Computerized Version of Manual for Adult Aphasia Therapy- in Kannada

(CV-MAAT-K)

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CHAPTER I

INTRODUCTION

Aphasia is a loss of language function resulting after an insult or damage to the left hemisphere of the brain. Depending on the site and extent of lesion, aphasia may vary in its type and severity. Recovery from the condition also depends upon several factors like rate at which spontaneous recovery occurs, the age of attack, immediate intervention if given, co-morbid factors etc. Aphasia is an acquired language disorder which is common and often an extremely severe consequence of stroke or other brain lesion (Benson, 1996).

Persons with aphasia (PWA) present themselves with various cognitive linguistic deficits. Deficits in auditory comprehension, verbal production along with higher cognitive functions such as reading, writing and arithmetic might be affected. Depending on the type of aphasia, extent of deficits in each of these areas might vary. Hence, an appropriate comprehensive treatment manual should be able to elicit responses in all the affected areas. Owing to the current technology, use of computers in the intervention of persons with aphasia has been found to be beneficial (Deloche, Dordain & Kremin, 1993). Thus, in the present study a Computerized Version of Manual for Adult Aphasia Therapy in Kannada was developed.

1.1 Need for the study

A lot of therapeutic strategies pertaining to language for rehabilitation of persons with aphasia exist. Even though most of them take its origin in the West, they have been effectively used in the Indian context as well. But, culturally appropriate linguistic material, to be followed is lacking in the Indian context. To quote a very

few are the Manual for Adult Non-Fluent Aphasia Therapy- in Kannada (MANAT-K, Venugopal & Goswami, 2008) and Manual for Adult Fluent Aphasia Therapy- in Kannada (MAFAT-K, Chaitra & Goswami, 2010) developed for the treatment of persons with aphasia. The sub-sections of the different domains cover a series of activities which can be carried out by the clinicians to elicit a wide range of responses from the persons with non-fluent and fluent aphasia. MANAT-K and MAFAT-K were modified and field tested by Goswami, Shanbal, Samasthitha and Navitha (2010) and Goswami, Shanbal, Chaitra and Ranjini (2011), respectively.

With the advent of technology in recent times, computer has become an integral part of one's everyday life and so has its role in medical sciences. A lot of computer assisted rehabilitation has been used for the treatment of language disorders since 1980s. A lot of software and computer applications have been used, particularly in English for the treatment of aphasia. But in spite of the alarming increase in the incidence of the disorder, no such move has been made to develop something similar in any of the Indian languages. Thus, the need for the present study was felt.

1.2 Aim of the study

To develop the Computerized Version of Manual for Adult Aphasia Therapy in Kannada (CV-MAAT-K) and field test it on persons with aphasia to check its applicability in clinical settings.

CHAPTER – II

REVIEW OF LITERATURE

Aphasia is an acquired language disorder resulting from a brain damage which affects speaking, listening, reading and writing abilities. Consequently, the intervention should focus on all the modalities of communication. An overview of the aphasia types and characteristics would help in better understanding for planning the appropriate intervention.

2.1 Aphasia; Classification and Characteristics

Aphasia, a loss of language after an insult or damage to the left hemisphere of the brain, has been defined and described by a number of people for the past many years. Goodglass and Kaplan (2001) defined aphasia as a disturbance of any or all of the skills, associations and habits of spoken and written language produced by injury to certain brain areas that are specialized for these functions. Aphasia can affect cognitive linguistic domains like auditory comprehension, verbal expression, reading, writing, and naming. It is generally seen that sensory and motor issues such as impaired vision, hearing, muscle weakness and paralysis or muscle in-coordination may also co exist.

Several types of aphasia have been recognized. Several types of classification have been put forward by different authors either depending on the site of the lesion or language deficits manifested. Language deficits exhibited by a particular type of aphasia is similar, which makes them specific to the type of aphasia. The types of aphasia thus classified, simply represent the most frequently occurring clusters of language deficits. It has been found that, 30% to 80% of cases match up with one

among of the sub-type of aphasia (Goodglass & Kaplan, 2001). Clinical manifestations are representative of the most frequently occurring response patterns of language behaviour and also have a corresponding lesion in particular sites within the language zone. Differences in language performance and error patterns of language may be due to the fact that lesions vary in exact location and extent, and because persons may respond differently in spite of the same lesion type and location (Goodglass & Kaplan, 2001). The major subdivisions of aphasia are based on the characteristics of speech output (Goodglass & Kaplan, 1983).

Fluent aphasia has normal articulation and rhythm of speech, but lacks meaning. Fluent aphasias are the result of lesions affecting the posterior portion of Rolandic area. Phoneme selection and sequencing as well as syntax are found to be preserved in fluent aphasia. Speech is characterized by long runs of words combined using a variety of grammatical constructions. Typically, there are word-finding problems that affect both nouns and picturable action words. Comprehension is comparatively poor with fluent aphasias. Conduction aphasia, wherein repetition is affected would be an exception to this. The frequency and type of paraphasias spoken, impairments in comprehension and impaired repetition are still variable in fluent aphasias, which will depend upon the exact site of lesion (McCaffrey, 2000).

Speech of persons with non-fluent aphasia is slow and laboured, also characterized by short utterance length. Non-fluent aphasias are the result of damage to the area of the brain anterior to the central fissure. The flow of speech is more or less impaired at the level of initiation, finding and sequencing of articulatory movements, and the production of grammatical sequences. According to Goodglass and Kaplan (2001), speech of persons with non-fluent aphasia is laboured and

effortful and there are usually less than three or four words in a breath group. The linguistic competence which underlies comprehension and production of language is the same, so both comprehension and production are usually affected in persons with non-fluent aphasia (McCaffrey, 2001).

As mentioned above, any type of aphasia presents with one or more areas of language being affected. Hence language therapy is one among the primary concerns of aphasia. It is a complex and time consuming process, where recovery depends on several other factors.

2.2 Language Therapy for aphasia

Several different therapeutic approaches have been used for persons with aphasia (PWA) since a very long time. The major therapeutic approaches were behaviour modification, cognitive therapy, combinations of behavioural and cognitive methods and pragmatic approach. These therapeutic approaches basically focus on language rehabilitation. Operant conditioning, which is considered to be the most traditional form of behaviour modification, was the first type of therapy used as a remedy to aphasia. This approach involves shaping language behaviour through a hierarchy of tasks presented in a fixed order, from least to most difficult (Holland, Fromm, DeRuyter, & Stein, 1996; Robey, 1998). Schuell (1983), the first person to take a cognitive approach to aphasia therapy, proposed that an extended period of intensive stimulation would improve the quality of the language behaviour in PWA, wherein only the auditory modality was emphasized. This was followed by Duffy (1996) who modified this by suggesting a multi modality approach to rehabilitate PWA. Several types of programmed stimulation for PWA have been developed by

other therapists. Among these are Melodic Intonation therapy (Estabrooks, 1984), and Visual Action Therapy (Estabrook, Fitzpatrick & Baressi, 1982).

Two broad approaches, namely the restoration approach and compensatory approach are widely used to restore the deficits in persons with aphasia. The hypothesis underlying restoration approach is that a specific aphasic symptom may be the surface manifestation of different underlying deficits within the cognitive structure of language. Only by revealing the specific underlying psycholinguistic deficit, therapy can be targeted as per the approach. However, the limitation with restoration approach is that, it is less efficient in completely restoring the linguistic system. That is, 40% of people with aphasia eventually plateau in their ability to re-establish their linguistic system and will continue to live with aphasia as a chronic condition (Estabrooks, 1984). Compensatory approaches to rehabilitation helps stroke-survivors learn new ways of performing tasks to compensate for any residual abilities. These include the use of drawing, gestures, written words, and written choices as well as low technology communication books and boards (Beukelman & Yorkston, 1983).

One example of compensatory approach is the computer-aided therapy, as mentioned by Baker and Berry in 1980s. This was further developed by Weinrich (1991). Computerized visual communication (or C-VIC) was designed as an alternative communication system for persons with severe aphasia and is based on the notion that those with severe aphasia can learn an alternative symbol system to communicate.

Several studies have been done to assess the efficacy of speech and language therapy in post-stroke individuals. Holland, Fromm, Ruyter and Stein (1996) noted that nearly 200 studies pertaining to aphasia treatment have been published in English

language alone. These studies included large and small group investigations, single-participant experiments, and single-case studies. They concluded that individuals with aphasia attaining specific selection criteria who are treated improve more than those who do not receive treatment. Improvement was documented in both the quantity and quality of language.

Kelly, Brady and Enderby (2010) compared results from a total of 30 trials in terms of three groups of persons with aphasia. The first group underwent speech and language therapy (SLT) while the second group with no SLT and the third group with SLT with social support and communication stimulation. Few significant differences were noted in SLT versus no SLT comparisons; however, the authors noted that there is an overall consistent direction of results in favour of speech and language therapy. Social support and stimulation also showed improved receptive and expressive language skills, although this result was primarily based upon findings of a single study.

2.3 Use of technology in language therapy

Technology has gradually become part and parcel of one's professional and personal lives. Assistive technology (AT) has become an integral part of life and has gained increased acceptance in the area of rehabilitation.

The use of computers in therapy was first seen in the late '70s. They were primarily used for people with deficits in word processing. In the '80s, computer use in therapy progressed to the use of drill-and-practice exercises that resembled workbook activities providing an additional advantage of instant feedback, which was believed to facilitate the learning process. The '90s presented an era wherein easier

access to the internet and more sophisticated software programs with voice output, the ability to customize options in programs for PWA, and more interesting and interactive software were available. Treatment started to incorporate the use of e-mail and websites for reading practice, research, and promotion of self-advocacy. Of late, a need to change the mindset from using only traditional treatment and incorporating technology into our services has been realised.

Computers and other devices, when selected and used with the help of a skilled clinician, can help improve communication and cognitive skills related to education, employment, recreation, and social and medical needs. Some professionals have welcomed this development of new resources to help others but some remain ignorant to these helpful tools and others are unaware that new and exciting treatment opportunities exist. Children and adults with a broad range of difficulties resulting from strokes, head injuries, degenerative diseases, and developmental delays can be independent in handling a wide range of activities with the help of software and devices to read, write, organize, remember, learn and communicate. Computer assisted therapy has numerous advantages like saving time, motivating the PWA, making the clinician's work easier, supporting unique learning styles, abilities, and backgrounds, facilitating positive outcomes and providing opportunities to objectively document change over time. It helps in using email to obtain information and interact socially and also provides the liberty to surf the Web. It's interesting and practical. Moreover, it offers ability to control tasks, gives independent and immediate feedback and promotes effective independent practices (Robertson, 1990).

The use of computers in aphasia rehabilitation was first explored in the 1980's. Robertson (1990) published a review of these studies entitled 'Does computerized rehabilitation work?'. He concluded that there was no evidence that the use of computers improved the standard of therapy delivered. He also suggested that the use of computers may in fact be harmful by fostering or supporting unrealistic expectations of complete recovery and therefore causing more problems than they solve. He also criticized the studies as having used poor hypothesis testing, weak methodologies and inadequate clinical trials. Yet another disadvantage of these studies was a lack of theoretical models to explain them (Fisher, 1989). These criticisms were considered to be premature and believed to reflect the state of knowledge and development of the field at that time. But surprisingly, the negative conclusions of Robertson appeared to have stimulated an increase in studies that attempt to meet the challenges that he set, and investigate the role of the computer within different contexts.

