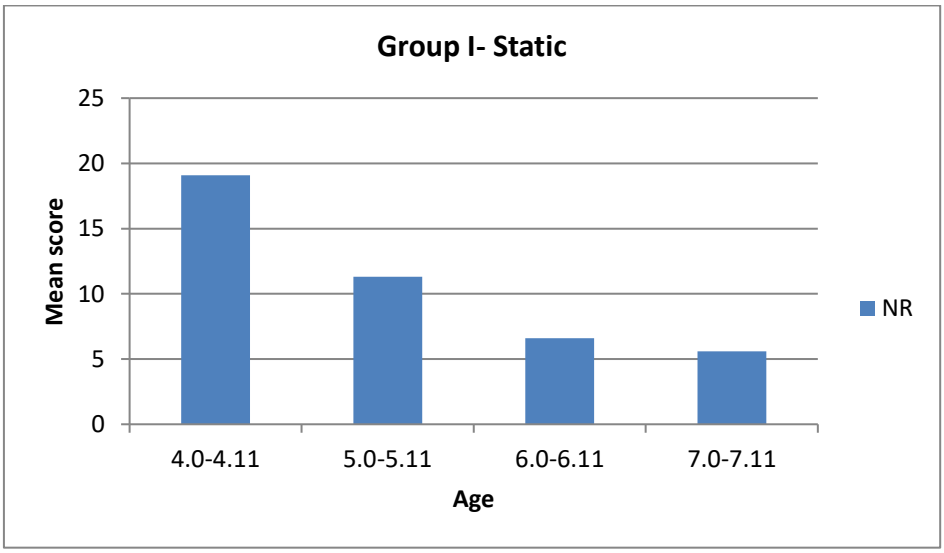
Total Error (in Percentage) Obtained for Each Age Group in Group I

	AGE	GROUP I (STATIC)
TOTAL ERRORS (%)	4.0-4.11	31%
	5.0-5.11	28%
	6.0-6.11	24%
	7.0-7.11	14%

In addition, the study also evaluated the responses of CHI in terms of 'no response' elicitation. The results showed that younger CHI had more 'no response' when compared to the older CHI in Group I. The frequency of 'no response' (NR) also reduced as age increases, following the normal developmental trend. The mean NR score obtained for Group 1 across the age groups as shown in Figure 4.2.

Figure 4.2

NR Scores Obtained for Group I



Kruskal Wallis test was carried out to determine the significant difference between the elicitation of 'No response' across the age groups. The test results revealed that there was a

significant difference between the elicitation of no response across the age groups, $\chi^2(3) = 16.343$, $p<0.05$. Further, Mann Whitney U test results revealed that there was a significant difference for 'No response' for the following age groups (4.0 – 4.11years vs 6.0 - 6.11 years; 4.0 - 4.11 years vs 7.0 – 7.11years; 5.0 - 5.11 years vs 7.0 - 7.11 years). However, there was no significant difference observed for No response between the nearer age groups.

Objective IV: To Measure and Compare the Error Categories and No Response Elicitation for Animated Pictures for CHI (4 - 7.11 years of age)

