DISCOURSE AND WORKING MEMORY IN NEURO-TYPICAL INDIVIDUALS AND ADULTS WITH APHASIA

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Abstract

The research findings on individuals with aphasia suggest that the manifestation of discourse/language deficit could be associated indirectly with their poor performance on working memory tasks. To be more specific, researchers proved that the n-back task can assess and index Working Memory (WM) in individuals with aphasia in comparison with the neuro-typical individuals (Wright & Fergadiotis, 2012). Here was an attempt to conduct research on 30 neuro-typical individuals and 30 individuals with aphasia exhibiting cognitive communicative deficits. N- back being a parametric task, aids in deciding if a current stimulus matches with prior stimulus sequentially which comes in 'n' place thus requiring temporary storage and manipulation of stored information along with continuously revising Working Memory components (Wright & Fergadiotis, 2012). 'Cognitive Module' (software) was used for the n-back task; the other task considered was a discourse task. Since the cognitive communicative deficits are manifested at the discourse level, there was a need to use the existing Discourse Analysis Scale (DAS) at conversation, narration, and picture description task. Thus, the objectives of the present study were 1). To investigate and compare the discourse abilities of individuals with aphasia (IWA) and neuro-typical individuals (NTI), 2). To assess and compare the working memory capacity of individuals with aphasia and neuro-typical individuals, 3). To study the correlation between discourse and working memory of individuals with aphasia and neuro-typical individuals. A comparison of the mean value of discourse quotient across three discourse tasks demonstrated the better performance of aphasia participants for picture description followed by narration and conversation task. The errors exhibited by aphasia participants like the use of unspecific vocabulary, poor discourse structure, and coherence violation were due to underlying cognitive deficit such as *poor attention* (sustained and focused attention), *perception, executive function* and *memory* about recent past (episodic memory), which is important for appropriate discourse pattern. Thus, the *macro linguistic* and *micro linguistic (typical aphasia symptoms) processing deficits* in individuals with aphasia was due to the poor working memory abilities. The support for this finding can be substantiated through the findings from our working memory assessment. For the *n-back* task, the best level for NTA was 3rd and the worst was the 5th and 6th level whereas for IWA the best was 2nd and the worst was 3rd. The majority of IWA had a capacity of 2-back and NTA had a capacity of 3-back. With respect to mean reaction time, the backward span task (BST) was better than the forward span task (FST) for the IWA group and NTA. The reaction time taken to executive FST and BST of the working memory test was found to be higher for the IWA group compared to the NTI group. There was an overlap between the FST and BST for the NTI group whereas there was no overlap between FST and BST for the IWA group. The contributing reason could be the poor phonological storage or articulatory rehearsal, reduced attentional capabilities, differences in the strategy used by the NTI and IWA participants, decreased working memory capacity, paradigm (verbal stimuli) used to assess working memory. The same is discussed in this study in detail. This study provides very good insight into the importance of discourse assessment and its appropriate practice for management purposes. It is important to consider the linguistic and non-linguistic working memory tasks with reference to the different clinical populations.

Keywords: *Phonological loop, working memory, discourse genre, coherence, N-back task*

CHAPTER I

INTRODUCTION

The brain is one of the most fragile parts of the human body, the patient with diffuse or focal injury will be still a very serious disease. Individuals, with these types of Neurological Insults, will exhibit a problem with cognitive-communicative aspects because the assessment procedures and rehabilitation are not done to the extent they are supposed to be because they show complete recovery or show symptoms as minimal as they can be. The Brain Injury Association Board of Directors (in 1997) accepted a definition of acquired brain injury to expand beyond the present definition of brain injury which is produced by trauma. "An acquired brain injury (ABI) is an injury to the brain that has occurred after birth." The brain injuries are classified under two types: traumatic and non-traumatic neurological insults. Traumatic Neurological Insults is one that is caused by physical trauma to the brain majorly due to accidental falling or road traffic accidents and is known as traumatic brain injury (TBI). The other type is a Non-traumatic Neurological Insults is one that is not caused by trauma, but caused from poisoning, a tumor, infections (encephalitis or meningitis), cell toxicity, or degenerative disease. According to North Eastern Ontario (NEO) Brain Injury Network, types of non-traumatic injuries consist of Meningitis or Encephalitis, Hypoxic Injury, electrolyte imbalance, metabolic disorder, or vascular problems.

These diverse brain insults, including traumatic brain injury and right hemisphere damage, cerebrovascular accident, infections, and tumors in the brain, neurodegenerative diseases, and prolonged acute symptomatic seizures, such as complex febrile seizures or status epilepticus (SE) lead to a condition called a cognitive communicative disorder. In the present research, the interest is towards the medical condition cerebrovascular accidents (Stroke) causing a clinical condition called aphasia.

All India Institute of Medical Sciences (AIIMS) says, “Stroke has become the 5th leading cause of death in 2016 from 12th cause in 1996 and claims 119-145 lives in every 100,000 population, which is almost a 100 percent increase. Every year, 1.8 million people suffer a stroke in India. Every year, approximately 1.8 million people suffer from stroke, which is the second most common cause of death after coronary artery disease (CAD) globally. Global Burden of Disease study of 2013, 25.7 million people survived stroke, 6.5 million died, and 10.3 million new strokes were recorded. It also noted that the low-and middle-income countries (LMICs), of which India is a part, have witnessed a more than 100 percent increase in the incidence of stroke whereas the developed countries have witnessed a drop of 42 percent. Stroke often goes undiagnosed and even if identified, is not addressed on time. According to Kaul et al (2018), a 10-year long study from India is the largest single-center prospective study so far of comprehensively evaluated acute ischemic stroke patients from South Asia. The characteristic feature was that the most common stroke subtype was intracranial Large Artery Atherosclerosis

(LAA), accounting for 29.4% of ischemic strokes. Risk factor profile demonstrated different patterns of associations with subtypes: hyperlipidemia was strongly associated with large artery atherosclerosis (LAA) and ischemic heart disease (IHD) with cardioembolic strokes.

Aphasia has been traditionally defined as a language-based impairment (Grodzinsky, 1990) typically resulting from a lesion in the perisylvian region of the left hemisphere caused majorly due to cerebrovascular accident (stroke). The speech and language deficits vary depending on the site of the lesion. Aphasia is also viewed as an upshot of reduced efficiency in cognitive processes which are thought to support language behavior (Luria, Karpov & Yarbuss, 1966; Martin & Stach, 1981).

1.1 Cognitive Process

The cognitive processes may include attention, memory, perception, and problem-solving. According to Just and Carpenter (1992), the working memory capacity has been conceptualized as a single "resource" pool for attention, linguistic, and other executive processing in neuro-typicals. It can be conceptualized that the working memory (WM) is one of the cognitive systems which is believed to be involved with language processing in individuals with aphasia.

According to Baddeley & Hitch (1974), the working memory model was earlier referred to as a verbal model. To be specific and with reference to Figure 1, "an articulatory loop" is the first component in the model. This is believed to be associated with sub-vocal rehearsal. But, later it was termed as "phonological loop" which emphasize on storing the information rather than rehearsal, which is considered as the second component. There is head among all these components known as "Central executive" (CE) which controls all the activities. The third component considered was the Visuospatial sketchpad which constitutes visual, spatial, or combination of both. In the original WM model, as there were limited capacities in the phonological and visuospatial sketchpad subsystem, the model failed to explain the results of various experiments. With reference to Figure 2, Baddeley (2000) added a fourth component called "episodic buffer" which acts as backup storage and thus interacts with short-term memory, long-term memory, and working memory.

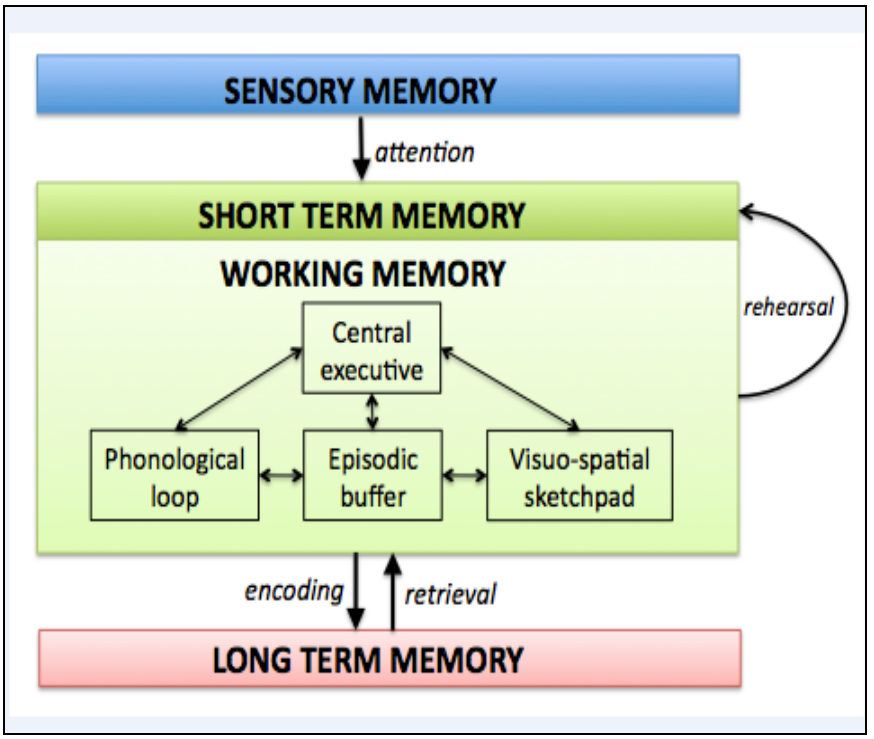


Figure1: Schematic representation of the Working Memory Model by Baddeley and Hitch (1974)

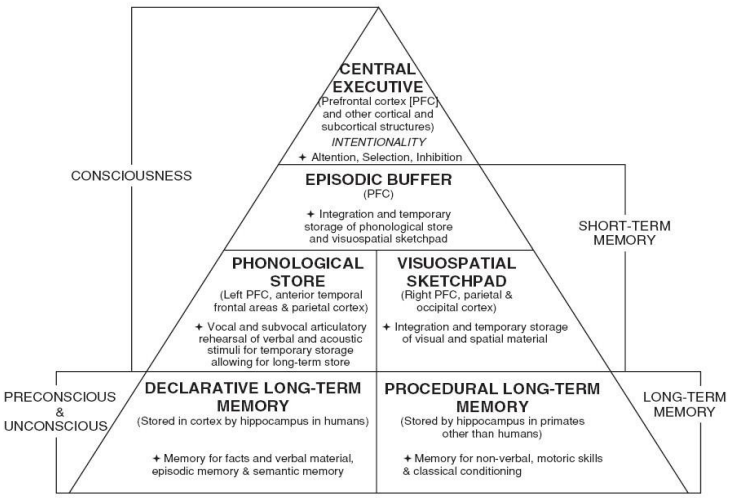


Figure2: Schematic representation of the Working Memory Model by Baddeley (2000)

1.2 Discourse

Discourse is borrowed from the components of pragmatics, and sociolinguistics, and behavioral psychology. Few specific techniques in discourse analyses have been inculcated from the psycholinguistic analyses like measures of syntax, productivity, and content. Sociolinguistic techniques include cohesion analysis, analysis of coherence, analysis of topic and compensatory strategies. Discourse analysis is the branch of applied linguistics dealing with the examination of discourse attempts to find patterns in communicative products as well as and their correlation with the circumstances in which they occur, which are not explainable at the grammatical level (Carter, 1993). Discourse analysis is employed both for written and spoken text.

Across conversational, narrative, and picture description discourse genres, the correlation between cognition and discourse vary differently. This implements the idea of essential multiple discourse tasks being a pre-requisite to acknowledge the relationship between cognition and discourse which covers the different properties and demands of different communicative contexts. Thus, the role of the communicative context contributes greatly to the assessment of the interplay between discourse and cognition according to March, Pattison, and Wales (2009).

CHAPTER II

REVIEW OF LITERATURE

2.1 Working memory assessment

Working memory can be assessed in both ways either using simple span tasks or complex span tasks. Forward digit, backward digit, ascending, and descending digit and visual, spatial spans can be used as a simple span. Reading span, operational tasks, rhyme judgment; visual letter monitoring and n-back task can be used as complex span tasks.

Forward digit is a task that requires registration of verbal or visual information and remembers passively of that information to repeat it immediately at the end of the stimulus presentation. For example, one has to observe a series of numbers for a brief interval of seconds and has to recall orally in order wise as they appeared on the screen.

Backward digit task is also similar task like forward digit after registration, the information has to be manipulated actively and formulate a response immediately at the end of the stimulus presentation. For example one has to observe a series of numbers for a brief interval of seconds, then remember the numbers and has to manipulate actively (backward) after the presentation.

Reading span: In this task, a series of unconnected sentences are read aloud and the individual has to recall the final word of each sentence being presented and there will be increased increment until the errors made by an individual.

Operational task: In this task, the participant will be asked to check the correct mathematical equation and read out the words in between along with the recall of those numbers verified after the stimulus presented.

Rhyme judgment task: Pair of real words and pseudo-words is presented and the subject has to verify whether a pair of stimuli rhyme with one another.

Visual attention task: Subject has to identify the stimulus by pressing the button when the stimulus is presented along with distracters simultaneously

n-back task: In this task, the subject is presented with stimulus one at a time and has to recognize and recall the items that appeared "n" items at the end of its sequence.

2.1.1 Assessing Working Memory in Aphasia

2.1.1.1 Simple Span Task

Simple span performance was assessed in individuals with aphasia and neuro-typical individuals to measure on Digit forward span and digit backward span in the group with aphasia (left hemisphere stroke and right hemisphere, but no aphasia). They were presented up to a maximum of eight digits, and a list of one to nine digits was also given to them to identify the stimulus. Participants were asked to point the correct order of numbers presented. Results suggested that there was a difference in digit backward span than the digit forward span which concludes that it is due to attentional capacity observed in IWA where deficient seen in phonological loop.

2.1.1.2 Complex Span Task

With reference to complex span task, the independent performance done by an individual has differences in domains like general processing efficiency and specific storage capacity According to Wright, Newhoff, Downey, & Austermann, S (2003), they checked in their study whether there was the difference in WM performance in individuals with aphasia (fluent, non-fluent and neurotypical individuals) using listening span task and also had good comprehension ability with mild to moderate severity. It was found that poorer scores were seen for individuals with aphasia in comparison with neurotypical individuals. Performance on WM was measured and correlated with oral language ability along with WAB AQ scores and found that significant correlation in WAB which contains information of both linguistic and cognition (Caspari, Parkinson, LaPointe, & Katz, 1998).

There was also an attempt made to find out the relation between working memory and reading comprehension in aphasia. For example, Caspari, Parkinson, LaPointe, & Katz (1998) considered 22 aphasic individuals and their task was to recall the end words of each sentence for subsequent recognition. Working memory capacity was measured using a modified version of Daneman and Carpenter's (1980) Reading Span Task. The maximum number of words recalled by an individual was termed an index of working memory capacity. Depending on the individual's ability there were two versions of the task introduced i.e. listening and reading. Results suggested that there were high correlations seen between working memory capacity, language function, and also in reading comprehension.

2.1.1.3 Forward span and backward span task

Individuals with aphasia have deficits in cognition processes especially storing information as well as in manipulating it. In the Forward span task, it helps in assessing the stored information temporarily and also maintaining the information. Whereas, the backward span task helps not only in assessing the stored information temporarily and maintaining it. FST also accompanies with manipulation of information observed during the task (Baddeley, 2007; Wilde, Strauss, & Tulsky, 2004). Hence these tests can be preferred to assess their WM abilities

by using simple tasks during the assessment and /or intervention before focusing on language therapy. One of the studies by Leung, Walton, Hallock, Lewis, Valenzuela, & Lampit, (2015) investigated the current research on auditory n-back auditory WM test during rehabilitation with two-stroke participants and session was carried out for six weeks for a total of 20 hours. Before and after training neural activity on auditory and visual mode was observed. By using the n-back task, the improvement was seen in both modalities (visual and auditory) and also found majorly there was activation in the cerebellum. Thus, results showed there was better performance in aphasic participants due to cross model activation. Remarkable improvements in the linguistic features in individuals with aphasia has been observed using WM rehabilitation during the intervention (Kalinyak-Fliszar, Kohen, & Martin, 2011; KoenigBruhin & Studer-Eichenberger, 2007; Majerus, Gill-Thwaites, Andrews, & Laureys, 2005).

An experiment conducted by Laures-Gore, Marshall, and Verner, (2011) to measure digit forward and backward span test and compared with different types of aphasia [Broca's, Anomic Aphasia & Right brain damage (RBD)], but no aphasia based on WAB test scores of age range 40-74 years were included. These participants were asked to indicate the correct order digits on a written notecard or orally repeat the numbers. Researchers found that individuals with aphasia (IWA) performed lower digit span scores than RBD individuals. In Digit backward span tests both groups performed poorly than digit forward span tests. This study states that decreases attentional capacity in IWA was observed which showed deficient in the phonological loop.

2.1.1.4 n-back task

This task was developed by Kirchner (1958), which is a continuous performance task and helps in assessing a part of working memory and its capacity. Also as working memory requires storage and manipulation of information at the same time, in n-back tasks similar procedure is carried out. Therefore, to assess WM capacity in individuals with aphasia n-back task with different types of stimulus either linguistic or non-linguistic may be suitable and suitably used one. For example, ten native English speakers with various types of aphasia (Broca's, Conduction, Anomic and individuals with Apraxia) diagnosed based on Western Battery Aphasia (WAB) or Boston Diagnostic Aphasia Examination (BDAE) with 6 months post-onset and no other neurological conditions were considered for the study. The participants had to perform on the n-back task (fruit task) and memory span task in both modalities (visual and auditory) (DeDe, Ricca, Knilans, & Trubl, 2014). Thus, the assessment of WM deficits is in relation to the language difficulty exhibited for longer or more complex sentences and discourse. They also found responses in visual presentation mode being faster than auditory presentation mode at all levels.

2.2 Discourse

Discourse analysis was first referred to by the linguist Zellig Harris. In the year 1951, he named his study ‘discourse analyses after investigating the connectedness of sentences’. He was

of the view that discourse analysis involved a formal methodology, that is resultant from methods of linguistics analysis structural in nature and such a methodology ably could break down the text into associations like substitution, equivalence, among its constituents at a lower level.

Harris's view of discourse held structurally so centrally to that he also put forth an argument that what conflicts discourse to a random sequence of sentences is indeed the fact that it has an arrangement: a form by which components of the discourse occur (and recur) relative to each other. A sentence's true meaning cannot be attributed to its linguistic construction alone, it also mainly depends on reference (meaning in relation to the exterior world) and sense (meaning in relation to the linguistic system). This parameter measures how well a speaker's discourse is forethought and organized in terms of the overall plan, the theme of a topic. It accounts for the correct description of the events before their occurrence.

Discourse is also defined as ‘‘continuous stretches of language or a series of connected sentences or related linguistic units that convey a message" (Cherney, 1998). This discourse does not have a strict set of rules, which specifies grammaticality as seen in sentence formation, nor specified length. Discourse genres are categorized into major classes: monologic (monologues) and interactive. Monologues refer to discourse that does not necessitate interaction, include several genres like narrations, descriptions, expository discourse, and procedural discourse. Descriptive discourse requires the delivery of qualities and concepts of a stimulus. Narratives entail storytelling (story creation or story retelling). Procedural discourse requires explanations of a string of actions to perform a task. Expository discourse enlightens a listener of a topic, which focuses upon higher-level thinking skills, like cause and effect, comparison and contrast, and generalization. On the contrary, conversational discourse is interactive where participants alternate roles as speakers and listeners to switch ideas, feelings, and thoughts. The conversation is the frequent mode of human communication. Also, storytelling mostly is surrounded by social exchanges. Monologic discourse might be important clinically than conversational discourse.

Discourse analysis checks on the use of assumed background knowledge of the topic of conversation, cultural knowledge, and general knowledge on areas of life, interpersonal knowledge like specific and possible knowledge about the history of the speakers themselves. This information plays a vital role in understanding the meaning of a word. The speaker’s meaning is dependent on the assumption of knowledge that is shared by both the speaker and the listener. The speaker forms the linguistic message and intents a meaning, and the listener deduces the message and concludes the meaning (Stilwell, 1999). In this regard, discourse analysis is accepted as a vital tool for speech-language pathologists, despite the time-consuming nature of this analysis. Thus, there is more attention paid to different kinds of discourse genres and several methodologies to measure.

Discourse genres can also be studied at micro, and macro-structural level. The micro linguistic aspects of discourse refer to lexical and morpho-syntactic skills. It analyzes the fine-

grained aspects of narrative discourse such as referential cohesion, sentence structure, and lexical diversity. Whereas, macro-structural aspects of discourse refer to pragmatic and collective forms of micro-linguistic aspects of discourse which is the concluding remarks or the summary of any discourse task. It analyzes the overall organization and theme of discourse. Some of the parameters of the Discourse Analysis Scale such as coherence, vocabulary specificity, temporal and causal relationships assess the micro linguistic aspects. Whereas, macrolinguistic assessment of discourse is assessed by other parameters such as discourse structure, global coherence, information adequacy, content, and message accuracy. These two aspects of discourse provide an understanding of the deviant discourse pattern in brain-damaged individuals.

Use of Discourse Analysis Scale (DAS) will enable to identify cognitive communicative deficits in a clinical population with diverse brain insults despite passing on traditional language tests. DAS will be an advanced test in comparison with the traditional language test which assesses only the basic linguistic competency of any individuals with brain insults. DAS assesses discourse in three different genres like conversation, narration, and picture description. DAS is an extensive test of discourse with less effort, follows the non-invasive procedure, and doesn't require high-cost equipment. Cognitive communicative deficits in clinical populations of adults with aphasia will be made aware of their discourse impairment through this assessment and later facilitate intervention at discourse since they are not aware of their impairment at the discourse level. Since cognitive communicative disordered populations "talk better than they communicate", certain cognitive aspects influence communication at the discourse level. On the administration of the discourse analysis scale, these cognitive aspects can be outlined.

A number of researchers (Ardila, 2003; Caplan & Waters, 1999; Christensen & Wright, 2010; Friedman, 2003; Mayer & Murray, 2012; Wright, Newhoff, Downey & Austermann, 2003) have reported that deficits in memory capacity (working memory) add to language processing difficulties in individuals with aphasia. Hence, individuals with aphasia exhibit impairment at discourse as a result of working memory impairment and the working memory capacity is being affected because of their evident linguistic impairment. Here is an attempt to research the clinical populations with diverse brain insults exhibiting cognitive communicative deficits and the one considered for the present research is the individuals with aphasia. Since the cognitive communicative deficits are manifested at the discourse level of language and working memory level of cognition in participants with aphasia showing certain language impairment symptoms. Hence, there is a need to understand discourse impairment and working memory capacity separately and also study the association between discourse and working memory.

2.3 Discourse analysis in Aphasia

Discourse relies on cognition and language, which are likely to change as a result of diverse brain insults. These insults include 1) traumatic brain injury, right hemisphere damage, and stroke resulting in aphasia, 2). Brain infections, tumors, Parkinson’s diseases, dementia, and prolonged acute symptomatic seizures disorders leading to cognitive-linguistic disorders. Of late

it has become challenging for both researchers and clinicians to assess the macrostructure (initial event, an action aiming at resolving problems and action-outcome) and microstructure (proportions of content words, functional words, morphemes, the total number of different words and type-token ratio) elements of discourse in these cognitive-communication disorders, where it is invariably affected.

Methods for both structural and functional discourse analysis have been developed in both the Western and Indian context. The structural assessment involves the analysis of micro-linguistic and macro-linguistic skills. The micro linguistic skills focus on lexical and morpho-syntactic features of language processing. This is achieved through knowledge of lexical and/or syntactic organization. Macro linguistic skills deal with pragmatic and discourse-level features of language processing and can be analyzed through the cohesion, local and global coherence. The functional methodologies to discourse processing abilities mostly focus on the ability to express information. These abilities can be assessed qualitatively or quantitatively.

Concerning the qualitative method, Discourse Analysis Scale (DAS) (Hema & Shyamala, 2013) may be a better test to assess cognitive communicative ability in multiple levels of different discourse genres in a clinical population with diverse brain insults. DAS includes various discourse parameters like ‘discourse structure', ‘communication intent', ‘topic management', ‘information content', ‘adequacy', ‘message accuracy', ‘speech-related parameters' under the propositional aspects and ‘turn-taking', ‘use of repair strategy' and ‘revision behaviors' under non-propositional aspects. These important domains of discourse analysis are not present as a major domain in the conventional language tests used for assessment of cognitive communicative abilities in a clinical population with diverse brain insults. Hence, for the present study, Discourse Analysis Scale will be used as a tool to analyze discourse qualitatively. Discourse analysis is a standardized assessment procedure. It was developed as, "Discourse Analysis Scale" (DAS) from the thesis titled "Discourse Analysis in Kannada-English Bilingual Individuals with Traumatic Brain Injury" and is standardized on neuro-typical individuals in the age range of 20 to 60 and above years, under All India Institute of Speech and Hearing (AIISH) research funded project. Among the clinical population with diverse brain insult leading to cognitive-communicative impairment, creates few difficulties to an individual's potential for vocational, social, and academic performance in their post morbid phase. During this period, discourse analyses of different discourse genres like the conversation, narration, and picture description are time taking to accomplish but provide information on cognitive, linguistic, and social functioning which is useful in designing tailored assessments and interventions for individuals with cognitive-communicative impairment.