Kinsey (1990) investigated the role of a computer to administer a specific linguistic task when compared to the same task administered by a clinician and found that there was no significant difference between the two. Deloche, Dordain, and Kremin (1993) explored the relationship between oral and written naming from a neuropsychological perspective using a computer to administer the tasks, and concluded that the PWA performed well on the task. They also investigated the use of a computer to administer intensive therapy for the treatment of confrontational naming administered on two dysphasic subjects. The approach was beneficial with performance improving on computer tasks, generalization to

untreated computer tasks, oral naming and handwriting. Although the therapist was also present during the computer sessions, the authors suggested there is a potential for the patients to work alone.

Crearer and Ellis (1995) used a cognitive neuropsychological approach to underpin the therapy when comparing two different computer therapy approaches for the treatment of sentence processing deficits (verb and prepositional therapy) and found positive results. Even in the early computer studies, there was evidence that patients could use computers, unaided (Katz & Nagy, 1983, 1984). Later studies have reinforced this belief. The trials by Petheram (1991, 1996) indicated that subjects were able to use the computer unaided with only one hour tuition. The weekly usage recorded for each patient in these studies indicated that they were highly motivated to use the computer using it on an average of three hours a week.

The study by Stachowiak (1993), addressed the issue of intensity by comparing the effect of supplementing one hour of conventional daily therapy with an additional one hour of computer therapy. The results indicated that the group receiving more intensive input made more progress. The therapist was present during the computer sessions in order to select the appropriate exercises and to provide feedback and intervention. This study, therefore, supports the case for intensive therapy but as the therapist was present throughout, it is not able to address the issue of whether a computer can be used to provide intensive therapy when resources are limited.

Katz and Wertz (1997) described a computerized reading treatment for PWA that consisted of 29 activities, each containing eight levels of difficulty in increasing order with a total of 232 different tasks. The treatment software was customized to automatically adjust the level of task difficulty in response to the participant's performance in order to maintain frequent and accurate responses while still presenting challenging tasks. Results of their randomized controlled clinical trial revealed the effectiveness of this computer-provided intervention over non-language related computer stimulation and no therapy. All participants in the computerized reading treatment group received the same treatment with each participant exposed to a systematic hierarchy of language-based treatment stimuli.

Wade and Mortley (2003) interviewed six of the seven PWA who took part in the above mentioned study to examine their experience of delivery of therapy in more detail. The patients' experience of remote-based therapy was positive. There was a reported high use, usually a one hour session on most days. Communication partners quoted that a major advantage of the software was that it could be used without them being present. Partner involvement during use of the computer was variable with one partner being present all the time, one not at all and four sometimes available and sometimes not. Despite the lack of face-to-face contact, all participants perceived the role of the therapist as crucial. The role of the therapist was recognized only when the exercises were difficult. Participants listed a number of effects of therapy including increased ability on therapy tasks, positive effects on conversation and phone/computer skills. In addition, self-esteem and confidence also were reported to be improved. Participants, in fact,

expressed anxiety about cessation of therapy, with two believing they needed constant practice to stop deterioration.

Norwich and Grove (1997) looked at the use of a computer-based system at two clinics. 23 persons with a wide range of deficits and aphasia types received therapy via the Lingraphica System (LG), a laptop computer platform with software that displays interactive icons that are semantically associated with over 2000 nouns, verbs, adjectives etc. All patients received one hour sessions with the therapist using Lingraphica. The duration of therapy was variable, ranging between 2-8 weeks with an average of 2 sessions per week. In between sessions, patients also had access to the computer-based therapy at home. Pre and post treatment tests demonstrated improvements on a number of language function outcomes. Usage data demonstrated patients used the system fairly intensively outside of the sessions with a mean daily usage of two hours per day. This study suggested that individuals have a positive response to computer based therapy, and are likely to make use of such resources.

Wright (2004) evaluated speech language therapy delivered remotely to seven chronic persons with aphasia who had difficulties in word retrieval. After receiving a home visit to plan initial therapy and load software with the first set of therapy exercises, all treatment was carried out remotely. Patients completed exercises and sent these to the therapist via the internet, who set further exercises for completion. The therapist communicated to each patient through telephone after looking at the completed exercises to discuss the patients' progress. This cycle continued for three months, after which a face-to-face assessment was

completed followed by three further months of therapy. The average usage of the computer system was two hours 45 minutes per week. In terms of acceptability, the patients found this remote delivery of therapy a very positive experience.

The literature therefore supports the independent use of a computer to supplement therapy. In almost all the studies cited here, performance on specific tasks improved when using a computer to administer therapy.

2.4 Software available for aphasia therapy

Parrot Software (Weiner,1981) first of its kind, launched a website featuring 60 different software programs for the treatment of speech, cognitive, language, attention, and memory deficits seen in individuals with aphasia post stroke or head injury. They believed that individuals consulting clinicians for more than two to three times a week reported it to be expensive and the Parrot Software internet site was relatively a low-cost extended care option. There are lessons with different levels of difficulty and programs report performance at the completion of each lesson. Parrot Software has been developing treatment software for people with communication problems since 1981. These programs are being used in France, Spain and Britain and U.S.

Oral Reading for Language in Aphasia (ORLA) (Cole & Cherney, 1987) involves repeated practice of reading sentences aloud with a clinician (Cherney, 1986, 1995). ORLA was developed to improve reading comprehension in individuals with aphasia by providing practice in the phonological and semantic reading routes. Earliest studies of ORLA indicated that individuals showed

improvement not only in reading comprehension, but also in other modalities, including oral expression, auditory comprehension, and written expression (Cherney, 1986). The author also investigated the cost-effectiveness of a computerized version of the ORLA where 25 individuals with chronic non-fluent aphasia each received 24 one-hour sessions of ORLA treatment, typically twice a week. These 25 subjects were right-handed, with at least a 12th grade education. Age at the time of stroke onset ranged from 25.2 years to 80.36 years, and age at the time of initial testing ranged from 35.18 years to 81.65 years. A delayed treatment design was utilized; therefore all PWA received treatment following a period of no-treatment. On primary outcome measure, the Western Aphasia Battery Aphasia Quotient (AQ), subjects achieved an average increase of 3.4 points following the low-intensity ORLA treatment as compared to a mean difference of 0.36 AQ points during a delayed treatment control period. This study also confirmed the cross-modality improvements but showed that the severity of aphasia influenced the modality which improved the most. In this same study, a computer version of ORLA was compared to ORLA treatment delivered by a speech-language pathologist. Although improvements were made on the computer version, these improvements were smaller than those achieved with the speech-language pathologist. A possible reason for this difference was that the person’s receiving the computer ORLA could not see the clinician's face, and thus could not make use of the visual motor information from the lips, tongue and lower face that improve speech production.

Aphasia Mate (Parr, 1999) is a comprehensive computer therapy program available commercially. The program targets auditory and visual processing of

both nonverbal and language stimuli. It also incorporates time and numerical concepts. It is organized into eight modules, each with hierarchically organized sections and subsections for a total of 146 tasks. Aphasia Mate incorporates both a computerization of familiar tasks drawn from traditional language therapy and novel tasks which is unique to a computer environment. Progress through the activities can be monitored through the automatically recorded session tasks, scores and timed responses. The program can be used under the direction of a speech-language pathologist, other trained person or can be self-directed. On a pilot study with Aphasia Mate, participants used Aphasia Mate at least one hour per week over an average of 15 weeks. Each participant began the program at the first level of a section or subsection, which was recommended by the clinician and progressed to other tasks when a criterion of at least 80% accuracy over two consecutive sessions was reached. Once the recommended sections and subsections were completed, participants progressed through other sections according to the criterion that followed. For those using the program independently, progress was reviewed via saved data records every two weeks. Tasks on which the participant did not receive a score of 80% or better over two sessions were highlighted on a list for the participant's reference. Three outcome measures, Western Aphasia Battery (WAB) (Kertesz, 1982), Communicative Effectiveness Index (CETI) (Lomas, Pickard, Bester, Elbard, Finlayson & Zoghaib, 1989) and Functional Assessment of Communication Skills for Adults (ASHA-FACS) (Frattali, Holland, Thompson, Wohl & Ferketic, 1995) were assessed pre and post computer therapy and the results revealed that computer-based language therapy can lead to positive changes in the language and

functional communication skills of individuals with aphasia. As a group, participants improved significantly and reliably on standardized measures of auditory comprehension, and showed a pattern of improvement in naming, spontaneous speech, overall ratings of communication and qualitative dimensions of communication.

Computerized Home Aphasia Therapy Program (Pitts, 1990) (CHAT) was a home based program developed for stroke survivors. The CHAT Program was designed for persons with aphasia who have been terminated from a formal therapy program or is going to be finalizing his/her formal therapy soon. It has 220 individual programs and seven menus. All programs can be operated either by mouse, keyboard, touch screen or any other input device. For a relatively small one-time cost, a PWA can use the CHAT Program indefinitely ones computer. Thus, therapy becomes available 24 hours a day.

Bungalow software (Nichols & Brancewicz, 1995) is a set of 22 programs for different types of disorders. Out of this, auditory comprehension, receptive comprehension and word retrieval are the three programs used for aphasia therapy. The software prompts the PWA with a cue (photo, spoken question, story, movie, etc.), enables the PWA to respond by answering a question (typing, speaking, or picking an answer), evaluates the answer and gives feedback and let patients try again until they get the right answer. Bungalow Software provides home carry-over practice after therapy. This maintains the gain made in therapy and helps the person recover further. Wertz and Katz (2004) used the software for three hours per week for a period of 26 weeks on PWA and found that computer reading treatment requires only minimal assistance from a clinician.

He also concluded that improvement on the computer reading tasks generalizes to improvement in language performance.

2.5 Summary of the review

The review of literature provides evidence for the presence of impaired linguistic skills in persons with aphasia (Goodglass & Kaplan, 1983, 2001; McCaffrey, 2000). Consequently, there have been several approaches for speech and language intervention (Duffy, 1996; Estabrook, Fitzpatrick & Baressi, 1982; Schuell, 1983). However, most of these approaches were studied on the Western population. Also, the literature indicates that the use of technology in speech and language intervention was found to have a positive outcome (Deloche, Dordain & Kremin, 1993; Robertson, 1990). Thus, there is a need to study the use of technology in restoring language for persons with aphasia in the Indian context.

CHAPTER III

METHOD

The present study aimed at developing the Computerized Version- Manual for Adult Aphasia Therapy- in Kannada (CV-MAAT-K) and field testing the same to evaluate its applicability in restoration of language in persons with aphasia. Appropriate modifications were made in the Manual for Adult Aphasia Therapy in Kannada (MAAT-K), developed by Goswami, Shanbal, Samasthitha, Navitha, Chaithra and Ranjini (2009) and the CV-MAAT-K was developed with the help of software professionals. The field testing of the same was carried out by speech language pathologists in persons with aphasia in the age range of 19-76 years.

Participants

A total of 13 persons with aphasia (PWA) were approached to be the participants for the study. However, three of the participants discontinued therapy due to various reasons and hence, only ten participants were considered for the study. Persons with stroke who had come to the All India Institute of Speech and Hearing for rehabilitation were assessed using adapted version of Western Aphasia Battery in Kannada (Chengappa & Vijayashree, 2007) by experienced speech language pathologists. The age of the participants ranged from 19-76 years with a mean age of 44.9 years. This group consisted of two participants with Wernicke's aphasia, two participants with conduction aphasia and six participants with Broca's aphasia. Participants were selected by adhering to the appropriate ethical procedures as stated by AIISH ethical committee (AEC). Participants and the family members were

explained about the purpose and procedures of the study. Verbal and written consent were taken.

