Development of Noun Gesture Corpus

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ALL INDIA INSTITUTE OF SPEECH AND HEARING

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MAY- 2019

CERTIFICATE

This is to certify that this dissertation entitled "**Development of Noun Gesture Corpus**" is a bonafide work submitted in part fulfilment for the Degree of Master of Science (Speech- Language Pathology) of the student (Registration No: 17SLP032). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier for the award of any other Diploma or Degree to any other University.

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DECLARATION

This is to certify that this dissertation entitled "**Development of Noun Gesture Corpus**" is the result of my own study under the guidance of Dr. S. P. Goswami, Professor, Department of Language Pathology, All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier for the award of any Diploma or Degree to any other University.

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"Never forgot what you are. The rest of the world will not. Wear it like armour, and it can never be used against you."

-Tyrion Lannister (A song of Fire and Ice)

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CHAPTER I

Introduction

Communication is an active process which involves encoding, transmitting and decoding information. Human communication, especially the verbal language is complex, though, it is systematic and context bound (Berko-Gleason, 1971). According to Owens (2012), communication is multi-faceted which is enhanced through paralinguistic (suprasegmentals), non-linguistic (body movements, facial expressions, etc), and metalinguistic (analytical skills) codes. One can express feelings, ideas, thoughts in varied ways such as writing, signing, gesturing, pushing buttons on the computer that speaks for them, etc. which are all forms of augmentative and alternative communication systems (AAC). Everyone uses AAC on a daily basis either to enhance the verbal language or replace it. AAC can be aided or unaided, based on the individual requirements. The major form of unaided systems- gestures- are said to be communicative (Alibali, Heath, & Myers, 2001) and are used regardless of the presence of a communication disorder. The gestural communication drew its connection to the language evolution and was the first form of recognized communication in apes. According to the gestural theory of language evolution, the current day verbal language we speak evolved from the manual gestures. Gestures can either co-occur with a speech to augment the verbal language or can be speech replacing to some extent which can be an alternate form of communication.

Studies have supported both notions, of gestures being augmentative and alternative to verbal mode. In this regard, it is found that gestures are visible form of

verbal utterance (Kendon, 2004). Also, gestures and speech are highly integrated, which aids in language reception and expression (Goldin-Meadow, 2003; McNeil, 1992). In similar lines, McNeil (1992) called the gestures to be *co-speech* in nature and gestures to occur with speech always and has classified the gestures accordingly. They are iconic gestures, deictic gestures, metaphoric gestures, beats, pantomimes, and emblems. According to McNeil (1992), iconic gestures as the name indicates are indicative of the shape of the referent, mainly the visual form of it whereas metaphoric gestures refer to abstract concepts; deictic gestures are pointing gestures that refer to concrete and abstract entities; beats are typically rhythmic movements of hands or feet, which rarely convey any semantic meaning; pantomimes refer to actions that demonstrate motor movements that are complex or a serial order of movements that are usually associated with an object and emblems are conventional hand movements that are most of the time perceived without the assistance of speech.

On the other hand, Kendon (2000), has classified gestures along a continuum and named them gesticulation. According to Kendon (2000), the gestures are classified based on the three characteristics namely: the relation of these gestures to speech, their degree of conventionality and its semantic characteristics. Thus, gestures are communicative in function and parallel the verbal language to a large extent (Goldin-Meadow,1999) and may also convey information that is not a part of their speech (De Ruiter, 2006). Studies on gesture-linguistic processing have repeatedly revealed that gestures play an important role in aiding the speaker in word retrieval (Mayberry & Jacques, 2000), in modifying the syntactic structure of a sentence (Alibali, Kita, & Young, 2000) and also emphasising the meaning of speech. In

addition to this Krauss and Hadar (1999) have opined that gestures play a role in tension reduction and lexical retrieval, thus aiding in functions that are beyond the communication and adds to the emotional well being of an individual. Thus, gestures and speech can go simultaneously in a conversation and thus develop into utterances (McNeill, 1992; Kendon, 2004) or speakers may split the content between gestures and speech (Melinger & Levelt, 2004). This property of supplementing or substituting speech output leads us to understand the linkages between speech and gestures at several levels of speech and gesture comprehension and production. Thus, it makes necessary to understand the neural correlates for gestures that are comprehensive and may take over functions to overcome deficits of a certain area when indicated.

Gestures are incorporated in various components of language and show overlap with some parts of language components, especially with speech. Literature reviews have shown that the reason for this could be the possible overlap that the neural correlates for speech and gestures show. Gesture and speech portray overlap in their neural representation in the inferior frontal cortex, Broadman's Area number 45 (Moll, De Oliveira-Souza, Passman, Cunha, Souza- Lima, & Andreiuolo, 2000). This view considers language and gestures as a part of cognition. Additionally, the premotor cortex is modulated by the semantic processing of action within a language. Thus, the left inferior frontal cortex is involved in integrating both gesture and language domains, which is consistent with the theory of language comprehension.

Further one can draw the link between the gesture and speech from the gestural processing models- the Growth Point Theory (McNeill, 1992), the Lexical Retrieval hypothesis (Hadar & Butterworth, 1997), the Sketch model (De Ruiter,

2000), and the Interface hypothesis (Kita & Özyürek, 2003). The Growth Point Theory/sketch/interface models regard the gesture and speech to be in a single integrated system and the processing to happen at the pre-lexical level. On the other hand, The Lexical Retrieval hypothesis (Hadar & Butterworth, 1997), opines speech and gesture to be in separate independent systems and the processing to happen at the post-lexical level. Thus, the models regard the link to be at different levels of processing with interaction at some levels. There can be either a parallel breakdown of both modalities wherein gestures and speech are affected equally, or a trade-off between the gesture and speech modes wherein one mode facilitates/compensates for the other (Mol, Krahmer, & Sandt-Koenderman, 2012). Thus, the gesture is an important form in organizing information before it can be used into a linguistic form for speech. Gesture helps in structuring the elicited speech in different ways as each of these models suggest, thus plays a role in thinking for a speech by enhancing the conceptualization of non-linguistic material. These concepts allow speakers to organize a string of concepts into mental representations, which are further broken down into units that can be verbalized. Thus, gesture-lexical processing facilitates word retrieval based on the priming and lexical decision studies (Kelly, Özyürek, & Maris, 2010). Thus, the association between language output and gestures drawn by each of the models questions the development of gestures with respect to the language development and the impact of impaired language system on gesture comprehension and gesture production. It also becomes necessary to understand the effect of gesture comprehension, production and repetition of a certain class of words on the impaired language system, as differential effect is seen in these word classes such as nouns, verbs, descriptive words, etc.

Need For The Study

Literature supports the view that gestures are important in communication sciences with respect to its development, learning, assessment, and therapy. Many of the standardized assessment tools that are available in India focus on verbal language development and the comprehension and expression skills that can be determined from verbal language responses. Further, non-verbal language is less prioritised and less studied on typically developing children and adults. Assessing children and adults entirely on the basis of verbal language mode may lead to underestimation of their communicative abilities. Similarly, culture influences the way in which one perceives or produces gestures, thereby making it difficult to use western assessment batteries on Indian population. Nouns form the major content of one's communication system. However, there are limited validated noun gestures available for professionals to be used for clinical and research purposes. This study aims to overcome this lacuna and develop a gesture corpus for nouns and validate the same.

Nouns form the core of one’s communication system and are usually acquired first. Similarly, in case of an individual with word finding difficulties, nouns seem to get affected first. Also, when one looks at the vast vocabulary, it is intriguing to understand the type of gestures that can help convey the information better for each of the lexical categories. Thus, it becomes necessary to know the reception and expression of gestural production of nouns in typically developing adults as well as individuals that belong to a clinical population.

The Aim Of The Study:

To develop and validate a corpus of gesture for nouns.

Objectives Of The Study

To classify the gestures across types for the set of nouns and validate it.