Initially, DAS assesses discourse at the conversation task, the most valid means of determining the interpersonal, verbal communication abilities of any individual. Following is the narration task, which necessitates the speaker to speak on an event experienced in the present or the past. The subsequent is picture description task, which has helped predict content that results in comparatively short language samples within a short duration and needs less time to

transcribe, assess and infer the abstract information and competence of coherence among concrete pieces in the stimuli. Hence, it is essential to carry out discourse assessment to discriminate among persons with diverse brain insults leading to cognitive-communicative impairment that do not differ in conventional language assessment procedures (Coelho, Liles, Duffy, Clarkson, & Elia, 1994).

Hence, cognitive and linguistic analysis at the level of discourse was attempted by Hema and Shyamala (2008). In this study, the experimental group comprised of 20 individuals with Traumatic Brain Injury (TBI) as participants with moderate to severe injury. Within the TBI group, there were two subgroups, viz. Left Hemisphere Damage (LHD), and Right Hemisphere Damage (RHD). Age, sex, and education matched normal subjects were selected as a control group. A discourse sample was elicited between the investigator and the subjects on preset topics for two sessions. A 10-20 minutes sample thus obtained was considered for analysis. A sample of picture description tasks was also considered. Transcription of the recorded sample using a broad International Phonetic Alphabet was done. Various speech discourse parameters under the propositional and non-propositional aspects of conversation and picture description tasks were analyzed. Perceptual rating scales were used to assess all the parameters. Results were statistically analyzed for a significant difference in performance between the TBI subjects with LHD, RHD group, and normal speakers. A non-parametric test was used to note if there was any significant difference between the three groups in terms of discourse. The discourse analysis procedure was used to assess the discourse ability in individuals with TBI and normal speakers. All the parameters of discourse were significantly different between the individuals with TBI and normal speakers. Comparison across TBI subjects with LHD and RHD group showed a significant difference only in communication intent; greets others by himself/herself, introduces self, turn-taking, conversational repair, fabricates/ imagines events, and delayed response parameters. From the above findings, it is clear that more studies are needed to analyze discourse at micro linguistic & macrolinguistic levels, which will give us an insight into the impaired communication skills in individuals with diverse brain insults. Hence studies need to focus on investigating discourse among aphasic individuals.

Ash et al., (2009) assessed speech fluency in 35 persons with frontotemporal lobar degeneration (FTLD). They presented progressive non-fluent aphasia (PNFA), semantic dementia (SemD), or a social and executive disorder without aphasia (SOC/EXEC). Fluency was attributed as the number of words per minute in an extended, semi-structured speech sample. PNFA people were significantly less fluent than the rest of the groups. Fluency correlated with grammatical expression but not with speech errors or executive difficulty. Persons with semantic dementia and SOC/EXEC were also less fluent than controls. In semantic dementia, fluency was linked with semantically limited output. In SOC/EXEC, fluency was associated with executive limitations.

The linguistic discourse analysis is used to examine the language of adults with aphasia. Bryant, Ferguson, and Spencer (2016) have reviewed seven databases with 165 studies on the

linguistic measures in aphasia at the discourse level. Over the past 40 years, the analysis of methodological applications revealed an increase in published research using linguistic discourse analysis. The results-focused particularly on the measure of generalization of therapy outcomes to language in use. Among the different genres of discourse, the narrative language samples were most frequently used for analysis. A total of 536 different linguistic measures were applied to examine language behaviors. This growth in linguistic discourse analysis suggests the need for clinical use of discourse analysis and to examine the differences that exist between the research and clinical practice.

Apart from the above review report a study by Fromm, Greenhouse, Hou, Russell, Cai, Forbes and MacWhinney (2016) evaluated the procedural discourse (narration of illness or injury stories) and personal narratives (peanut-butter-and-jelly-sandwich) task of 195 participants with aphasia (PWA) and 168 neuro-typical individuals (NTI) and observed how the proposition density can differentiate between these individuals and as well as among subtypes of aphasia. Language samples were transcribed using Codes for the Human Analysis of Transcripts and analyzed using Computerized Language Analysis, which automatically computes proposition density (PD) using the Computerized Propositional Idea Density Rater program. NTI group performed significantly higher than the PWA group. They concluded that the 'proposition' usage is markedly sensitive to the type of aphasia and very evidently distinguishes individuals with Broca's aphasia from the rest.

The additional point in the review of discourse analysis is the cognitive grammar (CG), which is a cognitive approach to language, was introduced by Langacker (1986), which believes that the symbols are the basic unit of language or conventional pairings of a semantic structure with a phonological label. This view takes a nonstandard outlook of linguistic semantic and grammatical structure. There is no clear division between language and other cognitive processes; all linguistic form is conceptually meaningful. Across different discourse genres, the correlation between cognition and discourse varies differently. For example, a study by March, Pattison, and Wales (2009) assessing the interplay between cognition and discourse depends fundamentally on the role of the communicative context. This implements the idea of essential multiple discourse tasks being a pre-requisite to acknowledge the relationship between cognition and discourse which covers the different properties and demands of different communicative contexts.

In a pilot study by Manning and Franklin (2016) by considering 22 (6 fluent, 16 non-fluent) individuals with aphasia exhibiting cognitive-linguistic difficulty which was not assessed in the traditional componential models of aphasia. The same was investigated using a Cognitive Grammar approach. The narrative discourse samples of these individuals were compared with 10 individuals without aphasia statistically. There was significant difficulty in temporal sequencing which is not a unique linguistic form. This deficit was separate from their naming skill as noticed in some individuals and it indicated that the cognitive-linguistic difficulties are not linked with more widespread brain damage. There is a need for further studies to account for aphasia

concerning cognitive science and linguistic approaches. Hence the present study is planned to assess the same.

Overall aphasia can impact spoken languages via expression and/or comprehension as well as reading, gesture, and writing. Memory, processing ability, auditory attention span, syntax, word retrieval is the deficits often displayed by adults with aphasia (Caspari, Parkinson, La Pointe, & Katz, 1998). The specific language characteristic which is affected in aphasia depends on the location and extent of brain damage (Ardila & Hough, 2013). Thus, the ability to produce and/or comprehend language is impaired in aphasia and with reference to individuals, it varies in severity.

2.2 Working memory deficits in Aphasia

Individuals with aphasia have impaired attention control processes, limited working memory capacity, as well as impaired inhibitory mechanisms (Adams & Dijksstra, 1966; Brown 1958; Peterson & Peterson, 1959; Pillsbury & Sylvester, 1940). Each individual's working memory includes maintenance and processing components that act simultaneously while processing language. Diamond (2013) has defined working memory as an executive function that involves holding information and working with it in mind. Whereas, to functionally use language and comprehend, it is necessary to use the general cognitive processes such as interpreting information or representations, maintaining, processing, and retrieval (Martin & Reilly, 2012).

Working memory (WM) is the one cognitive system which is believed to be involved with language processing in aphasia. There are different measures used to identify the association between and language performance and working memory. For example, the N-back task assesses memory components and the ability to process the memorized component simultaneously. There are usual N-back tasks for digits, lexical categories, and syntactic aspects of the sentence used as the stimulus to measure a person's working memory capacity. Thus, working memory capacity has been conceptualized as a single "resource" pool for attention, linguistic, and other executive processing (Just & Carpenter, 1992). WM capability is known to be linked to various cognitive tasks, including verbal reasoning skills, learning skills, math skills, and language processing (Conway & Engle, 1996; Engle, Tuholski, Laughlin, & Conway, 1999) since 40 years. These other specific cognitive abilities are not found to be significantly related to the performance of the Short Term Memory (STM) tasks (Daneman & Carpenter, 1980; Turner & Engle, 1989). From this perspective, STM may be contrasted with WM. In typical cognitive functioning, these processes operate with other abilities including executive functions, attention, and rehearsal to preserve the activation of words in short term memory (Martin & Reilly, 2012).

The above mentioned cognitive skills that are not captured by most aphasia batteries are recognized and appreciated by experienced speech-language pathologists. However, few types of research are required to characterize the difficulties they report. There are very fewer procedures that are clinically feasible in identifying the underlying impairments or objectively validating the complaints of individuals with aphasia (Frankel, Penn, & Ormund-Brown, 2007). The priority of

research on aphasia typically focuses on more severe and easily identified aphasia presentations. In contrast, evidence-based evaluative resources for various types of aphasia resulting from particular sites of damage affecting specific components of the language processing system as well as impacting working memory is limited (Ardila, 2003; Baddeley, 2003; Caramazza, 1988; Caspari, et al., 1998; Friedmann & Gvion, 2003; Gutbrod, Cohen, Maier, & Meier, 1987).

For example to certain clinicians with less experience, the treatment challenges for the identified clients with aphasia are likely to be present when the severity of aphasia is mild and limited evidence is available from which to derive treatment methods (Armstrong, Fox, & Wilkinson, 2013). Hence there is a need to improve the identification of persisting language difficulties in individuals with brain injury by developing sensitive assessment tools related to working memory. Following this, the research directing towards treatment outcome measurement for various types of aphasia is also in need (Frankel, Penn, & Ormund Brown 2007; Kemper, McDowd, Pohl, Herman & Jackson, 2006). Studies are showing the persisting language difficulties to be considered as the reduced working memory capacity in individuals with aphasia in comparison with the neuro-typical individuals (Wright & Shishler, 2005). And have assessed working memory capacity in fluent versus non-fluent aphasia and concluded that the working memory (WM) assessments might be a practical means for identifying high-level aphasia.

Therefore it is necessary to review the current concept of WM and its methodological considerations in clinical practice. Wright and Fergadiotis (2012) conducted a review study, and an effort was made to note its theoretical frameworks, the best task to measure WM, and also to find the relationship between WM and language processing in aphasia. Some of the theoretical frameworks which were commonly used in WM studies include Atkinson and Shiffrin's model (1968), Baddeley and Hitch's Working Memory Model (1974), Cowan's embedded processes model (1999) and Hasher and Zack's model (1988). The first and most influential theoretical framework used to study working memory was Atkinson and Shiffrin's model (1968). Hence there is a need to choose a specific paradigm to assess WM in individuals with aphasia. The modal model asserts that human memory consists of three stores: a sensory register, short term store (STS), and long-term memory (LTM). The STS was responsible for encoding and retrieving information from LTM. This model was hypothesized to function sequentially. Though the model was able to explain several phenomena, the conceptualization of the serial function of this model posed several limitations and appeared illogical and overly simplified. This model was not able to account for certain neuropsychological data.

Following the limitations of this model (Atkinson and Shiffrin's model), Baddeley and Hitch proposed a working memory model to address the limitations of the modal model (Please refer intro section for explanation). Following this model, Cowen proposed a model in response to some limitations of the multicomponent working memory model given by Baddeley and Hitch (1974). Cowen claimed that the nature of verbal and visuospatial stimuli explained in this model was too restrictive and eliminated the need for domain-specific storage structure through the

introduction of his model called Cowan's embedded processes model (1999). This is an information processing model, this model was influenced by the Hebbian theory-1949 (sited in Crowder, 1993), in which activation of elements believed to happen outside the conscious awareness. Cowen replaced the specialized buffer by proposing activated, generic representational formats. Another theoretical model explaining working memory was proposed by Hasher and Zack's in 1988. The authors state that WM consists of three mechanisms such as *access, deletion, and restraint*. This framework places greater importance on the inhibitory processes that restrict attention to the task of task-relevant information. The *access* mechanism connects to the cognitive apparatus to selectively attend the information. The *delete* mechanism is responsible for deleting the activated representations from conscious awareness once the represented information is no longer relevant. The *restraint* mechanism is responsible for controlling strong responses. Thus, they found various results for the different theoretical framework which was less susceptible hence recommended for further investigations to be done in order to see the contributions of WM in language processing in aphasia group.

Few limitations of the existing research are that: (1) WM tasks have been changed in different ways, making comparisons or collection of data across studies (Murray et al., 2001; Wright & Fergadiotis, 2012; Wright & Shisler, 2005); (2) WM tasks performed by people with aphasia are often not planned to take into account of potentially confounding factors related to task needs and measurement validity (Wright & Fergadiotis, 2012); and (3) Procedures and stimulus design are often not explained in sufficient detail, resulting in difficult to comprehend specific task requirements, interpret results, and compare findings. In addition to these methodological limitations, previous studies on WM and aphasia have included heterogeneous aphasia groups, and the observed effects were generalized to the whole sample population.

However, verbal and non-verbal working memory was assessed in aphasia participants using three n-back tasks by Christensen and Wright (2010). The aim was to check the effects of varying linguistic processing demands with reference to the context for participants with and without aphasia. Three different n-back tasks for example; Higher linguistic –fruits, semi-linguistic –fribbles, and non-linguistic –blocks were considered. They compared differences within and across individuals with aphasia and also with neurologically intact matched peers and each completed two levels of difficulty (1-back and 2-back test). All participants performed better in 1 back task than the 2-back WM task. To be specific, individuals with aphasia performed poorer compared to neurotypical individuals. Therefore, results suggest that **language ability has a significant influence on performance on working memory tasks** and should be considered when discussing cognitive deficits in aphasia. From the above study, it is observed that individuals with aphasia have deficits in cognition system (for example WM) which will affect their language sources which are not noticed often and concentrate more on assessment and intervention on language components than with cognitive processes.

Working memory deficits in aphasia with a history of unilateral left-hemisphere lesion with the post morbid duration of at least three months were considered in another study by

Mayer and Murray (2012). The aim was to check the feasibility, reliability, and internal consistency of the n-back task and thus evaluate WM in aphasia. Participants considered were 14 adults with aphasia, and the neuro-typical individuals with age and education-matched were 12 in number. All the participants completed the n-back task with varying stimulus types. Accuracy and reaction time (RT) was analyzed in among these experimental tasks, a standardized performance task, and also calculated effect size. Aphasia and aged-matched controls results showed similarity across stimulus forms with significantly greater WM accuracy for nameable versus non-nameable stimuli. **Individuals with aphasia were significantly more affected by increasing WM load when compared to the controls.** RT effects were in consensus to accuracy data, whereas age effects were not parallel across tasks. Hence, the *n*-back task holds well in measuring WM for adults with aphasia and can quantify to the clinical population.

In the recent study by Ivanova, Dragoy, Kuptsova, Ulicheva, & Laurinavichyute (2015), an attempt has been made to compare the two WM tasks such as n-back tasks and complex span and also between fluent and non-fluent groups. The task used was a modified listening span task, and auditory-verbal 2-back task, and a standardized Russian language comprehension test. The participants considered were 44 individuals with aphasia of non-fluent, fluent, and mixed type. The results suggested that two tasks indicated primarily different cognitive mechanisms. **The correlation between listening span test and language comprehension was good with non-fluent aphasia than fluent aphasia.** Researchers also claimed that two tasks could not be substituted for one another and further investigations have to be made for details.

There is also a similar study conducted by considering individuals with aphasia of fluent and non-fluent type. An unpublished study by Chaya and Hema (2017) showed the significant difference between the Forward Span Task (FST), Backward Span Task (BST), and n-back of working memory test for or within individuals with aphasia group. With reference to the group with neuro-typical individuals, there was no significant difference between the FST, BST, and n-back of the working memory test. This is in support of the fact that any brain injury rarely affects only one cognitive system. The neural network which contributes to the different aspects of executive functions will be damaged synchronously, specifically the case of middle cerebral artery stroke.

In comparison with the neuro-typical individual's the two processes of cue-dependent search and recognition (or switching versus updating) could combine and dissociate very easily. This implies the same in the clinical situation, hence there is a need for future lesion studies that would help to clarify further the neural underpinnings of the cognitive processes involved in the execution of these working memory tasks. **All the participants in aphasia group had a common level ‘1' for the n-back task and the group with neuro-typical individual's hierarchy of level was ‘5', ‘4', ‘3', ‘2', and ‘1'.** The participants' performances concerning level/threshold/accuracy worsen when the n-back levels increased. There are only a few studies that relate to the *n*-back task and discuss working memory capacity and also its influence in

language processing. As a future implication, studies have to be done to construct validity and reliability and thus obtain the threshold of an individual using different working memory tests.

Individuals with aphasia often have limitations in responding verbally and/or through gestures which are due to deficits in motor speech and limb movement and thus help them to perform poorly in complex span tasks (One complex form of WM assessment) during the testing/assessment. Therefore, it is very much important to evaluate every stage of WM tasks and their requirements, and also to challenge directly by comparing individuals with and without aphasia in all tasks where deficits can be assessed easily. Hence, pointing or through gestures, responses can be considered as an alternative to spoken language although rarely this is done because of delay in verbal recall in most of the complex span tasks. Consequently, there are a larger number of unanswered issues related to the WM tasks, but the procedures should be most valid and reliable for use among individuals with aphasia. Partial attempts have been made to validate the versions of WM tasks. Presently there is a great need for research to establish methodological, theoretical, and psychometrical measures of WM in individuals with aphasia. Therefore the assessment of WM using 'Cognitive Module' (software) has enabled a more thorough and valid investigation of the role of WM in aphasia. Measurements include the basic psychometric features as well as its usefulness for providing insight into the nature of WM deficits in individuals with aphasia.

Need for the study:

Use of Discourse Analysis Scale (DAS) will enable to identify cognitive, communicative deficits in a clinical population with diverse brain insults despite passing on traditional language tests. DAS is an extensive test of discourse with less effort, follows the non-invasive procedure, and doesn't require high-cost equipment. Cognitive-communicative deficits in clinical populations with diverse brain insults will be made aware of their discourse impairment through this assessment and later facilitate intervention at discourse since they are not aware of their impairment at the discourse level. Since cognitive communicative disordered populations "talk better than they communicate", certain cognitive aspects influence communication at the discourse level. Different discourse genres have their respective clinical implications in the assessment of linguistic functions of aphasic population apart from the routine standardized language assessment. The DAS will help estimate the prevalence of the cognitive, communicative disorders/deficits in the Indian population with diverse brain insults. By the administration of the discourse analysis scale, the cognitive aspects can be outlined. Since the efficient production of discourse depends on a myriad of cognitive functions working in concert to process, store, and manipulate information. Reliance over any one task will limit our knowledge about the underlying cognitive abilities which are very much important for proper linguistic functioning. Deficits in working memory will limit the efficiency with which individuals with aphasia produce and comprehend the discourse. It is, therefore, rational to assume that deficit in working memory will also reduce the overall organization and efficiency of language production. Hence, knowledge of the association between discourse production and

cognitive deficits may support clinicians in developing a more effective diagnostic and treatment plan for individuals with aphasia (Youse & Coelho, 2005). The present study is an attempt to estimate the clinical feasibility and basic psychomotor aspects among adults with aphasia for one instantiation of the n-back task. This study would take advantage of n-back flexibility in terms of stimulus and response type to the designed task which is apt for aphasia. The score of n-back task will serve to highlight the complexity of attempting to separate language and cognitive skill of working memory capacity. Thus, assessment of working memory in aphasia would be very important since the decreased working memory capacity interacts negatively with the linguistic and functional outcome of adults with aphasia. Also, there is a need for future studies to continue exploring the potential utility of the n-back task.

CHAPTER III

Method

3.1 Aim

The present project aims to investigate the discourse abilities and working memory capacity of adults with aphasia in comparison with the neuro-typical individuals.

3.2 Objectives

1. To investigate and compare the discourse abilities of adults with aphasia and neuro-typical individuals.
2. To assess and compare the working memory capacity of adults with aphasia and neuro-typical individuals.
3. To study the correlation between discourse and working memory of adults with aphasia and neuro-typical individuals.

3.3 Research Design

The present study was a standard group comparison with two group's clinical group (individual with aphasia-IWA) and control group (neuro-typical individuals-NTA).

3.4 Participants

The participants chosen for the study were 30 individuals with aphasia constituted as Group 1 and 30 neuro-typical individuals constituted as Group 2, both within the age range of 35 & above years. In total, sixty participants who were native speakers of Kannada language were considered for the present study. The neuro-typical individuals constituted the control group and individuals with aphasia constituted the clinical group. Both monolingual and bilingual speakers were recruited; the proficient language or L1 had to be Kannada (Mother tongue). L2 and/or L3 could be English (most frequently used/or medium of instruction at school/college) and/or Hindi and/or Tamil. As per the rating on the re-adapted version of the National Institute of Mental Health (NIMH) Socioeconomic Status Scale, (Venkatesan, 2011), all the participants were ensured belong to a middle/high socioeconomic status. These were the general selection criteria for control and clinical group.

3.4.1 Location of Participant Selection

All the participants from the clinical group were chosen from the All India Institute of Speech and Hearing, Mysuru, Karnataka, India. The participants from the control group were drawn from the work/residential place in and around Mysuru, Karnataka, India. Participants were included in the study only on fulfilling certain specific criteria. The criteria were different for the clinical and the control groups, with a few common criteria for the two groups.

3.4.2 Inclusion criteria for the control group

The additional inclusionary criteria for the neuro-typical individuals after following the general selection criteria as participants for the present study were:

1. No history of speech, language, and hearing impairment.
2. No reported history of neurological/psychological impairment confirmed through the administration of the General Health Questionnaire.
3. Performance on Mini-Mental Status Examination (Folstein, Folstein, & McHugh, 1975) within the normal range.
4. These individuals should have a minimum of 10 years of formal education. Thirty neuro-typical individuals were considered as normal participants.

3.4.3 Inclusion criteria for the clinical group

The additional inclusionary criteria for individuals with aphasia were:

1. Individuals with the diagnosis of aphasia caused due to the cerebrovascular accident and this diagnosis were indicated by a Neurologist with the help of neuroimaging data or by a Speech-Language Pathologist diagnosing aphasia on the administration of Western Aphasia Battery (Chengappa & Kumar, 2008).
2. No reported history of cognitive or speech and language impairment prior to aphasia onset.
3. Post onset duration of at least six months to twelve months. Thirty participants with aphasia were considered for the present study and underwent Western Aphasia Battery (WAB) to characterize the nature and severity of language deficits. The Aphasia Quotient (AQ) of WAB was calculated and the score less than 93.8 were included for the study. From a Speech-Language Pathologist, they received confirmation regarding the presence of aphasia component. Only participants who had aphasia due to the cerebrovascular accident were considered.

3.5 Assessment Procedure

3.5.1 Data collection: Phase I

3.5.1.1 Informed consent form including the verbal information sheet

Informed consent proposed by AIISH (All India Institute of Speech and Hearing) Ethical committee (2009) was used to obtain consent from each of the participants. The informed consent form consisted of two parts: the verbal information sheet and the consent form (Appendix A).

The information sheet included information on the title and objective of the study being undertaken along with the type and number of participants. They were highlighted about

risk/benefits for human research subjects willing to participate in the study. The assurance was provided to the participants that they would be clarified of any doubts at any time during the data collection/study. Emphasize is made on privacy confidentiality- the anonymity of participating human subjects. The information sheet also consisted of a clear appreciation and understanding about the introduction to the study, procedures and protocol, duration, confidentiality, sharing the results, right to refuse or withdraw, and whom to contact. The certificate of consent consisted of a written statement in the first person, in bold. The consent form was signed by all the participants in the group with neuro-typical adults (NTI) and individuals with aphasia/guardian of the same.

3.5.1.2 General information sheet

All the participants were interviewed individually and the general history was taken. The participants were made to sit in front of the examiner. Interviews were in the form of interactive sessions with questions and answers. General history included name, age/sex, address and contact, languages known, handedness, education, occupation, information about hearing and vision, history of neurological/psychological illness, presenting illness, and address and contact number. Detailed medical history (if any) which included presenting symptoms, details of medical and non-medical treatments, and information about tests which they had undergone was obtained from the participants. Thus, the General Information Sheet (Appendix B) was filled for all the participants.

3.5.1.3 Mini-Mental Status Examination (MMSE)

The mini-mental state examination (MMSE) or Folstein's test is a brief 30-point questionnaire test that is used to screen for cognitive impairment. It was introduced by Folstein, Folstein, and McHugh (1975) (Appendix C). It is commonly used to screen for cognitive impairment. It is also used to estimate the severity of cognitive impairment at a given point in time and to follow the course of cognitive changes in an individual over time. It is an effective way to document an individual's response to treatment. In a time span of about 10 minutes, MMSE samples various functions including arithmetic. The MMSE test includes simple questions and problems in several areas: the time and place of the test, repeating lists of words, arithmetic such as the serial sevens, language use, and comprehension, and basic motor skills. For example, a question is asked to copy a drawing of two pentagons. Any score greater than, or equal to 25 points (out of 30) is effectively normal (intact). Below this, scores can show severity like severe (≤9 points), moderate (10-20 points), or mild (21-24 points). Low to very low scores correlate closely with the presence of cognitive impairment, although other mental disorders can also lead to abnormal findings on MMSE testing. MMSE was administered in Kannada to the participants in both clinical and control groups. Table 3.1 shows the scores obtained on MMSE for all the Aphasia participants which ranged from 22 to 29. The participants' score <25 indicate mild to moderate, in the range between 17-23 indicates cognitive impairment. From table 3.1, we can appreciate that all aphasia participants cleared the MMSE task scoring >23, whereas two patients scored <23 indicating cognitive impairment.

3.5.1.4 Western Aphasia Battery (WAB)

This is a standard test initially given by Kertesz and Poole (1974, 1979, and 1982) to assess the language ability and classify the participants into different types of aphasia. The test consists of different tasks to check spontaneous speech, auditory verbal comprehension, repetition, and naming abilities. In the present study, the Kannada version of WAB with the normative and clinical data developed by Chengappa and Kumar (2008) (Appendix D) was used to rule out the presence/absence of aphasia component in individuals with aphasia. Only the participants with the presence of aphasia component were considered for the study. WAB was administered in Kannada to the participants in the clinical group. Table 3.1, shows the scores obtained on WAB for all the participants in the clinical group. The study consisted of 11 non-fluent aphasics and 19 fluent aphasics. The fluent aphasic group consisted of 9 participants with anomic aphasia, 4 with conduction aphasia, and 6 with Wernicke's aphasia. Whereas non-fluent aphasia types included in the study were one with transcortical motor aphasia, one with global aphasia, and 9 with Broca's aphasia. Thus, the demographic and diagnostic details of the participants in the clinical group are shown in Table 3.1. The control group was matched with the clinical group for age and education level as shown in Table 3.2 and all passed in the MMSE screening of cognitive impairment with a score of >25.