Inclusionary criteria

All the participants were native speakers of Kannada and had aphasia following stroke. The lesion was confined to left hemisphere. All the participants had their first attack of stroke. There was no known history of pre-morbid neurological illness, psychiatric disorders and/or cognitive decline, and no significant sensory and/or cognitive deficits. The socioeconomic status of the participants varied from lower to middle. The demographic details of the participants are presented in Table 1.

Table 1
Demographic details of persons with aphasia.

Sl.No	Age (years)	Gender	Time Post Onset	Type of aphasia	Attending therapy since
1	19	Male	Three months	Broca's aphasia	3 months
2	62	Male	One month	Broca's aphasia	15 days
3	35	Male	One year	Broca's aphasia	1 month
4	67	Male	Two months	Broca's aphasia	1 month
5	36	Male	One year	Broca's aphasia	1 month
6	52	Female	One year	Broca's aphasia	8 months
7	31	Male	Two years	Conduction aphasia	1year 6 months
8	24	Female	One month	Conduction aphasia	1 months
9	59	Male	One month	Wernicke's aphasia	1 month
10	34	Male	One year	Wernicke's aphasia	8 months

Procedure

The present study was carried out in three phases. Phase I included reviewing and making required modifications to the Manual for Adult Aphasia Treatment in

Kannada (MAAT-K), developed by Goswami, Shanbal, Samasthitha, Navitha, Chaithra and Ranjini (2009). Phase II included the development of CV-MAAT-K and phase III was field testing of the CV- MAAT-K. In this phase, persons with aphasia were given treatment using the CV-MAAT-K. Each participant attended a total of 15 speech and language therapy sessions, each session lasting for duration of one hour.

Phase I: Reviewing MAAT-K

The stimuli used in Manual for Adult Aphasia Therapy in Kannada (MAAT-K) developed by Goswami, Shanbal, Samasthitha, Navitha, Chaithra and Ranjini (2009) were reviewed. The illustrations of various activities in different domains were based on the principles of aphasia management. All the stimuli under different tasks of various domains of MAAT-K were retained and used in CV-MAAT-K. The activities of each sub-section were arranged in hierarchical order along with its stimulus and response mode hierarchy. Scoring pattern and progress criteria were provided in the beginning of each sub-section. Overall progress criterion is also provided for each domain and its sub-sections.

The broad domains for CV-MAAT-K as listed below were finalized:

- Functional communication (FC)
- Repetition (REP)
- Comprehension and Expression (C&E)
- Naming (NAM)
- Reading and writing (RW)

Each of these domains was further sub-divided into several sub-sections:

Functional Communication (FC)

In this domain, subsections aimed to cover common nouns and verbs which are basic and applicable in day-to-day life. The eight aspects covered under functional communication are:

1. Responding to own name
2. Recognition of family members
3. Recognition of familiar objects
4. Comprehension of simple verbal commands
5. Comprehension of action verbs
6. Functional verbal language
7. Activities of daily living
8. Activities of independence

Repetition (REP)

This domain checks repetition in persons with aphasia under the following sub-domains.

A. Equivocal response
B. Automatic speech
C. Egocentric stimuli
D. Environmental stimuli
E. Phrases and sentences

Comprehension and Expression (C&E)

The focus of this section is to improve auditory comprehension and expression abilities at various linguistic levels. These levels are:

1. Semantic level
2. Syntax level
3. Discourse level
4. Advanced Discourse level

1. Semantic level

A. Gross phonemic level

B. Finer phonemic level

C. Word level

i. Vocabulary

ii. Antonyms

iii. Synonyms

iv. Syntagmatic and paradigmatic relations

v. Semantic similarity

vi. Semantic contiguity

vii. Semantic anomaly

2. Syntax level

A. Person Number Gender (PNG) markers

B. Tenses

C. Answering yes-no (polar) questions

i) Egocentric ii) Environmental

D. Following body part command

i) One-step commands iii) Multi-step commands

ii) Two step commands

E. Following commands with visual stimuli

i) One-step commands iii) Multi-step commands

ii) Two step commands

F. Identification of objects described by function

G. Sentence types

i) Imperative
ii) Declarative
iii) Negatives
iv) Exclamation
v) Comparatives
vi) Voice
vii) Case markers
viii) Clause

3. Discourse level

Listening comprehension

4. Advanced discourse level

A. Picture description
B. Narration
C. Spontaneous speech

Naming (NAM)

This domain checks for the naming ability of a person with aphasia under the below mentioned tasks.

1. Confrontation naming
2. Lexical generative naming: Phoneme fluency, word fluency, category-specific naming
3. Responsive naming

Reading and Writing (RW)

This domain is sub-divided into four sub-sections as listed below:

1. Functional reading and writing

2. Advanced reading

3. Advanced writing

4. Arithmetic skills

Phase II – Development of CV-MAAT-K

MAAT-K, with all the domains and different tasks under each subsection, were made into power point slides. These slides were delivered to the software professionals who converted it to its computerised version. The five domains were made into five modules and were delivered by the software professionals one by one. A trial run of each of the module was carried out by the speech language pathologists soon after its delivery and troubleshooting issues were listed out. They were rectified and this continued for all the five modules. The pictures used in CV-MAAT-K were scanned, aligned in Coral Draw and saved in PDF format. The picture stimuli have a resolution of 704×740 pixels.

About CV-MAAT-K

Microsoft Structured Query Language (SQL) Server 2005 was the database used for the development of CV -MAAT-K. It is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network.

Extensible Mark-up Language, Notification and C# are the technology used for the development of CV-MAAT-K. Extensible Mark-up Language or XML is a mark-up language that is defined by a set of rules for encoding documents in

a format that can be read by both machines and humans. The design goals of XML emphasize simplicity, generality, and usability over the internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures. C# is a multi-paradigm programming developed by Microsoft. C# is intended to be a simple, modern, general-purpose, object-oriented programming language.

Structure of the Menu

The main menu opens with an introductory slide as shown in Figure 1 which opens to the home page. The home page provides a login menu, demo videos, tutorials and frequently asked questions (FAQ) tab along with basic information regarding the origin and development of the software, as shown in Figure 2.

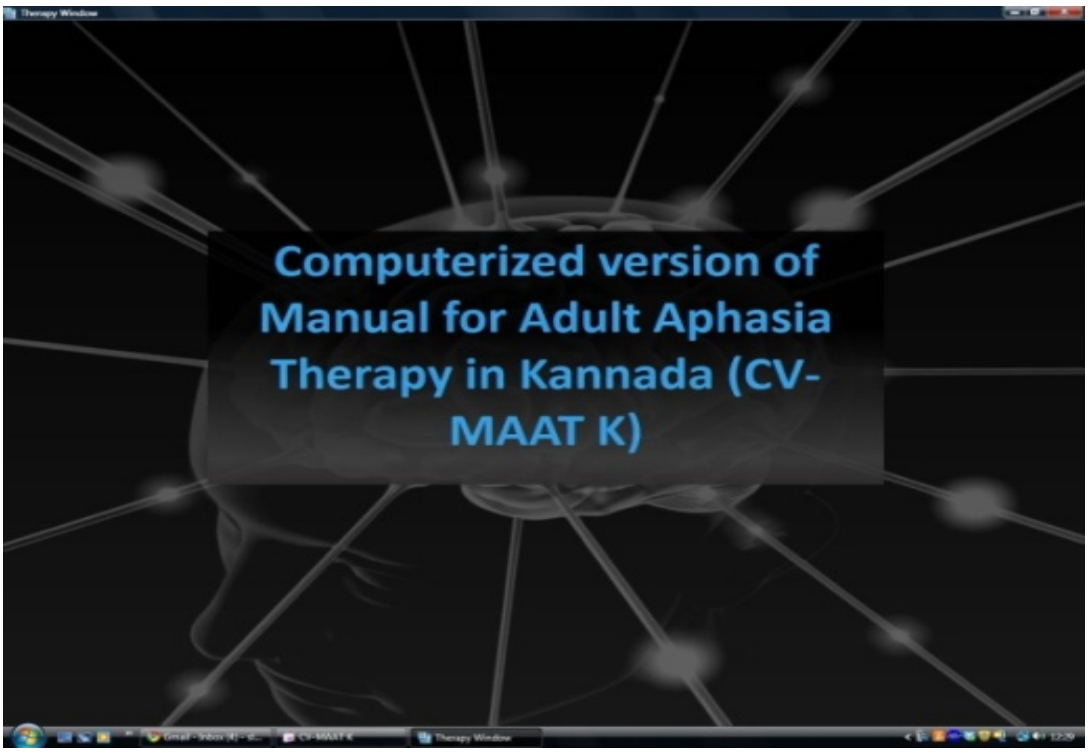

Figure 1. Introduction window

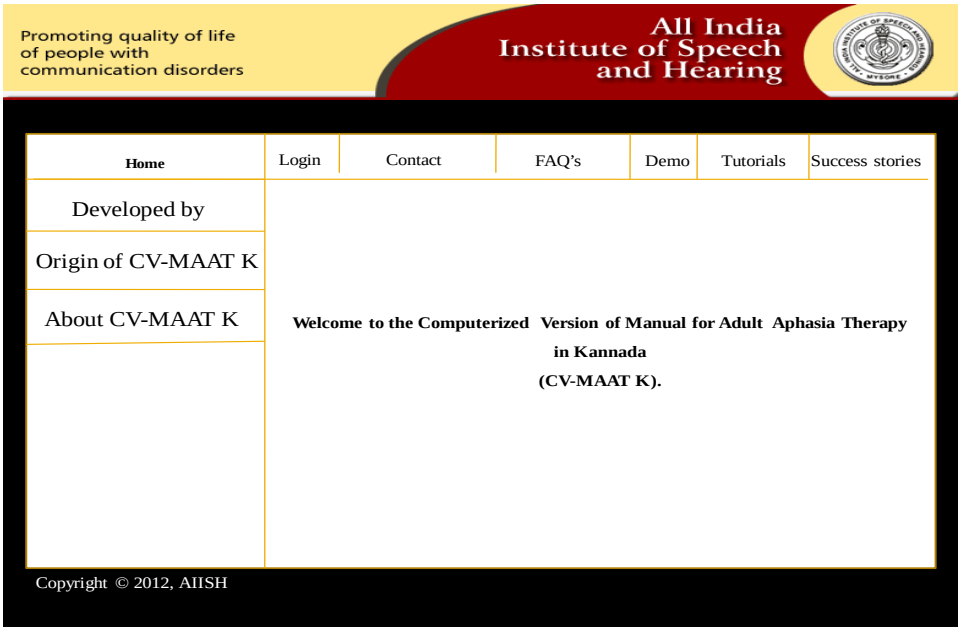

Figure 2. Home page

The log in menu will save the demographic data of the patient and therapy can thus be begun. The five domains appear as in Figure 3, and the domain to be worked on can be selected, as shown in Figure 4.