CHAPTER II

Review Of Literature

Gestures across population

Gesture, speech and language show tight developmental and neurological coupling (Bates & Dick, 2002). The neural control for speech and gesture show overlap in such a way that spreading neural activation from one region of the brain to another may underlie their co-occurrence. Thus, development of both, non-verbal communication and verbal communication takes place simultaneously in typically developing children. Ejiri and Masataka (2001) reported simultaneous production of canonical babbling with rhythmic hand movements in infants aged 6 to 8 months. A child is first noted to have developed deictic gestures for intentional communication at 8-10 months of age (Bates & Snyder, 1987; Bates 1979) which is followed by use of his first word. It is by 18-20 months of age, that a child not only shows word combinations in verbal language but also shows combination of gestures and word and gesture-gesture combinations for communication (Caselli, 1990; Bates, 1979, Volterra et al., 1979). By two years of age, child shows a preference for spoken language. Gestures still continue to scaffold the child's performance on cognitive tasks that are complex which includes language comprehension or expression- with an intent to augment his or her speech (Capone & McGregor, 2004). However, depending on the cognitive and/or language status of the individual, these gestures may vary in their form, frequency, and complexity. Nonetheless, gestures are still an alternative or augmentative form of communication in various disorders.

Gestures and Specific Language Impairment

Children with Specific Language Impairment (SLI) show deficits in the production of gestures along with language deficits (Wray, Norbury, & Alcock, 2016). Hill (1998), found similarities in the gestures of children with SLI to that of children with developmental coordination disorder i.e. children who experience movement difficulties out of proportion with their general development, and in the absence of any known medical condition (e.g., cerebral palsy) or identifiable neurological disease (American Psychiatric Association, 1994). They found that the two groups were similar in the production of representational gestures such as brushing teeth with toothbrush (transitive gestures), making a fist or snapping fingers (intransitive gestures) where they were reported to have dyspraxic errors. Partially supporting the study conducted by Botting (2010), who suggested that children with SLI are better in gesture comprehension than production of gestures. Wray, Norbury, and Alcock (2016) suggested that the gesture comprehension and production both are affected in children with SLI when compared to their Typically Developing peers. However, children with SLI tend to benefit from redundant gestures where the gesture supports the verbal message as opposed to gestures which provide additional information to the message that is intended to be communicated. Along similar lines, Blake, Myszczyszyn, Jokel, and Bebiroglu (2008) found that children with SLI produce more gestures to compensate for their deficit in verbal tasks in language as compared to their typically developing peers. In a study conducted by Iverson and Braddock (2011), children were asked to narrate stories from a wordless picture book and cartoon sequences. It was found that children with SLI gestured at a higher rate

despite producing fewer utterances per minute. This thought, thus supports the view that communicative gesture and linguistic abilities are independent dynamics in children with language impairment and also, that gesture maybe a compensatory method in comprehension.

Gestures and Autism Spectrum Disorder

Hobson (1986a, 1986b) reported impairment in understanding emotions conveyed via gestures in children with Autism Spectrum Disorder (ASD). They show gestural communication to a lesser degree as compared to other typically developing children and children who show developmental delays (Medeiros & Winsler, 2014; Bono, Daley, & Sigman, 2004). Colgan, Latner, Mccornish, Watson, Crais, and Barnek (2006) found decrease in the type of gestures produced by children, who were later diagnosed on the autism spectrum, in the age of 9-12 months. They reported repeated use of single gestures and decrease in self-initiated communication skills in such children. However, these gestural abilities in children with ASD highly reflect the severity of ASD symptoms and adaptive functioning. (Kjellner, Havel, Fenele, & Norrelgen, 2012).

The deficit and deviances in the gestural development in children with ASD can be attributed to various reasons. Wing Chee So, Ming Lui, Wong, and Long-Tin Sit (2015) hypothesized that such children show poor abilities to think from the perspective of others, thus show a decrease in producing gestures that identify the referents. Another possibility is that children with Autism Spectrum disorders show an overall decrease in their abilities to communicate with gestures and speech. Children

with ASD show poor gesture comprehension which can be attributed to their poor spatial and verbal memory while listening to the experimenter. Another possible reason could be their poor abilities in integrating gesture and speech during comprehension (Wing Chee So, Ming Lu, Wong, & Long-Tin Sit, 2015; Silverman, Benetto, Capana, &Tanenhaus, 2010). Irrespective of these deficits, children with ASD show fair skills in protoimperitive pointing (gestures for making requests; Baron- Cohen, 1989; Wetherby & Prizant, 2002), iconic and beat gestures, however; these skills might still show delay in their development (Luyster, Lopez, & Lord, 2007; Charman, Drew, Baird, & Baird, 2003). Thus, children with ASD show decrease in the overall production and comprehension of gestures that can be attributed to various factors including their deficits in social communication, an impaired theory of mind and sensory and perceptual deficits.

Gestures and Down's Syndrome

In contrast to children with autism, children with Down's syndrome (DS) show expressive gestures to convey emotions. They show greater use of gestures, to compensate for the difficulties that they encounter in spoken language (Iverson, Longobardi, & Caselli, 2003; Zampini 2008; Zampini D'Odorico, 2011). Their gestural development is similar to that of their typically developing peers, thus forming an early communicative repertoire in children with DS (Ozçalışkan, Adamson, Dimitriva, Bailey, & Schmuck, 2016; Mundy, Kasari, Sigman, & Ruskin, 1995). Özçalışkan, Adamson, Dimitrova, and Baumann (2017) observed twenty- three 30-month-old children with Down's five times over a year during parent-child interactions, along with 18-month-old typically developing children. It was seen that

many of the unique gestures entered the children's vocabulary within the period of observation, however, the same could not be said about the children with DS who showed marked delay in their spoken vocabulary. Children with DS used gestures like typically developing children to show referents that they otherwise cannot show in speech. Thus, children with Down's syndrome compensate for their lack of expressive vocabulary by gesturing at rates that are comparable to that of typically developing children (Iverson et al., 2003; Zampini, 2008; Zampini& D'Odorico, 2011) and in some cases, even higher than typically developing children (Caselli, 1990).

Gesture and Apraxia

Gestural impairment was initially thought to be a result of apraxic movement disorder. Pantomime deficit observed in individuals with limb apraxia (Duffy & Duffy, 1981). Apraxic individuals with more posterior lesions had difficulty comprehending meaning of pantomime gestures (Rothi, Heilman, & Watson, 1985). The posterior parietal region of the cortex maybe responsible for the production and comprehension of meaningful movements (De Renzi, Faglioni, Scarpa & Crisi, 1986); Kertesz, Ferro, & Shewan, 1984). Individuals with apraxia also showed deficits in the conceptual knowledge for actions. In such an individual, lesion mapping studies showed damage in the left premotor/prefrontal, parietal cortex and in the white matter beneath the posterior middle temporal cortex. Thus, a number of studies concluded that both, production and recognition are impaired in parallel in patients with left parietal lobe lesions whereas patients that show lesions that are more anterior and which do not involve the left parietal lobe, show difficulties in producing pantomimes (Heilman, Rothi, & Valenstein, 1982)

Gesture and Schizophrenia

Individuals with schizophrenia show less use of spontaneous hand gestures (Troisi, Spalletta, & Pasini, 1988) along with poor hand imitation skills (Walther, Vanbellingen, Müri, Strik, & Bohlhalter, 2013). These are usually linked to several deficits including negative symptoms, motor abnormalities, frontal lobe dysfunction, and working memory impairments (Park, Matthews, &Gibson, 2008; Lavelle, Healey, & McCabe, 2013; Walther, Vanbellingen, Müri, Strik, & Bohlhalter, 2013). Along with impairments in the expressive use of gestures for communication, these individuals also showed impairments in perception and recognition of faces, facial expression, and gestures. This was attributed to perceptual or cognitive impairment associated with this condition (Berndl, Von Cranach, & Grüsser, 1986). Thus, there is tight linkage in the perception and performance of gestures in persons with schizophrenia (Stegmayer & Sulzbacher, 2015). These deficits in persons with schizophrenia impair social interaction and thus affect social functioning.