Table 4.6

The Mean, Standard deviation, and Median values of error categories for Group II

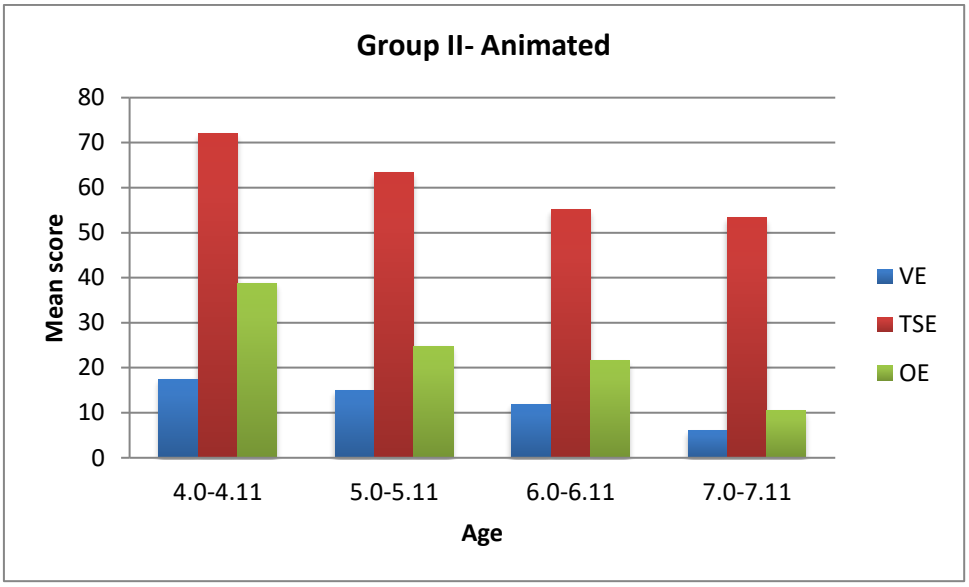
Error Categories	AGE	N	Mean	Std. Deviation	Median
VE Frank Visual Error	4.0-4.11	10	17.50	7.2	17.00
	5.0-5.11	10	15.0	6.3	.00
	6.0-6.11	10	11.90	4.5	7.00
	7.0-7.11	10	6.10	2.9	.00
	Overall	40	12.63	5.22	.00
TSE (Superordinate errors and Associative errors)	4.0-4.11	10	72.00	17.6	69.00
	5.0-5.11	10	63.40	23.2	65.00
	6.0-6.11	10	55.10	18.6	60.00
	7.0-7.11	10	53.30	24.2	50.00
	Overall	40	60.95	20.92	63.00
OE (Verb-noun errors)	4.0-4.11	10	38.80	17.2	39.00
	5.0-5.11	10	24.80	11.9	25.00
	6.0-6.11	10	21.70	9.85	.00
	7.0-7.11	10	10.40	4.35	.00
	Overall	40	23.93	10.86	25.00

Note: VE- Visual Errors (Frank visual error), TSE-Total Semantic Errors (Superordinate error and Associative), OE- Other Errors (Verb-noun errors)

The descriptive scores for the type of errors were analysed in Group II across the age groups. The mean values obtained for semantic errors, other errors, and visual errors were 60.95, 23.93, and 12.63 respectively. Table 4.6 provides the overall summary of the error categories for Group II. The mean scores (in percentage) for the error categories across the four age groups are depicted in Figure 4.3.

Figure 4.3

The Mean Scores (in Percentage) for the Error Categories across the Four Age Groups in Group II



Since differences were observed in the descriptive scores in type of error patterns, the Kruskal Wallis test was done to determine whether there was a significant difference across the four age groups. The test results revealed that there was no significant difference between the type of errors across the age groups in Group II condition, $p > 0.05$ as depicted in Table 4.7.

Table 4.7

Results of Kruskal Wallis Test of Group II

Type of Errors	Chi-Square	$\|p\|$ value
VE	5.135	.162
TSE	.982	.806
OE	6.101	.111

In the type of error analysis, semantic errors are found to be the largest error category in Group II followed by other errors and visual errors. In the semantic type of errors, 'superordinate errors' and 'associative errors' are found to be frequently reported across all the age groups. Whereas in the category of other errors, 'verb-noun error' is the most commonly reported error pattern, across the age groups. In visual errors, frank visual errors are the most common type of error produced by CHI.

Taking into account the conditions, the reason for the increased semantic errors in Group II might be attributed to the absence of sound with the animation. These findings are also in agreement with the findings of Harmon et al. (2014) who investigated the role of animated symbols with sound and without sound in the naming task of verbs in typically developing children. They found semantic errors as the largest category of error in naming the animated symbols without sound. Children had made more errors in animations without sound compared to animations with sound. Hence, they concluded that if animated symbols are presented with environmental sounds, the symbols will be identified more readily by their word-class and thus decreases the frequency of overall errors. Previous studies have also reported that animation can direct the attention to main concepts for a longer time (Washburn, 1993).

In the total error analysis, results showed that total errors are reducing gradually with increase in age, thus, following the normal developmental trend stated by Brown (1978). The total errors obtained for each age group in Group II is depicted in Table 4.8.