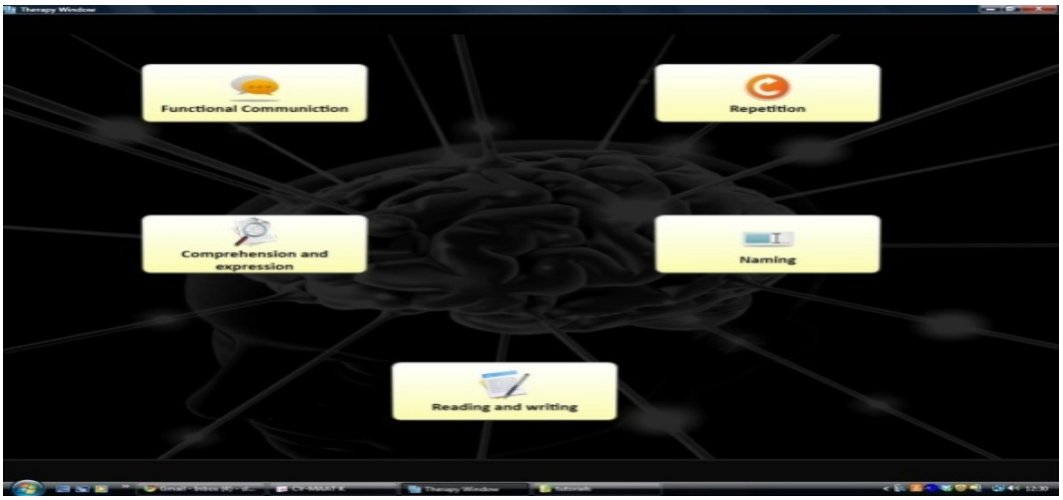

Figure 3. Domains of CV-MAAT-K

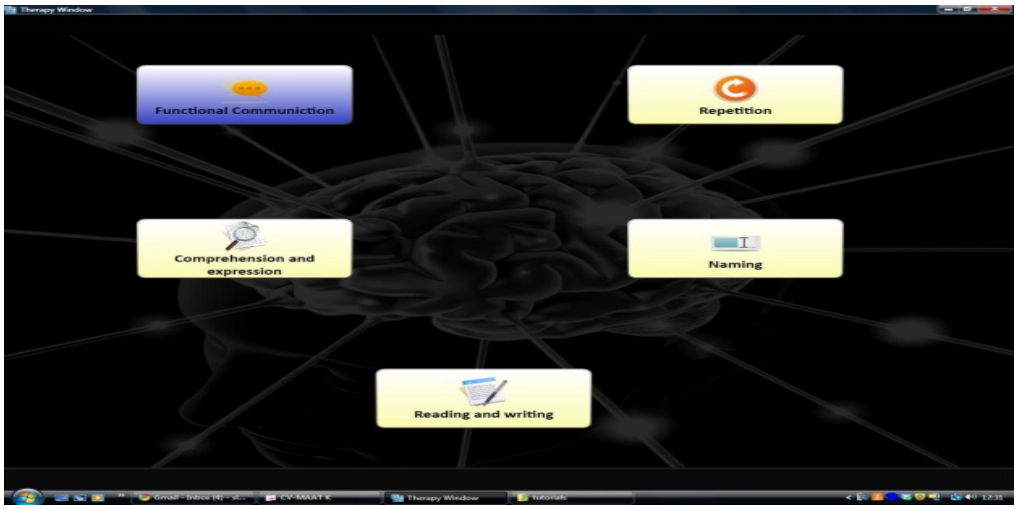

Figure 4. Display of the selected domain

Once a domain is selected, it is followed by the sub-sections present in the domain, of which the clinician can choose the sub-domain which is to be worked on. The stimuli appear on the screen for each task. It can be represented in orthographic form or as pictures depending on the task. The mode of stimuli as well as the mode of response can be chosen from the drop down boxes provided for these.

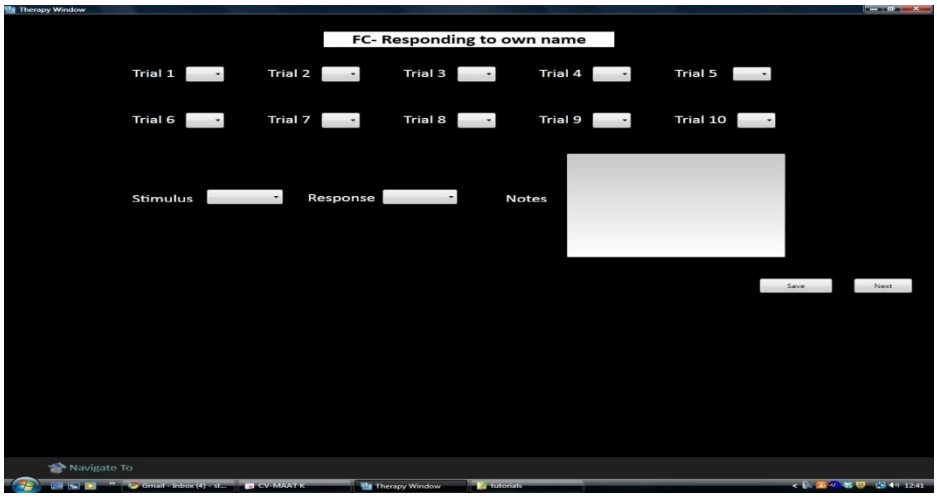

Figure 5. Stimuli work sheet

The drop down boxes for each trial also gives the clinician an option to choose one of the three scores 0, 1/2 and 1. Additional notes can be mentioned on the space provided. Stimuli after being worked upon will be as shown in Figure 5. This will be repeated for all the stimuli in each level of the sub-domains. As the clinician saves the

data (Figure 6), the score will be converted to percentage and will be generated in the report .Thus the summary report of a session will have all the stimuli worked, scores obtained in percentage, mode of stimulus and response used and additional notes entered (Figure 7). After the results are saved, a summary report can be generated as shown in Figure 8.

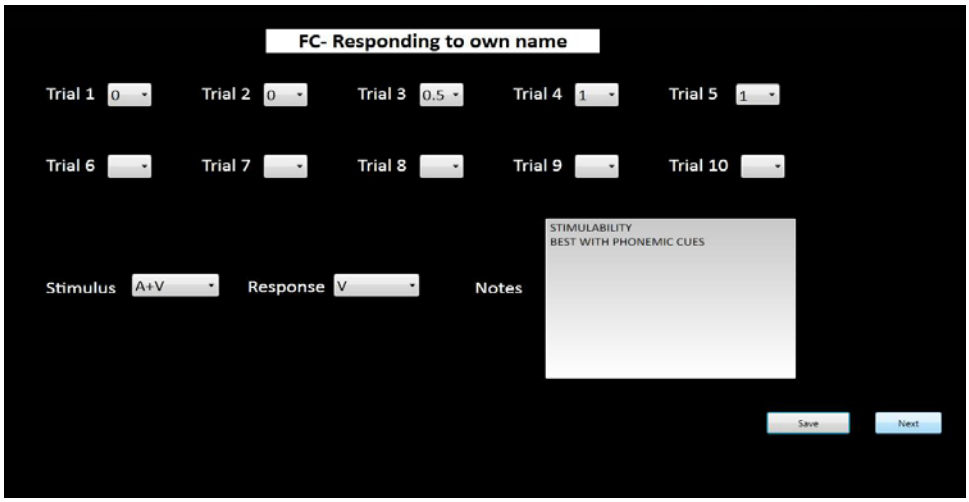

Figure 6. Scored stimuli sheet

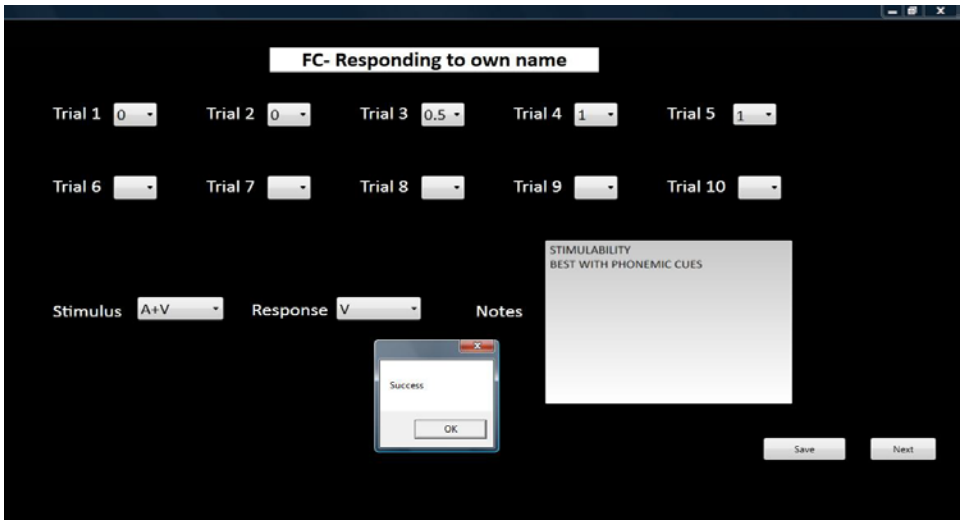

Figure 7. Illustration of saved results

FUNCTIONAL COMMUNICATION

EXIT

Activity	Stimulus number	Stimulus mode	Response mode	% correct response
Responding to own name	LEVEL 1	A+V	V	85%

Figure 8. Summary Report

A user guide along with tutorials on how to use the CV-MAAT-K is provided which will orient the PWA about CV-MAAT-K. The video tutorials enable one to be familiar with CV-MAAT-K making it more user-friendly. It is also recommended that one should use a computer system with a minimum resolution of 1024×768 for effective use of CV-MAAT-K. Further the CV-MAAT-K works at 32-bit operating system.

Phase III: Field testing

In phase III, the field testing of CV MAAT-K was carried out. Video recording of each session of language therapy was done. A score of ‘1’, ‘1/2’ ‘and ‘0’ was given for every correct, partial/intelligible and incorrect/no responses, respectively. The performance of the participants on the 1st (Baseline), 7th (Mid) and 15th (Post) therapy sessions was considered for statistical analysis. Once baseline evaluation was completed, appropriate goals were chosen, and only those performances on corresponding sub-sections were scored and analysed. The scores obtained, error patterns, cueing hierarchy used, mode of stimulus and response were

entered to the CV-MAAT-K during each session. Written responses for the writing domains were documented on paper, error patterns being noted on the software itself.

The raw scores of each participant for different activities were converted to percentage by the software and a summary of the result was generated for each therapy session. Further these scores were subjected to statistical analysis using SPSS software (version18.0) package. Qualitative analysis was also done for the different types of linguistic errors, wherever qualitative analysis was necessary. The results of the present study have been described in Chapter IV.

CHAPTER IV

RESULTS AND DISCUSSION

The present study focussed on developing the Computerised version of Manual for Adult Aphasia Therapy in Kannada (CV-MAAT-K) and determining its applicability in language restoration in persons with aphasia. After developing the CV-MAAT-K, language therapy was given to 13 persons with aphasia (PWA). Out of the thirteen PWA, only ten completed 15 sessions of therapy and hence were considered for analysis. The responses obtained from the participants were compiled for various activities of different sub-sections across the domains. Mean (M) and standard deviation (SD) were calculated for the same. Qualitative analysis of the type of linguistic errors was also done.