Gestures and Aphasia

Gestures have been reported to augment speech communication in Persons with Aphasia (PWA) or used as an alternate form of communication. Goodwin (2006) in a single case study, suggested that persons with aphasia used a combination of gesture and speech for communication and was able to express more complex ideas and thus, attune their verbal output which was limited. It is seen that, gestures were used as an alternate form of communication by individuals with aphasia (Poggi, 2008) and that individuals with severe aphasia and decreased speech fluency, showed

gestures that were ‘meaning-laden’ (Preisig et al., 2018). They attributed this phenomenon as a way of non-verbal compensatory strategy for their language deficit (Hogrefe, Ziegler, Wiesmayer, Weidinger, & Goldenberg, 2013). Another reason could be that it is a strategy for lexical retrieval that is seen is healthy individuals (Krauss & Hadar, 1999).

In contrast to this view, both gesture and speech can also have a parallel breakdown in persons with aphasia (Mol, Krahmer, & Sandt-Koenderman, 2011). This has called the need for a more holistic approach for the treatment of individuals with aphasia, which focuses on the flexible multimodal form of communication. Such an approach may lead to manage better and improve the quality of life of a person with aphasia. Several studies had reported significant improvement in persons with aphasia when gestures were paired with verbal production in the treatment (Pashek, 1997). This leads to benefit in the overall communication of an individual as it can facilitate word retrieval, augment or be an alternative form of communication in persons with language deficit. Rose, Douglas, and Matyas (2002) found that gestural treatment using pantomimes in persons with aphasia was more effective in treating word retrieval impairments that were more phonologically based than errors that were semantically based. Raymer, Singletary, Rodrigues, Ciampitti, Heilman, and Gonzales Rothi (2006) reported that PWA showed improvement in the voluntary use of gestures following treatment that involved gestures plus speech treatment (GV treatment). GV training was equally effective in increasing verbal naming of nous as it was for verbs.

Gesture and Therapy

Use of gestures as a strategy to retrieve word is very common. Thus, literature supports that word retrieval errors were more when participants are prevented from gesturing during speech (Rausher, Krauss, & Ches, 1996; Fric-Horbury, & Guttentag, 2002). At the same time, when gestures were accompanied by speech, such failures decreased remarkably (Butterworth & Haddar, 1997). Gestural treatment when coupled with speech treatment can bring about different results for nouns and verbs, depending on the type of aphasia. Many authors have suggested that left inferior temporal lobe lesion and fluent aphasia show impairment in noun retrieval as compared to verb retrieval. On the other hand, individuals with lesions of the left inferior frontal cortex and non-fluent aphasia show lesions difficulty in verb retrieval as compared to that of nouns (Zingeser & Berndt, 1990; Shapiro et al., 2005).

Gestures and Nouns

As seen in the traditional language, the noun-verb distinction is also found in gestural language. Children and adults appear to have an implicit way of storing nouns and verbs when they come across an unfamiliar noun or verb (Nagy, & Genter, 1990). E.g., when one encounters a noun, they use properties that describe its physical appearance, to store that object in memory. Similarly, verbs are stored by the action that they perform (Nagy & Getner, 1990). There are limited studies that are available to study the type of gestures used for the production of noun form in gestures in typically developing adults. It is necessary to understand that nouns form an important part of ones utterances and form the content words in communication. Nouns from the

core of ones communication system and are usually acquired first and similarly, affected first in case of individuals who may face word finding difficulties. Also, when one looks at the vast vocabulary, it is intriguing to understand the type of gestures that can help convey the information better for each of the lexical categories. Thus, it becomes necessary to know the reception and expression of gestural production of nouns in typically developing adults as well as individuals that belong to a clinical population.

The way the noun-verb distinction is made in verbal language, a similar distinction can be made in sign language (Tkachman & Sandler, 2013). Hunsicker and Goldin-Meadow (2013), conducted a single case study on a boy named David, over a period of two years. The child was hearing impaired, born to normal hearing parent. David learned homesign over his developmental years. Around 3.5 years of age, David used *object* gestures, that are similar to iconic gestures to represent nouns, however, after this age, as David began to combine forms, to convey more complex ideas via gestures, he used *object* and *handling* gestures (that are similar to pantomime gestures) to represent nouns and verbs. However, this child used different spatial-temporal characteristics to differentiate between nouns and verbs. For e.g. opening a jar handling action, when done next to the jar, meant that he needed help to open the jar (verb), however doing so at chest level, close to the body, meant he was referring to the jar (noun).

Gestures are different from sign language, as gestures are more arbitrary. However, both are similar regarding noun production. Al-Sayyid Bedouin Sign Language (ABSL) is a sign language that is in its developmental stage, from a

prevailing sign language from a community in Bedouin that was found more than 200 years ago, in the Israeli borders (Sandler, Meir, Padden, & Aronoff, 2005). This is reported to use iconic gestures to represent nouns. However, it has not been established if they use similar gestures to represent verbs by Padden and his colleagues. Z language, as the language is referred to, is a sign language developed by a community of Zinacantán highland Chiapas, Mexico, called the Mayan. This community had no prior exposure to an established sign language, however, similar to to the ABSL, it uses describing gestures to represent nouns. A remarkable feature of this sign language is that their gesture to represent nouns is in contrast to that used for verbs, wherein gestures for verbs are more pantomime in nature. Thus, differences can be seen in way a gesture is produced for nouns compared to other word classes, wherein the gestures produced for nouns are more iconic in nature. This finding can be seen across various cultures and the different ways of acquisition of these gestures (learned or developed) for the purpose of communication.

CHAPTER III

Method

The study was carried out in three phases adhering to the AIISH ethical committee guidelines:

1. Phase 1: Stimulus generation - Developing gesture videos.

2. Phase 2: Rating - Appropriateness rating for the gesture videos that was developed.

3. Phase 3: Validation - Validating the corpus by participants

Equipment/Tools used for developing gesture corpus

A. Laptop- 13 inch, macOS Mojave version 10.14.2

B. HD video recorder

C. Appropriateness rating scale for gestures adapted from Feedback Questionnaire scale for Aphasia Treatment developed by Goswami, Shanbal, Samasthitha, and Navitha in 2010

Phase 1: Stimulus generation

After a thorough review of the Indian version of Boston Naming Test- BNT (Shyamala, Sunil Kumar, & Vijayetha, 2011), Manual for Adult Aphasia Therapy (MAAT) (Goswami, Shanbal, Samasthitha, & Navitha, 2010) and a study by Prarthna and Rao (2015), 253 nouns were shortlisted which served as stimuli for developing

the gesture corpus. Of these, a total of 50 nouns were selected from BNT, 78 from MAAT, and 125 from the study by Prarthna and Rao (2015). Four individuals from different professional backgrounds [two Speech- Langauge Pathologist (SLP) and one Audiologist with training in classical dance form and an Audiologist with an acting background in theatre arts] who served as actors, enacted different gestures. Informed consent was taken from all the actors participating in the study. The demographic details of the actors are given in the Table 1. In order to develop a gesture corpus which is both comprehensive and useful, professionals like a SLP and an audiologist were included in the study as they have prior experience of extensive interaction with persons who resort to non-verbal modes of communication owing to a certain communication disorder. A trained dancer was able to provide explicit gestures while enacting, thereby improving the clarity of the stimulus. An audiologist with experience in theatre arts was able to provide expressive and varied gestures for nouns that may require improv and on the spot thinking, yet in a natural manner.

Procedure for developing gesture videos. The shortlisted nouns were then presented to the four actors, one at a time, on a laptop (13.3 inches, Intel HD graphics 6000) kept at a distance of approximately 10 feet from the rater to enable accurate reading of the word presented. To derive at specifications of stimulus duration, the duration for the enactment of the gesture and inter-stimulus interval a pilot study was conducted with a set of ten nouns and two actors. Based on the pilot study a feasible duration of the stimulus presentation, the duration for enacting gesture and inter-stimulus duration has been selected 3sec, 10sec, and 3 sec respectively. The actors were then instructed to enact a spontaneous and comprehensive gesture as the stimulus is presented. Using a Nikon D3300 video recorder, the gestures being

enacted by the three actors was recorded, one actor at a time, in a soundproof audio-visual room keeping the distractions as minimal as possible. The gesture videos thus acquired were edited using the iMovie software (version 10.1.10).