Table 4.8

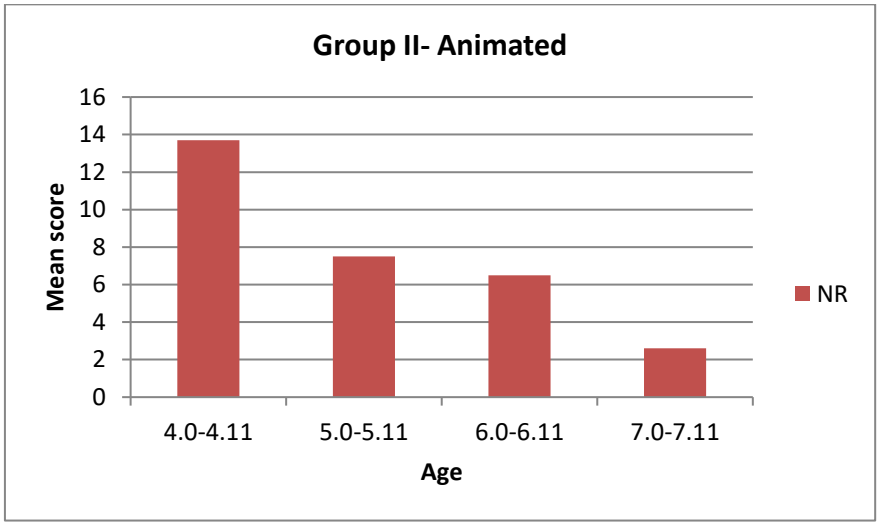
Total Error (in percentage) for each Age Group in Group II

	AGE	GROUP II (ANIMATED)
TOTAL ERRORS (%)	4.0-4.11	23%
	5.0-5.11	16%
	6.0-6.11	14%
	7.0-7.11	7%

While analyzing the 'no response' elicitation, the results showed that younger CHI had more 'no response' when compared to the older CHI in Group II. The frequency of 'no response' (NR) is reducing with increase in age, thus following the developmental trend across the age groups. Figure 4.4 indicates the mean NR score obtained for Group II.

Figure 4.4

Mean No Response (NR) Scores Obtained for Group II



Kruskal Wallis test was carried out to determine the significant difference between the elicitation of 'No response' across the age groups. The test results showed that there was a significant difference between the elicitation of no response across the age groups, $\chi^2(3) = 14.441$, $p < 0.05$.Further, Mann Whitney test results revealed a significant difference in 'No response' elicitation between all the age groups. Hence, the results showed that the 'No response elicitation' for Group II (animated condition) reduced as age increases even for nearer age groups.

Objective V: To Compare the Naming Accuracy between Static Pictures and Animated Pictures for CHI (4 - 7.11 years of age)

The mean naming accuracy scores obtained for Group I was 19.48 and Group II was 23.28. The results revealed that Group II had better naming accuracy scores as compared to Group I. As differences were noticed in the descriptive scores, two-way ANOVA was performed to examine the significant differences across the group, among the age and the interaction between the group and age on the naming accuracy. The results revealed that there was a statistically significant difference between the groups, F (1,72) = 34.24, p = .000 and between the age, F (3,72) = 15.279, p = .000. Whereas the interaction between the group and age on the naming accuracy results showed no significant difference, F (3, 72) = 1.905, p< .136. Thus, it can be inferred that Group II had shown better naming accuracy scores as compared to Group I.

Hence, it was clear that Group II has shown increased naming accuracy in naming the action verbs as compared to Group I. These findings support the hypothesis stated by Jagaroo and Wilkinson (2008) which shows that animated symbols are more transparent in representing the action verbs in the naming task. This study demonstrated that CHI identifies animated symbols of verbs more accurately than static symbols. Table 4.9 summarizes the

mean value obtained for naming accuracy in both Group I and Group II. Figure 4.5 indicates the graphical representation of the mean NA for Group I and Group II.