The data collected from ten participants across 15 therapy sessions was subjected to quantitative analysis using SPSS (18.0 version) software. The following statistical analyses were used:

(i) Mean and Standard deviation: It was computed for the various domains in the baseline, mid and post therapy sessions (i.e. 1^{st}, 7^{th} and 15^{th} session) for all PWA.

(ii) ***Friedman test***: It was done to analyze differences among baseline, mid and post therapy session for each domain in all the ten PWA.

(iii) ***Wilcoxon-signed rank test***: If any statistically significant difference among the sessions across the various domains was observed, the data was further subjected to Wilcoxon-signed rank test for pair-wise analysis.

Based on the statistical analysis, the results are discussed under the following sections:

I. Quantitative analysis of performance on different domains in persons with fluent aphasia (N=4) and non fluent aphasia (N=6) across therapy sessions.

II. Quantitative analysis of different error types by all persons with fluent aphasia (N=4) and non fluent aphasia (N=6) across therapy sessions.

After the baseline assessment (session 1), different goals were set for all the ten PWA depending on the domain which was affected. As the clinical group is heterogeneous in nature, domains and subsequent levels worked upon varied with each PWA.

I. Quantitative analysis of overall communication abilities in persons with fluent aphasia (N=4) and non fluent aphasia (N=6) across therapy sessions.

The mean scores and standard deviation was obtained for each of the PWA in all the domains for baseline, mid and post therapy sessions. The following comparisons were made using non-parametric tests.

1. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on functional communication (FC) domain for the baseline, mid and post therapy sessions (i.e. 1^{st}, 7^{th} and 15^{th} session).

2. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on repetition (REP) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).

3. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on comprehension and expression (C&E) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).

4. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on naming (NAM) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).

5. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on reading and writing (RW) domain for baseline, mid and post therapy sessions (i.e., 1st, 7th and 15th session).

Note: *In further sections of the results, persons with non-fluent aphasia are referred to as PNF, and those with fluent aphasia as PFA, six persons with Broca's aphasia (BA) will be referred to as P1, P2, P3, P4, P5, P6 and those with Conduction aphasia (CA) as P7 and P8, and the participants in the Wernicke's aphasia (WA) group as P9 and P10. Also while depicting the graph, the X-axis would represent the therapy sessions viz. baseline (BL), mid- and post-therapy session. The Y-axis represents the mean scores for the respective domain explained.*

1. **Comparison of performances of persons with fluent [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on functional communication (FC) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).**

The total scores were summed up for all the activities of the sub-sections under functional communication domain. The mean (M) and standard deviation (SD) for baseline, mid and post therapy sessions were calculated for ten PWA. The raw scores were converted to percentage scores. Table 2 and Figure 9 illustrate the mean and SD values of percentage scores for persons with fluent and non fluent aphasia for functional communication domain.

From Table 2, it can be seen that six persons with fluent aphasia (PFA), scored an overall mean of 50.53(SD=6.4), 65.1(SD=5.15) and 73.89(SD=5.82) and four persons with non fluent aphasia (PNF), scored an overall mean of 29.94(SD=8.96), 56.26(SD=7.08) and 74.66(SD=4.92) for baseline, mid therapy and post therapy sessions respectively. It was noted that all the ten PWA showed marked difference in the scores obtained for this domain across the sessions.

Table 2

Mean and SD values for persons with fluent and non fluent aphasia for functional communication domain.

% scores	Functional communication					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	50.53	65.1	73.87	29.94	56.26	74.66
SD	6.4	5.15	5.82	8.96	7.08	4.92

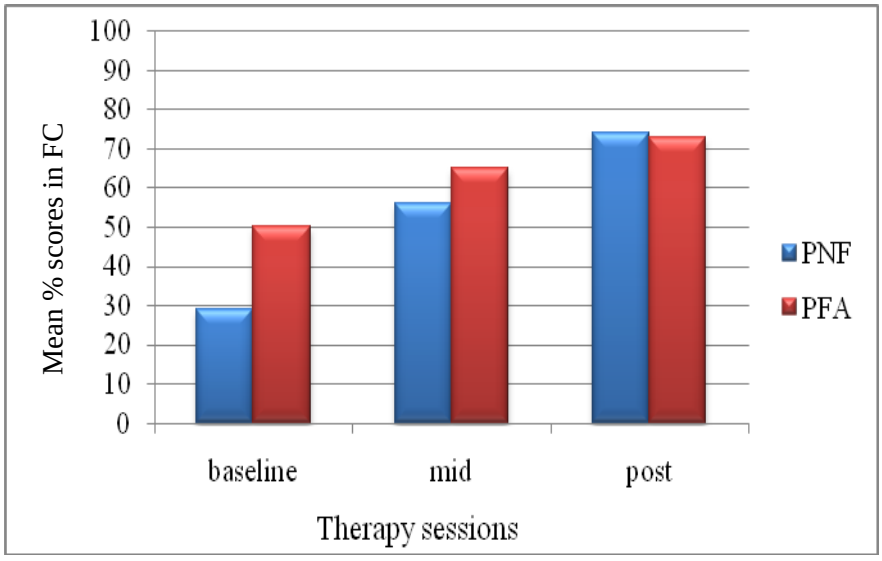

Figure 9. Response of persons with fluent and non fluent aphasia in functional communication domain across baseline, mid and post therapy sessions.

The performance of the participants was analyzed across the therapy sessions based on the raw scores. Table 3 shows the mean of raw scores of the Broca's aphasia group (BA) (N=6), Conduction aphasia group (CA) (N=2) and Wernicke's aphasia group (WA) (N=2) on functional communication domain across therapy sessions. Figure 10 illustrates the same.

Table 3

Mean raw scores for persons with both fluent and non fluent aphasia for functional communication domain.

Types of aphasia	Functional communication		
	Baseline session	Mid therapy session	Post therapy session
BA	188.83	339.5	464.5
CA	328.0	432.5	470.5
WA	255.0	380.0	464.0

**- BA- Broca's aphasia; CA- Conduction aphasia; WA- Wernicke's aphasia. The raw score varies and depends on the number of trials one requires to elicit the response.*

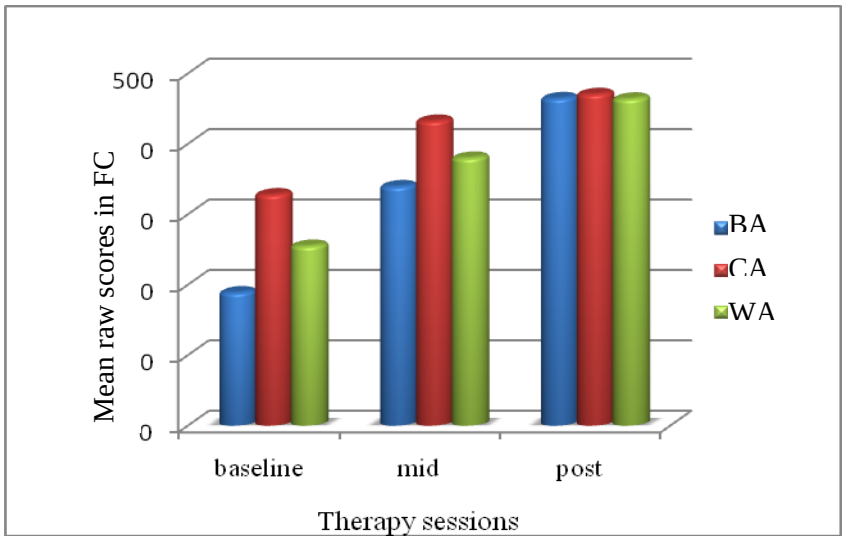

Figure 10. Mean of raw scores for three aphasia groups in functional communication domain across therapy sessions

As seen in Figure 10, all the three types of aphasia were found to improve on functional communication across therapy sessions. As the mean score values differed across three sessions, Friedman's test was carried out to identify any statistically significant difference in the baseline, mid and post therapy sessions. A significant difference was obtained across baseline, mid and post therapy sessions $\{\chi^2 (2) = 20, p<0.001\}$. The data was further subjected to Wilcoxon signed rank test. Results of this test indicated a significant difference between baseline and mid ($|z|= 2.85, p<0.01$); mid and post ($|z|= 2.80, p<0.01$) and baseline and post therapy

sessions ($|z|= 2.83$, $p<0.01$). Therefore, it can be inferred that all the participants improved across the three therapy sessions in this domain.

As seen in the results, on comparing the PNF (N=6) group with PFA (N=4) group, it can be inferred that the PNF group showed better improvement in functional communication. This might be because of the intensive training given for P1, P2, P3 and P4 since they lacked significantly in this domain, compared to the patients in PFA group. Also, the PFA group had a higher baseline score compared to the PNF group.

On analysis of each type of aphasia, it was found that even though the Broca's aphasia group had significantly lower scores on the baseline session compared to the other groups, on the post therapy session all the three types of aphasia (464, 470, 464.5) attained similar scores. This could be attributed to the intensive training Broca's aphasia group received. This result gains support from a study by Goswami, Shanbal, Samasthitha and Navitha (2009) who also reported an improvement in functional communication domain in persons with non-fluent aphasia using Manual for adult non-fluent aphasia therapy in Kannada (MANAT-K).

The performance of Wernicke's aphasia group and Conduction aphasia group also showed similar improvements from baseline to post-therapy sessions using CV-MAAT-K. The present finding receives support from a study by Goswami, Shanbal, Chaithra and Ranjini (2010) who found a significant improvement in

functional communication in persons with fluent aphasia using Manual for adult fluent aphasia therapy in Kannada (MAFAT-K).

The above observations provide evidence that functional communication is a skill that does require focus in the therapy program of persons with fluent aphasia. La Pointe (2005) stated the importance of functional communication as, “bridging language skills and adaptations into the real-life needs of the person with aphasia”. Hence, by including activities to enhance functional communication, CV-MAAT-K aids in relearning essential functional components of communication including the activities of daily living and activities of independence, thereby making persons with aphasia competent in basic everyday situations.

2. Comparison of performances of persons with fluent aphasia [Wernicke’s aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca’s aphasia (N=6)] on repetition (REP) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).

The mean and standard deviation for the repetition domain was obtained for all the ten PWA for the three sessions. Accordingly six persons with fluent aphasia (PFA), scored an overall mean of 15.59(SD=7.8), 43.67(SD=5.6) and 79.21(SD=6.15) and four persons with non fluent aphasia (PNF), scored an overall mean of 28.81(SD=4.3), 56.5(SD=8.5) and 70.91(SD=5.6) for baseline, mid therapy and post therapy sessions respectively. The same has been depicted in Table 4 and Figure 11.

Table 4

Mean and SD values for persons with fluent and non fluent aphasia for repetition domain.