Table 1: *Demographic details of Actors*

Sr. No.	Actor Number	Age	Gender	Profession	Number of years of practicing a specific art form
1	Actor 1	23	F	Student in Masters programme of SLP	Cultural Dancing since 17 years
2	Actor 2	29	F	Audiologist	Cultural Dancing since 20 years.
3	Actor 3	32	M	Audiologist	Theatre Acting with since 15 years.
4	Actor 4	32	F	SLP	Cultural Dancing since 15 years.

Phase 2: Appropriateness rating

The gestures of the stimulus enacted by all four actors were presented to a total of 18 individuals, three each, under six different categories namely Speech Language Pathologist, Audiologist, Special Educator, Sign Language user/trainer/ interpreter, caregiver of a person with a communication disorder, and commoner for appropriateness rating. The selection of raters under these categories thus provided a holistic perspective on the current lines of research.

Procedure for rating the gesture corpus. Informed consent was taken from all the raters participating in the study. After randomizing the gesture set derived at the end of phase 1 of the study, appropriateness rating was carried out using a 3-point Likert rating scale (0-poor, 1-fair, 2-good) for rating the gestures across 3 domains such as familiarity, simplicity, and relevancy adapted from Feedback Questionnaire scale for Aphasia Treatment developed by Goswami, Shanbal, Samasthitha, and Navitha in 2010. Individual raters were invited and given a brief introduction to the

study. There was no interaction between the raters throughout the study. The raters were presented with the stimuli in a distraction-free environment where each gesture was displayed for a maximum of 2 times, and the raters were given a maximum 2 minutes for each gesture video to be rated. For the next phase of the study, i.e., validation, those gestures which receive a fair and good rating and with good inter-rater reliability were selected.

Phase 3: Validation

The validation of the developed corpus was facilitated through 10 individuals who are above the age of 18 years.

Procedure for validation. Informed consent was taken from all the validators participating in the study. 10 individuals, who were preferably native speakers of Kannada were presented with the gesture corpus developed at the end of phase 2. They were presented each gesture video for a maximum of two times and were instructed to name the video by writing down their responses against designated columns in the response sheet provided. The final corpus included only those gestures that receive good consensus among the validators and also with the original stimuli of phase 1. The "Noun Gesture Corpus (NGC)" corpus developed was transferred to an appropriate stage device where it will be stored in a digital form. Thus, the storage device also include the following materials

(a) User manual for NGC (b) Corpus of Nouns (c) Gesture Videos

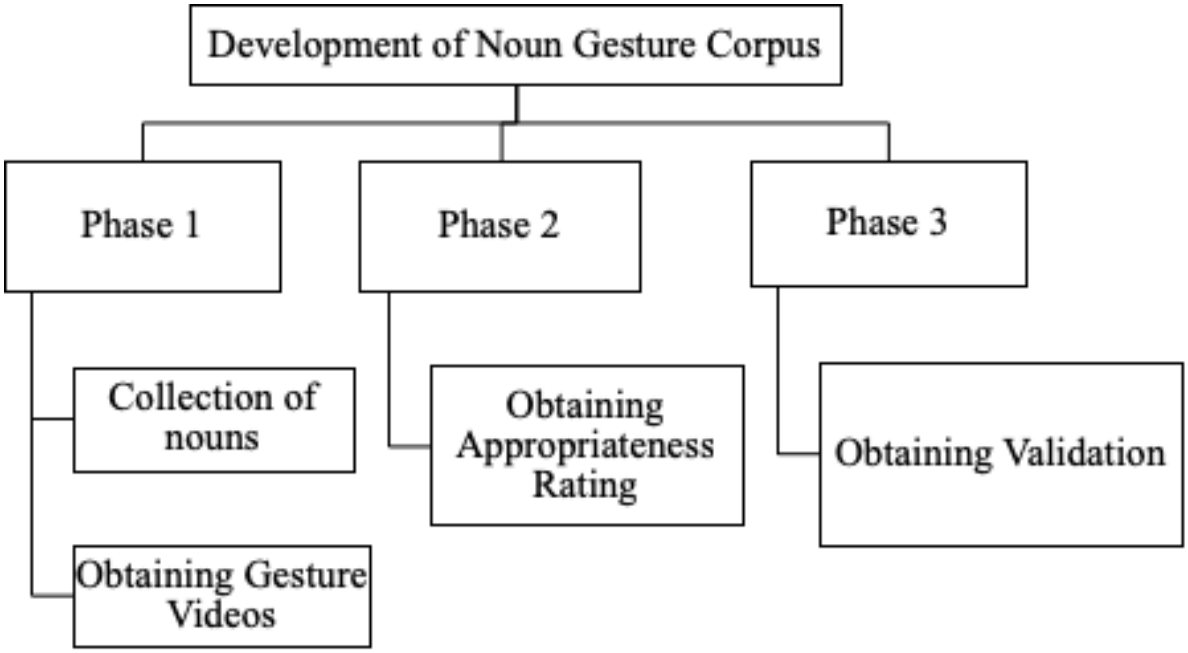

Figure 1: Development of Noun Gesture Corpus

CHAPTER IV

Results And Discussion

The primary aim of this study was to develop and validate a gesture corpus for a set of nouns that can be used for assessment, therapy and future experimental research. The study was carried out in three phases.

Phase 1

Phase 1 included obtaining nouns from the various sources and recording videos from the 4 actors i.e. two speech language pathologist, one audiologist and one trained dancer. Nouns that were repeated in multiple tests or had similar meanings, for example ‘Airplane’ and ‘Aeroplane’ were discarded and only one of each of such nouns were retained. Thus, total of 50 nouns were selected from BNT, 78 from MAAT, and 125 from the study by Prarthna and Rao (2015) adding to a total of 253 nouns. The videos obtained by recording the gestures performed by actors were edited on the iMovie software (Version 10.1.10) and were introduced in phase two.

Phase 2

A total of 18 raters from different groups (Audiologists, SLPs, Special Educators, Sign Language Users/Interpreters, Caregivers, and Commoners) were shown each of these videos on the VLC media player. The videos obtained from phase one were rated on three parameters, namely- familiarity, simplicity and relevance. This scale was an adaption of the Feedback Questionnaire scale for Aphasia Treatment developed by Goswami, Shanbal, Samasthitha, and Navitha in 2010. These parameters were selected as they were most appropriate and most suited parameters to rate the gesture videos to establish its meaningfulness for individuals belonging to the cultural society based in the Southern region of India. While looking

for familiarity, raters were asked to see how familiar the gesture is with respect to a particular noun. Similarly, while looking at the simplicity raters were asked to note how easy was it to comprehend the gesture and lastly, to note if the gesture was culturally/ethically relevant to them while rating its relevance. Qualitative analysis was carried out on this rating. Videos that were most familiar, simple and relevant (i.e. mode =2) were selected for the validation phase. Videos were discarded by the raters when the gestures representing the nouns were not familiar, not simple to comprehend or were not culturally relevant. A total number of 50 videos enacted by Actor 2 were rated as poor because of poor video quality as mentioned by the raters. Thus, a total of 752 gestures which were selected for the validation phase and a total of 25.7% of the videos were discarded in Phase 2. In the corpus that proceeded to the validation phase, 72.73% belonged to Actor 1, 90.12% belonged to Actor 2, 60.08% belonged to Actor 3 and 74.31% belonged to Actor 4. At any of these three stages, variable such as age, gender and education were not considered. All the actors, raters and validators were residents of South India, thus minimising cultural variation in enacting, rating and validation.