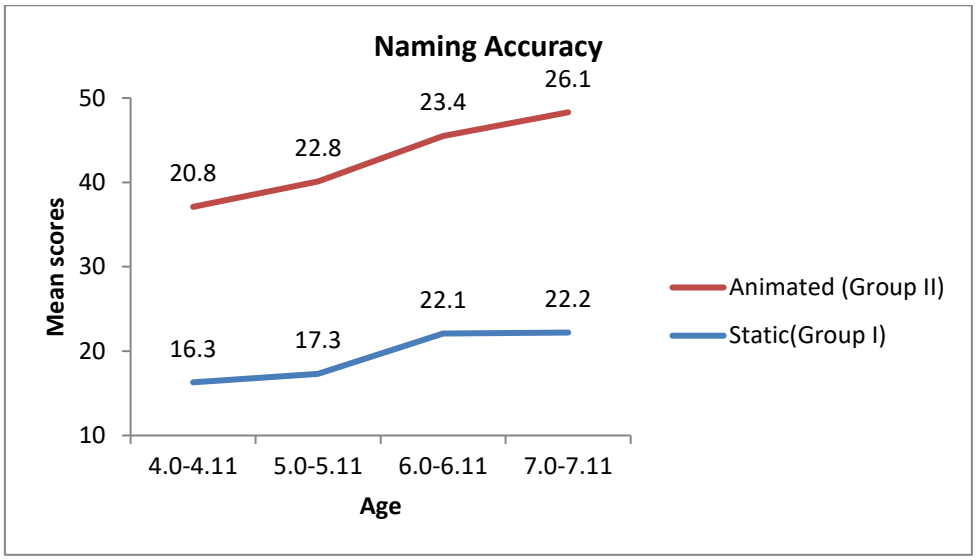
Table 4.9

The Mean, Standard Deviation, and Median Values for Group I and Group II

GROUP	Age	N	Mean	Std. Deviation	Median
Group I Static	4.0-4.11	10	16.30	2.312	16.00
	5.0-5.11	10	17.30	3.302	16.00
	6.0-6.11	10	22.10	2.234	22.00
	7.0-7.11	10	22.20	2.898	23.00
	Overall	40	19.48	3.782	20.00
Group II Animated	4.0-4.11	10	20.80	3.824	22.00
	5.0-5.11	10	22.80	3.765	23.00
	6.0-6.11	10	23.40	1.430	24.00
	7.0-7.11	10	26.10	2.644	26.00
	Overall	40	23.28	3.523	24.00

Figure 4.5

Mean Naming Accuracy (NA) Results Obtained for Group I and Group II



The relatively poor performance of naming accuracy on Group I condition (static pictures) may be attributed to the fact that static symbols of action verbs are more abstract and difficult for CHI to elicit responses. This may increase the cognitive demand required to identify the verb. This is in agreement with the findings of Bandura (1986), who stated that learning occurs as a result of the video.

Objective VI: To Compare the Error Categories and No Response Elicitation between Static and Animated Pictures for CHI (4 - 7.11 years of age)

The Mann Whitney test was carried out to compare the significant difference of the type of errors between Group I and Group II. The results revealed that in the age group of 4.0 - 4.11 years there was a significant difference for all three error categories (VE, TSE, OE). However, in the age group of 5.0-5.11 and 6.0 - 6.11 years, a difference was observed in terms of TSE and OE. Finally, in the age group of 7.0 - 7.11 years, visual errors showed a significant difference between Group I and Group II. The results of the Mann Whitney test are depicted in Table 4.10.

Table 4.10

Results of Mann Whitney Test between Group I and Group II on Type of Errors

Age	Type of Errors	|Z|	|*p*| Value
4.0-4.11 years	VE	2.470	.014
	TSE	3.107	.002
	OE	2.619	.009
5.0-5.11 years	VE	238	.812
	TSE	2.502	.012
	OE	2.090	.037
6.0-6.11 years	VE	.000	1.000
	TSE	2.479	.013
	OE	2.023	.043
7.0-7.11 years	VE	2.397	.017
	TSE	.774	.439
	OE	.162	.871

Further, the Kruskal Wallis test was carried out to verify the significant difference in the type of errors between the age groups of Group I and Group II. Significant difference was noticed across the type of errors for Group I condition, $p < 0.05$. However, no significant difference was found across the type of errors in Group II condition. Table 4.11 shows the Kruskal Wallis test results across the type of errors for both the conditions.

Table 4.11

Results of Kruskal Wallis Test across the Age Groups on the Type of Errors

Group	Type of Errors	Chi-Square	df	$\|p\|$ value
Group I	VE	12.449	3	.006
	TSE	12.466	3	.006
	OE	15.113	3	.002
Group II	VE	5.135	3	.162
	TSE	.982	3	.806
	OE	6.010	3	.111

The significant difference noticed in Group I condition might be attributed to the poor naming accuracy. The increased naming accuracy deficits might have lead to more error patterns in Group I conditions. On the contrary, since Group II had better naming accuracy, less error patterns were exhibited by Group II.