% scores	Repetition					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	22.0	43.5	73.8	16.5	43.0	68.0
SD	3.3	2.1	2.24	2.2	2.6	3.7

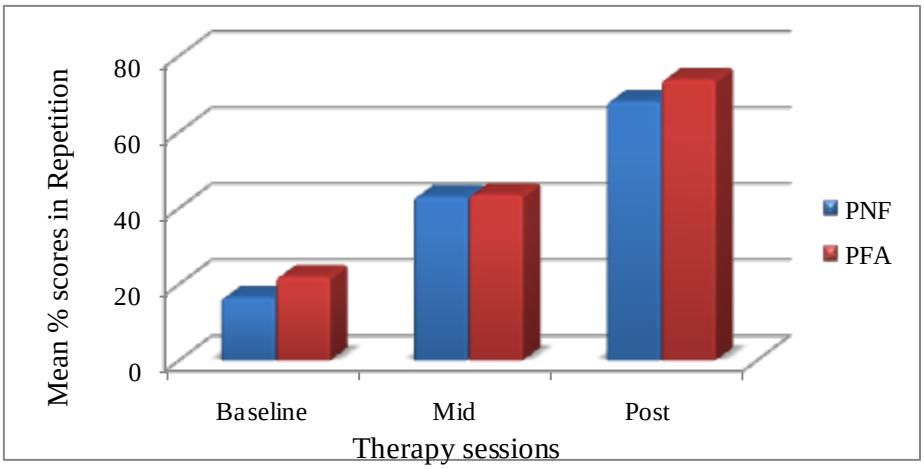

Figure 11. Response of persons with fluent and non fluent aphasia in repetition domain across baseline, mid and post therapy sessions.

The raw scores of all the participants were considered for analysis of their performance in repetition domain. Also the mean of scores of the Broca's aphasia group (N=6), Conduction aphasia group (N=2) and Wernicke's aphasia group (N=2), separately in repetition domain across therapy sessions were calculated. Table 5 and Figure 12 depict the same.

Table 5

Mean of raw scores for persons with both fluent and non fluent aphasia for Repetition domain.

Types of aphasia	Repetition		
	Baseline session	Mid therapy session	Post therapy session
BA	75.83	182.3	224.3
CA	28.5	167.5	212.5
WA	122.5	195	250

**- BA- Broca's aphasia; CA- Conduction aphasia; WA- Wernicke's aphasia. The raw score varies and depends on the number of trials one requires to elicit the response.*

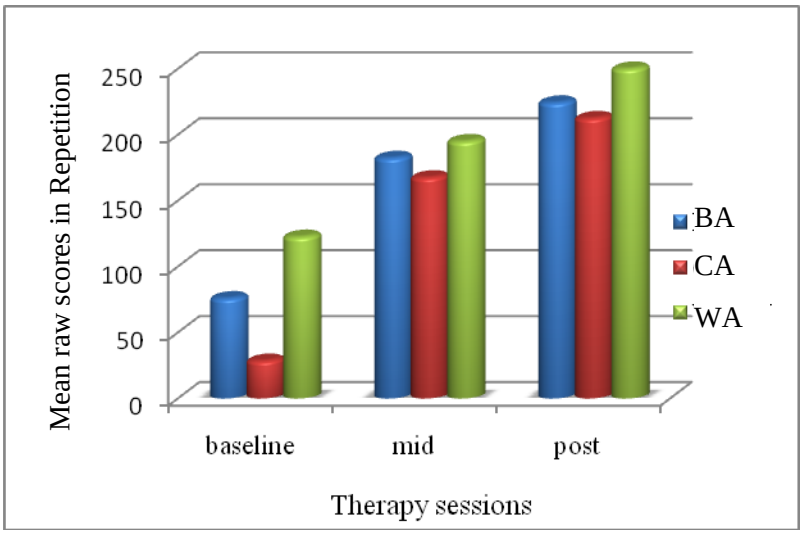

Figure 12. Mean of raw scores for three aphasia groups in repetition domain across therapy sessions

An obvious difference in the mean score values across three sessions necessitated the need for Friedman's test. This was carried out in order to identify any statistically significant difference in the baseline, mid and post therapy sessions. A significant difference was obtained in baseline, mid and post therapy session $\{\chi^2 (2) = 20, p<0.001\}$. Thus, the data was further subjected to Wilcoxon signed rank test. A significant difference between baseline and mid ($|z|= 2.80$, $p<0.01$); mid and post ($|z|= 2.80$, $p<0.01$) and baseline and post ($|z|= 2.87$, $p<0.01$)

was the finding of this test. Therefore, it can be concluded that all the participants progressively improved across the therapy sessions in the repetition domain.

Treatment of repetition deficits in persons with aphasia, especially fluent aphasia is important as they generally present with difficulty in repeating words, phrases and/or sentences. All the ten persons with aphasia improved from baseline to post therapy sessions in this domain. In the group of persons with Wernicke's aphasia, consistent improvement was observed for repetition and both P9 and P10 met the 75 % criterion by the 15^{th} session.

P7 and P8 of the conduction aphasia group showed drastic improvement from the baseline session to the mid therapy session, but comparatively lesser improvement from mid therapy session to post therapy session. This could be because of the hesitancy in carrying out home training observed during the later sessions as compared to the earlier sessions. Disproportionate repetition deficits at phrase level are characteristic of conduction aphasia although they are not exclusive to this type of aphasia (Biller, 2008). In the present study, both the participants with conduction aphasia showed good repetition at word-level, but relatively impaired phrase repetition.

All the patients with Broca's aphasia also showed significant improvement across therapy sessions. In fact the improvement was better than conduction aphasia group but poorer than the Wernicke's aphasia group. This must be because of the fact that not much time of the sessions were used for working on repetition

for the Broca's aphasia group, as functional communication and comprehension and expression domains were more.

Though typically, repetition is an important aspect to improve the communication skills, generalization can be achieved only if these repetition tasks are integrated with the activities involved in improving the auditory comprehension, naming and expression.

3. **Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on comprehension and expression (C&E) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).**

The total scores were summed up for all the activities of the sub-sections under comprehension and expression domain. Comprehension and expression were considered as a single domain, and the mean (M) and standard deviation (SD) for baseline, mid and post therapy sessions were calculated for all the ten persons with aphasia. Table 6 and Figure 13 depict the mean and SD values for persons with fluent and non aphasia for comprehension and expression domain.

Table 6

Mean and SD values for persons with fluent and non fluent aphasia for comprehension and expression domain.

% scores	Comprehension and expression					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid therapy	Post	Baseline	Mid	Post
Mean	27.28	51.95	77.38	19.50	38.37	52.70
SD	9.4	10.6	6.2	7.8	6.6	10.5

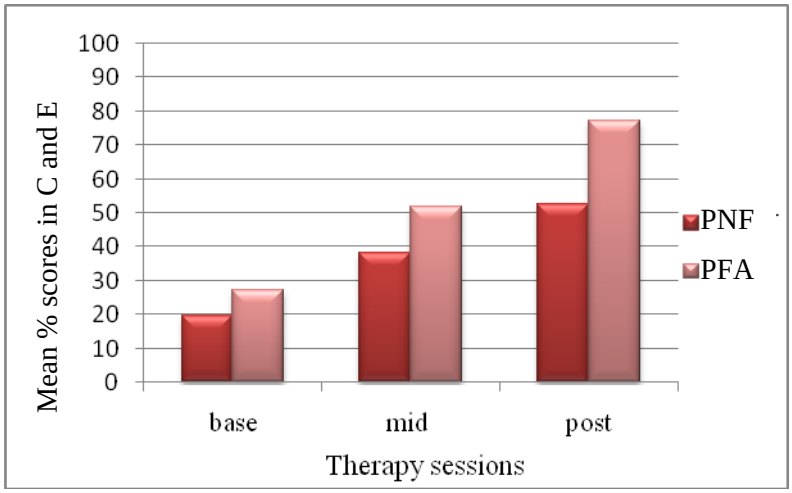

Figure 13. Response of persons with fluent and non fluent aphasia for comprehension and expression domain across baseline, mid and post therapy sessions.

Six persons with fluent aphasia (PFA), scored an overall mean of 27.18(SD=9.4), 51.95(SD=10.6) and 77.38(SD=6.2) while four persons with non fluent aphasia (PNF), scored an overall mean of 19.50(SD=4.3), 56.5(SD=8.5) and 70.91(SD=5.6) for baseline, mid therapy and post therapy sessions, respectively.

The mean of raw scores for PFA and PNF in comprehension and expression domain has been illustrated in Table 7. The difference in scores across sessions can be very well noted in Figure 13. A significant difference was obtained in baseline, mid and post therapy sessions $\{\chi^2 (2) = 20, p<0.001\}$, as Friedman's

test was carried out to check for the same. The data was further subjected to Wilcoxon signed rank test. Results of this test indicated a significant difference between baseline and mid ($|z|= 2.81$, $p<0.01$); mid and post ($|z|= 2.83$, $p<0.01$) and baseline and post ($|z|= 2.81$, $p<0.01$). Therefore, it can be concluded that all the ten participants improved across the therapy sessions.

Table 7
Mean raw scores for persons with fluent and non fluent aphasia in comprehension and expression domain.

Types of aphasia	**Comprehension and Expression**		
	Baseline session	Mid therapy session	Post therapy session
BA	244.0	445.16	612.6
CA	443.0	666.5	792.0
WA	239.5	423.5	688.5

**- BA- Broca's aphasia; CA- Conduction aphasia; WA- Wernicke's aphasia. The raw score varies and depends on the number of trials one requires to elicit the response.*

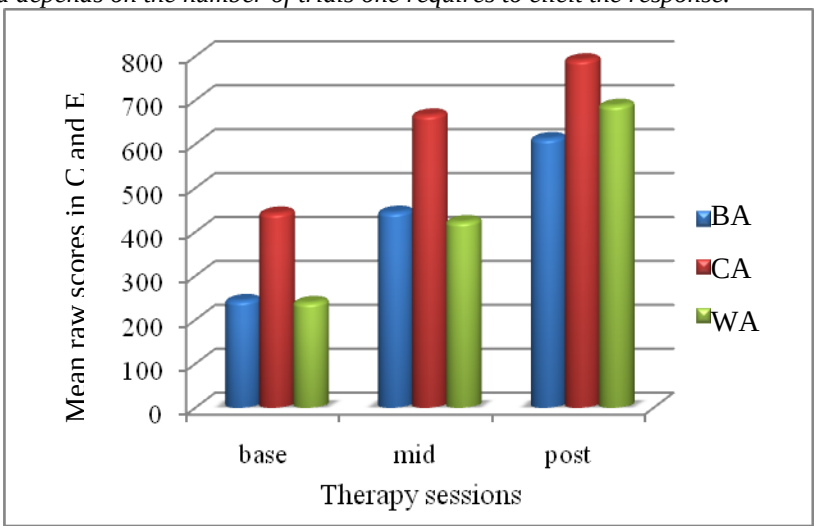

Figure 14. Mean of raw scores for three aphasia groups in comprehension and expression domain across three therapy sessions.

All the tasks in every sub domain focused on both comprehension and expression considering that the population involved persons with deficits with both comprehension and expression. Even though scoring was done separately,

comprehension and expression were worked upon simultaneously for the patients and hence the scores were summed up during analysis.

The CA group performed better on this domain, compared to BA and WA groups. Both P7 and P8, with CA in the present study scored the more than the other two groups at all 1st, 7th and 15th therapy sessions. These participants had minimal deficits at word-level comprehension, but notable impairments in comprehension and expression of case markers, tenses, PNG markers and in following sequential commands. This is in agreement with Goodglass and Kaplan (1983) who state that auditory comprehension is generally an undamaged skill in persons with conduction aphasia, but with deficits in morphemic structures.

The performance of BA group was better than WA at baseline and mid-therapy session. However, the scores of BA group at post-therapy session were the least of the three aphasia groups. This domain was considered as a major goal for P1, P2, P3, P4, P5 and P6, who comprised of the BA group and they were being worked on a regular basis. In spite of this, the poor scores at post-therapy session might be due to the associated sensory deficits in few participants of BA group. Also, the discourse level and advance discourse level of this domain were significantly impaired in P4, P5 and P6 of BA group.