Table 3.1: *Demographic details of clinical participants*

Sl no	Age/Sex	Language Known	Education Level	AQ score	Aphasia Type	MMSE score	Duration of illness
1.	19/M	K, E	UG	87.3	Fluent	25	8 months
2.	52/M	K, E	G	58.8	Non-fluent	28	12 months
3.	49/M	K, E	G	76.6	Fluent	24	6 months
4.	35/F	K, E	G	74.8	Fluent	26	12 months
5.	35/M	K, E	G	55.5	Non- fluent	27	12 months
6.	65/M	K, E	PG	84.2	Fluent	28	5 months
7.	35/ F	K, E	G	38.9	Non-fluent	24	9 months
8.	56/M	K, E	PG	88.8	Fluent	27	6 months
9.	37/ F	K, E	G	42.9	Fluent	25	5 months
10.	44/M	K, E	PG	42.4	Fluent	25	12 month
11.	40/M	K, E	G	76.6	Fluent	29	9 months
12.	63/M	K, E	G	79	Fluent	27	6 months
13.	47/M	K, E	PG	76	Fluent	26	6 months
14.	42/ F	K, E	G	38.9	Fluent	24	8 months
15.	70/ F	K, E	G	38.9	Fluent	23	12 months
16.	44/M	K, E	PG	82	Fluent	26	7 months
17.	40/M	K, E	G	68.2	Non-fluent	25	7 months
18.	45/M	K, E	G	62.4	Non-fluent	26	9 months
19.	40/M	K, E	UG	39	Fluent	24	12 months
20.	51/M	K, E	G	62.4	Non-fluent	25	12 months
21.	45/M	K, E	G	32	Fluent	24	9 months
22.	40/ F	K, E	G	26	Non-fluent	24	6 months
23.	65/M	K, E	G	46.3	Fluent	27	12 months
24.	40/ F	K, E	G	67	Fluent	22	12 months
25.	55/M	K, E	PG	86	Fluent	26	12 months

26.	70/M	K, E	G	58.6	Non-fluent	27	12 months
27.	44/ F	K, E	PG	82	Non-fluent	24	12 months
28.	30/M	K, E	PG	59.8	Fluent	28	5 months
29.	40/M	K, E	G	42.9	Non-fluent	22	6 months
30.	43/M	K, E	PG	53.7	Non-fluent	24	8 months

Note: M-Male, F-Female, K-Kannada, E-English, UG-Under Graduation, PG-Post Graduation, MMSE-Mini Mental Status Examination, WAB-Western Aphasia Battery.

Table 3.2: *Demographic details of control participants*

Sl no	Age/Sex	Language Known	Education Level	MMSE scores
1.	56/F	K, E	G	29
2.	47/M	K, E	PG	30
3.	70/M	K, E	PG	28
4.	40/M	K, E	PG	30
5.	50/ F	K, E	G	30
6.	48/M	K, E	PG	30
7.	40/M	K, E	PG	30
8.	40/M	K, E	PG	30
9.	42/ F	K, E	UG	30
10	53/ F	K, E	UG	30
11	64/M	K, E	G	30
12	53/M	K, E	PG	30
13	50/ F	K, E	UG	30
14	75/M	K, E	PG	30
15	70/M	K, E	G	28
16	70/ F	K, E	G	29
17	40/ F	K, E	G	30
18	35/M	K, E	PG	30
19	40/M	K, E	PG	30
20	75/M	K, E	G	29
21	68/M	K, E	G	29
22	75/ F	K, E	G	29
23	65/ F	K, E	G	28
24	75/M	K, E	G	30
25	73/ F	K, E	G	30
26	36/ F	K, E	G	30
27	64/ F	K, E	G	30
28	27/M	K, E	G	30
29	55/M	K, E	PG	30
30	27/ F	K, E	PG	30

Note: M-Male, F-Female, K-Kannada, E-English, UG-Under Graduation, PG-Post Graduation, MMSE-Mini Mental Status Examination,

3.5.2 Data collection & analysis: Phase II

3.5.2.1 Discourse data collection

All the participants diagnosed with Aphasia were subjected to complex discourse production tasks. This involved three types of discourse elicitation from the participants in the Kannada language, namely; picture description, narration, and conversation genre.

1. Picture description task.

For the picture description task, line drawing picture 'a picnic spot' (WAB by Chengappa & Kumar, 2008) was used. (The picture was 6 x 4 inches in dimension). All the participants were instructed to tell the gist of information and then describe the events happening in the picture. They were asked to name all the contents in the picture and describe the same.

2. Narration task.

Participants were given the topic "Journey to a place" to narrate in detail.

Instruction: "Imagine your past/future journey to a place and narrate the preparations done before the journey and how did you spend your time during the journey."

3. Conversation task.

For the conversation task, the topic selected was "My country- India". Instructions provided to the participants were as follows.

Instruction: "What do you say about our country "India"? Please tell me in terms of culture, politics, education, and famous places in this country. I want you to tell me everything about these topics in general until I ask you to stop after a few minutes."

Instruction: "Can you tell me about your family"? Please tell me about who all live with you, their work, names, and your favorite pass time with them. I want you to tell me everything about your family in gist until I ask you to stop after a few minutes."

All the participants were informed prior, that the discourse samples will be video recorded and the recording will be started when they will be ready for the same. The recordings for all the three tasks were done in two phases: Phase- I and Phase-II. In Phase-I, 4 to 5 minutes' interaction was recorded which aimed to improve interaction and build rapport between the investigator and the participants. In Phase- II, to obtain discourse samples of all the participants the recordings were done in one or two sessions according to the convenience of the participants. Here the participants showed less inhibition in their discourse since they became quite accustomed to the investigator, only fifteen to twenty minutes of speech samples of these sessions were selected for the final analysis. Before recording, the participants were instructed to talk in a casual way. In the first session recording, the participants had to use only L1 (for example- Kannada language) for picture description, narration, and conversation tasks. Subsequently, after a few days, the same participants had to complete the remaining tasks which were pending from the first session. This was mainly done for the participants who require a break. An attempt was made to complete the entire task in one session itself for these

participants. All the recordings were carried out in a quiet room with no distraction during or in between the recordings at All India Institute of Speech and Hearing, Mysore, or residential places of the participants. The participants were aware that their speech was being recorded and was also informed that they were free to ask any questions related to the topic to the examiner during the conversation. Handy cam (Sony digital recorder H302233) was used to video record each session. Three tasks would last for 15-20 minutes allowing as much time as required to collect at least 400-500 words (arbitrarily determined for the study) of picture description, narration, and conversation from each participant using the specific instructions as mentioned above to complete the data collection process.

3.5.2.2 Discourse data analysis

The discourse samples were analyzed qualitatively for picture description, narration, and conversation task. Qualitative rating of discourse was carried out using Discourse Analysis Scale (Hema & Shyamala, 2008) developed as a part of a thesis titled 'Discourse Analysis in Kannada-English individuals with Traumatic Brain Injury' (Appendix E, F, and G).

The description of the Discourse Analysis Scale (DAS) is as follows; this analyses the discourse samples qualitatively using a perceptual rating scale. It consists of a set of discourse parameters and a list of skills under each parameter. Each skill will be rated separately and a final index is obtained for discourse tasks like conversation, narration, and picture description. The scale has separate ratings for picture description, narration, and conversation task. It measures the propositional and non-propositional aspects of picture description, narration, and conversation task. The propositional aspects of discourse include discourse structure, communication intent, coherence, information adequacy, information content, message accuracy, temporal and causal relationship, topic management, vocabulary specificity, linguistic fluency, speech styles, intonation, gaze efficiency, and response time. The non-propositional (interactional) aspect of communication includes turn-taking, revision behaviors, and conversational repair/repair strategy. These parameters have been described and statements are framed to rate the parameters of discourse. The (three points perceptual) rating scale consisted of the uniform rating of 0, 1 and 2 where '0' represented the behaviors that were poor, '1' represented behaviors that were fair (at least 50% of the time there is a positive response) and '2' when the behaviors were good. This rating scale was used for scoring. Thus, total scores of the Discourse Analysis Scale (DAS) for picture description, narration, and conversation task could be obtained. These total scores of DAS for these tasks have been further divided into two sub-levels, the propositional and non-propositional total.

3.5.2.3 Working Memory Assessment

The Software used in the study was "Cognitive Module" (Kumar & Sandeep, 2012) to assess working memory (WM) in individuals with and without aphasia. Three subtests such as forward span, backward span, and *n*-back test performed according to the instructions given with respect to each subtest.

1. n-back task recording:

In the n-back task, the current stimulus is judged whether it was matched with one that presented ‘n' places previously in a sequence. All participants were asked to complete the task, for example, three *n* -back tasks: which has 3 levels of WM load (0, 1, and 2) and having linguistic complexity of high-frequency words per load.

Figure. 3. Schematic representation of the n-back tasks at 0-, 1-, and 2-back levels.

For example in the 0-back condition, the target will be considered as any stimulus that has to be matched with a pre-specified stimulus. In the 1-back condition, the target will be any stimulus that has to be matched with one stimulus which will be preceded immediately (i.e., one trial back). In the 2-back condition, the target might be of any stimulus and the individual has to identify the stimulus presented two trials back (Fig. 3). Prior to the experimental n-back tasks, all participants had to complete training trials for 0-, 1-, and 2-back conditions initially in order to ensure that instructions are comprehensible to the individuals and also to make them perform easily in the actual task. For every subtest, the participant's user ID will be created in a .note file format and **only testing trials** will be carried out to complete tasks with the accuracy corresponding to the individual participants. Task instructions emphasized both accuracy and speed, and include both pictured examples and demonstration will be given to minimize the possible effects of auditory comprehension deficits in participants with aphasia group as depicted in Figure 4.

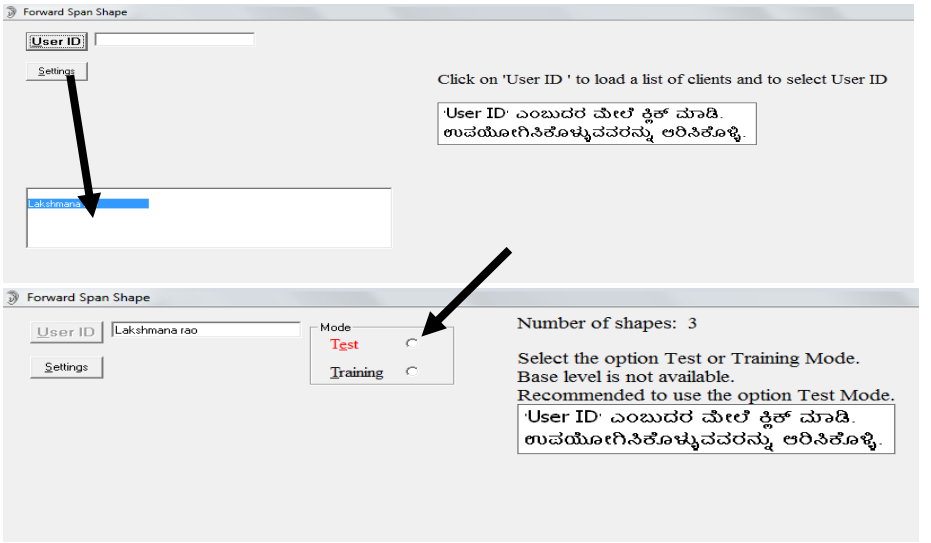


Figure 4. User ID created for a participant to undergo tests following the instructions.

The n-back task will be presented on a laptop computer using the "Cognitive Module" developed as part of the projects under AIISH (All India Institute of Speech and Hearing) Research Fund, Mysore by Kumar and Sandeep (2012). The subsection called n-back task will be selected from this software (Figure. 5) and each stimulus in the n-back task will be displayed for 900 ms with an inter-stimulus interval of 1600ms. Participants will be made to seat at a comfortable distance from the screen with their **unaffected or dominant hand** resting on the keyboard and press a left click on the mouse whenever they see a target stimulus. Left hand or right-hand weakness as a variable will be noted for each participant (Example: Clinical group with right hemiparesis using the left hand to perform the task) and results will be interpreted accordingly when compared with the neuro-typical individuals (trained to use the left hand to perform the task).

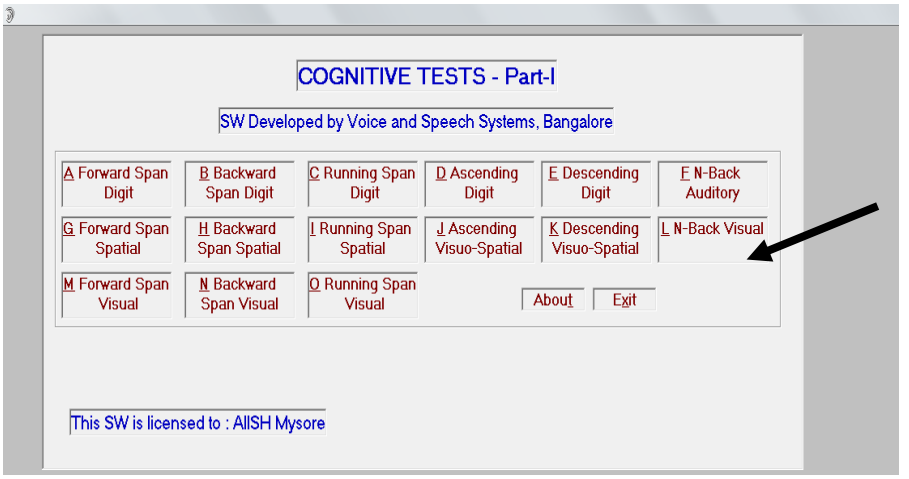


Figure 5. *Selection of subsection called n-back task, forward span, and backward span from the "Cognitive Module software".*

The length of each n-back sequence will be varied automatically by the software according to WM load, there were ‘n' of trials specified and when individuals perform well in the task, the level of stimulus presented will be increased (one example from the software is shown in Figure 6). For the 0-back tasks and 1-back tasks, the participant had to match with a pre-specified target when shown and for the 2-back tasks, some target stimuli will be repeated. Across n-back tasks, non-target stimuli will be contributing simultaneously and will be distributed across the set of stimuli by the same number of times in a similar manner. For every attempt of the task, the software provided feedback.

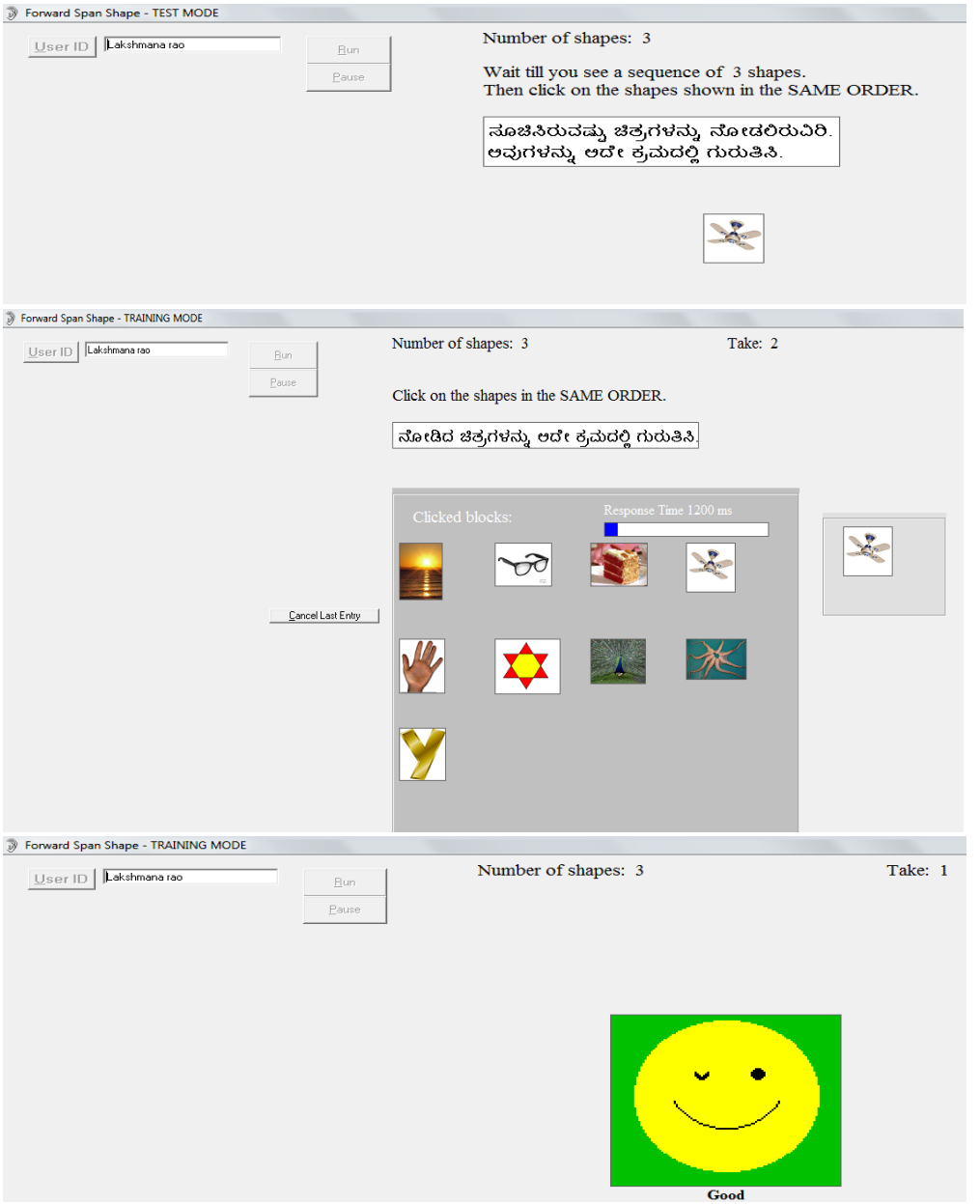


Figure 6: *Depiction of the stimulus presentation and matching response.*

N-back tasks will be administered in a partially fixed order to reduce confusion within the set of the stimulus. That is, participants would complete all three 0-back tasks before completing the 1-back and then the 2-back tasks, respectively. For every trial, the order of tasks along with the complexity (within high-frequency stimuli) will be considered as randomized and a break will be given after every set of stimuli as preferred by the participants with aphasia. Most of them might complete the 0- and 1-back tasks (approximately 20 and 25 min per task, respectively), aphasia tests and this experimental n- back task will be completed in 90 minutes of one session or two separate sessions if required and the 2-back tasks (approximately 25 min each), in addition to any incomplete tasks, participants will be assessed in a second session (60 mins) approximately/one week after the first session.

Instruction: *On the desktop screen, you will be seeing a sequence of the picture (1, 2, 3), please judge whether the current stimulus matches with previous stimulus sequentially which comes in 'n' place (n-0, n-1, n-2). A positive response (happy face) and negative response (sad face) were shown as feedback after every response.*

2. The forward and backward span visual task recording:

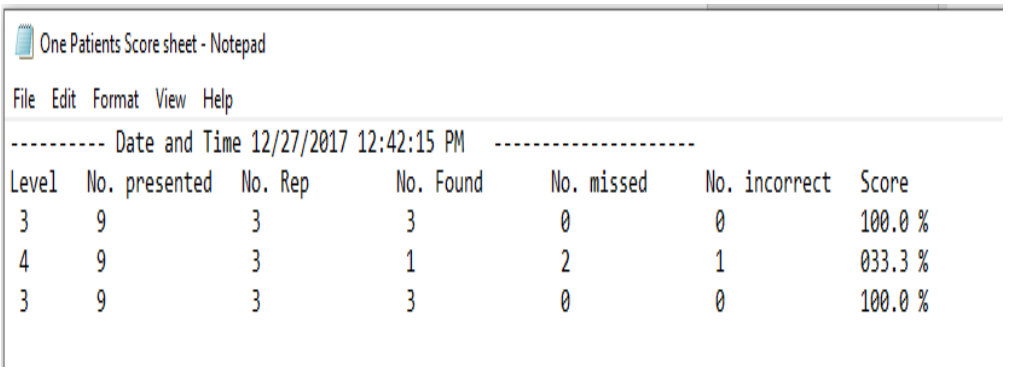
This was a visual (forward and backward) span task which is used most often in this form. Participants with and without aphasia had to view the visual stimulus (pictures) presented on the computer screen, remember this set of separately presented pictures, and then had to recall the individual pictures after each set of pictures. The visual stimulus was nine in number and which was presented nonlinearly. Pictures to be remembered were concrete and phonologically simple words. All these visual stimuli were presented only visually without any auditory cues. The task was to recall by selecting the three target visual stimuli presented in the specific sequence (forward and backward) amongst the given choice of nine pictures (multiple-choice arrays). Items recalled after the time limit was scored as incorrect responses. The storage score (accuracy and reaction time) was considered as an index of WM capacity. Pictures used for the multiple-choice arrays were colored images created by a professional artist with extensive experience in developing visual stimuli specifically designed to minimize the influence of visual image characteristics on the allocation of attention.

Instruction*: You will be seeing a sequence of target pictures (1, 2, 3) which will be presented, please recognize the sequence (forward or backward) of pictures presented amongst the multiple-choice array. A positive response (happy face) and negative response (sad face) were shown as feedback after every response.*

3.5.2.4 Working Memory Assessment (n-back task and forward and backward visual span Task): Scoring and analysis

The results were saved in the .notepad file within the software. The data of each participant was then examined manually to record the reaction times (RT) associated with correct and wrong responses at different levels (Figure 7) so that the mean RT and accuracy of one

participant representing correct responses were considered for comparison amongst the other participants.


One Patients Score sheet - Notepad

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Level	No. presented	No. Rep	No. Found	No. missed	No. incorrect	Score
3	9	3	3	0	0	100.0 %
4	9	3	1	2	1	033.3 %
3	9	3	3	0	0	100.0 %

Figure 7: Results saved in the .notepad file for *n* back task and forward and backward span visual task

The accuracy scores were obtained in the module of *n*-back, forward, and backward span tasks along with reaction time were also recorded and a threshold/level was established for the considered IWA and NTI. The scores of DAS under the headings of discourse quotient, propositional (sub-parameters), non-propositional aspects (sub-parameters) for picture description, narration, and conversation genre were documented in excel datasheet and later used for the statistical analysis. Thus, the scoring for discourse task and working memory assessment obtained from the study from individuals with aphasia and neuro-typical adults were analyzed using appropriate statistical measures in Statistical Package for the Social Sciences (SPSS) software package (Version 23.0).

CHAPTER IV

RESULTS

The present study aimed to investigate the discourse abilities and working memory capacity of adults with aphasia in comparison with the neuro-typical individuals. The discourse sample for the picture description task, narration task, and conversation task from 30 individuals with aphasia in the age range of 40 and above was considered for analysis. A qualitative procedure of analysis was applied to analyze the discourse samples using a separate Discourse Analysis Scale for picture description, narration, and conversation genre. This rating scale consisted of the uniform rating of 0, 1 and 2 where '0' represented the behaviors that were poor, '1' represented behaviors that were fair (at least 50% of the time there is a positive response) and '2' when the behaviors were good. Thus, three points perceptual rating scale was used for scoring, and total scores of the Discourse Analysis Scale (DAS) for picture description, narration, and the conversation was obtained. The total scores of DAS for these tasks have been further divided into two sub-levels, the propositional and non-propositional total. Also, few aspects within Propositional and Non-propositional were summed up for comparison. The DAS raw score of individuals with aphasia is given in Appendix J and the neuro-typical individuals secured full scores in DAS.

The working memory assessment was carried out for forward and backward visual span task and n-back task. The working memory capacity of individuals with aphasia was measured in terms of a level with reference to accuracy and reaction time. Similarly, the discourse and working memory assessment score of 30 neuro-typical individuals were also considered for analysis. Thus, all the totals of each section were computed in terms of percentage and subjected to statistical analysis of the data using *the Statistical Package for Social Sciences (SPSS) software (version 23.0).* Initially, the data were subjected to the test of normality. On administration of Kolmogorov–Smirnov, and Shapiro–Wilk tests for the parameters of discourse and working memory assessment, none of the parameters showed normal distribution at $p > 0.05$. Hence, non-parametric tests were applied for the overall discourse scores of conversation, narration, and picture description of discourse task and working memory assessment.

The complete statistical analysis for discourse parameters at propositional, non-propositional and discourse quotients (Picture description, narration, and conversation) (Section A) and working memory assessment in forward and backward span task and n-back task (Section B) was done in the following steps: Step I: Descriptive statistic was done to obtain mean, median and standard deviation. Step II: Between-group comparison (Individuals with Aphasia versus Neuro-typical Adults) done using Mann Whitney's U test to study the differences between the

groups. Step III: Within-group comparison was done using Wilcoxson's Signed Rank test (Individuals with Aphasia and Neuro-typical adults).

4.1. Section A: Qualitative Rating of the Discourse Samples

4.1.1. Picture Description Task

4.1.1.1 Descriptive statistics for parameters under propositional and non-propositional parameters of a discourse of individuals with aphasia group and a neuro-typical adult group for picture description task.