In the type of error analysis, visual errors were found to be more in Group I (static condition) than for Group II (animated condition). The total mean score obtained for visual errors in Group I and Group II was 15.45 and 12.63 respectively. Previous studies also reported similar findings. Studies of visual attention support the notion of altered visual organization in deaf individuals. They exhibit wider attention to the stimuli than normal individuals to monitor the environment due to their auditory incompetency (Tharpe et al., 2002). This may be the reason behind the increased frequency of visual errors in static conditions. However, there are literature findings that support the effect of animation on

visual attention. Berney and Betrancourt (2016) reported that animation can capture the learner's visual attention and give a clear picture of the information. Franconeri (2004) stated that our perceptual system has an inbuilt ability to direct attention to motion changes in the environment. Similarly, Nealis et al. (1977) reported that sudden changes in the stimulus properties or position can automatically elicit attention.

While investigating the semantic errors, Group II obtained more errors compared to Group I. While Group II obtained a mean score of 60.95, Group I obtained only 40.20. This trend was also reported by Diehm (2020) who investigated the effect of animation in eliciting narrative retells in TDC. The results indicated that those children assigned to animated condition of story presentation had longer narrative retells, more diverse vocabulary, and more complex syntax while retelling the story. Moreover, the children produced more action verbs in response to the animated form of presentation than the static form. While examining the verb usage of CHI, Saito et al. (1974) reported that CH used more general verbs than specific verbs which will be considered under the superordinate errors of semantic errors. However, they might use specific verbs in quality and quantity based on their comprehensive language ability. This increased frequency of semantic errors in Group II might be due to the above reasons.

Taking into account the other error conditions, Group I (static condition) have shown more errors than that of Group II (animated condition). The total mean score obtained for other errors in Group I and Group II was 43.25 and 23.93 respectively. These results again support the previous literature findings of animation by Jagarooo and Wilkinson (2008). Static symbols of action verbs can create confusion between the noun and verb agreement while naming the action verb whereas animation can clearly emphasize the verb agreement by its motion effects, hence, reducing the confusion between the noun and verb agreement while naming the action symbols. Harmon et al. (2014) also supported the effect of animation

with the added effect of environmental sounds in naming symbols of action verbs. According to their findings, verb-noun errors are more pronounced in no sound condition of animated symbols. Hence, they suggested that animated symbols with sounds can reduce the verb-noun error by clearly specifying the verb class and its associated sound class. In our results also the same trend was observed. Animation can aid in a better understanding of concepts through simple exposure, thus, reducing the burden of explanation while using static pictures. The total errors obtained for both Group I and Group II condition is depicted in Table 4.12.

Table 4.12

Total Error Percentage for Each Age Group in Group I and Group II

	AGE	GROUP I (STATIC)	GROUP II (ANIMATED)
TOTAL ERRORS (%)	4.0-4.11	31%	23%
	5.0-5.11	28%	16%
	6.0-6.11	24%	14%
	7.0-7.11	14%	7%

In the total error analysis (VE, SE, OE), the results revealed that overall errors are reducing gradually as the age increases in both Group I and Group II conditions. Both groups were shown the developmental trend as stated by Brown (1978). These findings are similar to other related studies such as Ainsworth, 2006, which says that the skill of comprehending a picture develops over time. Comparing the overall error results of Group I and Group II, Group II (animated condition) showed fewer errors in the naming task of verbs. This again supports the effect of animation on the naming task of action verbs.