The WA group scored the least at baseline and mid-therapy session compared to BA and CA groups. However, their performance was better than BA group at post-therapy session. This could be because of more emphasis given on

higher levels of the domain as they showed a deficit in levels such as discourse comprehension.

4. Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on naming (NAM) domain for baseline, mid and post therapy sessions (i.e. 1st, 7th and 15th session).

The mean (M) and standard deviation (SD) of all the sub-sections of naming domain for baseline, mid and post therapy sessions were calculated for ten persons with aphasia. Table 8 and Figure 15 depict the mean and SD values for persons with fluent and non aphasia for this domain.

Table 8
Percentage mean and SD values for persons with fluent and non fluent aphasia in naming domain.

% scores	Naming					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	42.59	64.36	69.26	26.24	48.6	68.9
SD	26.31	26.5	3.04	10.53	9.52	9.62

It was found that six persons with fluent aphasia (PFA), scored an overall mean of 42.59(SD=26.3), 64.36(SD=26.5) and 62.26(SD=3.04) and four persons with non fluent aphasia (PNF), scored an overall mean of 26.24(SD=10.53), 48.6(SD=9.52) and 68.9(SD=9.62) in naming domain across baseline, mid therapy and post therapy sessions, respectively.

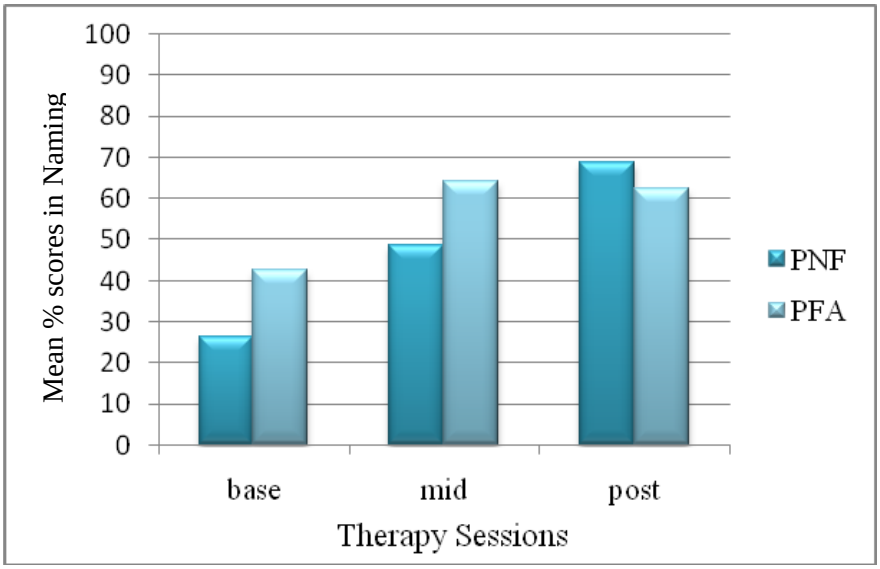

Fig.15. Response of persons with fluent and non fluent aphasia for naming domain across baseline, mid and post therapy session.

To identify any statistically significant difference across the baseline, mid and post therapy sessions, Friedman's test was carried out. As seen in Table 9 and Figure 16, by the mid therapy session two persons with conduction aphasia scored greater than 75 percent in all the sub-domains of naming, and hence naming was not further worked upon.

Table 9

Mean raw scores for persons with both fluent and non fluent aphasia for naming domain.

Types of aphasia	**Naming**		
	Baseline session	Mid therapy session	Post therapy session
BA	92.16	195.6	316.6
CA	349.0	460.0	-
WA	106.0	227.0	332.5

**- BA- Broca's aphasia; CA- Conduction aphasia; WA- Wernicke's aphasia. The raw score varies and depends on the number of trials one requires to elicit the response.*

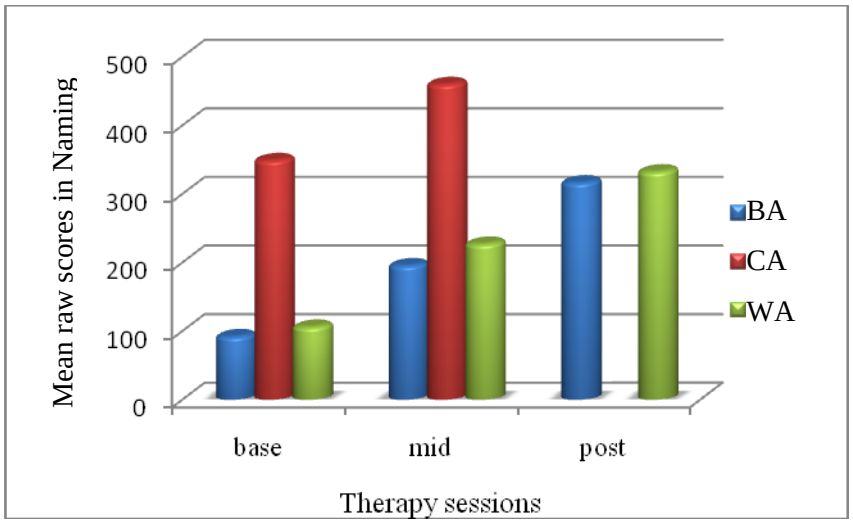

Figure 16. Mean of raw scores for three aphasia groups in naming domain across three therapy sessions.

A significant difference was obtained in baseline, mid and post therapy sessions $\{\chi^2 (2) = 16, p<0.001\}$. The data was further subjected to Wilcoxon signed rank test. Results of this test indicated a significant difference between baseline and mid ($|z|= 2.81, p<0.01$); mid and post ($|z|= 2.83, p<0.01$) and baseline and post ($|z|= 2.85, p<0.01$). Therefore, it can be concluded that all the ten participants improved across the therapy sessions.

The CA group consistently showed a better performance in naming at baseline and mid-therapy sessions. P7 and P8 of the CA group who met the 50 percent criterion for the baseline session, met the 75 percent criterion by the mid therapy session and hence was not further worked upon in this domain.

At the same time Broca's aphasia group and Wernicke's aphasia group who exhibited poor scores (<25%) on naming showed marked improvement from baseline to mid therapy session and from mid therapy session to post therapy session. The familiarity and iconicity of stimuli used for treatment made it easier to

score better on this domain. But P1 and P2 from Broca's aphasia group and P9 and P10 from Wernicke's aphasia group had deficits in time constrained naming tasks. These was regularly carried out during the sessions and also recommended for home training. All these four patients hence had shown a significant difference in scores across therapy sessions.

The better performance of WA group than BA group at baseline, mid and post-therapy sessions can be explained by the presence of motor deficits such as Apraxia of speech in few participants of BA group, which could limit their performance in time-constrained naming tasks.

Thus, from the results of this domain, it can be stated that all the ten PWA benefitted from training of naming deficits. This exemplifies that the activities presented in the CV-MAAT-K are stimulable for eliciting responses for the naming tasks.

5. **Comparison of performances of persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=6)] on reading and writing (RW) domain for baseline, mid and post therapy sessions (i.e., 1st, 7th and 15th session).**

   Out of the six persons in PNF group, reading and writing domains were worked only on two persons. Reading and writing could not be worked on four participants as one was illiterate, and reading and writing could not be taken up for therapy in the remaining three as, more recommended domains to be worked

were functional communication, repetition, comprehension and expression and naming.

Table 10
Mean and SD values for persons with fluent and non fluent aphasia in reading and writing domain.

% scores	Reading & Writing					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=2)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	81.85	-	-	8.3	39.8	47.6
SD	3.13	-	-	1.4	7.1	10.2

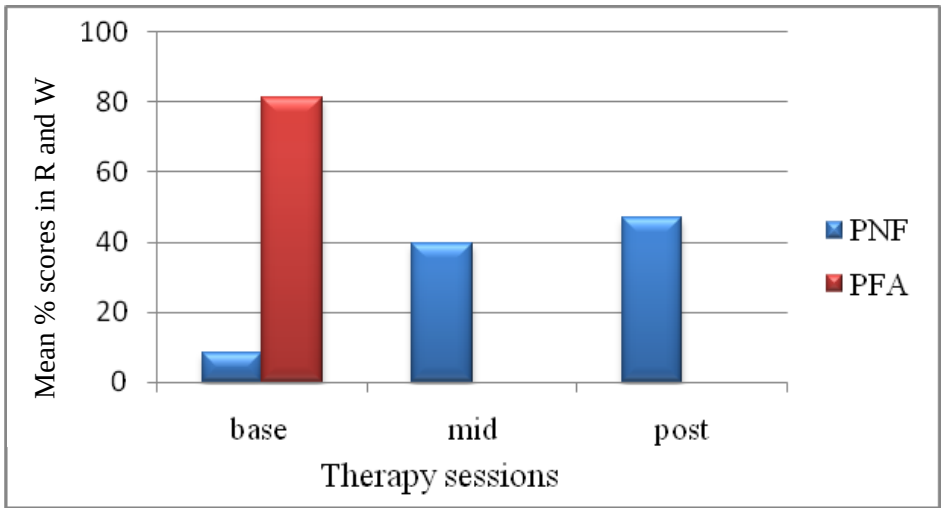

Figure 17. Response of persons with fluent and non fluent aphasia in reading and writing domain across baseline, mid and post therapy sessions.

As shown in Figure 18, the Conduction aphasia group and Wernicke's aphasia group scored above 75 percent in the baseline, and hence they were not considered for therapy.

Table 11

Mean scores for persons with fluent and non fluent aphasia in reading and writing domain.

Types of aphasia	Reading and Writing		
	Baseline session	Mid therapy session	Post therapy session
BA	37.5	178	215
CA	372	-	-
WA	365	-	-

**- BA- Broca's aphasia; CA- Conduction aphasia; WA- Wernicke's aphasia. The raw score varies and depends on the number of trials one requires to elicit the response.*

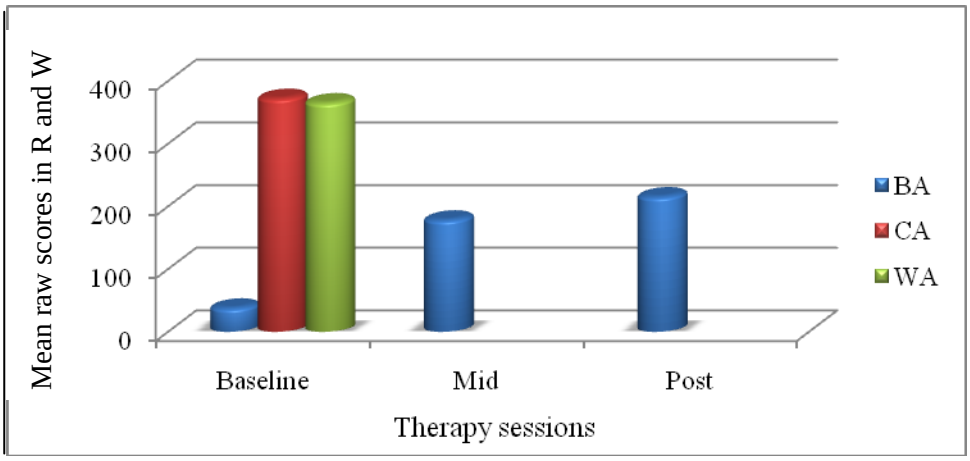

Figure 18. Mean of raw scores for three aphasia groups in reading and writing domain across three therapy sessions.