SPSS (PASW) Version 23 was used to carry out the statistical analysis. The results of descriptive statistics in terms of mean, median, a standard deviation of parameters under propositional and non-propositional aspects of individuals with aphasia and neuro-typical individuals on picture description tasks are shown in Table 4.1. Median is also given since the ratings were considered. It is observed that there is a lower mean and median for the IWA group compared to the NTA group at sub-parameters of propositional and non-propositional aspects, at propositional and non-propositional total and Discourse Quotient. A high standard deviation is noticed in the IWA group at Discourse Quotient.

Table 4.1: *Mean, median and standard deviation of propositional and nonpropositional parameters of the discourse of individuals with aphasia group and neuro-typical adults group for picture description task*

Parameters	**Groups**					
	IWA			**NTA**		
	Mean	**Median**	**SD**	**Mean**	**Median**	**SD**
Propositional Aspects						
Discourse structure	1.97	2.00	1.129	3.93	4.00	0.25
Communication Intent	4.77	5.00	2.029	7.93	8.00	0.25
Coherence	2.20	2.00	1.349	4.00	4.00	0.00
Topic Management	5.73	6.00	2.532	12.00	12.00	0.00
Other Discourse Parameters	3.30	3.00	1.841	5.93	6.00	0.36
Speech Related Parameters	4.70	5.00	2.667	11.80	12.00	0.40
Propositional total	22.50	24.50	10.464	45.60	46.00	0.89
Non-Propositional Aspects						
Revision Behaviour	1.43	1.50	0.626	2.00	2.00	0.00
Repair Strategy	4.90	5.00	2.440	8.07	8.00	0.36
Non-Propositional total	6.37	7.00	2.810	10.00	10.00	0.00
Discourse quotient	53.50	57.00	18.959	99.27	100.00	1.59

Note: IWA: individuals with aphasia, NTA: neurotypical adults

4.1.1.2. Between-group comparison (Individuals with Aphasia and Neuro-typical Adults) using Mann Whitney's U test for picture description task.

Mann-Whitney U test was administered to examine the difference in picture description discourse between the IWA group and the NTA group. The results of propositional and non-propositional aspects of picture description are represented in Table 4.2. There was a significant difference between the groups for all the parameters of propositional and non-propositional aspects of picture description task, propositional total, non-propositional total, and discourse quotient.

Table 4.2: *Results of Mann-Whitney Test between NTA & Aphasia for the propositional & non-propositional aspects of DAS for picture description task.*

Parameters	**/z/ value**	***p*-value**
Discourse structure	6.558	0.000**
Communication intent	6.716	0.000**
Coherence	5.863	0.000**
Topic management	6.961	0.000**
Other discourse parameters	6.204	0.000**
Speech related parameters	6.890	0.000**
Revision behaviors	4.414	0.000**
Repair strategy	6.356	0.000**
Propositional aspect total	6.833	0.000**
Non-propositional aspect total	6.390	0.000**
Discourse quotient	6.879	0.000**

Note: ***p<0.001*

4.1.1.3. Within-group comparison of proposition total and the non-proposition total of picture description task in IWA groups.

Wilcoxon's Signed Rank test was administered to examine the difference between proposition total and the non-proposition total of discourse for picture description tasks in IWA and NTA groups. As represented in Table 4.3, there was a significant difference between proposition total and the non-proposition total of picture description discourse in the IWA group. Whereas, the NTA group did not show any significant differences between proposition total and the non-proposition total of picture description discourse.

Table 4.3: *Results of Wilcoxon's Signed Rank test for proposition total and the non-proposition total of discourse in the IWA group for picture description task.*

Groups	Parameter	/z/ value	*p* value
IWA	*Proposition total and the non-proposition total of discourse for picture description task*	2.542	0.011*

***p<0.05*

The within-group comparison was not performed for normals as all of them secured full scores for this task and there was no difference between propositional versus non-propositional total.

4.1.1.4. Within-group comparison of proposition aspects and non-proposition aspects of narration task in IWA using mean ranks

Friedman's test was done to compare across all the parameters of propositional and non-propositional aspects and the mean ranks were obtained using Friedman's test. From table 4.4, it was observed that the highest mean rank was obtained for revision behavior and the lowest was for the speech-related parameter. While arranging in an order of least to the most affected, the hierarchy is as follows, revision behavior, communication intent, repair strategy, coherence, other discourse parameters, topic management, and speech-related parameter.

Table 4.4 *Mean rank obtained using Friedman's test for Picture description task*

Discourse Parameters	**Mean Rank**
Discourse structure	3.75
Communication intent	5.43
Coherence	4.77
Topic management	3.65
Other discourse parameters	4.77
Speech related parameters	**2.57**
Revision behaviors	**5.83**
Repair strategy	5.23

4.1.2. Narration Task

4.1.2.1 Descriptive statistics for parameters under propositional and non-propositional parameters of the discourse of individuals with aphasia group and neuro-typical adults group for narration task.

From Table 4.5, it is observed that there is a lower mean and median for the IWA group compared to the NTA group at sub-parameters of propositional and non-propositional aspects, at

propositional and non-propositional total and Discourse Quotient. As shown in table 4.4, a high standard deviation is noticed in the IWA group at a propositional total, non-propositional total, and Discourse Quotient. Furthermore, median values are observed to be lesser for the IWA group and are greater for the NTA group.

Table 4.5: *Mean, median and standard deviation of propositional and nonpropositional parameters of a discourse of individuals with aphasia group and neuro-typical adults group for narration task*

Parameters	**Groups**					
	IWA			**NTA**		
	Mean	**Median**	**SD**	**Mean**	**Median**	**SD**
Propositional Aspects						
Discourse structure	1.80	2.00	1.095	3.80	4.00	0.61
Communication Intent	3.47	3.00	2.00	5.90	6.00	0.403
Coherence	1.80	2.00	1.186	4.00	4.00	0.00
Topic Management	4.93	5.50	3.140	12.00	12.00	0.00
Other Discourse Parameters	2.80	3.00	1.562	5.73	6.00	0.64
Speech Related Parameters	3.57	4.00	2.431	9.97	10.00	0.18
Propositional total	18.47	20.50	9.785	41.40	42.00	1.40
Non-Propositional Aspects						
Revision Behaviour	1.47	2.00	0.629	2.00	2.00	0.00
Repair Strategy	4.87	5.00	2.255	7.93	8.00	0.36
Non-Propositional total	6.30	7.00	2.693	9.93	10.00	0.36
Discourse Quotient	46.93	49.00	20.403	98.70	100.00	3.16

Note: IWA: individuals with aphasia, NTA: neurotypical adults

4.1.2.2. Between-group comparison (Individuals with Aphasia and Neuro-typical Adults) using Mann Whitney's U test for narration task.

Mann-Whitney U test was administered to examine the difference in narration discourse between the IWA group and the NTA group. The results of propositional and non-propositional aspects of narrative discourse are represented in Table 4.6. There was a significant difference between the groups for all the parameters of propositional and non-propositional aspects of narrative discourse, propositional total, non-propositional total, and discourse quotient.

Table 4.6: *Results of Mann-Whitney Test between NTA & aphasia for the propositional & non-propositional aspects of DAS for narration task*

Parameters	**/z/ value**	***p* value**
Discourse structure	5.976	0.000**
Communication intent	6.827	0.000**
Coherence	6.625	0.000**
Topic management	6.946	0.000**
Other discourse parameters	6.233	0.000**
Speech related parameters	7.070	0.000**
Revision behaviors	4.219	0.000**
Repair strategy	5.908	0.000**
Propositional aspect total	6.826	0.000**
Non-propositional aspect total	6.372	0.000**
Discourse quotient	6.856	0.000**

***p<0.001*

4.1.2.3. Within-group comparison of proposition total and the non-proposition total of narration task in IWA and NTA groups.

Wilcoxon's Signed Rank test was administered to examine the difference between proposition total and the non-proposition total of narrative discourse in IWA and NTA groups. There was a significant difference between narrative proposition total and the non-proposition total of discourse in the IWA group as shown in Table 4.7. Whereas, NTA group did not show any significant differences between proposition total and the non-proposition total of narrative discourse.

Table 4.7: *Results of Wilcoxon's Signed Rank test for proposition total and the non-proposition total of discourse in the aphasia group for narration task.*

Groups	**Parameter**	**/z/ value**	***p* value**
Aphasia Group	*Proposition total and the non-proposition total of discourse for narration task*	2.671	0.000**

***p<0.001*

The within-group comparison was not performed for normals as all of them secured full scores for this task except one and there was no difference between propositional versus non-propositional total.

4.1.2.4. Within-group comparison of proposition aspects and non-proposition aspects of narration task in IWA using mean ranks

Friedman's test was done to compare across all the parameters of propositional and non-propositional aspects and the mean ranks obtained using Friedman's test are given in Table 4.8. It was observed that the highest mean rank was obtained for revision behavior and the lowest was for the speech-related parameter. While arranging in an order of least to the most affected, the hierarchy is as follows, revision behavior, communication intent, repair strategy, other discourse parameters, discourse structure, coherence, topic management, and speech-related parameter.

4.8: *Mean ranks obtained using Friedman's test for narration task*

Discourse Parameters	Mean Ranks
Discourse structure	4.30
Communication intent	5.40
Coherence	4.18
Topic management	3.45
Other discourse parameters	4.43
Speech related parameters	**2.82**
Revision behaviors	**6.40**
Repair strategy	5.02

4.1.3. Conversation Task

4.1.3.1 Descriptive statistics for parameters under propositional and non-propositional parameters of a discourse of individuals with aphasia group and a neuro-typical adult group for conversation tasks.

There is a lower mean and median for the IWA group compared to the NTA group at sub-parameters of propositional and non-propositional aspects, at a propositional and non-propositional total and Discourse Quotient as shown in Table 4.9. The standard deviation was high for the IWA group at propositional total and discourse quotient.

Table 4.9: *Mean, median and standard deviation of propositional and nonpropositional parameters of a discourse of individuals with aphasia group and neuro-typical adults group for conversation task*

Parameters	Groups					
	IWA			NTA		
	Mean	Median	SD	Mean	Median	SD
Propositional Aspects						
Discourse structure	1.80	2.00	1.095	3.93	4.00	0.36
Communication Intent	9.13	9.00	3.071	12.83	12.00	1.70
Coherence	1.83	2.00	1.177	4.00	4.00	0.00
Topic Management	6.67	8.00	4.444	15.97	16.00	0.18
Other Discourse Parameters	2.70	3.00	1.368	5.93	6.00	0.36
Speech Related Parameters	5.07	6.00	2.703	11.87	12.00	0.43
Propositional total	27.20	28.00	12.837	57.47	58.00	1.54

Non-Propositional Aspects						
Revision Behaviour	1.50	2.00	0.572	2.00	2.00	0.00
Conversational behaviour	3.47	3.00	1.814	6.00	6.00	0.00
Turn taking	8.73	9.50	2.947	12.00	12.00	0.00
Non-Propositional total	13.70	15.00	4.728	18.00	20.00	4.06
Discourse Quotient	52.37	54.00	19.641	99.30	100.00	2.07

Note: IWA: individuals with aphasia, NTA: neurotypical adults

4.1.3.2. Between-group comparison (Individuals with Aphasia and Neuro-typical Adults) using Mann Whitney's U test for conversation task.

Mann-Whitney U test was administered to examine the difference in conversational discourse between IWA and NTA group. The results of the propositional and non-propositional aspects of conversational discourse are represented in Table 4.10. There was a significant difference between the groups for all the parameters of propositional and non-propositional aspects of conversational discourse.

Table 4.10: *Results of Mann-Whitney Test between NTA & aphasia for the propositional & non-propositional aspects of DAS for conversation task*

Parameters	**/z/ value**	***P* value**
Discourse structure	6.401	0.000**
Communication intent	4.897	0.000**
Coherence	6.453	0.000**
Topic management	6.698	0.000**
Other discourse parameters	6.790	0.000**
Speech related parameters	6.961	0.000**
Revision behavior	4.228	0.000**
Conversational behavior	6.030	0.000**
Turn-taking	5.834	0.000**
Propositional aspect total	6.850	0.000**
Non-propositional aspect total	4.359	0.000**
Discourse quotient	6.878	0.000**

***p<0.001*

4.1.3.3. Within-group comparison of proposition total and the non-proposition total of conversation task in IWA

Wilcoxon's Signed Rank test was administered to examine the difference between conversational proposition total and the non-proposition total of discourse in IWA and NTA group. The performances of the IWA group and the NTA group on the propositional and non-propositional aspects of DAS are represented in Table 4.11. There was a significant difference between conversational proposition total and the non-proposition total of discourse in the IWA

group. Whereas, NTA group did not show any significant differences between conversational proposition total and the non-propositional total of discourse.

Table 4.11: *Results of Wilcoxon's Signed Rank test for proposition total and the non-proposition total of discourse in the aphasia group for conversation task*

Groups	Parameter	/z/ value	*p* value
Aphasia Group	*Proposition total and the non-proposition total of discourse for conversation task*	3.940	0.000**

***p<0.001*

For normals, within-group comparison was not performed since all of them secured full scores for all the parameters except two participants. No difference in performance was observed between propositional and non-propositional aspects as all of them secured full scores.

4.1.3.4. Within-group comparison of proposition aspects and non-proposition aspects of narration task in IWA using mean ranks

Friedman's test was done to compare across all the parameters of propositional and non-propositional aspects and the mean ranks obtained using Friedman's test are given in Table 4.12. It was observed that the highest mean rank was obtained for turn-taking and the lowest was for the speech-related parameter. While arranging in an order of least to the most affected, the hierarchy is as follows, turn-taking, revision behavior, communication intent, conversational behavior coherence, other discourse parameters, discourse structure, topic management, and speech-related parameter.

Table 4.12: *Mean ranks obtained using Friedman's test for conversation task*

Discourse Parameters	Mean Ranks
Discourse structure	4.13
Communication intent	5.58
Coherence	4.37
Topic management	3.65
Other discourse parameters	4.25
Speech related parameters	**3.58**
Revision behavior	7.07
Conversational behavior	5.15
Turn-taking	**7.22**

4.2. Section B: Assessment of Working Memory task

The performance of individuals with aphasia and neuro-typical individuals are explained under two aspects like reaction time and level/threshold/accuracy for the working memory test.

Results of the present study for working memory tasks are discussed under the following headings.

4.2.1. Forward span task and backward span task

4.2.1.1 Mean & Standard Deviation for Forward Span Task and Backward Span Task of individuals with Aphasia (IWA) and neuro-typical individuals (NTI).

In this working memory tasks, participants were given 3 trials for each level. For this study, the correct performance of 2 out of 3 trials was considered as accurate response as IWA was not able to follow the criteria of 3 out of 3 trials of the correct response. Following the administration of the task, the mean value for each level was obtained by taking an average of three trials. Subsequent to this average of all the levels were taken to calculate the total mean value for FST & BST.

The mean and standard deviation of forward span and backward span reaction time of all the levels obtained for individuals with Aphasia (IWA) and neuro-typical individuals (NTI) was calculated using descriptive statistics and the results are shown in Table 4.13. From the table, it is observed that the mean reaction time (in terms of milliseconds) or the time taken to execute the forward span task by IWA was greater compared to NTI. Similarly, the mean reaction time or the time taken to execute the backward span task by the IWA was greater compared to NTI.

Table 4.13: *Results of descriptive statistics for Forward Span Task and Backward Span Task of individuals With Aphasia (IWA) and neuro-typical individuals (NTI).*

Working memory tasks	Group	N	Mean	SD
Forward Span Task Reaction Time	NTA	30	6117	3301.172
(FSTRT)	IWA	30	8702	4827.024
Backward Span Task Reaction Time	NTA	30	2718	1420.614
(BSTRT)	IWA	30	4097	1477.427

The Figure 8, represents the pictographic representation of the mean score or the reaction time to execute forward span task and backward span task of working memory tests irrespective of the levels, the neuro-typical individuals and the individuals with aphasia performed better with less reaction time for the backward span task compared to forward span task. However, the reaction time taken by the individuals with aphasia group for BSTRT was higher compared to the neuro-typical individuals.

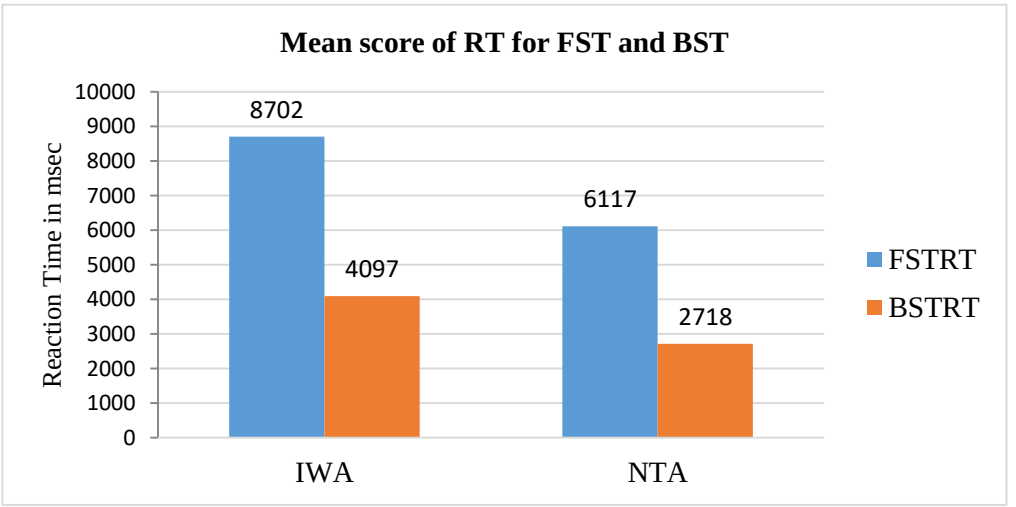

Figure 8. Mean scores for reaction time for Forward Span Task Reaction Time and Backward Span Task Reaction Time of Neuro-typical Individuals and Individuals with Aphasia.

It was observed that, for FST, a majority of the IWA performed at a level of 1, 2, 3, and some at level 4. Apart from the above statistical analysis with reference to the level/threshold/accuracy of executing the FST, ***nine*** participants with aphasia were able to reach only **1st level** with a mean reaction time of **3143.33**, ***eight*** participants reached only **2nd level** with a mean reaction time of **9504.88**, ***twelve*** participants achieved **3rd level** with a mean reaction time of **6001.25** and ***one*** participant reached **4th level** with a mean reaction time of **7173.00**. For the same FST, a majority of the NTA could reach levels 3 & 4 and some at levels 5, 6 & 7. However, the NTA group performed better than the IWA group for FST by securing the highest level with lesser reaction time. For FST, ***12 individuals*** from the NTA group reached **3rd level** with a mean reaction time of **4916.00**, eleven participants reached 4th level with a mean reaction time of 10661.82, five participants reached 5th level with a mean reaction time of 11483.20, one participant secured 6th level with a mean reaction time of 10700.00 and one achieved 7th level with a mean reaction time of 16700.00. This frequency distribution of IWA & NTA participants across each level in FST is represented in Figure 9.

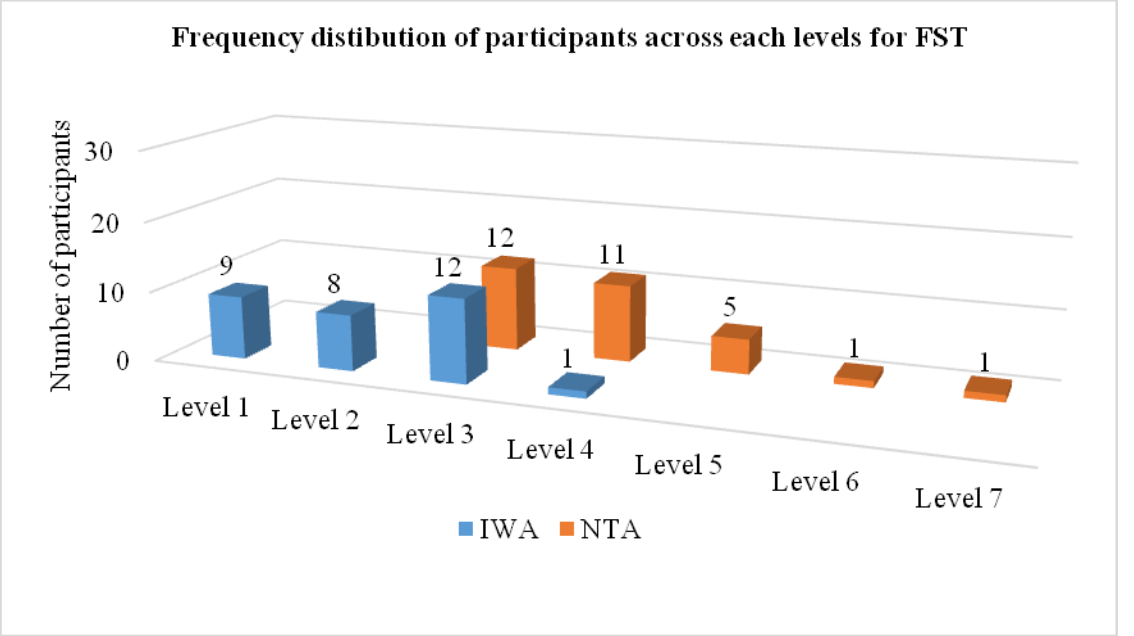

Figure 9. Frequency distribution of IWA and NTA across each level in performing in FST

For BST, a majority of the IWA could reach the 1st level with the least reaction time compared to the 2nd or 3rd level. With respect to mean reaction time value, ***sixteen*** participants with aphasia reached only **1st level** with a mean reaction time of **2270.25**, ***seven*** participants secured only **2nd level** with a mean reaction time of **2845.00** and ***four*** participants achieved **3rd level** with a mean reaction time of **4287.25**. For the same BST, a majority of NTA participants could reach level 3. With respect to mean reaction time, five participants from the NTA group reached 2nd level with a mean reaction time of 2762.00, ***twenty*** participants reached **3rd level** with a mean reaction time of **4432.90,** and five achieved 4th level with a mean reaction time of 4092.00. This frequency distribution of IWA & NTA participants across each level in BST is represented in Figure 10.

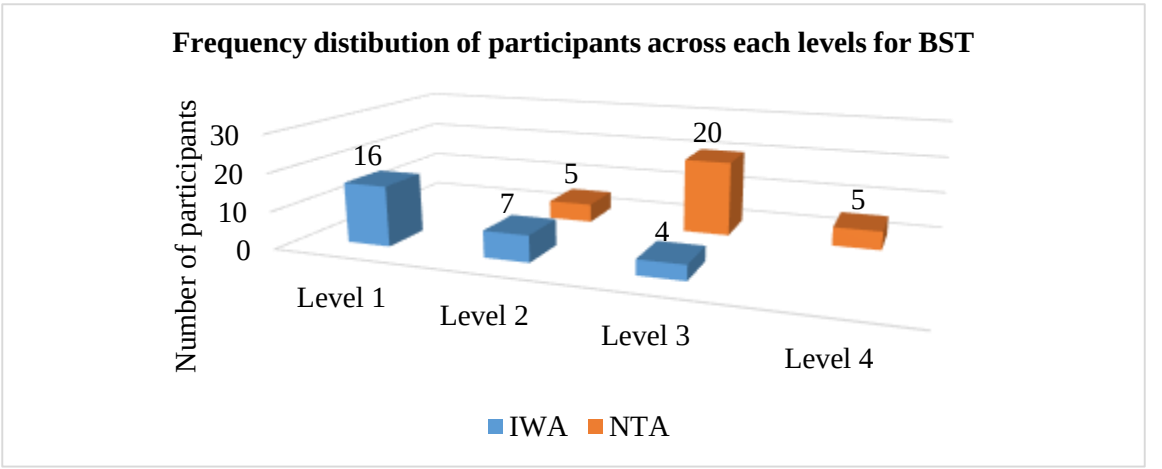

Figure 10. Frequency distribution of IWA and NTA across each level in performing BST

4.2.2.2 Between-group comparison for Forward Span Task and Backward Span Task of individuals with Aphasia (IWA) and neuro-typical individuals (NTI).

Mann-Whitney U test was administered to examine the difference in working memory tests like forward span task (FST) & backward span task (BST) between the individuals with aphasia group and group with neurotypical individuals. Table 4.14 shows a significant difference between the groups for the FST & BST task of working memory tests.

Table 4.14: *Results of Mann-Whitney Test for the Forward span Task & Backward span*

Working Memory Test	**/Z/ value**	***p value***
Forward Span Task	4.485	0.000**
Backward Span Task	3.572	0.000**

***p* value<0.001

4.2.2.3 Within-group comparison for Forward Span Task and Backward Span Task of individuals with Aphasia (IWA) and neuro-typical individuals (NTI).

Wilcoxon's signed-rank test was used to study the comparison within the individuals with aphasia group and group with neuro-typical individuals for level/threshold/accuracy.

Wilcoxon's Signed Rank test results showed a significant difference between the FST & BST of working memory tests within neuro-typical individuals. With reference to the individuals with aphasia, there was no significant difference between the FST & BST of the working memory test. The same is represented in Table 4.15.