Of these videos, gestures enacted by Actor 1 and Actor 2 received highest validation from Sign language users/interpreters i.e. for 69.96% and 90.12% (Mode=2). Actor 3 received highest rating from Audiologist with 74.7% (Mode=2) and Actor 4 received highest rating from special educators i.e. 90.91% gestures being selected for phase 3. All the actors received lowest rating from Speech language pathologist with 40.31%, 65.22%, 35.97% and 43.08% for Actor 1, Actor 2, Actor 3 and Actor 4 respectively, proceeding to the validation phase. Thus, it is seen all four actors have received lowest rating from SLP professionals when compared to other

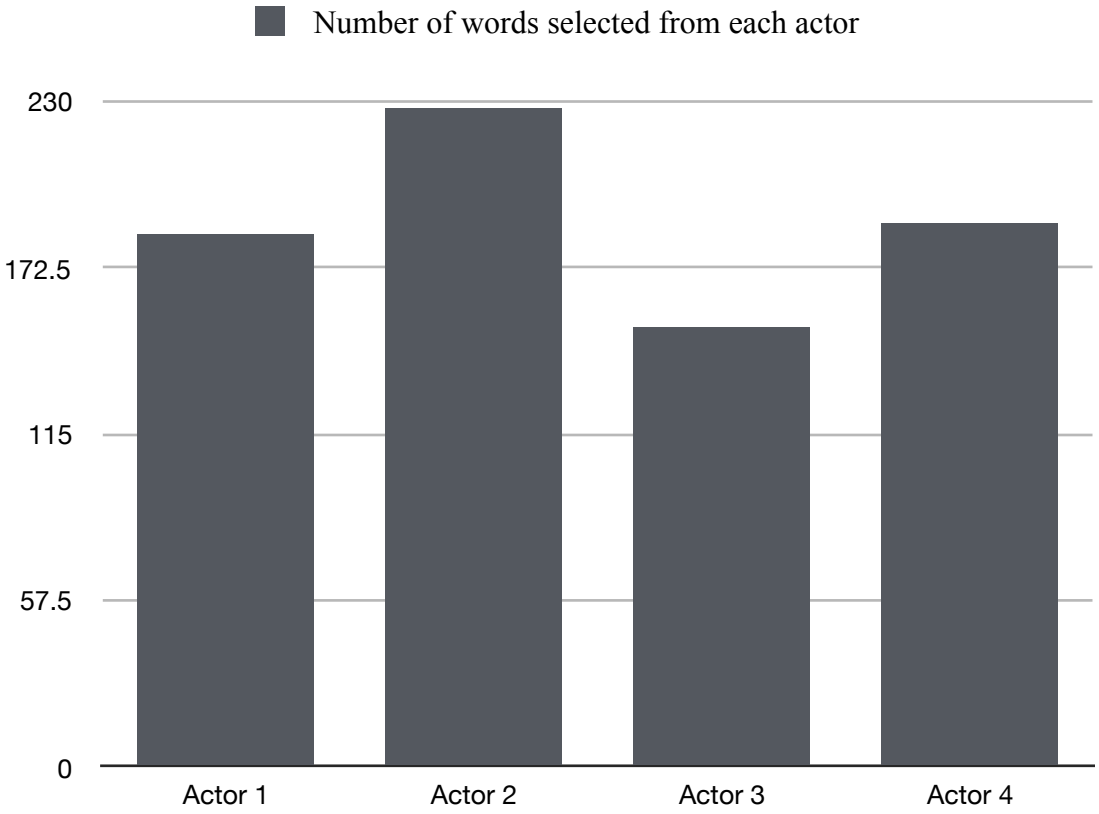

Figure 2: Number of words selected in Phase Two

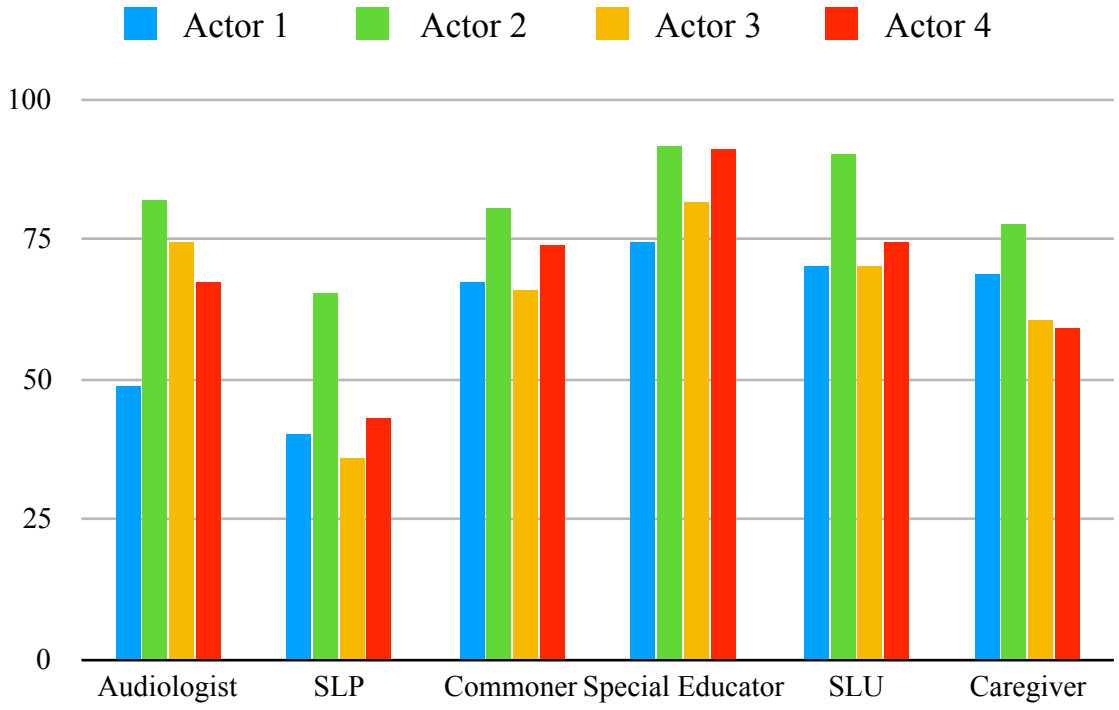

Figure 3: Rating received for actors across various groups

group of raters (Figure 3). A possible reason for this can be that Speech Language Pathologist use gestures that are co-speech in nature and thus, as an augmentative form of communication. There is limited use of only gestures solely for communication purposes in assessment and treatment. Similarly, one can also say that Audiologist also may use gestures associated with nouns that are arbitrary, iconic or dietetic in nature, as they often encounter persons with congenital and acquired hearing impairment with or without formal training in sign language. These professionals can fairly associate these gesture forms with nouns in individuals with hearing impairment for the purpose of communication. There looks to be a close consensus amongst the commoner, Special Educator, Sign Language User and caregiver of persons with disabilities. Commoners and caregivers of persons with disabilities may have minimal understanding of use of gestures and may use it solely as a purpose to augment or alternate speech in the understanding or production to persons with disabilities. Similarly, Sign Language Users and interpreters in India use sign language that is representative of the semantic form of a particular word. However, the comparison of sign language and gesture forms of nouns are beyond the scope of this study. Amongst all the raters, a consensual high rating was received for Actor 2 and Actor 4 who are Audiologist and SLP with a background of training in professional dance. A possible reason for this could be the number of years of training and the proficiency the actor has in cultural dancing. Actor 1 has comparatively received less number of training in cultural dancing that can account for the less consensual rating amongst all the raters. All the raters gave mutual feedback of more grooming moments present in the gestures performed by Actor 1 which accounted can also account for less intelligibility of gestures. Actor 1 was also reported to have less

intelligible gestures when compared to other actors. However, her facial expressions were elaborate and expressive, as reported by the raters. Actor 2 was reported to have elaborate gestures with increased duration, with appropriate expression and gestural cues to indicate the nouns. Actor 3 was reported to perform gestures that were concise but lacked precision in terms of movements. The gestures performed by actor 4 were concise and of less duration. Various factor such as number of years of training in the cultural background, proficiency, personal style, etc. could account for these differences. Thus, at the end of Phase 2, 752 gestures were included in the validation phase that received consensual rating by various group of professionals, caregivers and commoners.

Phase 3:

Videos that were named correctly in stage 3 at least 80% of the times were included in the final gesture corpus. It was seen that a total of 259 gestures were identified correctly at least 80% of the times it was presented to the validators. It was seen that of the 259 nouns that were validated, 135 noun gestures were repeated i.e. they received validation from more than one actor. Therefore, repeated noun gestures were deleted by selecting the ones that had highest validation or at random, as necessary. Thus, 124 noun gestures were included in the final gesture corpus. Of these, 15.32% of the gestures belonged to Actor 1, 45.16% of the gestures belonged to Actor 2, 25.00% of the gestures belonged to Actor 3 and 14.52% of the gestures belonged to Actor 4 and thus, received validation.