All the four participants of PFA group (P7, P8, P9 and P10) had met 75 % criterion for reading and writing at baseline session and hence were not taken up for later sessions. There could be two reasons for the better performance of the CA and WA groups in reading and writing at baseline session. The persons with CA and WA were linguistically at a higher level than the persons with BA. Also, these persons retained the motor abilities that are required for writing.

The BA group has a significantly poor performance than the other two groups at baseline session. This can be attributed to the sensory and motor deficits in all the

participants of BA group, which could have significantly impaired their ability to read and write. However, the scores of the BA group significantly improved from baseline to post-therapy session suggesting that CV-MAAT-K was successful in restoring the reading and writing abilities in PWA.

II. Quantitative analysis of different error types by all persons with fluent aphasia (N=4) and non fluent aphasia (N=6) across therapy sessions.

Note: It is to be noted in this part of the results, that the X-axis in the graphs represents the therapy sessions viz. baseline (BL), mid- and post-therapy session and the Y-axis represents the mean percentage of perseveration or paraphasia in the speech of the participants.

1. Comparison of types of perseveratory errors in persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=2)] at baseline, mid and post therapy sessions (i.e., 1st, 7th and 15th session).

The mean (M) and standard deviation (SD) for baseline, mid and post therapy sessions for percentage of perseveratory errors were calculated for ten persons with aphasia. Table 12 and Figure 19 show the mean and SD values for persons with aphasia for perseveratory errors across therapy sessions.

Table 12
Mean and SD values in persons with fluent and non fluent aphasia for perseveratory *errors.*

% scores	**Perseveratory errors**					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	65.2	33.4	12.8	3.8	-	-
SD	3.13	2.2	2.6	1.8	-	-

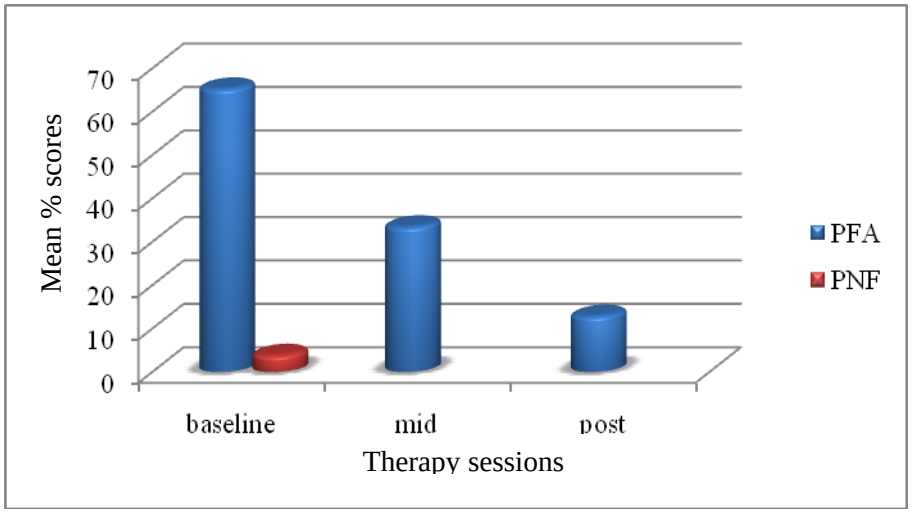

Figure 19. Percentage mean scores of perseverations in PNF and PFA at baseline, mid, and post-therapy sessions.

As shown in Table 11, since a percentage as less as 3.8, of perseverations in the PFA group is shown, it was not considered during the later sessions of therapy. Since perseverations were found to decrease across therapy sessions for PNF, Friedman's test was carried out. A significant difference was obtained in baseline, mid and post therapy session $\{\chi^2 (2) = 11.2, p<0.001\}$. The data was further subjected to Wilcoxon signed rank test. Results of this test indicated a significant difference between baseline and mid ($|z|= 2.25$, $p<0.01$); mid and post ($|z|= 2.27$, $p<0.01$) and baseline and post therapy sessions ($|z|= 2.65$, $p<0.01$). Therefore, it can be concluded that all the six PWA showed a reduction in perseveration which helped in their quality of communication.

The perseverations were found to be minimal in PNF group than PFA group. The presence of perseverations in PFA group indicates that the accessibility of words from the lexicon is impaired along with memory deficits. However, presence

of minimal perseverations in PNF group indicates the occurrence of blocks due to retrieval deficits.

2. Comparison of types of paraphasic errors in persons with fluent aphasia (N=4) [Wernicke's aphasia (N=2) and Conduction aphasia (N=2)] and non fluent aphasia [Broca's aphasia (N=2)] at the baseline, mid and post therapy sessions (i.e., 1st, 7th and 15th session).

In order to analyze the parapahsic errors shown by persons with aphasia, the mean (M) and standard deviation (SD) were calculated for all the participants. Table 13 and Figure 20 show the mean and SD values of persons with aphasia for paraphasic errors across therapy sessions.

Table 13
Mean and SD values for persons with fluent and non fluent aphasia for paraphasic errors.

% scores	**Paraphasic errors**					
	Fluent Aphasia (N=4)			Non fluent Aphasia (N=6)		
	Baseline	Mid	Post	Baseline	Mid	Post
Mean	20.2	13	4	16	5.6	-
SD	3.1	2.8	3.56	2.2	3.2	-

Friedman's test was carried out in order to find any significant difference across the therapy sessions. A significant difference was obtained in baseline, mid and post therapy sessions $\{\chi^2(2) = 16, p<0.001\}$. The data was further subjected to Wilcoxon signed rank test. Results of this test indicated a significant difference between baseline and mid ($|z|= 2.24$, $p<0.01$); mid and post ($|z|= 2.28$, $p<0.01$) and baseline and post therapy sessions ($|z|= 2.24$, $p<0.01$). Therefore, it can be

concluded that all the persons with aphasia showed a significant reduction in paraphasias, which in turn helped them to improve their communication skills.

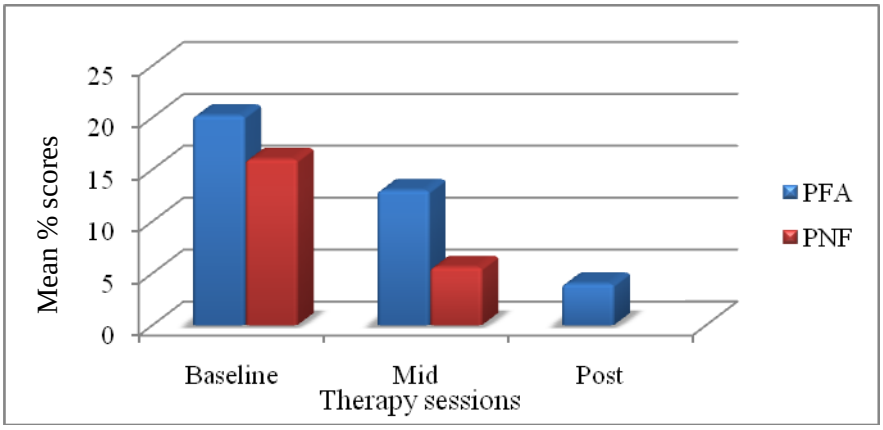

Figure 20. Percentage mean scores of paraphasias in PNF and PFA at baseline, mid, and post-therapy sessions.

The paraphasias were found to be lower in the PNF group than PFA group. The persons in the PNF group were less verbal, had lower motivation and made fewer verbal attempts when compared to PFA group. Also, semantic paraphasias were commonly observed in PFA group which showed obvious decline in cognitive skills. On the other hand, phonemic paraphasias were more common in PNF group, indicating associated motor programming deficits and oro-motor weakness.

Based on the results of the study, it can be summarised that using CV-MAAT-K, persons with aphasia did show an improvement under all the domains. These performances indicate that the activities described in CV-MAAT-K do bring a change in the overall communication skills in persons with aphasia. Also, the results from field testing of CV-MAAT-K were in par with the results from MANAT-K and MAFAT-K. This suggests that the computerized version is equally effective in restoring the lost linguistic skills in persons with aphasia.

CHAPTER V

SUMMARY AND CONCLUSION

The aim of the current study was to develop the Computerized Version of Manual for Adult Aphasia Therapy in Kannada (CV-MAAT-K) and to field test it on persons with aphasia to check its applicability in clinical settings. The contents of Manual for Adult Aphasia Therapy in Kannada (MAAT-K) (Goswami, Shanbal, Samasthita, Navitha, Chaitra & Ranjini, 2010) were converted into power point slides. The five domains were converted into five modules. After delivery of each of the module, troubleshooting was done, issues were listed and rectified. These were prepared into a computerised version by software professionals. And thus, the Computerised Version of Manual for Adult Aphasia Therapy – Kannada (CV-MAAT-K) was formed. It has five domains namely Functional Communication, Repetition, Comprehension and Expression, Naming and Reading and Writing. Subsequently, the finalised version was then field tested on ten persons with aphasia by speech language pathologists. The persons with aphasia belonged to the age range of 19-65 years, with native language being Kannada. Language therapy using CV-MAAT-K was provided for 15 sessions and each participant's performance was assessed at baseline, mid-therapy and post-therapy sessions (1^{st}, 7^{th} and 15^{th} session, respectively).

The CV-MAAT- K provided various sub-sections and activities under each domain relevant to remediating the communicative deficits of persons with aphasia. Systematic assembly of activities, stimulus, and scoring pattern facilitated

documentation of the participants' responses. These data were analyzed quantitatively as well as qualitatively across various domains and across sessions. The results showed an overall improvement in all the ten participants from baseline to post-therapy sessions. Also, the linguistic errors such as perseverations and paraphasias were worked upon for 15 sessions. The results showed a reduction in the linguistic errors in all the participants across sessions. Thus, the results revealed that the field tested CV-MAAT-K was indeed useful in facilitating better performance in persons with aphasia, in all the linguistic domains, that lead to improved interactions with significant others.

Implications

The results of the present study show that CV-MAAT K is effective in treating persons with aphasia. It comprises of all the domains that are generally affected in fluent and non fluent aphasia. Each domain covers a wide range of activities from basic, immediate communication needs to advanced verbal discourse. The activities in each sub-section have been arranged in a hierarchy of difficulty level. Correspondingly, stimulus mode (from multimodal-e.g. auditory + visual + graphic- to single modality-e.g. auditory only) and response mode hierarchy (pointing and gestures to verbal response) is also provided. In order to elicit the responses, specific cueing strategies have also been incorporated in the manual.

CV-MAAT-K is a very flexible, yet very comprehensible computer application. It is a valuable tool that can be used by speech language pathologists as

well as care-givers in the rehabilitation of persons with aphasia. It is an eco-friendly approach of rehabilitation in that it does not make use of papers. The demo videos, user guide and tutorials make it very user friendly. It is also an excellent home training tool and the caregiver themselves can monitor the patient's progress. CV-MAAT-K, in all its aspects, follows a scientific approach and thereby encourages evidence based practise. It can document the activities of everyday sessions and they can be generated and accessed at any point of time in the future. Thus it provides a huge database pertaining to a specific clinical population. As the scores are automatically being converted to percentage, it helps in easy comparison of scores across domains and sessions. Therefore, CV-MAAT-K can be successfully used with persons with aphasia for speech and language intervention.

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