Table 4.15: *Results of Wilcoxon's Signed Rank test for levels of working memory tests within IWA and NTI*

Groups	**Levels of working memory test**	**/z/**	***p* value**
IWA	FST Level & BST Level	3.258	0.001**
NTA		1.829	0.067

***p* value<0.001

4.2.2. Working memory task: N-back

4.2.1.1 Frequency distribution of level/threshold/accuracy of n-back working memory test was compared with IWA & NTI.

Frequency distribution of level/threshold/accuracy of the n-back working memory test

Working memory test includes FST, BST, and n-back task. The FST and BST corresponded with the reaction time measurement and the levels/threshold/accuracy as explained in the previous section. Whereas, n-back, for example, is represented as 0-back, 1-back, 2-back, 3-back, 4-back, 5 back, 6-back. In the present study, the N-back task corresponded only with the

accuracy of individuals' (Aphasia and neurotypicals) response to working memory capacity starting with 0-back till the n^{th} back of individual capacity. Thus, in the present section, the performance of the two groups (IWA & NTI) on N-back task is depicted graphically to show the accuracy of working memory capacity. From the Figure 10, in the **IWA group majority of the participants -8 IWA had a capacity of 2-back**, 7 IWA had a capacity of 1-back, 5 IWA had a capacity of 3 back & 10 IWA had a capacity of 0- back of n-back task. For the **NTA group, 19 had a capacity of 3-back**, 8 had a capacity of 4-back, 1 had a capacity of 5-back and 2 had a capacity of 6-back. Therefore, the majority of IWA had a capacity of 2-back and NTA had a capacity of 3-back as represented in Figure 11. To study the significant differences between NTA and IWA with reference to this working memory capacity of n-back task the Mann-Whitney U test was administered and the descriptions are in the following sections.

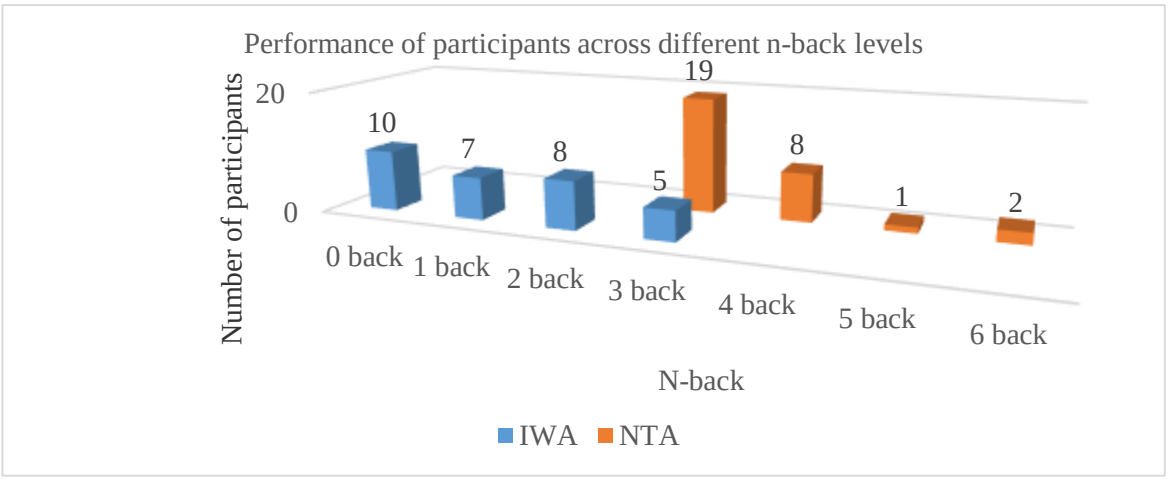

Figure 11. *The difference in level/accuracy/threshold of working memory of IWA and NTI.*

4.2.2.2 Between-group comparison for n-back tasks of individuals with Aphasia (IWA) and neuro-typical individuals (NTI).

Mann-Whitney U test was administered to examine the difference in the N-back task which measures the working memory capacity between the individuals with aphasia group and group with neurotypical individuals. There was a significant difference between the groups for the working memory capacity of the n-back task as shown in Table 4.16.

Table 4.16: *Results of Mann-Whitney Test for the n-back task*

Working Memory Test	**/Z/ value**	***p value***
N-back task	3.869	0.000**

***p* value<0.001

CHAPTER V

DISCUSSION

The study aimed to measure discourse and working memory in individuals with aphasia (IWA) and neurotypical adults (NTA) and to identify whether a relationship existed between working memory ability and linguistic processing ability in individuals with aphasia. The discourse task was used to identify the presence of linguistic difficulties and errors in the aphasic individual. Working memory tasks were employed to find the presence of cognitive impairment and to explore whether there is any possible relationship between discourse and working memory. The first part of the discussion will be about the discourse pattern in aphasics and neurotypical adults for tasks like picture description, narration, and conversation as mentioned below. Following this, an attempt is made to substantiate the findings obtained from the working memory assessment as mentioned below.

5.1. Picture Description Task

5.1.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.1.1.1. Propositional aspects

5.1.1.2. Non- Propositional aspects

5.2. Narration Task

5.2.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.2.1.1. Propositional aspects

5.2.1.2. Non- Propositional aspects

5.3. Conversation Task

5.3.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.3.1.1. Propositional aspects

5.3.1.2. Non- Propositional aspects

5.4. Working memory task

5.4.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.4.1.1 Working memory and Language processing difficulties in IWA

5.1. Picture Description Task

5.1.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.1.1.1. Propositional aspects

The results indicate poor mean values for IWA when compared to NTA for all the parameters of propositional aspects of picture description discourse obtained on a test stimulus "a picnic spot picture" from Western Aphasia Battery (Chengappa & Kumar, 2008). The differences in performance between the groups (IWA and NTA) are explained under different sections of propositional parameters of picture description discourse. Each of the discourse parameters is profiled and discussed in detail in the following section.

Discourse Structure

The qualitative analysis of discourse revealed poorer results on both propositional and non-propositional aspects of discourse genres for IWA compared to neurotypical individual's discourse. The sparseness in the description by the individuals with aphasia seems to reflect the inability to retrieve words and provide a detailed discourse sample due to working memory deficit. The comparison of mean values across all the tasks revealed the better performance of IWA for picture description followed by conversation and then narration. While NTA performed equally good across all the tasks. The difference in discourse performance in IWA could be due to the difference in linguistic and cognitive load underlying the discourse task. The structural organization and the content of the discourse are available for a picture description task, thus requiring minimal cognitive, organizational abilities, and do not have a common place homologue in everyday communication. Hence, individuals with aphasia performed better for picture description task.

The poor performance of IWA groups for parameter *discourse structure* could be attributed to the deficit at 'discourse forethought' and 'organizational planning'. On comparing the raw scores, **organizational planning was most severely affected than the discourse forethought**. Seven IWA participants obtained a score of zero in organizational planning whereas only five participants obtained a score of zero in discourse forethought. Due to these characteristics, the discourse of IWA participants was confusing, even if all of the propositional content was present which can be seen in the illustration. IWA group showed poor discourse forethought by supporting Zalla, Phipps, and Grafman (2002), where they found certain characteristics associated with Pre Frontal Cortex Damage (PFCD) patients' discourse production specifically in the context of story-telling, include difficulty recalling narrative components of a story, processing inference and appreciating the story's thematic aspects or gist. There are studies reported in the literature evidencing gray matter atrophy in the left hemisphere; inferior frontal gyrus and the anterior insula areas (Gorno-Tempini et al, 2006; Peelle et al., 2008) in subjects with progressive non-fluent aphasia resulting in disorganized discourse. Similar findings were evident in our patients too. The aphasia group in this study consisted of fluent and

non-fluent aphasics exhibiting apparent damage at inferior frontal, anterior insula, temporal and parietal regions as seen in their MRI reports.

Illustration of poor discourse structure- Example in the Kannada language

I: Show the picture (Chengappa & Kumar, 2008), of a picnic spot.

P: ondhu mane idhe..manege ondhu ka:ridhe..allondhu mara idhe..alli ondhu aunty mathe anna koothidha:re..yu:ru ondhu anna pukku..pukku no:dtha:yidhane. A:mele anna e:n ma:didhe..ondhu kopi thakombanthru ..avaru annage thagombandru. A:mele ondhu hudugi ondhidhane, avana kai ka:lipata ma:dthayidhane. Alli hudugru barthayidhe. (There is one home..there is a car at home..there is one tree..auty and anna are sitting there..this anna..one book..looking at the book..what did anna do after that..got a coffee..she got it for anna..and there is one girl, he is playing with kites. Boys are coming from there)

Communication Intent

For the parameter *communication intent*, the IWA group performed significantly poorer than the NTA group. The **most affected parameter was 'criticizes the picture by agreeing/disagreeing to a part in the picture' followed by 'imagining events correctly', and 'asking for assistance' and lastly the 'initiation of picture description'.** The subparameter 'Criticizes the picture by agreeing/disagreeing to a part in the picture' was affected more on raw scores when compared to other sub-parameters. Eight participants in the IWA group obtained a score of zero in this parameter. Furthermore, 'imagining events correctly', and 'asking for assistance' was affected more when compared to 'initiation of picture description' on raw scores. Four participants in the IWA group obtained a score of zero in 'imagining events correctly', and 'asking for assistance', whereas only one participant secured zero scores for the sub-parameter 'initiation of picture description'. This is because; few IWA participants imagined the picture to be a 'school setup', 'home setup', and 'village scene' and did not make an effort to either initiate picture description or asked assistance in describing a picture.

This result derives support from few literature findings where the discourse production deficits associated with RHD show difficulties in integrating information for generating some types of inferences (Myers & Brookshire, 1996; Rehak, Kaplan, Weylman, Kelly & Brownell, 1992), revising interpretations (Brownell, Potter, Bihrle & Gardner, 1986; Tompkins, Bloise, Timko & Baumgaertner, 1994), or selecting the most plausible meaning of a passage (Tompkins, Baumgaertner, Lehman & Fassbinder, 2000; Tompkins, Fassbinder, Blake, Baumgaertner & Jayaram, 2004; Tompkins, Lehman-Blake, Baumgaertner & Fassbinder, 2001). The major important point to discuss in this section would be the communication intention being an important measure to communicate effectively than just employing syntactic and semantic rules. Unless an individual has an intention to communicate, all other aspects of language are essentially meaningless. The basic unit of communication is not just the employment of propositions, but rather the use of propositions in the performance of speech acts. The communicative intention is one of the important phenomenon helping listeners to recognize the

meaning of an utterance. The micro linguistic errors in the aphasic group are due to the irrelevant propositions as seen in the fluent aphasia group. To mention few are the lexical errors seen in individuals with Broca's aphasia and poor repetitions seen in individuals with conduction aphasia. This breakdown hampers the listener's ability to infer the communicative intention of participants with aphasia as mentioned in the below illustration.

Illustration of imagining events incorrectly- Example in the Kannada language:

P: *ondhu….park hog…ho:gi barthayidhave. Illi boating idhe. A:mele…tharkavi…ganda, henthi,pa:pu…amma...appayige….tea..kodthayidhave.Mathe..ga:lipat a:dthayide..mag magan u..maganu ga:lipatanu harisuthidhane. Batte oguyutha:re..amma batte ogeyuthale. Flag idhe..a:mele dho:ni ho:gthayidhane..mane idhe..tape recorder idhe..(coming back after the park..there is one boating..after that, one husband,,child..mother is giving tea to father..then they are playing in kite..daughter and the flying the kite..mother is washing the clothes..there is a flag..boat is going..there is one home and tape recorder)*

Coherence

For the parameter *coherence*, for both the sub-parameters of coherence 'the local coherence' and 'the global coherence' there was a highly significant difference between the groups. **Local coherence was affected more than the global coherence in IWA participants** as shown in the illustration. Seven participants from the IWA group obtained a score of zero in local coherence whereas, for global coherence, only five participants obtained zero. None of the participants from the NTA group obtained a score of zero in these parameters reflecting preserved coherence for discourse. The poor performance of the IWA group on local coherence could be due to the presence of irrelevant propositions and wrong references made in discourse. The literature reports that individuals with aphasia have the poor ability in structuring discourse. Our results are consistent with those reported by Ulatowska et al, 1981, who have shown preservation of supra-syntactic structures and information content of narrative discourse among a mixed group of aphasics. In addition Gloser and Deser (1990) reported preservation of thematic coherence among a group of fluent aphasics, who also demonstrated other significant errors in syntactic, lexical, and phonological aspects. The violation at local coherence could be due to their inappropriate comments, repetitions, semantic paraphasias, excessive deictic terms, and pronouns without antecedents. In contrast, one approach of discourse analysis involving examination of the cognitive functions distinguishing macrostructural and microstructural discourse processing has revealed that TBI participants demonstrate greater difficulty with global than local coherence and showed more performance variability among participants in global as compared to local coherence (Van Dijk & Kintsch, 1983; Glosser, 1993; Myers, 1999; Hough & Barrow, 2003). Thus, the group with these individuals with TBI is grouped under cognitive-communicative disorder.

Illustration of poor local coherence- Example in the Kannada language:

P: Idhu kaitu…huduga ha:dusthayidhane..alli radio idhe..mane thumba chanaagidhe no:dakke. Nan mane thara idhe nodakke..idhu husband ..mathe wife …ivanu, genda

o:dhuthayidaane..ivalu coffee maadtha..kodthayidaale.(This is a kite..boy is flying it..there is one radio..it is looking soo good..it looks like my home..this is husband..then wife..this person, the husband is reading..she is making coffee and giving it to him.)

Illustration of poor global coherence- Example in the Kannada language:

P: ondu shaale vaatavaraNa.... makkaLu shaale munde aaTa aaDutta iddare. Ondu kaaru ide, mara aide, shaale munde kuutidaare jana. (One school setup, children are playing in front of the school, one car is there, tree is there, people are sitting in front of the school.)

Topic Management

For the parameter *topic management*, the sub-parameter 'topic shift', 'minimal elaborations', and 'perseveration in the topic' were more severely affected with reference to the raw scores when compared to other sub-parameters such as 'topic shift' and 'elaboration of the topic'. Seven participants with aphasia secured a score of zero in the sub-parameters 'topic shift', 'minimal elaborations', and 'perseveration in the topic'. Whereas for the sub-parameters 'topic changes' and 'elaboration of the topic' only five participants obtained zero scores. Therefore the **most affected parameter was 'topic shift', 'minimal elaborations', and 'perseveration in the topic' followed by 'topic change' and 'elaboration of the topic'.**

These results were seen because IWA participants irrelevantly initiated the topic to be as 'school situation' or 'village scene' as shown in the illustration. This is in support of the study by Mentis and Prutting, (1991) and Coelho, Liles, and Duffy, (1991) who found that TBI individuals produced unrelated topic changes in their discourse associated with minimal elaboration. IWA participants demonstrated more topic introduction, tangential and non-coherent, poor topic shift, and topic maintenance. The discourse of IWA participants demonstrated disruption at discourse-pragmatics, which is very much important for social interaction. Hence assessment procedure should delineate the presence of deficits in this area to improve the social interaction of aphasia patients. The results indicated a clear difference between IWA and NTA for the number of parameters of *topic management*. A number of factors could potentially account for the breakdown in topic maintenance causing communication breakdowns, such as poor listening skills, perceptual, emotional, cultural and language barrier, information overload, poor retention, and inattention. For successful topic management, coherence measures are considered important. In order to maintain coherence, one should essentially establish an integrated thematic structure and develop logical prepositional (Schiffrin, 1987), IWA participants were impaired at this level of discourse.

Illustration of irrelevantly initiating topic with minimal elaboration- Example in the Kannada language:

P: i: picture nooDidare ondu haLLiyalli jana jiivan naDesuta iirodu. Ondu mane ide, samudrada pakka ide. ondu huDuga, hengasu, ganDasu, naayi, kaaru ede. ivaru avara kelasadalli toDagiddare. elaaru vishranti togotaa iiddare. Allondhu radio idhe..idhiralli ha:du play ke:lthayidhe. (This picture.. This picture depicts a village scene where people

are leading their life. One house is there. It is next to the ocean, one boy, women, men, dog, a car is there. These people are involved in their work. There is a radio..Music is played on that radio.)

Other Discourse Parameters

Finally, in *other discourse parameters*, the **sub-parameter 'message accuracy' was affected more on raw scores when compared to 'information content', and 'information adequacy'.** Six participants with aphasia obtained a score of zero in the sub-parameter 'message accuracy', whereas for the sub-parameters 'information content', and 'information adequacy only five participants obtained zero scores. Furthermore, none of the NTA participants obtained a score of zero in these parameters. Participants with aphasia were able to give a lengthy discourse on picture description; however, they failed to convey the gist of the information. They were unable to interpret the theme of the picture. Most of them, specifically those participants with fluent aphasia misinterpreted the picture as a village and school setup, further affecting the information content and its accuracy as shown in the illustration. Content of the picture was not conveyed appropriately resulting in the incorrect/inaccurate description of people, location, object, activities, and attributes that played a role in the events being narrated about.

Detailed linguistic pictures of the events were not obtained from aphasic participants. The detailed description of the picture at the linguistic component of semantics and syntax was not obtained due to their specific features of typical aphasia condition. For example, Wernicke's aphasic (WA) had poor verbal-linguistic and semantic knowledge which affected message accuracy/content and Broca's Aphasia (BA) exhibited poor syntax at linguistic expression level which resulted in information inadequacy. WA gave a lengthy discourse with irrelevant propositions making it a jargon. Whereas, individuals with BA patients gave limited information which incorporated stuck-in kind of perseveration.

Here, the aphasia participants showed poor information content because of their restricted vocabulary. They were unable to explain each content/objects available in the picture. They were explaining more about one particular content which they were familiar with or easy to explain, such as elaborating more on husband and wife sitting together and having coffee were explained several times, but they missed other components of the picture such as lady washing clothes and a boat passing by. Hence they exhibited limited information content.

There was an inappropriate topic shift which was non-coherent (inaccurate message) with the main topic (the gist of information). Frequent topic shifts were observed when they encountered poor recalling of words, and linguistic breakdown. This result is in support with the findings of Zalla, Phipps, and Grafman (2002); Frattali and Grafman, (2005) who reported that subjects with RHD having difficulty in recalling narrative components of a story, processing inference and appreciating the story's thematic aspects or gist specifically in the context of the story-telling task. There is no literature based on a single picture description task which can support the present finding.

Illustration of poor information content - Example in the Kannada language:

P: Idhu ka:rally bandhidhare.. yu:ru newsalli o:dhuthayidhaare..yu:ru coffee kodthidhaare..mmm..adhu yu:rukke kodthaayidhare. Illi lo:tta idhe..dho:ni idhe..a:mele illi boat idhe. (it came in car, he is reading the news..she/he is giving the coffee..mm..that is given to him..there a a glass, boat..and there is a boat.

From this example, one can appreciate the poor information content in discourse. The participant has listed out the name of all the objects present but failed to elaborate on it. Whereas an NTA narrated it like-There is a man sitting under the tree reading the newspaper, his wife is pouring him a cup of coffee/tea, and they have played radio and enjoying their picnic. There is a boat passing through the river. The son is playing in a kite and a lady is sitting next to the river bank and washing the clothes.

Speech related parameters

For the *speech-related parameters* on the comparison (IWA verses NTI) of raw scores, the **most severely affected sub-parameter was 'vocabulary specificity' followed by 'linguistic fluency' and 'the gist of information' and to some extent, the sub-parameter 'speech style', 'intonation', and 'response time' were also affected.** Fourteen individuals with aphasia obtained a score of zero for the sub-parameter 'vocabulary specificity'. The sub-parameters "linguistic fluency' and 'the gist of information' were also affected to a greater extent. In these sub-parameters, twelve and ten IWA secured zero scores respectively. Whereas for 'speech style', 'intonation', and 'response time' five, six, and five participants obtained zero scores respectively. Moreover, none of the NTA participants obtained zero scores in any of these parameters. There was a significant difference between both the groups in all these sub-parameters.

Looking into the adherence to the rules of the language, IWA participants used unspecific vocabulary due to circumlocution, and word-finding difficulty simultaneously they exhibited repetition of the uttered word, phonological paraphasias, semantic paraphasias, perseverations and neologistic errors (less frequent) interrupting the cohesion and the fluency of the speech as it is illustrated below. Moreover, a deficit in auditory-verbal short-term memory has been reported in the absence of noticeable speech impairment (Saffran & Marin, 1975; Shallice & Butterworth, 1977), reinforcing the observed dissociation between speech and other cognitive impairments.

Illustration of poor vocabulary specificity and linguistic non-fluency

P-illi ondhu huduga koothidaane..hudu..hudugi kodthayidhe..hudugi..wife ansathe coffee / tea kodthayidhale..radio idhe..la:li..lo:li..go:lippata..maga..harusthayidhe(There is a girl sitting, girl..no wife is giving the coffee..there is a radio..son is flying the kite)

In this example you can see the usage of unspecific vocabulary such as saying the word boy instead of a husband, calling wife/mother as a girl. Phonemic paraphasia's were present such as saying "/la:li..lo:li..go:lippata/" for /galipata/ (kite).

5.1.1.2. Non- Propositional aspects

For the parameter *repair strategy* and *revision behavior*, there was a significant difference between both the groups. IWA participants could not use any repair strategies and revision behaviors to correct their discourse during the picture description task.

Similar findings were reported by Prutting and Kirchner (1987) they designed a pragmatic protocol and administered on six subject groups including left brain-damaged, consisting of fluent and non-fluent aphasia. They reported impairment in repair and revision strategies in fluent aphasia when compared to non-fluent aphasia. An investigation by Busch and Brookshire (1985) parallels this observation; they reported poor use of self-correction in fluent aphasic subjects compared to non-fluent aphasia.

This result for 'use of self-correction' is supported by a study by Tanuja and Manjula (2004), who found that within TBI group RHD subjects showed more self-repair than LHD subjects. The possible reasons for the use of too much self-correction could be due to confusion, which was the result of poor ability in structuring discourse. This result for 'use of repair through repetition or clarification' contradicts the result found by Marsh and Knight, (1991) where the TBI individuals do not ask for clarification even if they do not understand the conversation. The literature on the basis of the picture description task is not available. In the present study, the reason for the presence of excessive use of repair strategies in the speech of the IWA group can be reasoned on the basis of their inability to add on further information in their speech with reference to giving clarification. Few participants while using self –correction as a repair strategy used more repetitions and few participants made an effort to use clarifications given by the investigator and tried using the same as revisions as shown in the below illustration.

Illustration of the use of self-correction- Example in Kannada language:

P: nanna hesaru Deepa..naanu Dhavanigare..Idhu ka:rally bandhidha:re..yu:ru newsalli o:dhuthidhaare. Yu:ru coffee kodthidhare…mm adhu yu:rukke…alla…gandanige kodthidhare..avaru henthi kodthayidhe, gandake henthi kodthayidhare. (My name is Deepa, I am Davanigere.. it came in car.. he is reading news..she is giving the coffee..mm..that is for him..not..giving to husband..wife is giving..wife is giving to the husband.)

5.2. Narration Task

5.2.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.2.1.1. Propositional aspects

The significant difference between the groups (IWA and NTA) for the narration task is explained under different sections of propositional parameters of narrative discourse. Each of the discourse parameters is profiled and discussed in detail in the following section.

Discourse Structure

For the sub-parameter *discourse structure* under propositional aspects had a significant difference between the IWA and NTA groups due to their poor 'discourse forethought' and 'organizational planning' in their narrative discourse on a topic "Journey to a place". On comparing the raw scores, **aphasia participants performed poorly for the sub-parameter 'discourse planning'**, eight IWA obtained a zero score in this parameter. The raw scores show the better performance of IWA for the sub-parameter 'discourse forethought', only four participants obtained a zero score in this parameter. Moreover, none of the participants in the NTA group obtained zero scores in any of these parameters. This was most likely an indication of poor organization and planning skills in IWA as compared to NTA as shown in the illustration. Probably the lower mean value among IWA could be attributed to poor discourse planning in narration as compared to NTA, thus reflecting their poor discourse structure.

This result is in support of a study on persons with RHD exhibiting difficulty in dealing with the coherent organization of discourse in a narrative production task. In their narrative discourse, these individuals tend to focus on irrelevant details, use tangential utterances and introduce irrelevant comments (Ferre´, Ska, Lajoie, Bleau, Joanette, 2011), produce fewer target concepts (Uryase, Duffy & Liles, 1991) and be unable to generate (Brownell, Gardner, Prather & Martino, 1995) and/or modify (Stemmer, 1999; Marini, Carlomagno, Caltagirone & Nocentini, 2005) appropriate mental models during a conversation and/or description. It has been suggested that these difficulties may rely on a general impairment in the integration of ongoing information with the inferential cues derived from the situational context. Some of the errors in discourse clearly point towards the impairment at discourse structure, for example in case of non-fluent aphasia, errors such as word-finding difficulty, circumlocutory behavior, and aggramatic features contribute to the perception of poorly structured discourse for a listener. These patients often fail to convey their intended messages to the listener because of their aphasic features making them a poor communicator. Some of the conduction aphasia participants were able to picture or figure out the content they wanted to narrate yet they failed to structure a proper discourse genre because of their repetition errors and phonemic paraphasias. Whereas fluent aphasia participants were able to give a lengthy narration, they failed to convey planned and organized discourse because of their jargon paraphasias, irrelevant propositions, and poor self-monitoring skills.

Another pioneering study by Kaczmarek (1984), considering individuals with focal lesion s in varied portions of the brain. The task was a narrative discourse task and the analysis revealed a very poor organization of information that they wish to communicate in individuals with both left and right frontal damage. In addition, they could not avoid producing irrelevant and tangential digressions as well as sentential fillers and stereotyped phrases.

Illustration of poor discourse structure in Kannada

P:*Sikkandhuru..henge..inga..sikandhuru..sikkandhurige annu:rige ho:gidhvi..a:mele chirangu:du ho:gidvi. Swalpa ja:sthi dhoora a;gathe..nan appaji, yu:ru, nan ibru thamma, a:mele nanna dhoddappa, a:mele yu:ru amma , ho:gidhvi.*

(Sikkanduru..how..like.. I have gone to a Sikkanduru..a place called Sikkanduru..after this I went to chiragusdu..it is too far from here..my father,, this person..my two brothers ..then my uncle,, then her mom went there)

Communication Intent

In *communication intent*, the sub-parameters such as 'imagine events correctly' and 'ask for assistance' was affected more while comparing raw scores when compared to other sub-parameters like Initiation of narration, Asks for assistance in understanding, Criticizes the narration by agreeing/disagreeing to a part in the narration. Five and four IWA participants obtained a score of zero in these parameters respectively. However, the mean value obtained for the IWA group for the sub-parameter 'initiation of narration' was considerably better. IWA group was able to initiate the narration without any prompts. They were able to narrate the events of their journey with fewer prompts from the caregiver. However, fluent aphasics in the present study produced irrelevant utterances indicating disorganized imagination of narrative events.