Gestures follow the iconic, deictic and arbitrary nature in the present corpus. However, the actors in the final corpus performed a series or a combination of these gestures to represent a single noun. For example, to represent the gesture for while

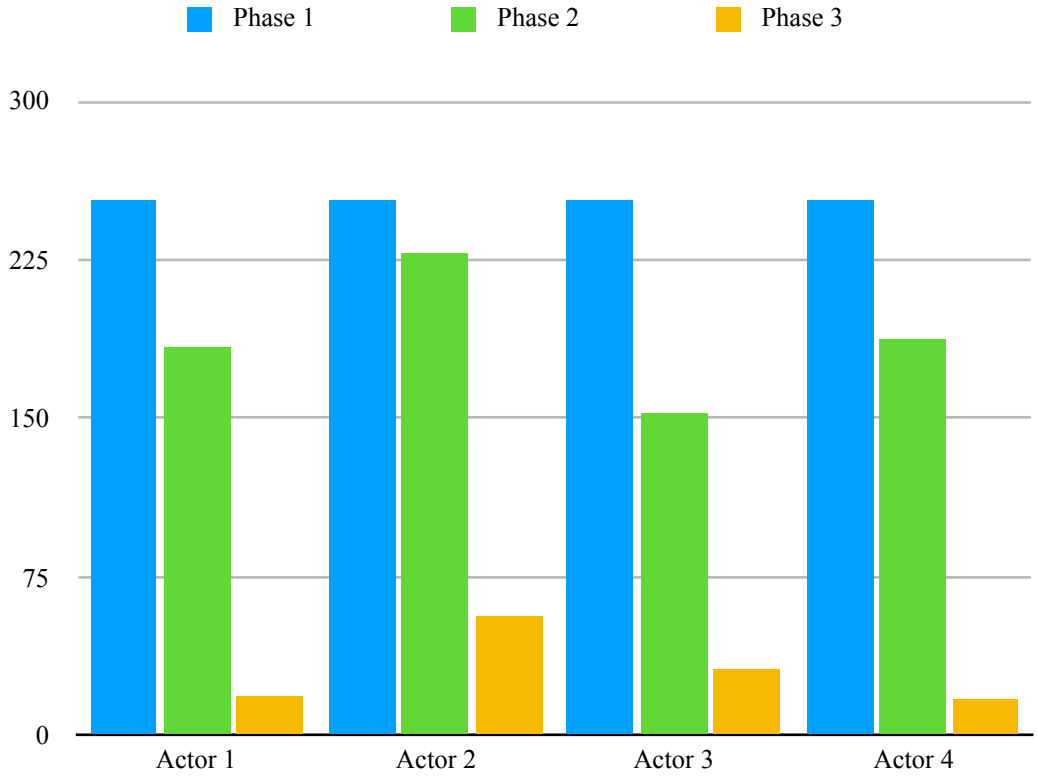

Figure 4: Words selected across various phases across actors

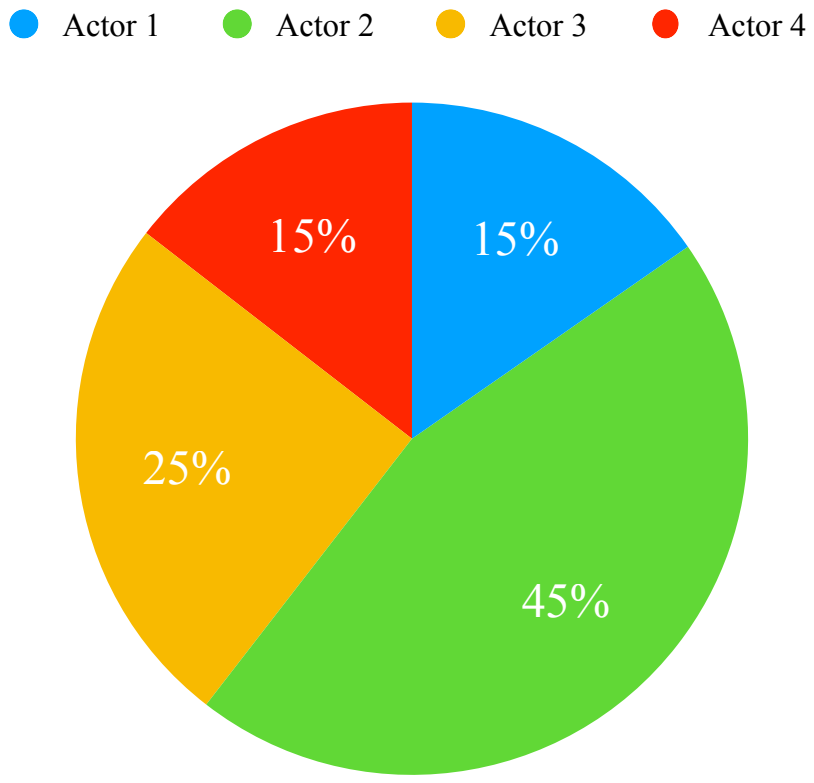

Figure 5: Distribution of gestures across actors in Noun Gesture Corpus

referring to a chair, Actor 4 gestured to write with a pen on a paper gestured by her left hand and then pointed to the pen to show the target noun in this stimulus (Figure 6a). Similarly, Actor 2 enacted the act of sitting, got up and then pointed to the gestured chair (Figure 6b). Thus, it is seen that the nouns in the corpus are identified by a series of identifying gestures. Sassure (1916) claimed that the reason behind the dynamic nature of gesture is because the meaning of a word is multi-dimensional, whereas language is unidirectional in nature. Supporting this finding, Antinucci an Parisi (1973) stated that noun identifies the referent in a verbal language in order to attribute new predications. Thus, by attributing a set of predications, the task of identifying a referent is achieved univocally and can be identified by a collection of semantic features. To identify a chair one can say, an OBJECT, TO SIT ON, WITH LEGS, WITH BACK, etc. (Figure 6b). Thus, some of the identifying features are abstract in nature, some refer to its function, while others refer to the physical properties of the referent.

Figure 6a: Actor 4- Pen

Figure 6b: Actor 2- Chair

Figure 6: Combination of gestures

However, a general trend seen on the results is that nouns represented in the corpus are mainly iconic in nature. This means to say that, the way in which nouns are represented shows the way in which the object is handled or it looks. This receives the support from the study by Padden, Hwang, Lepic, and Sharon Seegers (2015), where they reported that non-signers (persons who used gestured to communicate) used handling strategy to represent tools eg- holding a lipstick in hand and applying it on face (Figure 7a and 7b) as opposed to the signs used by sign language users who used the finger to refer to the lipstick and moving it across the lips in an applying motion. These gestures thus, can be referred to as "creative-iconic-gestures" (Poggi, 2008). These are gestures that do not have a standard form to represent them and need on-the-spot thinking to refer to an object you can point at it, or imitate its shape or movements, or the actions performed with it. Thus, when accompanied with speech, such gestures could indicate information about the corresponding speech units. This can go a step further and help in disambiguate speech units. Holle and Gutner (2007)

Figure 7a and 7b: Actor 2- Lipstick (Iconic Gesture)

used electroencephalogram to study the degree to which iconic gestures convey information that is not found in speech. In this experiment, participants watched videos of a person who was gesturing and speaking concurrently. These sentence consisted of a homonym in the first half of the sentence which co-occurred with sentences that either supported a dominant or a subordinate meaning which occurred in the latter half of the statement. N400 obtained from these studies showed smaller amplitude in the congruent paradigm and larger amplitude in the incongruent paradigm, supporting the view that listeners relied on iconic gestures to disambiguate the speech. A similar experiment was also conducted by Holler and Beattie (2003). In almost half of all explanations, participants produced co-speech gestures to illustrate the relevant meaning. Thus, iconic gestures present in the corpus for several classes of

Figure 8a: Actor 1- Nose *Figure 8b:* Actor 2- Stomach

Figure 8: Deictic Gestures

nouns required immediate thinking and enacting so as to associate the gesture with the linguistic form of the word (Ekman & Friesen, 1969).