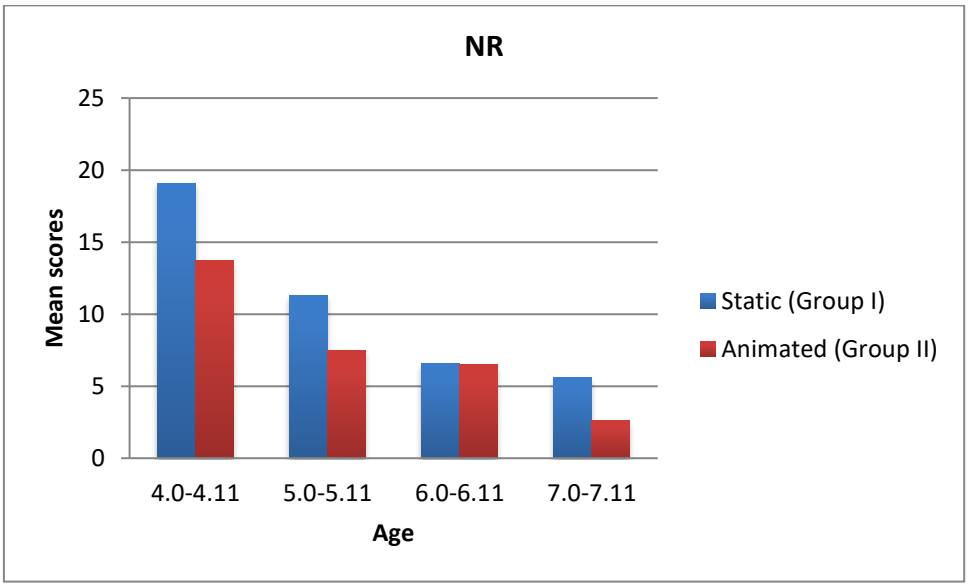
Furthermore, the Kruskal Wallis test was done to determine whether there was a significant difference between the NR across the age groups of Group I and Group II. The results revealed that there was a significant difference between the NR across the age groups

for both Group I and Group II, $p<0.05$. In addition, both the groups reported a reduction in the frequency of 'no response' elicitation as age increases.

The descriptive scores obtained for NR of Group I were 10.65 whereas, Group II obtained a mean score of 7.58. Hence, Group I has reported more 'no response' than that of Group II. The above results revealed that animated pictures are named more correctly by CHI when compared to static pictures. Figure 4.6 indicates the mean NR score obtained for Group I and Group II.

Figure 4.6

Mean score of No Response (NR) for Group I and Group II



To summarize, the results of the present study revealed that naming accuracy for both static and animated pictures were improved with an increase in age. However, animated pictures are named more accurately when compared to static pictures. In the type of error analysis, the results showed that overall errors are reducing with an increase in age for both static and animated condition. The results also indicated that other errors (verb to noun error) are found to be more in static condition due to the confusion between the usage of noun and

verb agreement whereas, the animated group produced more semantic errors due to their inadequate usage of verbs (general verbs for specific verbs). However, while comparing the type of errors between static and animated condition, results revealed fewer errors in response to animated pictures than static pictures. Hence the present study highlights the effect of animation in naming pictures for children with hearing impairment.

Chapter V

Summary and Conclusion

In the current clinical scenario, it is highly necessary to incorporate more advanced assessment and intervention tools for the betterment of children with various communication difficulties. In recent years, the usage of technology has been improved in the field of communication disabilities by providing rehabilitation with the help of teletherapy and teleassesssment options. One such technology feature is animation, which presented advantages on the comprehensive and expressive language of young children (Betrancourt & Tversky, 2000). Several researchers have investigated the impact of animation on learning in typically developing children and few developmental disabilities such as autism and intellectual disabilities. To date, no studies have been conducted in CHI to examine the naming abilities of animated pictures in comparison with static pictures.

The present study investigated the effect of animated pictures on the naming accuracy and error patterns in comparison with static pictures in CHI in the age range of 4-7.11 years. Eighty CHI have participated in the study. All the participants were divided into two groups (Group I and Group II) which consisted of forty CHI in each group. Group I participants were presented with static pictures of action verbs whereas, Group II participants were presented with animated pictures of the same action verbs. The general instruction given to the participants were to name the picture shown on the laptop. The study was carried out in three phases which are given below:-

- Phase I – Stimuli selection
- Phase II – Familiarization and Experimental Identification Task
- Phase III – Analysis

The analysis of the naming task was done in two ways (i) Naming accuracy and (ii) Type of errors. The present study also accounted for the frequency of 'No responses' (NR) for both Group 1 and Group 2 across the four age groups. The responses of the children were transcribed verbatim and further subjected to the statistical analysis using SPSS version 20.0. The results of the study revealed that animation influenced the naming accuracy of CHI in picture naming task. In addition, types of errors are also found to be less in animated condition as compared to static conditions. Thus, the present study demonstrated that animation benefitted CHI to identify the verb symbols accurately relative to their static counterparts.