Coherence

In coherence, for both the sub-parameters 'local coherence' and 'global coherence' there was a difference between the groups. However, **local coherence was more severely affected than global coherence** when comparing the raw scores. Nine aphasia participants obtained a score of zero in 'local coherence' whereas only six participants obtained zero in 'global coherence'. This indicates poorer connected discourse in IWA as compared to NTA for narrative discourse as shown in the illustration. However, Discourse quotient score obtained for narration task was poorer than the conversation task. It could be because, the narrative performance is influenced by a variety of contextual parameters such as characteristics of the listener, medium of presentation, content complexity, elicitation procedure employed, the structural complexity of discourse, social function, and manner of textual coherence (Togher, 2001).

In addition to these contextual influences, the narrative performance measurements are further complicated by the multiplicity of measures that have been employed. In this study, the narration task given was to talk about the topic 'journey to a place' which requires correct imagination of events related to people, place, location, speaker's cognitive organization, his/her social role, the linguistic structure of narration and sentence-level complexity. Hence the observed result disseminated a finding that aphasic participants performed better for conversation than the narration task. More support for this disturbing narrative discourse could be extrapolated from the neuroimaging studies.

A study on RHD patients by Mar (2004) suggested that damage to the frontal lobe of the right hemisphere may not only obliterate broad semantic networks but also impairs inhibition processes proposed to take place while the left hemisphere engages in selection. He concluded that the frontal lobe is responsible for narrative skills and helps in the integration of complex information manipulation required in any narrative task. On observation, it was noticed that the majority of individuals with RHD showing narrative disturbances were a result of frontal

damage. His hypothesis is important and it is in support with recent studies reporting frontal participation in the production of global coherence and organization of information errors in a different population of patients, for example, persons with schizophrenia (Marini, Spoletini, Rubino, et al. 2008; Spalletta, Spoletini, Cherubini., et al. 2010) and traumatic brain injury (Marini, Galetto, Zampieri, Vorano, Zettin & Carlomagno, 2011) involved in the narrative form of story description tasks. Therefore, the reduced percentage of information content was an insignificant correlation with the production of global coherence errors. This confirms that the lowered production of words that were perceived as informative was not due to micro linguistic deficits but was the epiphenomenon of macrolinguistic impairment. Thus, these individuals with aphasia also had poor global coherence in terms of the poor relationship of meaning or content of verbalization with respect to the general topic of conversation. From the results of the present study, it can be hypothesized that these IWA participants had varied (greater) involvement of the left hemisphere region compared to the right hemisphere region which could be due to the varied impact of stroke. This hypothesis can be proved with further neuroimaging studies.

Illustration of poor local coherence- Example in the Kannada language

P: *a:thara e:nu illa..maduve a:mele sumne bartha:re ella:ruve..a:thara ho:gilla..a:thar hogilla..dipolomo a:dhmele ho:gidhe…diploma adhu ondhu ..yeradu..mooru year..a:mele company ella hogbeku..a:thara bassallin antha ho:gidhvi….a:dhre yaava companykkuve ho:gilla. (There's nothing like that, after marriage everyone comes for no reason..did not go like that, went after diploma course..diploma is for one, two and three years..after that we need to got to the company..like that we went in bus..but we did not go to any company)*

Illustration of poor global coherence-Example in the Kannada language

P: *na:nu uduppi ho:gidhvi..de:varge ho:gidhvi..a:mele na:ve o:tta anbittu ma:diddhe..a:mele allondhu irtharalwa avaru ootta ma:dkodthare antha..avaru alle banthu bassalli..alle ma:dkondu ho:dhvi.(I have been to Udupi, been to temple, after that had food..and there is one person right he makes food..they came there in bus only..we had from there only and left)*

Topic Management

In topic management, aphasia participant's **difficulty was exhibited more in sub-parameters such as 'minimal elaboration', 'elaboration of the topic', and 'perseveration in the topic'**. Thirteen, eleven, and nine participants with aphasia obtained a score of zero in these parameters respectively. Minimal elaborations were seen more in Broca's, Transcortical motor and conduction aphasia participants, whereas elaboration of the topic on an unnecessary topic was seen in Wernicke's aphasia participants. The narration task requires very good cognitive and linguistic organization skills. Aphasia participants in this study did not exhibit much difficulty in introducing the topic. However, they showed difficulty in a coherent topic shift and topic changes instead there were many episodes of rapid topic shifts in a combination of minimal elaborations as shown in the illustration. It has been observed that IWA exhibited perseveration in the topic & it is important to mention that the topic management was observed to be greatly

affected in fluent aphasics as it was heavily dependent on pragmatic skills (Prutting & Kirchner, 1987). The examiner had to provide cues more often to fluent aphasic's to get a coherent discourse pertaining to the topic. In addition, for effective topic management, one should have a clear knowledge about the syntactic and semantic relations together with the use of surface linguistic structures. Reduced availability of these devices along with the presence of neologistic paraphasias, jargon words, incorrect references, and missing information may result in the disruption of topic management skills. These differences signify that the topic management abilities of IWA participants are impaired and restricted than those of NTA.

Illustration of the rapid topic shift in IWA

P: *a:thara e:nu illa..maduve a:mele sumne bartha:re ella:ruve..a:thara ho:gilla..a:thar hogilla..dipolomo a:dhmele ho:gidhe…diploma adhu ondhu ..yeradu..mooru year..a:mele company ella hogbeku..a:thara bassallin antha ho:gidhvi….a:dhre yaava companykkuve ho:gilla.. na:nu uduppi ho:gidhvi..de:varge ho:gidhvi..a:mele na:ve o:tta anbittu ma:diddhe..a:mele allondhu irtharalwa avaru ootta ma:dkodthare antha..avaru alle banthu bassalli..alle ma:dkondu ho:dhvi.* (*There's nothing like that, after marriage everyone comes for no reason..did not go like that, went after diploma course..diplomo is for one, two and three years..after that we need to got to company..like that we went in bus..but we did not go to any company, I have been to Udupi, been to temple, after that had food..and there is one person right he makes food..they came there in bus only..we had from there only and left)*

(From this example you can appreciate the topic shift from 'Journey to a place to her professional career')

Other Discourse Parameters

In *other discourse parameters,* the **sub-parameters 'message accuracy' and 'information content' was more severely affected than 'information adequacy'** on comparing raw scores. Eight IWA obtained a score of zero in 'message accuracy' and five obtained zero scores for 'information content'. For all the parameters there was a significant difference between IWA and NTA participants. The IWA participants showed reduced 'information content' in their narrative discourse whereas for picture description task they secured better discourse quotient score. It could be because; in picture description task (visual stimulus) visual clues were readily available without any need to search memory for a procedural sequence of events that are required for narration. And for the narration task, the discourse should be logically related to prior experience which requires a very good memory search or episodic memory. The IWA participants exhibited more fillers in order to maintain the flow, because of their difficulty in recalling the events from their past memory. Aphasic participants with non-fluent type showed more of this error as they were more concerned about what they were narrating in front of their caregivers and the investigator which made their narratives filled with fillers in order to maintain the flow of information. (As mentioned in the Illustration)

It is reported in the literature that some individuals with TBI have difficulty in producing a narrative that is temporally anchored in a dominant tense, as well showing their pragmatically-motivated tense shifting and a kind of rhetorical flexibility is absent in their overall narration (Marini, Carlomagno, Caltagirone & Nocentini, 2005).

Illustration of poor information content

P: *Mangalore alli ho:gidhvi..alli ella samudhre alli poore allidhvi..alli ganapathi e:nadhu...thandhi..alli ella poora samudhra..alli mathe ni:ru idhvi..ondhe onn ma:thra…ni:ru iradhu..poora ni:ru.(I have been to mangalore, there ocean, we were completely there only, there was ganapathy..ehat was it..there is full of ocean, there was water in that place, only one thing..water there..full of water)*

Speech Related Parameters

In *speech-related parameters*, the most severely affected parameters on raw score comparison were ‘vocabulary specificity', and ‘linguistic fluency'. Fifteen participants with aphasia obtained a score of zero in these parameters. In comparison, none of the participants in the NTA group obtained a score of zero for these speech-related parameters of narrative discourse. There was a significant difference between NTA & IWA participants in this parameter. IWA participants used unspecific vocabulary, exhibited linguistic non-fluencies, and anomic features. Non-fluencies observed in aphasia participants consisted of the word and phrase repetition, pauses, and interjections. Because of these features, the flow of the message was interrupted.

5.2.1.1. Non-Propositional aspects

For the parameter repair strategy and revision behavior, there was a significant difference between both the groups. IWA participant's especially fluent aphasics exhibited impaired ability to repair narration during communication breakdown. They were unaware of the errors made during their narration because of poor self-monitoring of expressive communication as it is noticed in the following illustration.

Illustration of poor communication repair strategy

P: *a:thara e:nu illa..maduve a:mele sumne bartha:re ella:ruve..a:thara ho:gilla..a:thar hogilla..dipolomo a:dhmele ho:gidhe…diploma adhu ondhu ..yeradu..mooru year..a:mele company ella hogbeku..a:thara bassallin antha ho:gidhvi….a:dhre yaava companykkuve ho:gilla. (There's nothing like that after marriage everyone comes for no reason..did not go like that, went after diploma course..diplomo is for one, two and three years..after that we need to go to the company..like that we went in bus..but we did not go to any company)*

5.3. Conversation Task

5.3.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

5.3.1.1. Propositional aspects

The results of the statistical analysis showed significant differences between the groups (IWA and NTA) for the conversational task and in the present section, the same is discussed

under the heading of sub-parameters of propositional aspects of conversational discourse. Each of the conversational discourse parameters is profiled with illustrations in the following section.

Discourse Structure

In the *discourse structure*, it was observed that IWA lacked 'discourse forethought' and 'organizational planning'. However on comparing raw scores **'organizational planning' was affected more when compared with 'discourse forethought'**. Nine IWA secured a score of zero in this parameter. This is most likely an indication of poor organization and planning skills in IWA as compared to NTA for conversational discourse. Probably the lower mean value among IWA could be attributed to poorer forethoughts in conversation as compared to NTA, thus reflecting their poor discourse structure. However, comparing discourse quotient across a conversation and narration tasks revealed the better performance of IWA participants for conversation tasks than the narration. This disparity in discourse performance indicates that each discourse type places different cognitive & linguistic demands on the communicator. The interactive nature of conversation makes the task cognitively less demanding as the conversation flow can be maintained by the partner's familiarity with the topic. However, some of the aphasia participants exhibited a clear deficit in propositional aspects for conversational discourse due to unfamiliarity/ poor knowledge towards the topic 'My country India'. Most of the participants were able to give correct responses only for the familiar questions. This discourse error in conversation could be due to the social aspects, such as familiarity with the topic (Familiarity with a topic like they were good on subtopic culture but poor on the topic politics), relationship with the conversational partner, status and the role.

Communication Intent

In *communication intent*, IWA participants performed poorly than NTA. However, looking at the mean value aphasia participants performed better for this parameter for the conversation task than the narration task. IWA participants were able to follow some of the aspects of communication intent like 'greet others in response to others greeting', 'greeting others by themselves', 'start a conversation' and 'ask information' for conversation tasks better than the narration task. However for some of the other sub-parameters like 'ask assistance in understanding conversation', 'Criticizes the conversation by agreeing or disagreeing to a part in the conversation' and 'imagines events correctly', IWA participants performed poorly, wherein a majority of IWA secured a score of zero in these parameters. Furthermore, IWA participants could not act as an excellent converser and were not able to follow all the manners in conversation, especially when the conversation was a semi-structured one like in the present study.

Since it was a semi-structured conversation, the speech act might have taken place for the given topic of conversation. Here the NTA participants might have thought to have a descriptive/ explanatory situation, so all have "initiated the conversation" by greeting others by themselves (spontaneously). But the IWA participants did not have a descriptive/explanatory situation so

they had ‘greeting others’ in response to others greeting as shown in the illustration. Another plausible reason could be the personality factor. If a person does not like to contradict others, then he would not show the feelings by disagreement or criticism to the other person and vice versa. The final reason could be the topic of conversation ‘My country India'. Since this topic is very vast (extensive), participants might have been aware of a few things and unaware of certain other things. This might have specially created difficulty for the IWA participants to ‘start conversation', ‘ask information', ‘ask for assistance in understanding conversation', ‘criticize conversation by agreeing or disagreeing', and ‘fabricating or imagining events' as it can be noticed in the following illustrations.

Illustration of poor communication intent- Example in the Kannada language:

I: nimma hesaru ae:nu ? (What is your name?)

P: nanna hesaru participants 1. (My name is Participant 1.)

I: naavu iiga bhaaratada bagge maatanaaDooNa. (Now shall we speak about India?)

P: sari. (K)

I: bhaarata deeshada bagge niivu maatanaaDatiira. (Will you speak about India?)

P: India namma de:sha..namma de:sha ndia..

I: niivu bhaaratada samkruti, raajakiiya, shikshaNa mattu prasidda staLagaLa bagge maatanaaDi. (You speak about the culture, politics, education and famous places in India)

P: na:vu huttidhu India dhalle ma:diddhe..na:vu huttidha u:ra namma parentsu, namma appa, namma amma idhare. Nam sistru avarelle maysooralli iddha:re. namma tha:yi thandhe berooralli idhru.(I was born in Indiamy birth country my parentsmy father, my mother are there My sister is in mysore only,,my mother and father is in Beroor only)

Coherence

In *coherence*, both the sub-parameters ‘local coherence' and ‘global coherence' were observed to be affected in aphasics. On comparing raw scores, **local coherence was affected more than the global coherence.** Nine participants in the IWA group obtained zero in ‘local coherence’, whereas only five secured zero in ‘global coherence’. This indicates poorer connected discourse in IWA as compared to NTA for conversational discourse. The violation at local coherence could be due to: their inappropriate comments, repetitions, semantic paraphasias, excessive deictic terms, and pronouns without antecedents.

These findings are in agreement with the study reported by Nicholas et al (1985) on individuals with WA, who reported these errors in WA in comparison with Alzheimer's Dementia and NTA. Furthermore, they demonstrated information gaps, poverty of use of conjunctions, and irrelevant propositions which accounted for coherence violation, thus resembling subjects in a study by Gleason et al. (1980). Ehrlich and Barry (1989), Glosser and Desser (1990), Hough and Barrow (2003) indicated that global coherence is affected more than local coherence in TBI participants. Among the aphasia participants, local coherence in terms of the relationship of meaning or context of verbalization with that in the immediately preceding

utterance produced either by interviewer or subject was relatively better compared to global coherence as seen in the following illustrations.

Poor local coherence example in the Kannada language:

I: bhaarata deeshada bagge niivu maatanaaDatiira. (Will you speak about India?)

P:India namma de:sha..namma de:sha ndia..

I: niivu bhaaratada samkruti, raajakiiya, shikshaNa mattu prasidda staLagaLa bagge maatanaaDi. (You speak about the culture, politics, education and famous places in India)

P: na:vu huttidhu India dhalle ma:diddhe..na:vu huttidha u:ra namma parentsu, namma appa, namma amma idhare. Nam sistru avarelle maysooralli iddha:re. namma tha:yi thandhe berooralli idhru. (I am born in India, Done here, The birth place is my parents native, my father, I have my mother. My sister all are in Mysore, My father and mother were in other places.)

I: Indian Politics alli Ga:ndhiji bage e:nadhru helthira?

P: Gandhiji namma deshak ko:skara kattidhru. Namma de:sha ko:skara kashtapettu swathandhra kottru avaru. a:mele ge:ne nadilli chakradhalli dha:ra udhiddu..avaru Gandhi uddiddhu..(Gandhiji worked for the nation, built our nation, he struggled a lot for our country to get freedom and got the freedom. And weaved cotton thread using the charakas, he was Gandhi who weaved cotton thread.)

Topic management

In *topic management*, most of the aphasia participants obtained a score of zero in the sub-parameters such as **'topic shift', 'topic change' and 'minimal elaboration'**. Six of the IWA participants obtained a score of zero in these parameters, whereas none from the NTA participants obtained zero. This impairment was so evident in conversation than the narration because of the pragmatic nature of the conversation. Because of the dyadic nature of the conversation, the aphasic participants had to provide relevant information which was cognitively taxing due to working memory deficit. Because of this pragmatic nature of the conversation, communicative dysfunction was very much evident in aphasics.

For successful participation in the conversation, the speaker should maintain appropriate referencing and topic management, which in-turn requires intact selective and sustained attention. In addition, the comprehension of sarcasm and metalinguistic abilities are considered to be important for successful conversational participation. Impairment at these can result in withdrawal from social participation by aphasia participants, especially of non-fluent type. Since non-fluent participants were aware of their communication breakdown, they were often trying to maintain the flow of information by sustaining their conversation on the same topic and perseverating. In addition, functional memory is important to sustain in the topic in order to remember what the speaker has said. These findings are in consonance with studies reported by Coelho, Youse, le & Feinn (2003) on patients with a closed head injury. This difference in performance has been observed invariably in patients with varied brain insults. One study which

adds on to this point was reported by Mentis and Prutting (1991) and Coehlo, Liles, and Duffy (1991) observation, who found that the persons with TBI produce non-coherent topic changes compared to normal speakers.

Poor Topic Management example in the Kannada language:

P: Nan de:sha India..India namma desha..I was born in India..The national bird of our country is Peacock..nam rashtra prani huli..nan india dhalli karnataka, mysore, ta..ta..tamil nadu, AAndra pradesh states kalive..nange karnataka tumba ishta,,nan huttidhu karnataka dhalli..nan makkalu U.S alli idhe..nam india dhalli education thumba important. (My country is India..I was born in India.. The national bird of our country is Peacock. The national animal is tiger, In India, we have, Karnataka, Mysuru, Andra Pradesh states are there..I love Karanataka..I was born in Karnataka, my childrens were born in US..In our India education is considered very important)

In this example, you can observe the Perseveratory behavior. Though the topic of conversation was about India, the participant was explaining more about Karnataka which is his state. Since he was not able to talk more about politics and different famous places in India, he sustained his explanation on Karnataka alone.

Other Discourse Parameters

Finally, in *other discourse parameters*, the sub-parameter 'message accuracy', 'information adequacy', and 'information content' non-fluent aphasia participants were able to give relevant propositions than fluent aphasics because of the interactive nature of the conversation. The most **severely affected parameter was 'message accuracy' followed by 'information content' and 'information adequacy' as shown in the illustration**. A total of six IWA participants obtained a score of zero in 'message accuracy' when compared to other sub-parameters such as 'information content' and 'information adequacy'.

The fluent aphasics in the present study exhibited limited information content with excessive verbal flow reflecting impaired self-monitoring of expressive communication. A number of studies reported by Ulatowska and collaborators support these findings. The investigation of information content, coherence, and cohesion of aphasic discourse revealed reduced complexity of language and quantity of information conveyed in narrative discourse (Ulatowska & Bond, 1983; Ulatowska, Freedman-Stern, Doyel, Macaluso-Haynes, & North, 1983; Ulatowska, North, & Macaluso-Haynes, 1981). Although the mildly impaired aphasic subjects in Ulatowska's study exhibited preserved discourse structures, their narrative was reduced in both the amount and complexity of information. These results are in agreement with previous results from the study reported by Gleason et al. (1980) using a picture story test, reported a significant reduction in the proportion of target lexemes, noun to verb proportion, number of themes, and amount of embedding in WA subjects.

Example of discourse with poor message accuracy and limited information content

Inaccurate message - Example in the Kannada language:

I: namma deeshada shikshaNada vyavaste hegide? (How is the education system in our country?)

P:Shiksh..shikshanada vyavaste thumba channagidhe..idhu bage enu hel beku..nange odhadu thumba ishta..a:dhre odakke agilla..India education system is good. (Education system is really good in India, what should I say about this..I like to study..but I could not study.. India education system is good)

I: Which are the famous places in India?

P:Mysuru,,Mysuru palace..chamundi betta..idhalli famous..nange palace ista..channagidhe nodakke..illi thumba places idhe..a:dhre famous place yavadu antha gothilla.(Mysuru,,Mysuru palace..chamundi hills, I love Mysuru palace..looks soo beautiful,, there are different places here,,but also I don't know which is famous.)

In this example, the participant exhibited excessive verbal flow, but he was not able to give any relevant information about the education system in India. He was simply repeating the question presented to him in a statement form. This indicates the poor message accuracy of the participant. For the second question, though he was able to list out the different places in Mysuru, he was unable to provide other famous historical places indicating limited information content.

Non-propositional aspects.

In contrast to the neuro-typical adults who were able to initiate many turns in a conversation, the aphasia participants were seen to take more time to start a turn. This is in support of the study reported by Prince, Haynes, and Haak (2002) suggesting that individuals with closed head injury produce more errors in conversation than in a structured communication task. This breakdown is attributed to the social aspects of communication such as familiarity, relationship, and the face-saving strategies employed for politeness by the aphasic speaker when confronted with the communication breakdown. Similar results were found in TBI patients wherein they initiate very few turns and at most, they take time to initiate a turn in conversation (Milton, Prutting, & Binder, 1984). According to Schegloff (1987), normal individuals are reported to take contingent turns in conversation. The performance of the TBI group on non-contingent turns could be attributed to the lack of perception of the flow of conversation. In view of fluent aphasia participants in this study, exhibited similar impairments, in which they concentrated on one particular word and started speaking in relation to that word in a non-coherent way. Thus, the fluent aphasia participants could not perceive the meaning of the preceding turn due to lack of sustained and focused attention as well as concentration as shown in the illustration.

I: Can you please talk about famous places in India

P: nanna uru iradhu India,,I love India,,my country is India,,I was born in India,, nan makkalu huttidhu India dhalli,,makkalu Americadalli kelsa ma:dthayidhe..nange India ishta..Americadhalli engineer maga..engineer..hmm..Bangaloralli study ma:didru..Bangalore nan cousin idhe..cousin..Prakash..Avanu alli teacher a:gidhe..(My county is India..I love India..My county is India..I was born in India..my children were born in India..They are working in America..I love India..My son is an engineer in America..hm..America..he studied in Bangalore..my cousin is also there in Bangalore..My cousin Prakash,..He is a teacher)

In this example, you can appreciate the attention deficit due to which he was not able to sustain his narration to a particular topic within the conversation task. He was explaining more with respect to the preceding word. First, he spoke about India, then said about his son and his course in Bangalore, then he associated the place name Bangalore to his cousin who is working there as a teacher. Here this example it can be appreciated to notice the complete loss of context of narration within a conversation from famous places in India.

To summarize, the performance of IWA participants varied across all the tasks and the parameters, whereas NTA did not show much difference in performance across tasks and parameters as the majority of them secured full scores for all the parameters. With respect to three different discourse tasks used in this study, **the performance of IWA participants was better in a picture description task, followed by conversation, and then the narration task**. The better performance of IWA participants for picture description tasks was marked by a greater mean value obtained for discourse quotient which was comparatively less for conversation task and the narration task. The better performance in picture description task could be due to the availability of structured events within the picture, wherein the subject does not have to recall the events from his/her past experience requiring considerably lesser reliance over recall memory. While comparing across all the parameters with respect to the mean rank scores obtained using **Friedman's test for propositional and non-propositional aspects, it was observed that** the **highest mean rank was obtained for revision behavior and the lowest was for the speech-related parameter.** While arranging in an order of least to the most affected, the hierarchy was as follows, revision behavior, communication intent, repair strategy, coherence, other discourse parameters, topic management, and speech-related parameter. Whereas for **conversation task it was observed that the highest mean rank was obtained for turn-taking and the lowest was for the speech-related parameter.** The hierarchy of least to the most affected parameter was as follows, turn-taking, revision behavior, communication intent, conversational behavior coherence, other discourse parameters, discourse structure, topic management, and speech-related parameter. **Whereas for narration task it was observed that the highest mean rank was obtained for revision behavior and the lowest was for the speech-related parameter.** While arranging in an order of least to the most affected, the hierarchy was as follows, revision behavior, communication intent, repair strategy, other

discourse parameters, discourse structure, coherence topic management, and speech-related parameter.

From the above findings, we can see a common trend across the tasks in which the least affected parameter was non-propositional aspect such as turn-taking, revision behavior, and the repair strategy and the most affected was propositional aspects specifically the speech-related parameter, topic maintenance and other discourse parameters and the least affected parameter within propositional aspect was the communication intent.

5.4. Working memory task

5.4.1 Between-group comparison (Individuals with Aphasia and Neuro-typical Adults):

Working memory abilities in aphasia participants

In this present study, an attempt has been made to determine if working memory tasks can differentiate people with aphasia and neuro-typical individuals. To explain in detail about the performance of aphasia participants in the WM task, it was observed that aphasia participants had a pronounced difficulty in performing a working memory task. The **reaction time taken to execute the forward span task (FST) and backward span task (BST) of a working memory test were higher for the IWA group compared to the NTA group**. There is also a significant difference between the IWA and NTA groups at the working memory test of FST and BST. The sample size for the clinical and control group was restricted to thirty in number and for the purpose of a comprehensive discussion of the results a **level/**threshold/accuracy for the FST, BST, and the n-back task of working memory test is considered in the following sections.