On the other hand, if one has a location or an object, person, concrete or abstract event present in or linked to the place the person is gesturing in, such as to bring the addresses attention, one can use deictic gestures. These gestures mainly use finger pointing. For example, while showing the nouns representing body parts, all the actors in the current corpus pointed to the same, for example- pointing to the nose to refer to the nose (Figure 8a) or pointing to the stomach to refer to the stomach (Figure 8b). Gesture that are either deictic or iconic, refer to an entity that is concrete or abstract respectively. This was taken into account by the actors for selecting a particular feature of the noun. If this referent was present in the immediate environment, the feature of this noun that was most salient was its present location. Thus, the actor simply indicated in what direction the addressee can find the referent (deictic gesture). However, if this referent was not present or if it cannot be easily pointed, the actor had to create a signal for that was iconic in nature. This gesture imitated the referent by selecting one or more of its visually perceivable features and representing them with hands.

Another way to classify to the gestures seen in the corpus was by referring to the arbitrary nature. A gesture is arbitrary when between the signal and its meaning there is no relationship — similarity, mechanical determinism, or any other kind of link that allows one to understand the meaning from the signal without knowing it in advance (Poggi, 2008; Ekman & Friesman, 1969). For example- when referring to a fish, most of the actors did the arbitrary action for fish by placing the palm of one hand on the back of the other hand and then wiggling the fingers. Similarly, Actor 2

Figure 9: Actor 4- House (Arbitrary gestures)

referred to plane by placing her right palm downward at the level of her forehead and moving it in a sweeping action from right to left. Arbitrary gestures are also typical of culture and its learning is achieved in a similar manner, by associating the form to its shared meaning (Ekman, 2004; Ekman & Friesen, 1969; Gullberg, 2006; Haviland, 2005). These gestures are similar to words and have neuroscientific evidence that there is a difference in the neural activity between emblems and meaningless gestures which is analogous to the difference observed between words and pseudowords (Gunter & Bach, 2004; Wu & Coulson, 2005). Thus, like words, arbitrary gestures are prone to cultural influence and can take different meanings in different cultures, more than pantomimes (Agostini, Papeo, Galusca, & Angelika Lingnau, 2018). For example- a house is usually represented by the holding both the hands in a slant position and touching them only at the fingertips, as represented by actor 4 (Figure 9).

This was validated by the raters 80% of the times. However, this nature cannot be highlighted in this study due to the restricted area in which the study was carried out. However, one can easily say that arbitrary gestures are more easily understood as compared to other gestures and are attended to more frequently (Ekman & Friesman, 1969). This can be because of its explicit definition. For example, gestures for animals like elephant where all actors stretched their arms forward with palm pointing down and fingers pointing outward and making a continuous up and down motion of the hand, to sign the elephant's trunk.

Apart from these, the actors also used facial expression to express their gestures. These expressions have the capability to replace a sequence of words (Ekman, 1989). For example, Actor 2 enacted ice-cream by gesturing to hold an ice-cream cone in her left hand and then licking it. She then smiled and shut her eyes to show that its tasty, cold and sweet. Similarly, in another stimuli, she made a holding gesture with her right hand, pretended to lick the held item and then smiled to indicate the sweet nature of the object she was eating. This object was a mango. Thus, facial expression can be associated with speech content, emotion, personality and other behaviour variables (Cassell et al., 1994).

The study has several advantages. Firstly, the study is the first of its kind, providing a gesture corpus for nouns that includes a corpus of arbitrary, iconic and dietetic gestures. Secondly, the corpus as created in a controlled manner, by allowing the same set of actors to perform all the gestures, the background is neutral and identified across all the videos and all videos have a comparable length of nearly 10 seconds and have been edited and presented using the same software. Third, the rating and validation of the videos were carried out by a comparable population all based in

the southern part of India. Thus, there is a reliable measure of the meaningfulness of the gesture and a correspondence between the intended the expressed meaning (i.e., the meaning as understood by the raters).

In conclusion, this study provides highly controlled quality videos of deictic, arbitrary and iconic gestures, with the results of a study that was first of its kind to establish their meanings and consistency across individuals in the southern part of India. This data can stimulate research on the processing of gestures and can promote the replication of observations from independent studies.

CHAPTER V

Summary And Conclusion

The aim of the present was to develop a corpus of gesture for nouns and validate the same such that it is publicly available. This corpus can be used in a wide range of areas such as research wherein, one can identify the processing of meaningful noun gestures, which can include usage of neuroimaging techniques, research on identifying the processing of arbitrary, deictic or iconic gestures as well as selective impairment gesture processing, production or comprehension in brain-damaged individuals. This gesture corpus can be a part of a protocol for assessment in various clinical population. Similar to picture naming therapy, gesture naming therapy can be developed using gesture corpus.

The study was carried out in three phases. Phase one included generation of stimulus for 253 set of nouns collected from various sources. Four individuals from varied background served as actors who enacted the gestures for the noun stimulus provide. Stage two included appropriateness rating of these nouns from 18 raters that have various professional background and who interact with individuals with disabilities such as SLPs, audiologists, Sign Language Users/ Interpreters, Caregivers of individuals with disabilities, Special Educators, and Commoners. Further, the nouns that received a rating of most familiar, simple and relevant proceeded to phase 3 which included validation of these nouns. These noun gestures are highly controlled quality videos that are a mixture of arbitrary, iconic, and deictic gestures and were rated by a varied group of professionals who come in contact with person with disabilities on a regular basis. Rating also included commoners to get an insight into

their perception of gestures. Further, validation helped in obtaining a corpus of gestures that were identifiable by typically developing adults. It also helped in obtaining nouns in their most accepted lexical form, by identifying their most used English name. In conclusion, this study has helped in obtaining a corpus, named 'AIISH Noun Gesture Corpus', containing 124 noun gestures that have an established meaning and consistency across individuals based in the southern part of India.

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APPENDIX A

MANUAL

AIISH Noun Gesture Corpus (ANGC)

MANUAL

What are gestures?

Communication is an active process which involves encoding, transmitting and decoding information. This information is mainly expressed verbally. However, one also needs skills that will enhance communication. This can be achieved through suprasegmental skills, body movements, facial expressions, metalinguistic skills etc.. Gestures are form of communication that uses various parts of the body, mainly the hands and the feet, along with facial cues to express ideas, emotions, or an attitude (Merriam Webster).

Why assess gestures?

A majority of the standardised tools available in India use focus on verbal language development and the comprehension and expression skills that can be determined from verbal language responses. Non-verbal language is less prioritised and less studied on typically developing children and adults. Assessing children and adults entirely on the basis of verbal language mode may lead to underestimation of their communicative abilities. Similarly, culture influences the way in which one perceives or produces gestures, thus making it difficult to use western assessment batteries on Indian population. Nouns form the major content of one's communication system. However, there are limited validated noun gestures available for professionals to be used for clinical and research purposes. This assessment aims to overcome this lacuna and asses gesture comprehension in individuals with various disorders.

Why assess nouns?

Nouns form the core of one’s communication system and are usually acquired first. Similarly, in case of individual with word finding difficulties, nouns seem to get affected first. Also, when one looks at the vast vocabulary, it is intriguing to understand the type of gestures that can help convey the information better for each of the lexical categories. Thus, it becomes necessary to know the reception and

expression of gestural production of nouns in typically developing adults as well as individuals that belong to a clinical population.

Who can use it?

The Noun Gesture Corpus can be used by Speech Language Pathologists (SLPs) who want to estimate the overall communication abilities in various childhood and acquired communication disorders such as hearing impairment, aphasia, cerebral palsy, etc.

Requirements for the test:

- A laptop or a computer to display the Noun Gesture Corpus
- Noun Gesture Corpus CD
- Scoring sheet

Administration Time:

- Approximately 1 hour

About Noun Gesture Corpus

The Noun Gesture Corpus includes a total of 124 nouns enacted by 4 actors that are labelled as Actor 1, Actor 2, Actor 1 and Actor 4. The number of gestures enacted by each of these actors are listed below

Actor 1- 19

Actor 2- 56

Actor 3- 31

Actor 4- 18

Each test material comes with a CD that includes the Noun Gesture Corpus and a manual with instructions to use the Noun Gesture Corpus.