Clinical Implication

1. Animation helps to understand the meaning of newly introduced verb symbols more easily, without description. Static symbols would have required description for each symbol which would have been time consuming for the clinician.
2. Static symbol representations potentially create confusion between the word class (example: between verbs and nouns) when the same symbol depict a verb and a noun, in children with communication difficulties. For example, the static symbol for "sit" may depict a chair. In this scenario, the animation can help the child to accurately denote word class, minimize or eliminate any confusion between noun and verb class (Jagaroo & Wilkinson, 2008).
3. Most of the research on AAC symbols date has focused on the static symbols and less attention is given to animated symbols. In the era of technological revolution, animation can also be implemented for symbols in AAC devices for better elicitation of responses for children with severe developmental difficulties.

4. Animation can also be incorporated in digital storybook reading activities which aid comprehension in children with communication disabilities as well as in typically developing children.

Limitations

1. Two group of participants were selected to participate in the two conditions (static and animated) in the present study. However, if the same set of participants were selected to perform both the condition after a specific time of interval, the results would have been more reliable. This could not be accomplished in the present study due to limitation in time and also because of the difficulty in following up the same subjects, as they were from different institutions, geographically distant.
2. In addition, some of the participants have been reported irregular usage of hearing aid due to distortions and programming issues and reduced speech and language stimulation at home. This may be attributed to variations in the responses of CHI even though their expressive language matches.
3. More than half of the participants were selected from different special schools in Kerala. The mode of communication that they were followed in schools was sign language even for children who had better verbal expressive language abilities. Consequently, it was observed that children had confusion in the usage of vocabulary while naming the picture verbally. This may be contributed to more error responses during the assessment.

Future Directions

The present study will throw light on the effect of animation in improving the naming abilities on verbs in CHI. Further, this can be tried out with different word classes such as nouns, prepositions, intransitive verbs vs transitive verbs on a larger group of CHI, and also in Indian clinical populations such as Autism, Intellectual disability and Cerebral palsy to validate the findings.

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Appendix A

Demographic Details

Case name: Date:
Age/Sex:
Diagnosis:
Age at which hg aid fitted:
Speech therapy duration:
Expressive Language Age:

NAMING ACCURACY & TYPE OF ERRORS CHECKLIST

Sl. No.	Action Verb	Response in IPA	Naming Accuracy		Type of Errors		
			Correct response	Incorrect response	Semantic Errors Coordinate errors/Super-ordinate errors/ Associative errors	Visual type errors Frank visual errors/misinterpretation of symbol	Other errors Verb to noun/Verb to adjective/No response/Delayed correct response
1.	Clean /vrithiyakunnu/ വൃത്തിയാക്കുന്നു						
2.	Bath /kulikunnu/ കുളിക്കുന്നു						
3.	Clap /kai/ /adikunnu/ കൈഅടിയ്ക്കുന്നു						
4.	Give /kodukunnu/ കൊടുക്കുന്നു						
5.	Cut /murikunnu/ മുറിക്കുന്നു						
6.	Close /adaikunnu/ അടയ്ക്കുന്നു						
7.	Catch /pidikunnu/ പിടിക്കുന്നു						

8.	Sitting /irikunnu/ ഇരിക്കുന്നു						
9.	Sleep /urangunnu/ ഉറങ്ങുന്നു						
10.	Write /ezhuthunnu/ എഴുതുന്നു						
11.	Kiss /umma/ /kodukunnu/ ഉമ്മകൊടുക്കുന്നു						
12.	Dance /dance/ /kallikunnu/ ഡാൻസ് കളിക്കുന്നു						
13.	Cough /chummaikunnu/ ചുമ്മയ്ക്കുന്നു						
14.	Eat /kazhikunnu/ കഴിക്കുന്നു						
15.	Hug /kettipidikunnu/ കെട്ടിപ്പിടിക്കുന്നു						
16.	Jump /chadunnu/ ചാടുന്നു						
17.	Kick /thattunnu/ തട്ടുന്നു						
18.	Knock /muttunnu/ മുട്ടുന്നു						
19.	Listen /kelkunnu/ കേൾക്കുന്നു						
20.	Open /thurakunnu/ തുറക്കുന്നു						