It was observed that, for FST, the majority of the IWA performed at a level of 1, 2, 3, and some at level 4. For the same FST, the majority of the NTA could reach levels 3 & 4 and some at levels 5, 6 & 7. **However, the NTA group performed better than the IWA group for FST by securing the highest level with lesser reaction time.** For BST, the majority of the IWA could reach the 1st level with the least reaction time compared to the 2nd or 3rd level. For the same BST, the majority of NTA participants could reach level 3. However, with reference to **BST levels, the NTA group performed better than the IWA group.** Again with reference to the mean (reaction time) value of the working memory assessment test, **within the NTA group, there was no significant difference in the reaction time for FST versus BST but within the IWA group, there was a significant difference in the reaction time for FST versus BST. The contributing reason could be the participants in the IWA group had evident lesser reaction time for BST compared to FST**.

The other contributing reasons for this could be a similar threshold of performance by all the participants in the NTI group. Where they could carry out FST and BST both at a common highest level/threshold/accuracy of ‘3'. Among the IWA group, all the participants could carry

out FST and BST at a common level/threshold/accuracy of ‘2' and ‘1' respectively. Overall, the NTI group had a better threshold with lesser reaction time compared to the IWA group performing at the lower threshold with greater reaction time. Thus, there was an overlap between the FST and BST for the NTI group whereas there was no overlap between FST and BST for the IWA group. They were an apparent difference in performance on the FST with reference to level/threshold/accuracy.

The additional contributing reasons could be the phonological storage or articulatory rehearsal being sensitive to impairment in an individual with aphasia or could be the poor performance due to their reduced attentional capabilities. To support the same, Martin and Reilly, 2012 have predicted differences in participants with mild aphasia on short-term memory span tasks and also extending to a few individuals with a high level of aphasia. In the present study the level/threshold/accuracy of working memory test, for example, FST, BST, and n-back correspond to the difference in the visual span between IWA and NTI. This reduced score in IWA suggests that this reduced working memory capacity is likely to have a central executive and attentional component in addition to impairments in the phonological loop with reference to Baddeley’s working memory model.

To explain the same in detail, aphasia participants were overtly rehearsing the names of items presented on the screen, which was audible to the examiner in spite of relative rapid presentation rate chosen to discourage this attempt to covertly verbalize the linguistic stimuli. The overt rehearsal of names of visual stimuli was filled with literal paraphasias and perseveration. The consequence of this erroneous rehearsal was reflected in the selection of items in the response window as well, during which they were not able to recall or select the items in both forward and backward span task. This deficit exhibited by IWA holds good with the explanation of the processes called phonological storage or articulatory rehearsal explained in Allan Baddeley’s Working Memory Model (Baddeley & Hitch, 1974) which is predicted to be affected in IWA.

Therefore, impairment exhibited by IWA could be allocated to the phonological loop. It was proposed that the phonological loop could be divided into two subcomponents, a temporary storage system, and a subvocal rehearsal. The temporary storage system is responsible for retaining memory traces for over a matter of seconds; the traces could decay unless rehearsed by the second component. Hence the subvocal rehearsal is not only very important to retain information within the store, but also to register visual information within the store. IWA participants exhibited marked impairment in recalling the names of visually presented items during the WM task because of literal paraphasias and repetition impairment. Since the articulatory rehearsal itself was impaired, the subvocal rehearsal system could not retain the information within the temporary storage system which caused the decay of visual images in the system. Hence, the corresponding result of WM performance is also poor on forward, backward, and n-back visual span tasks. Though this task requires the subject to retain the sequences of images for immediate recall either in forward or backward depending on the task, despite their

visual presentation, subjects often subvocalize them, and hence their retention had to depend crucially on their phonological or acoustical characteristics. The visual images in the task consisted of a peacock, cake, fan, glasses, octopus, palm, star, sun, and the letter Y. Neither of these words is phonologically or semantically related to each other, hence we can rule out the influence of semantic or phonological similarity effect.

Support comes from studies that have compared patients with left hemisphere lesions to neuro-typical individuals. Patients with left hemisphere lesion performed significantly poorer on verbal memory and spatial memory tasks than the neurotypical individuals (Burgio & Basso, 1997; Caspari, Parkinson, LaPointe, & Katz, 1998). Overall, in the present study with reference to mean (Reaction time) score within the IWA group, they could perform better in BST compared to FST and with reference to the level, BST was poorer compared to FST. Therefore, with reference to the level/threshold/accuracy, the FST was better compared to BST. This particular result of the present case study is in support of the Lezak (1995) study on working memory. Lezak (1995) reported that a patient with brain dysfunction performed better in digit forward task than digit backward task which infers that digit forward task stores information in short-term memory whereas digit backward task has the highest demands on working memory where manipulation is required to identify the information. Similar results that support the differences in working memory capacity between individuals with aphasia and neuro-typical individuals using tasks like forward and backward digit span, word span, the N-back task, and judgment task have also been reported (Mayer & Murray 2012; Wright & Shishler, 2005).

Other supporting studies that document the findings of better performance in BST (reaction time score) compared to FST are by Laures-Gore, Marshall, and Verner, 2011. They compared the performance of the individual with aphasia (left hemisphere stroke) and the group with right brain damage, no aphasia performed worse in digit backward span task than digit forward span task and concluded that scores were poorer because of decreased attention capacity in individuals with aphasia group when compared to individuals with right brain damage. According to Bonini and Radanovic (2015) study, they also reported that aphasic patients performed poorer in the digit span task, visual memory task (cognitive tasks) than non-aphasics which suggests that they have deficits in attention, working memory and mental control. They concluded that the type of stimulus used in the working memory task act as a major contributing factor causing the difference in the participants' performance in their study. In the present project, the paradigm (FST & BST) used to assess working memory capacity has been shown to be very effective in assessing the cognitive skills which are being influenced by the impaired linguistic deficits of individuals considered as aphasia participants. Hence, an initial attempt is also made to study the differences or study the association between cognition and language in individuals with aphasia.

5.4.1.1 Working memory in relation to language processing in IWA

Poor discourse output is noticed in individuals with aphasia due to their linguistic processing deficits and their working memory deficits. The underlying working memory limitations in the aphasia participants demonstrated difficulty in performing forward span tasks, backward span tasks, and n-back task as seen in the previous section. Therefore it is important to evaluate the working memory output (quantitative) and the discourse output (qualitative) in individuals with aphasia. This quantitative and qualitative analysis is essentially done together because the appropriate discourse pattern is possible only when an individual with good cognitive ability *(first point of discussion)* uses specific vocabulary, good discourse structure, and no coherence violation. Hence the linguistic errors exhibited by aphasia participants due to their underlying cognitive deficits should be measured simultaneously.

Therefore the present study was aimed to understand the influence of working memory over different discourse genres *(second point of discussion)*. Reliance on any one task will limit our knowledge about the different patterns of discourse elicited by each discourse genre. Therefore, it was important to select an appropriate discourse task for initial assessment and monitoring as each discourse targets different cognitive-linguistic domain to facilitate appropriate responses. Hence, three different discourse tasks like picture description, narration, and conversation are considered in any studies on discourse. Hence, in the present study three different discourse genres such as picture description, narration and conversation were used to elicit discourse in individuals with aphasia. It is observed that the use of only one discourse task would under-represent the plausible impairments in an individual since the cognitive demand required for each task is different as it is evident from the qualitative assessment of discourse. Therefore the method used in this project consisted of the tasks ranging from cognitively less taxing to highly taxing (picture description- narration-conversation). Hence, we can rule out the influence of highly demanding cognitively loaded tasks (direct/indirect influence) on the poor working memory abilities seen in the aphasia participants. It is evidenced from this study that, the (good) performance on working memory tasks and the (good) performance in discourse tasks are sensitive to tap the cognitive-linguistic dysfunctions in aphasia participants following brain damage. Some of the aphasic errors like word-finding difficulties are again related to poor memory skills in aphasics. Individual variation in WM capacity was reported by Just and Carpenter (1999), they reported a difference in reading performance by college students. Students with greater working memory abilities had faster reaction time and words than the counterpart. Greater WM capacity helps an individual to hold lengthy sentences and allows them to interpret the same. Similarly, for the better interpretation of an ambiguous statement, one should have greater WM abilities to give its multiple interpretations.

The appropriate discourse pattern depends on the presence or absence of the linguistic errors exhibited specifically by the aphasia participants *(third point of discussion)* in terms of use of unspecific vocabulary, poor discourse structure, and coherence violation which might be due to the underlying cognitive deficit. Aphasia is normally considered language-based impairment

(Schnider, Benson, & Scharre, 1994; Grodzinsky, 1990). However, in individuals with aphasia, the language processing difficulty and the deficits in working memory capacity are attributed by some researchers (Caspari, Parkinson, LaPointe & Katz, 1998; Friedman & Gvion, 2003). Linguistic information processing difficulties appear in the areas of syntax, phonology, and semantics (Wright, Downey, Gravier, Love, & Shapiro, 2007). The severity of the deficit of verbal working memory on discourse depends on the type of processing necessary in the sentence structure, whether it be syntax, phonology, semantics, or a combination of the three (Friedmann & Gvion, 2003). Forgiving a well-connected and coherent discourse the category of syntax is essential. Semantics is essential for appropriate vocabulary in a sentence without any semantic and jargon paraphasias. Deficits in these areas are likely to negatively influence discourse comprehension and production. Consequently, working memory capacity deficits may contribute to the language processing impairments seen in individuals with aphasia (Caspari, Parkinson, LaPointe, & Katz, 1998).

The working memory generally contributes to cognitive tasks by allowing the individual to hold information while manipulating and processing it in a variety of ways (FST, BST, N-Back task). This helps us with problem-solving and thinking (Ricker, AuBuchon, & Cowan, 2010). Language comprehension and reasoning are again related to working memory abilities. A poor reasoning ability in IWA is associated with poor working memory abilities (Just & Carpenter, 1992). Language comprehension is facilitated by memory. It seems obvious that language comprehension is a resultant of some kind of memory involvement (Friedman & Gvion, 2003). Poor language comprehension due to impaired working memory along with aphasic errors contributed to poor discourse structure in IWA. WM capacity will vary across individual participants *(fourth point of discussion)*. Wernicke's aphasia participant was able to narrate more on the given topic lacking message accuracy and information content in it. This inappropriate discourse in fluent aphasia participants is due to their comprehension and attention deficit. Because of this, they lose their track from previously uttered sentence to the next, thus violating local and global coherence. Even though the non-fluent counterpart has intact to mild comprehension skills they failed to give a well-organized discourse, this is again due to their poor recalling abilities and poor memory abilities to memorize the events from the recent past.

The relation between WM and language processing has been studied with respect to aging and sentence comprehension *(fifth point of discussion)*. DeDe, Caplan, Kemtes, and Waters (2004), reported greater reliance on verbal working memory ability for better performance on sentence comprehension tasks. Hence decline in working memory abilities will have a negative impact on sentence and paragraph comprehension with the advance in age. Individuals with high verbal working memory span process sentence more quickly than their peers with lower verbal working memory capacities. This is demonstrated during the measures of comprehension taken at the end of the sentence. Individuals with lower working memory capacities are able to comprehend less complex sentences with lesser ease than those with higher working memory capacities. These results indicate that working memory is related to sentence comprehension.

Finally, to conclude, the working memory deficits exhibited by the participants in this study could be due to the brain lesion also *(sixth point of discussion)*. Some of the areas of the brain are involved in working memory. Regions such as Broca's area, dorsolateral prefrontal cortex, posterior parietal cortex, and the pathways running between these areas (Ricker, AuBuchon, & Cowan, 2010) are responsible for WM. The left hemisphere speech areas such as supplementary motor areas and Broca's area and the pre-motor are activated during sub-vocal rehearsal (Smith & Jonides, 1998). Hence, working memory training facilitates language production and comprehension. Some of these areas also play key roles in language processing. Therefore, from these investigations, we observed that working memory deficits are in association with the linguistic processing impairments in IWA.

CHAPTER VI

SUMMARY AND CONCLUSION

The present study aimed to investigate the discourse abilities and working memory capacity of adults with aphasia in comparison with the neuro-typical individuals. The objectives of the study were,

1. To investigate and compare the discourse abilities of adults with aphasia and neuro-typical individuals.
2. To assess and compare the working memory capacity of adults with aphasia and neuro-typical individuals.
3. To study the correlation between discourse and working memory of adults with aphasia and neuro-typical individuals.

Standard group comparison was made by considering individuals with aphasia (IWA) and neuro-typical individuals (NTI) (35 and above years) as participants. A total of 60 individuals participated in the study. Among them, 30 participants formed a control group (NTI), and the other 30 participants a clinical group (IWA). All the participants were native speakers of Kannada language and they also had vision and hearing acuity within normal limits and the handedness was right according to their self-report. The clinical and non-clinical group participants were separated based on the inclusionary and exclusionary criteria. General histories with demographic details were taken from all the participants along with the consent for agreeing to participate in the study. The Mini-Mental Status Examination (MMSE, Folstein, Folstein, & McHugh, 1975) was used to screen any cognitive difficulties which would influence the communicative abilities of aphasic individuals with NTA.

The data collection involved elicitation of discourse samples such as picture description, narration, and conversation along with working memory assessment. The discourse samples video recorded were analyzed using Discourse Analysis Scale (DAS) (Hema & Shyamala, 2008) a qualitative perceptual rating scale. DAS consists of a set of parameters and a list of skills under each parameter. Each skill was rated separately and a final index was obtained for them. The scale has separate ratings for picture description, narration, and conversation task and measures the propositional and non-propositional aspects of each task. The execution of forward span task, backward span task, and *n*-back task of working memory (WM) tests was by using the "Cognitive Module" developed by Kumar and Sandeep (2012) as part of All India Institute of Speech and Hearing Research Fund Project (ARF). In this software, subsections like forward visual span (FST), backward visual span (BST), and *n*-back task were only considered for the

present study. Participants were made to sit comfortably in a quiet room and had to follow specific instructions to carry out each task. The scores (reaction time in terms of milliseconds) and the level/threshold/accuracy) of the tasks were considered for all the working memory tests. Compared to FST and BST, majorly n-back tasks would assess the WM index. Based on the participants' performance, for example, if there was better ‘n' of trials the software would automatically increase and decrease the level of complexity with reference to FST, BST, and *n*-back. Reaction time and the level/threshold/accuracy of performance by an individual were automatically saved in the software. Feedback was provided for every positive response in each task. Thus, the objective score of the working memory test and the subjective scores of discourse assessment were tabulated for further statistical analysis.

The major findings of the present study for discourse task and working memory task are discussed under two sections, the between-group comparison and within-group comparison. The discourse analysis revealed a different pattern of discourse production from IWA. The type of error surfaced from the picture description was different from that of narration and conversation tasks. A comparison of the mean value of discourse quotient across three discourse tasks demonstrated the better performance of aphasia participants for picture description followed by narration and conversation task. Probing further into this pattern of error and response unveils the importance of *cognition* for performing these tasks. Among all the tasks, aphasia participants experienced more difficulty in the narration task because of its reliance over *the cognitive-linguistic organization*. A very good *episodic memory* is important to recall events from the past experience and narrate on it. In addition, *sustained and focused attention* is equally important for conversation and narration task to give relevant propositions. The *functional memory* places major importance on the conversation, any disruption in this can cause a communication breakdown.

Fluent and non-fluent aphasia participants in this study performed invariably poorer on discourse tasks. Moreover, fluent aphasia participants performed poorer for non-propositional tasks evidencing a *lack of self-monitoring skills* which is exhibited as a communication breakdown. In addition, fluent aphasics secured better mean scores for propositional aspects than non-fluent aphasics because of their *preserved skills on speech-related parameters* and *other parameters* (information content, message accuracy, and message adequacy). However, discussion regarding the performance of fluent and non-fluent aphasics is beyond the scope and interest of this project. Nevertheless, the linguistic processing difficulties exhibited by aphasia participants in this study such as disorganized discourse structure, poor naming abilities, poor recalling of events, coherence violation, poor topic maintenance, and message accuracy could be attributed to the *poor working memory abilities*. This impairment at discourse level is again associated with aphasic errors such as *aggramatic features* and *repetition errors* as seen in Broca’s aphasia, *phonemic paraphasias,* and *repetition errors* as seen in conduction aphasia, *word-finding difficulties* in Anomic aphasia, *neologistic and semantic paraphasias* in Wernicke’s aphasia. Because of these aphasic features, their discourse was perceived as disorganized and

out of context. That is, the macro linguistic and microlinguistic processing deficits at discourse in individuals with aphasia could be due to the poor working memory abilities. The support for this finding can be substantiated through the findings from our working memory assessment.

For the results of FST & BST, it was observed that the majority of the aphasia participants reached the 1st, 2nd, and 3rd levels with increased reaction time when compared to NTA. With respect to the level and mean reaction time the findings were as follows: nine participants with aphasia were able to reach 1st level with a mean reaction time of 3143.33, eight participants reached 2nd level with a mean reaction time of 9504.88, twelve participants achieved 3rd level with a mean reaction time of 6001.25 and one participant reached 4th level with a mean reaction time of 7173.00. From these findings, an increase in mean reaction time was observed from the lower level to the higher level except for the 3rd level, where mean reaction time was observed to be lesser than that for the 2nd level. This could be due to the severity of the aphasia participant who attempted the 2nd level. The increased mean reaction time for 2nd level could be due to the increased processing time taken to select the targets from the response window. The lesser mean reaction time for the 3rd level could be due to the practice effect and semantically similar pictures appeared on the screen due to the incorrect responses from the 2nd level, wherein the software presented similar pictures as targets.

Whereas for BST, sixteen participants with aphasia reached the 1st level with a mean reaction time of 2270.25, seven participants secured 2nd level with a mean reaction time of 2845.00, and four participants achieved 3rd level with a mean reaction time of 4287.25. In the BST task, we can appreciate the increase in mean reaction time corresponding to the increase of levels. However, aphasia participants obtained a lesser mean reaction time for BST when compared to FST. This could be due to the shorter response time given in BST but, the BST task requires the highest demands on working memory where manipulation is required to identify the information. Whereas, for FST the response time was not restricted since the information had to be stored in short-term memory.

However, the NTA group performed better than the IWA group for FST & BST by securing the highest level with lesser reaction time. For FST, 12 individuals from the NTA group reached 3rd level with a mean reaction time of 4916.00, eleven participants reached 4th level with a mean reaction time of 10661.82, five participants reached 5th level with a mean reaction time of 11483.20, one participant secured 6th level with a mean reaction time of 10700.00 and one achieved 7th level with a mean reaction time of 16700.00. Whereas for the BST task, five participants from the NTA group reached the 2nd level with a mean reaction time of 2762.00, twenty participants reached the 3rd level with a mean reaction time of 4432.90, and five achieved 4th level with a mean reaction time of 4092.00.

On comparing the best and worst level across FST & BST it was observed that the best level **for FST** was 3 and 1 for IWA participants, whereas the worst level was 4 (which means, they reached the 4th level with greater reaction time, whereas they performed at level 1 and 3

with lesser reaction time). Furthermore, for NTA participants, the best level was 3rd, 4th, and 5th and the worst was the 8th level. Similarly, **for BST**, the best-observed level for IWA was 1st and 2nd, the worst was 3rd & 5th. Whereas for NTA the best level was 3rd & 5th, the worst level was 6th.

For *n back* task, IWA the best level was 2 and the worst level was 3. Similarly, for NTA, the best was 3rd and the worst was the 5th and 6th levels. The majority of IWA had a capacity of 2-back and NTA had a capacity of 3-back. With respect to mean reaction time, BST was better than FST for the IWA group and NTA. For BST, the mean reaction time obtained was lesser when compared to the mean reaction time obtained for FST.

Therefore the reaction time taken to the execute forward span task (FST) and backward span task (BST) of working memory test was found to be higher for the IWA group compared to the NTI group. From this present study, an attempt has been made to determine if working memory tasks can differentiate people with aphasia and neuro-typical individuals. Within the NTI group, there was no difference in the reaction time for FST versus BST and the participants in the IWA group had lesser reaction time for BST compared to FST. Thus, there was an overlap between the FST and BST for the NTI group whereas there was no overlap between FST and BST for the IWA group. The contributing reason could be *the phonological storage or articulatory rehearsal* being sensitive to impairment in an individual with aphasia or could be the poor performance due to their *reduced attentional capabilities*. The other possible reason could be the *differences in the strategy used by the NTI and IWA participants*. Some participants appeared to orally rehearse the name of the visual image and keep a count of the same in the correct sequence instead of memorizing visually. But there was a statistically significant difference between the NTI and IWA groups for the FST, BST, and n-back task of working memory tests. This is because the language learning and performance of IWA are affected due to their *decreased working memory capacity* and the other possibility is the paradigm (verbal stimuli) used to assess working memory (Baddeley, 2003; Murray, 2004). Hence the visual span (instead of verbal stimuli) forward and the backward task was used in the present study. Within-group comparison, for Group I (IWA) and Group II (NTI) there was no significant difference with reference to the reaction time of FST versus BST. Since the working memory paradigm (FST & BST with visual stimuli) to assess working memory capacity is very effective in assessing the cognitive aspects alone and is not influenced by the impaired linguistic aspects of any individuals with aphasia.

The findings of this study also unveil the influence of working memory over discourse by using three different discourse tasks such as picture description, narration, and conversation. Reliance on any one task will limit our knowledge about the different patterns of discourse elicited by each discourse genre. Hence, it is important to select an appropriate discourse task for initial assessment and monitoring as each discourse targets different cognitive-linguistic domain. It is apparent from these studies that, use of only one discourse task would under-represent the plausible impairments in an individual. Cognitive demand required for each task is different and

is evidenced in our findings too (varied performance for three discourse genres). These linguistic processing deficits (at discourse level) exhibited by aphasia participants are due to the working memory difficulty. The difficulty in performing forward span tasks, backward span task, and n-back task demonstrated by aphasia participants will reflect their underlying working memory limitation. Some of the errors exhibited by aphasia participants such as, use of unspecific vocabulary, poor discourse structure, and coherence violation are due to underlying cognitive deficits such as poor attention, perception, executive function, and memory about the recent past, which is important for appropriate discourse pattern.

This study provides very good insight into the importance of discourse assessment and its appropriate practice for management purposes. Introducing discourse into our therapeutic goal will not only facilitate the improvement of the linguistic domain but also the underlying cognitive domain which is important to nourish the linguistic domain. Nevertheless, the study did not consider fluent and non-fluent aphasia participants as a separate entity which could be a limitation. This will have a definite influence on the result. However, we have attempted in discussing the difference in performance by these two groups at a certain point, further elaboration on this topic was beyond the aim of this project. The second limitation we want to make clear is the type of working memory task used in this study. We used forward, backward span task and n-back task. This can be replaced and studied further by using semantic back, a syntactic back task which is purely based on the linguistic domain. Hence, it is important to consider the linguistic working memory task or the non-linguistic one with reference to the clinical population.

Implications of the study

The present project made an attempt to estimate the clinical feasibility and basic psychomotor properties for adults with aphasia of one instantiation of the forward visual span task, backward visual span task, and *n*-back task. This study took advantage of n-back flexibility and forward and backward visual span in terms of stimulus and response type to the designed task which is appropriate for aphasia. The score of the n-back task served to highlight the complexity of attempting to separate language and cognitive skills of working memory capacity. Thus, assessment of working memory in aphasia is very important, since the decreased working memory capacity interacts negatively with the linguistic and functional outcomes of adults with aphasia. From the present investigations, it is observed that working memory deficits are in association with the linguistic processing impairments in individuals with aphasia. Hence, working memory training using n-back task of different lexical categories with different syntactic levels facilitates language production and comprehension. There is also a need for future studies to continue to explore the potential utility of the *n*-back task at assessment and intervention level.

The clinical implications in using discourse analysis in the field of diagnosis and rehabilitation of adults with aphasia in addition to working memory assessment would be a

prognostic indicator in dealing with the cognitive-communicative aspects of this disordered clinical population. This study employed three different tasks that have probably revealed different effects due to their varied cognitive load. The discourse assessment should, therefore, be done separately for these three different discourse genres. Methodologically, the discourse genre can be quantified using perceptual measures. This method helps to divide the huge discourse sample into different variables in terms of propositional and non-propositional aspects. This helps the clinician or the researcher to identify the linguistic and non-linguistic errors in the discourse and helps in differentiating between language and speech aspects. This can be clinically helpful in the assessment and rehabilitation of individuals with the cognitive-communicative disorder a sequel of diverse brain insults.

Limited working memory capacity in individuals with aphasia contributes to poor discourse performance. Thus, for example, in the complex span task, these individuals performed poorly due to comprehension and/or verbal demands caused by typical aphasia symptoms. Therefore language ability has an influence on working memory performance and one should consider what extent language processes influence cognitive ability in individuals with aphasia. In the present study, the language deficits were measured at the discourse level.

As future directions, there is a need for further studies to continue to explore the potential utility of the discourse task, the forward-backward visual span task, and the *n*-back task to do so in association with the neurophysiological and neuroimaging studies.

Utilization of the study

The results from the current study will help in understanding and comparing the clinical performance of individuals with aphasia and neuro-typical adults on the discourse and working memory assessment. With references to the symptoms of aphasia, the association between the linguistic aspects of discourse in relation to the performance on forward, backward visual span task, and n-back task are discussed and should be considered during clinical assessment and management of individuals with aphasia.

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APPENDIX A

All India Institute of Speech and Hearing, Naimisham Campus, Manasagangothri, Mysore – 570006.

CONSENT FORM

Project on

Discourse and Working Memory in Neuro-typical individuals and Adults with Aphasia.