The Nouns of this corpus was acquired in 3 phases.

Phase one included generation of stimulus for 253 set of nouns collected from various sources. This was done in 4 actors.

Stage two included validating these nouns from 18 raters that have various professional background and who interact with individuals with disabilities such as SLPs, audiologists, Sign Language Users/ Interpreters, Caregivers of individuals with disabilities, Special Educators and Commoners. Further, the nouns that received a rating of most familiar, simple and relevant proceeded to phase 3 .

Phase three included validation of these nouns. Validation was carrie out by making 10 individuals identify gestures that were presented to them. This helped in obtaining the final gesture corpus that included 124 noun gestures that have an established meaning and consistency across individuals based in the southern part of India.

Administration for Recognition Task:

Seat the individual in a comfortable position in front of the display device. Instruct the person to name the noun gesture that he or she will see on the screen by saying, “I will now play gestures on the screen. These gestures represent nouns that can be object, animals, birds, fruits vegetables, etc. Look at these videos and name the noun.” Play the video on QuickTime of VLC player, one at a time. Video can be repeated once in case the person cannot name the video or asks for repetition. Maximum time given for naming is one minute. The mode of response is a free choice depending on the persons condition.

Response mode: Pointing/Verbal/Orthographic (depending on the persons choice)

Scoring:

Correct response: 1

Incorrect Response: 0

Appendix B

AIISH NOUN GESTURE CORPUS: SCORING SHEET

Name:

Age:

Provisional Diagnosis:

Sr. No.	Stimuli gestures presented through video	Response Mode			
		Pointing	Verbal	Orthogrphic	Any Other
1	Tap	☐	☐	☐	☐
2	TV	☐	☐	☐	☐
3	Elephant	☐	☐	☐	☐
4	Necklace	☐	☐	☐	☐
5	Cricket	☐	☐	☐	☐
6	Spoon	☐	☐	☐	☐
7	Neck	☐	☐	☐	☐
8	Lines	☐	☐	☐	☐
9	Bed	☐	☐	☐	☐
10	Handkerchief	☐	☐	☐	☐
11	One thousand	☐	☐	☐	☐
12	Head	☐	☐	☐	☐
13	Pen	☐	☐	☐	☐
14	Ear	☐	☐	☐	☐
15	Dog	☐	☐	☐	☐
16	Peacock	☐	☐	☐	☐
17	Needle	☐	☐	☐	☐
18	Screwdriver	☐	☐	☐	☐
19	Onion	☐	☐	☐	☐
20	Seven	☐	☐	☐	☐
21	Flower	☐	☐	☐	☐
22	Iron box	☐	☐	☐	☐
23	Earring	☐	☐	☐	☐
24	Fan	☐	☐	☐	☐
25	Knee	☐	☐	☐	☐

Sr. No.	Stimuli gestures presented through video	Response Mode			
		Pointing	Verbal	Orthogrphic	Any Other
26	Fire	☐	☐	☐	☐
27	Phone	☐	☐	☐	☐
28	Pant	☐	☐	☐	☐
29	Ice cream	☐	☐	☐	☐
30	Apple	☐	☐	☐	☐
31	Comb	☐	☐	☐	☐
32	Tongue	☐	☐	☐	☐
33	Socks	☐	☐	☐	☐
34	Teacher	☐	☐	☐	☐
35	One hundred and forty	☐	☐	☐	☐
36	Computer	☐	☐	☐	☐
37	Helmet	☐	☐	☐	☐
38	Teeth	☐	☐	☐	☐
39	Blackboard	☐	☐	☐	☐
40	Dot	☐	☐	☐	☐
41	Back	☐	☐	☐	☐
42	Paper	☐	☐	☐	☐
43	Carrom	☐	☐	☐	☐
44	Dustpan	☐	☐	☐	☐
45	Chilli	☐	☐	☐	☐
46	Anklet	☐	☐	☐	☐
47	Boat	☐	☐	☐	☐
48	Shirt	☐	☐	☐	☐
49	One thousand and twenty	☐	☐	☐	☐
50	Mirror	☐	☐	☐	☐
51	Table	☐	☐	☐	☐
52	Circle	☐	☐	☐	☐
53	One	☐	☐	☐	☐
54	Bike	☐	☐	☐	☐
55	Glass	☐	☐	☐	☐

Sr. No.	Stimuli gestures presented through video	Response Mode			
		Pointing	Verbal	Orthogrphic	Any Other
56	Snake	☐	☐	☐	☐
57	Clock	☐	☐	☐	☐
58	Rifile	☐	☐	☐	☐
59	Bag	☐	☐	☐	☐
60	Cow	☐	☐	☐	☐
61	Eyebrow	☐	☐	☐	☐
62	Spectacles	☐	☐	☐	☐
63	Knife	☐	☐	☐	☐
64	Pencil	☐	☐	☐	☐
65	Monkey	☐	☐	☐	☐
66	Frog	☐	☐	☐	☐
67	Towel	☐	☐	☐	☐
68	Whistle	☐	☐	☐	☐
69	Ladder	☐	☐	☐	☐
70	Saree	☐	☐	☐	☐
71	Toothbrush	☐	☐	☐	☐
72	Earthquake	☐	☐	☐	☐
73	Aeroplane	☐	☐	☐	☐
74	Cupboard	☐	☐	☐	☐
75	Lipstick	☐	☐	☐	☐
76	Car	☐	☐	☐	☐
77	Cat	☐	☐	☐	☐
78	Star	☐	☐	☐	☐
79	Book	☐	☐	☐	☐
80	Door	☐	☐	☐	☐
81	Soap	☐	☐	☐	☐
82	Nose	☐	☐	☐	☐
83	Football	☐	☐	☐	☐
84	Flute	☐	☐	☐	☐
85	Stethoscope	☐	☐	☐	☐

Sr. No.	Stimuli gestures presented through video	Response Mode			
		Pointing	Verbal	Orthogrphic	Any Other
86	Fish	☐	☐	☐	☐
87	Eagle	☐	☐	☐	☐
88	Cap	☐	☐	☐	☐
89	Fifty	☐	☐	☐	☐
90	Blanket	☐	☐	☐	☐
91	Pillow	☐	☐	☐	☐
92	Triangle	☐	☐	☐	☐
93	Rain	☐	☐	☐	☐
94	Hair	☐	☐	☐	☐
95	Mango	☐	☐	☐	☐
96	Garland	☐	☐	☐	☐
97	Orange	☐	☐	☐	☐
98	Fridge	☐	☐	☐	☐
99	Sugarcane	☐	☐	☐	☐
100	Stomach	☐	☐	☐	☐
101	Ring	☐	☐	☐	☐
102	Hundred	☐	☐	☐	☐
103	Three	☐	☐	☐	☐
104	Hammer	☐	☐	☐	☐
105	Grapes	☐	☐	☐	☐
106	Scissors	☐	☐	☐	☐
107	Lip	☐	☐	☐	☐
108	Semicircle	☐	☐	☐	☐
109	Bowl	☐	☐	☐	☐
110	Leg	☐	☐	☐	☐
111	Eye	☐	☐	☐	☐
112	Lemon	☐	☐	☐	☐
113	Train	☐	☐	☐	☐
114	Window	☐	☐	☐	☐
115	Bat	☐	☐	☐	☐

Sr. No.	Stimuli gestures presented through video	Response Mode			
		Pointing	Verbal	Orthogrphic	Any Other
116	Twenty five	☐	☐	☐	☐
117	Watermelon	☐	☐	☐	☐
118	Banana	☐	☐	☐	☐
119	Ten	☐	☐	☐	☐
120	Chapathi	☐	☐	☐	☐
121	House	☐	☐	☐	☐
122	Broom	☐	☐	☐	☐
123	Chair	☐	☐	☐	☐
124	Rectangle	☐	☐	☐	☐
Total					