21.	Read /vaayikunnu/ വായിക്കുന്നു						
22.	Throw /eriyunnu/ എറിയുന്നു						
23.	Stand /nilkunnu/ നിൽക്കുന്നു						
24.	Watch /kannunu/ കാണുന്നു						
25.	Run /odunnu/ ഓടുന്നു						
26.	Walk /nadakunnu/ നടക്കുന്നു						
27.	Wash /kazhikunnu/ കഴുകുന്നു						
28.	Sing /padunnu/ പാടുന്നു						
29.	Repair /nannakunnu/ നന്നാകുന്നു						
30.	Ride /odikunnu/ ഓടിക്കുന്നു						

Appendix B

Dissertation Stimulus Validation Report

A total of 30 static and animated pictures of the selected action verbs were given to three experienced speech language pathologists for the content validation of the stimulus. They were asked to name each picture and suggest the changes that have to do for better understanding of the picture. Suggestions are given below.

I. Static Pictures

Sl. No.	Static Pictures	
	Action verb	Suggestions
1	Clean	Make the floor dirty.
2	Bath	Change the color of towel or floor.(Avoid using same color for person's dress and floor)
3	Clap	Make the hand position in diagonal manner. Sound effects for clapping can be added.
4	Give	Add space between people or change the hand posture of receiving person(open hand for receiver)
5	Cut	Make the scissor much more darker.
6	Close	The picture is creating confusion between open and close. Change the hand posture to make it more meaningful.
7	Catch	Side view is better Increase the size of the ball
8	Sitting	Make the color of chair much more darker.(Avoid using same color for person's dress and floor)
9	Sleep	Fine
10	Write	Use dark color on border of book in order to highlight the book
11	Kiss	Fine
12	Dance	Add music box near to the girl and change the hand and leg movements (eg. hands in diagonal position and one leg raised)
13	Cough	Face expression have to improve
14	Eat	Add some food items inside the utensil and the spoon
15	Hug	Fine
16	Jump	Increase the height while jumping and remove bending
17	Kick	Fine
18	Knock	Fine
19	Listen	Fine
20	Open	Opening is not visible. Use half opened bag with zip and add books inside.
21	Read	Highlight the book and hold it in hands.
22	Throw	Fine

23	Stand	Fine
24	Watch	Side view is better or show the person's shoulder a little bit up in order to view the person.
25	Run	Running effects can be added and slight body bending.
26	Walk	Fine
27	Wash	Fine
28	Sing	Fine
29	Repair	Use any damaged objects like broken parts of vehicles or show some repaired/damaged objects in background.
30	Ride	Fine

II. Animated Pictures

Sl. No.	Animated pictures	
	Action verb	Suggestions
1	Clean	Make the floor dirty
2	Bath	Change the color of towel or floor.(Avoid using same color for person's dress and floor)
3	Clap	Make the hand position in diagonal manner. Sound effects for clapping can be added.
4	Give	Fine
5	Cut	Make the scissor much more darker.
6	Close	Fine
7	Catch	Side view is better Increase the size of the ball
8	Sitting	Make the color of chair much more darker.(Avoid using same color for person's dress and floor)
9	Sleep	Fine
10	Write	Highlight the book by using dark color on borders
11	Kiss	Fine
12	Dance	Add music box near to the girl and change the hand and leg movements (eg. hands in diagonal position and one leg raised)
13	Cough	Fine
14	Eat	Add some food items inside the utensil and the spoon
15	Hug	Fine
16	Jump	Increase the height while jumping and remove bending of legs
17	Kick	Fine
18	Knock	Fine
19	Listen	Fine
20	Open	Add zip and books inside the bag
21	Read	Highlight the book and hold it in hands.
22	Throw	Fine

23	Stand	Change the color of the shirt or floor.(Avoid using same color for person and floor)
24	Watch	Side view is better or show the person's shoulder a little bit up in order to view the person.
25	Run	Running effects can be added and slight body bending.
26	Walk	Fine
27	Wash	Fine
28	Sing	Fine
29	Repair	Use any damaged objects like broken parts of vehicles or show some repaired/damaged objects in background.
30	Ride	Fine