Information to the participants

I, Ms. _____ working as Research Officer for an ARF project titled- **"Discourse and Working Memory in Neuro-typical individuals and Adults with Aphasia"** with the Principal Investigator _____, Assistant Professor, Dept. of Speech – Language Sciences, AIISH, Mysore – 6. The aim of the research is to investigate and compare the discourse abilities and the working memory capacity of adults with aphasia and neuro-typical individuals and to study the correlation between discourse and working memory. I need to collect data from 30 individuals in the age range of 35 and above. Information will be collected through an interview and video recording for the duration of 30 minutes each. I assure you that this data will be kept confidential. There is no influence or pressure of any kind by us or the investigating institute to your participation and the research procedure is different from routine medical or therapeutic care activities. There is no risk involved to the participants but your cooperation in the study will go a long way in helping us in understanding discourse in individuals with Aphasia and it will, thus assist in assessment and treatment of these individuals.

Informed Consent

I have been informed about the aims, objectives and the procedure of the study. I understand that I have a right to refuse participation as participant or withdraw my consent at any time.

I, _____, the undersigned, give my consent to be participant of this investigation/study/program.

Signature of participant — Signature of investigator

(Name and Address) — Date

_____

_____

APPENDIX B

General Information Sheet

Name:_____ Date:_____

Age/Sex:_____ Date of birth:_____

Mother tongue:_____ Languages Known:_____

Bilingual: Yes/No Medium of instruction:_____

Highest educational qualification: Graduation/Post Graduation

Handedness: Writing_____ Thowing_____ Drawing_____ Brushing_____

Occupation: _____

Present illness:_____

_____

_____

Investigations: Date:

CT scan:_____

MRI:_____

EEG:_____

Others (vision or auditory etc):_____

Associated illness (depression, psychiatric disorders, aphasia, dysarthria etc:_____

Any others:_____

Diagnosis:_____

Remarks:_____

_____

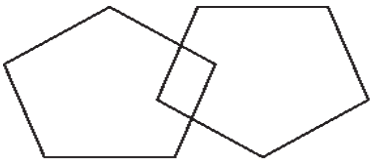
APPENDIX C

Mini-Mental State Exam

(Folstein, Folstein & McHugh, 1975)

Patient_____ Age/Sex _____ Date_____

Maximum	***Score***	
		Orientation
5	( )	What is the (year) (season) (date) (day) (month)?
5	( )	Where are we (state) (country) (town) (hospital) (floor)?
		Registration
3	( )	Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record. Trials _____
		Attention and Calculation
5	( )	Serial 7's. 1 point for each correct answer. Stop after 5 answers. Alternatively spell "world" backward.
		Recall
3	( )	Ask for the 3 objects repeated above. Give 1 point for each correct answer.
		Language
2	( )	Name a pencil and watch.
1	( )	Repeat the following "No ifs, ands, or buts"
3	( )	Follow a 3-stage command: "Take a paper in your hand, fold it in half, and put it on the floor."
1	( )	Read and obey the following: CLOSE YOUR EYES
1	( )	Write a sentence.
1	( )	Copy the design shown.



_____ Total Score

ASSESS level of consciousness along a continuum _____

Alert ***Drowsy*** ***Stupor*** ***Coma***

APPENDIX D

Western Aphasia Battery

(Chengappa & Kumar, 2008)

I. Spontaneous Speech

1. How are you today?
2. Have you been here before?
3. What is your name?
4. What is your address?
5. What is your occupation?
6. Tell me a little about why you are here? Or what seems to be the trouble?
7. Description of picture.

II. Auditory Verbal Comprehension

A. Yes/No Questions

		Verbal	Gestural	Eye Blink
1.	Is your name Kuppa swampy? ("no" should be correct)			
2.	Is your name Rama Krishna? ("no" should be correct)			
3.	Is your name_____?			
4.	Do you live in Bangalore? ("no" should be correct)			
5.	Do you live in_____?			
6.	Do you live in Calcutta? ("no" should be correct)			
7.	Are you a man/woman? ("yes" should be correct)			
8.	Are you a Doctor? ("no" should be correct)			
9.	Am I a man/women? ("yes" should be correct)			
10.	Are the lights on in this room? ("yes" should be correct)			
11.	Is the door closed? ("yes" should be correct)			
12.	Is this a hotel?			
13.	Is this _____?			
14.	Are you wearing red dhoti? ("no"			

should be correct)

15. Will paper burn in fire?
16. Does March come before June?
17. Do you eat a banana before you peel it?
18. Does it rain in July?
19. Is a horse larger than a dog?
20. Do you cut the grass with an axe?

B. Auditory Word Recognition

Real objects	Drawn objects	Forms	Letters	Numbers
Cup	Matches	Square	J	5
Matches	Cup	Triangle	P	61
Pencil	Comb	Circle	B	500
Flower	Knife	Arrow	K	1867
Comb	Pencil	Cross	M	32
Knife	Flower	Half Moon	D	5000

Colors	Furniture	Body parts	Fingers	Right-Left
Blue	Window	Ear	Thumb	Right shoulder
Brown	Chair	Nose	Ring Finger	Left knee
Red	Desk	Eye	Index Finger	Left ankle
Green	Light	Chest	Little Finger	Right thigh
Yellow	Door	Neck	Middle Finger	Left Elbow
Black	Ceiling	Fore head	Right Ear	Right cheek

Sequential Command

	Score
1. Raise your hand.	2
2. Shut your eyes.	2
3. Point to the chair.	2
4. Point to the window, then to the door.	4
5. Point to the pen and the book.	4
6. Point to the pen with the book.	8
7. Point to the comb with the pen.	8
8. With the book point to the comb.	8
9. Put the pen on top of the book the give it to me.	14
10. Put the comb on the other side of the pen and turn over the book.	20

III. Repetition

		Maximum score
1.	Hand	2
2.	Nose	2
3.	Bed	2
4.	Window	2
5.	Banana	2
6.	Rain bow	4
7.	Forty five	4
8.	Ninety-five percent	6
9.	Sixty-two and a half.	10
10.	The farmer is ploughing.	8
11.	He is not coming back.	10
12.	All that glitters is not gold.	10
13.	First Indian Field Army.	8
14.	No ifs, ands or buts.	10
15.	Load my cart with five dozen bags of white wheat.	20

IV. Naming

A. Object naming

Stimulus	Response	Tactile cues	Phonemic cue	Score
Paise				
Ball				
Knife				
Cup				
Safety pin				
Mirror				
Tooth brush				
Book				
Lock				
Pencil				
Scissors				
Key				
Needle				
Bangle				
Comb				
Watch				

Spoon
Flower
Plate
Matches

B. Word Fluency

Ask the patient to name as many animals as he or she can in 1 minute. The patient may be helped if hesitant; “Think of a domestic animal, like the horse, or a wild animal, like the tiger”. The patient may be prompted at 30 seconds. Score 1 point for each animal named (except for those in the example), even if distorted by literal paraphasia.

C. Sentence Completion

1. The grass is _____ (green)
2. Sugar is _____ (sweet or white)
3. Roses are red, Jasmines are_____ (White)
4. They fought like cats and_____ (dogs)
5. Indian Independence day is in the month of _____ (August)

D. Responsive Speech

1. What do you write with? (pen, pencil)
2. What color is Milk? (white)
3. How many days are in a week? (seven)
4. Where do doctors work? (hospital)
5. Where can you get stamps? (post office, variety store)

APPENDIX- E

Discourse analysis scale for picture description task
(Hema & Shyamala, 2008)

Points to be considered while using Discourse Analysis Scale:
The parameters of propositional and non-propositional aspect of picture description can be quantified with few general instructions to the evaluator as follows:

1. Initially read the keys provided in the sub headings which explain the exact meaning of the parameters to be scored as good, fair and poor with respect to the particular context of conversation.
2. Scoring procedure involves the use of rating scale. Three points perceptual rating scale is used to evaluate each parameters.
3. Each appropriate behavior *(normal)* is given a *higher score* and the inappropriate behavior *(abnormal)* is scored *low.*

<u>Propositional aspects of communication.</u>

This includes the notion of relevancy, clarity of reference and coherence of information. It deals with how discourse is organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to main theme/topic.

1) Discourse Structure

Good- The discourse is organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to maintain unity.

Fair- The discourse is partially confusing even if it is partially organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to main theme/topic.

Poor- The discourse is completely confusing since it is unorganized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to each other.

a) Discourse forethought----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

b) Organizational planning ----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

2) Communication intent

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual use this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.

Fair- Individuals using this parameter inconsistently in the required circumstances.

Poor- This parameter is absent in the entire context of picture description.

a). Initiation of picture description----------→( )

[Score: 0-Poor, 1-Fair, 2-Good]

b). Asks for assistance in understanding picture----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

c). Criticizes the picture by agreeing/disagreeing to a part in the picture→( )
[Score: 0-Poor, 1-Fair, 2-Good]

a) Imagines events correctly----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

3) Coherence

a. Global coherence----------→( )

Good- Presence of good relationship between the meaning and context of verbalization with respect to the general topic of picture description.

Fair- Presence of partial relationship between the meaning and context of verbalization with respect to the general topic of picture description.

Poor- Relationship between the meaning and context of verbalization with respect to the general topic of picture description is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

b. Local coherence----------→ ( )

Good- Presence of good relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant.

Fair- Presence of partial relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant.

Poor- Relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

4) Topic management

a). Introducing topic----------→ ( )

Good- Correctly introducing the topic.

Fair- Partial but correct introduction to topic.

Poor- Irrelevantly introducing topic or no response.

[Score: 0-Poor, 1-Fair, 2-Good]

b). Topic shift----------→ ( )

Good- Staying within the given topic.

Fair- Gradual shift from the given topic.

Poor- Rapid shift from the given topic.

[Score: 0-Poor, 1-Fair, 2-Good]

c). Topic changes----------→ ( )

Good- Coherent topic change where the topic is within the context of verbalization.

Fair- Partially inappropriate topic change but still the topic is within the main context of verbalization.

Poor- Non coherent topic change is present.
[Score: 0-Poor, 1-Fair, 2-Good]

d) Perseveration in the topics----------→ ( )

Good- Perseveration not present.
Fair- Perseveration partially present.
Poor- Perseveration continuously present.
[Score: 0-Poor, 1-Fair, 2-Good]

e). Minimal elaboration----------→ ( )

In presence of prompts from the investigator, the participants attempting to give yes/no responses along with very few sentential level discourse to elaborate the topic.
Good- Minimal elaboration appropriately present in all required circumstances
Fair- Minimal elaboration partially present in all required circumstances.
Poor- Minimal elaboration absent in required circumstances or minimal elaboration only present throughout the context of picture description.
[Score: 0-Poor, 1-Fair, 2-Good]

f). Elaboration of topics----------→ ( )

Good- Adequate elaboration of topic.
Fair- Partial elaboration of topic.
Poor- Extra elaboration of topic.
[Score: 0-Poor, 1-Fair, 2-Good]

5) Information adequacy

Good- Completely adequate picture description at word level/ single sentence level/ multiple sentence level without any prompts from the investigator.
Fair- Partially adequate picture description at word level/ single sentence level/ multiple sentence level in the presence of few prompts from the investigator.
Poor- No picture description at word level/ single sentence level/ multiple sentence level despite several prompts from the investigator.

a) Word level/ Single sentence level/ Multiple sentence level------→( )

Underline the level at which the participant is positioned.
[Score: 0-Poor, 1-Fair, 2-Good]

6) Information content

Good- Meaningful and adequate information of the picture description in terms of initiating and/or sustaining the task.
Fair- Meaningful and adequate information of the picture description in terms of initiating and/or sustaining the task or if you know what the person is talking about, even if the information doesn't appear to be available or more than half of the picture described.
Poor- Nonmeaningful and inadequate information of the picture description in terms of initiating and or/sustaining the task or less than half of the picture described.

a. Meaningful and adequate information----------→ ( )

[Score: 0-Poor, 1-Fair, 2-Good]

7) Message Accuracy ----------→( )

Good- An attempted picture description involving correct descriptions of picture without any confabulation or any inaccurate information within the same context of picture description.

Fair- An attempted picture description involving correct description of picture and few accurate information without any confabulation within the same context of picture description.

Poor- An attempted picture description involving incorrect descriptions of picture with confabulation within the same context of picture description with all inaccurate information.

[Score: 0-Poor, 1-Fair, 2-Good]

8) Vocabulary specificity----------→ ( )

Good- Using specific vocabulary when specific information is required.

Fair- Partially using specific vocabulary when specific information is required.

Poor- Overuse of generic terms such as "thing" and "stuff" when more specific information is required.

[Score: 0-Poor, 1-Fair, 2-Good]

9) Linguistic fluency ----------→ ( )

Good- Fluent discourse without any repetition, unusual pauses or hesitations.

Fair- Partially fluent discourse with very few repetitions, unusual pauses or hesitations.

Poor- Presence of repetition, unusual pauses, hesitations

[Score: 0-Poor, 1-Fair, 2-Good]

10) Speech Style ----------→ ( )

Good- Appropriate use of any dialectal structural forms, code switching and style-shifting.

Fair- Inappropriate use of dialectal structural forms, code switching, style-shifting is partially present.

Poor- Presence of totally inappropriate dialectal structural forms, code switching, style-shifting.

[Score: 0-Poor, 1-Fair, 2-Good]

11) Intonation ----------→ ( )

Good- Absence of any inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of picture description.

Fair- Inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of picture description is partially present.

Poor- Presence of inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of picture description.

[Score: 0-Poor, 1-Fair, 2-Good]

12) Response time----------→ ( )

Time taken to start the picture description and is measured in terms of seconds.

Good- Response at 0.5-2sec.
Fair- Response at 3-5 sec.
Poor- Response delayed beyond 6-8 sec.
[Score: 0-Poor, 1-Fair, 2-Good]

13) Gist of information ----------→ ( )

Good- Presence of correct depiction (picnic spot).
Fair- Partially correct depiction (picnic spot) with good local and poor global coherence.
Poor- Completely wrong depiction (picnic spot) with poor local and global coherence.
[Score: 0-Poor, 1-Fair, 2-Good]

Non propositional or Interactional aspects of communication

This is one of the important categories of social communication behavior. These behaviors reflect the reciprocal nature of conversation and the joint co-operation required of the participant. *(Note: In picture description it is only from participants' point of view)*
The following subcategories are considered:

1) Revision behaviors ----------→ ( )

Good- Absence of false starts and self interruptions in the entire context of picture description.
Fair- Presence of false starts and self interruptions in some contexts of picture description.
Poor- Continuous presence of false starts and self-interruptions in the entire context of picture description.
[Score: 0-Poor, 1-Fair, 2-Good]

2) Repair strategy

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual use this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.
Fair- Individuals using this parameter inconsistently in the required circumstances.
Poor- Individuals not using this parameter at all in the entire context of picture description.

a). Use of self correction ----------→ ( )

Participants find a word or sentence after giving a small pause and continue the topic of picture description.
[Score: 0-Poor, 1-Fair, 2-Good]

b). Use of repair through repetition/revision----------→ ( )

Repeating themselves and correcting the discourse without the investigators help.
[Score: 0-Poor, 1-Fair, 2-Good]

c) Use of other initiated correction----------→ ( )

Participants not able to find the right word, so the investigator fills it with the correct word to continue the topic of picture description.
[Score: 0-Poor, 1-Fair, 2-Good]

d) Use of request for clarification ----------→ ( )
Requesting the investigator to modify the discourse and use the corrected version of discourse to continue the topic of picture description. [Score: 0-Poor, 1-Fair, 2-Good]

Picture card from Western Aphasia Battery, Shyamala and Ravikumar (2008) and edited to colored picture card

Finally, one can find discourse quotient, using the total score on propositional and non propositional aspects of communication which should be divided by total scores of all the features of propositional and non propositional aspects of picture description. This must be multiplied with hundred to get the score in percentage.

Example: The participant's score is 32

Discourse Quotient = 32/44+10= 32/54 x 100= 59.25

APPENDIX- F

Discourse Analysis Scale for narration task
(Hema & Shyamala, 2008)

Points to be considered while using Discourse Analysis Scale:
The parameters of propositional and non-propositional aspect of narration can be quantified with few general instructions to the evaluator as follows:

1. Initially read the keys provided in the sub headings which explain the exact meaning of the parameters to be scored as good, fair and poor with respect to the particular context of narration.
2. Scoring procedure involves the use of rating scale. Three points perceptual rating scale is used to evaluate each parameters.
3. Each appropriate behavior *(normal)* is given a *higher score* and the inappropriate behavior *(abnormal)* is scored *low*.

<u>Propositional aspects of communication.</u>

This includes the notion of relevancy, clarity of reference and coherence of information. It deals with how discourse is organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to main theme/topic.

1) Discourse Structure

Good- The discourse is organized with respect to overall plan, theme or topic and how events occurring earlier in time being described before events occurring later, and causative events preceding their consequences. The narrative discourse is never confusing in terms of logically and chronologically.

Fair- The discourse is partially confusing even if it's partially organized with respect to overall plan, theme or topic and how events occurring earlier in time being described before events occurring later, and causative events preceding their consequences, logically and chronologically making the narratives confusing.

Poor- The discourse is completely confusing since it is unorganized with respect to overall plan, theme or topic and how events occurring earlier in time being described before events occurring later, and causative events preceding their consequences. Thus the narrative is completely confusing in terms of logically and chronologically.

a) Discourse forethought----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

b) Organizational planning ----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

2) Communication intent

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual use this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.

Fair- Individuals using this parameter inconsistently in the required circumstances.

Poor- This parameter is absent in the entire context of narration.

b) Initiation of narration----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

c) Asks for assistance during narration----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

d) Imagines events correctly----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

3) Coherence

a). Global coherence----------→( )

Good- Presence of good relationship between the meaning and context of verbalization with respect to the general topic of narration.

Fair- Presence of partial relationship between the meaning and context of verbalization with respect to the general topic of narration.

Poor- Relationship between the meaning and context of verbalization with respect to the general topic of narration is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

b). Local coherence----------→( )

Good- Presence of good relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant.

Fair- Presence of partial relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant.

Poor- Relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced by the participant is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

4) Topic management

a). Introducing topic----------→( )

Good- Correctly introducing the topic.

Fair- Partial but correct introduction to topic.

Poor- Irrelevantly introducing topic or no response.

[Score: 0-Poor, 1-Fair, 2-Good]

b) Topic shift----------→( )

Good- Staying within the given topic.

Fair- Gradual shift from the given topic.

Poor- Rapid shift from the given topic.

[Score: 0-Poor, 1-Fair, 2-Good]

c) Topic changes----------→( )

Good- Coherent topic change where the topic is within the context of verbalization in terms of when and where the narrating event occurred.

Fair- Partially inappropriate topic change but still the topic is within the main context of verbalization in terms of when and where the narrating event occurred.

Poor- Non coherent topic change where the topic is decontextualized.

[Score: 0-Poor, 1-Fair, 2-Good]

d) Perseveration in the topics----------→( )

Good- Perseveration not present.

Fair- Perseveration partially present.

Poor- Perseveration continuously present.

[Score: 0-Poor, 1-Fair, 2-Good]

e) Minimal elaboration----------→( )

In presence of prompts from the investigator, the participants attempting to give yes/no responses along with very few sentential level discourse to elaborate the topic.

Good- Minimal elaboration appropriately present in all required circumstances

Fair- Minimal elaboration partially present in all required circumstances.

Poor- Minimal elaboration absent in required circumstances or minimal elaboration only present throughout the context of narration.

[Score: 0-Poor, 1-Fair, 2-Good]

f) Elaboration of topics----------→( )

Good- Adequate elaboration of topic.

Fair- Partial elaboration of topic.

Poor- Extra elaboration of topic.

[Score: 0-Poor, 1-Fair, 2-Good]

5) Information adequacy

Good- Completely adequate narration at word level/ single sentence level/ multiple sentence level without any prompts from the investigator.

Fair- Partially adequate narration at word level/ single sentence level/ multiple sentence level in the presence of few prompts from the investigator.

Poor- No narration at word level/ single sentence level/ multiple sentence level despite several prompts from the investigator.

a). Word level/ Single sentence level/ Multiple sentence level-----→( )

Underline the level at which the participant is positioned.

[Score: 0-Poor, 1-Fair, 2-Good]

6) Information content

Good- Completely correct description of people, locations, objects, activities and attributes that played a role in the events being narrated about. Good narratives pointing a detailed linguistic picture of the events they are describing.

Fair- Partially correct description of people, locations, objects, activities and attributes that played a role in the events being narrated about; Good narratives pointing more than half a linguistic picture of the events they are describing.

Poor- Incorrect description of people, locations, objects, activities and attributes that played a role in the events being narrated about. Good narratives pointing less than half a linguistic picture of the events they are describing.

a). Meaningful and adequate information----------→( )

[Score: 0-Poor, 1-Fair, 2-Good]

7) Message Accuracy ----------→( )

Good- An attempted narration involving correct narration without any confabulation or any inaccurate information within the same context of narration.

Fair- An attempted narration involving correct narration and few accurate information without any confabulation within the same context of narration.

Poor- An attempted narration involving incorrect narration with confabulation within the same context of narration with all inaccurate information.

[Score: 0-Poor, 1-Fair, 2-Good]

8) Temporal and causal relation (TCR)----------→( )

Good- Presence of all the temporal terms like then, and then, first, next, before, and after; causal terms like because, when, if, while, and until.

Fair- Presence of few temporal terms like then, and then, first, next, before, and after; causal terms like because, when, if, while, and until.

Poor- Absence of all the temporal terms like then, and then, first, next, before, and after; causal terms like because, when, if, while, and until.

[Score: 0-Poor, 1-Fair, 2-Good]

9) Vocabulary specificity----------→( )

Good- Using specific vocabulary when specific information is required.

Fair- Partially using specific vocabulary when specific information is required.

Poor- Overuse of generic terms such as "thing" and “stuff" when more specific information is required.

[Score: 0-Poor, 1-Fair, 2-Good]

10) Linguistic fluency ----------→( )

Good- Fluent discourse without any repetition, unusual pauses or hesitations.

Fair- Partially fluent discourse with very few repetitions, unusual pauses or hesitations.

Poor- Presence of repetition, unusual pauses, hesitations

[Score: 0-Poor, 1-Fair, 2-Good]

11) Speech Style ----------→( )

Good- Appropriate use of any dialectal structural forms, code switching and style-shifting.

Fair- Inappropriate use of dialectal structural forms, code switching, style-shifting is partially present.

Poor- Presence of totally inappropriate dialectal structural forms, code switching, style-shifting.

[Score: 0-Poor, 1-Fair, 2-Good]

12) Intonation ----------→( )

Good- Absence of any inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of narration.

Fair- Inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of narration is partially present.

Poor- Presence of inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of narration.

[Score: 0-Poor, 1-Fair, 2-Good]

Non propositional or Interactional aspects of communication

This is one of the important categories of social communication behavior. These behaviors reflect the reciprocal nature of conversation and the joint co-operation required of the participant. *(Note: In narration it is only from participants' point of view)*
The following subcategories are considered:

1) Revision behaviors ----------→( )

Good- Absence of false starts and self interruptions in the entire context of narration.

Fair- Presence of false starts and self interruptions in some contexts of narration.

Poor- Continuous presence of false starts and self-interruptions in the entire context of narration.

[Score: 0-Poor, 1-Fair, 2-Good]

2) Repair strategy

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual use this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.

Fair- Individuals using this parameter inconsistently in the required circumstances.

Poor- Individuals not using this parameter at all in the entire context of narration.

a) Use of self correction ----------→( )

Participants find a word or sentence after giving a small pause and continue the topic of narration.

[Score: 0-Poor, 1-Fair, 2-Good]

b) Use of repair through repetition/revision----------→( )

Repeating themselves and correcting the discourse without the investigators help.

[Score: 0-Poor, 1-Fair, 2-Good]

c) Use of other initiated correction----------→( )

Participants not able to find the right word, so the investigator fills it with the correct word to continue the topic of narration.

[Score: 0-Poor, 1-Fair, 2-Good]

d) Use of request for clarification ----------→( )

Requesting the investigator to modify the discourse and use the corrected version of discourse to continue the topic of narration.
[Score: 0-Poor, 1-Fair, 2-Good]

Finally, one can find discourse quotient, using the total score on propositional and non propositional aspects of communication which should be divided by total scores of all the features of propositional and non propositional aspects of communication. This must be multiplied with hundred to get the score in percentage. *Example*: The participant's score is 32. **Discourse Quotient** = 32/44+10= 32/54 x 100= 59.25

APPENDIX- G

Discourse Analysis Scale for conversation task
(Hema & Shyamala, 2008)

Points to be considered while using Discourse Analysis Scale:
The parameters of propositional and non-propositional aspects of conversation are quantified with few general instructions to the evaluator as follows:

1. Initially read the keys provided in the sub headings which explain the exact meaning of the parameters to be scored as good, fair and poor with respect to the particular context of conversation.
2. Scoring procedure involves the use of rating scale. Three points perceptual rating scale is used to evaluate each parameters.
3. Each appropriate behavior *(normal)* is given a *higher score* and the inappropriate behavior *(abnormal)* is scored *low.*

***Propositional aspects of communication*.**

This includes the notion of relevancy, clarity of reference and coherence of information. It deals with how discourse is organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to main theme/topic.

1) Discourse Structure

Good- The discourse is organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to maintain unity.

Fair- The discourse is partially confusing even if it's organized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to main theme/topic.

Poor- The discourse is completely confusing since it is unorganized with respect to overall plan, theme or topic and how individual utterances are conceptually linked to each other.

a) Discourse forethought----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

b) Organizational planning ----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

2) Communication intent

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual uses this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.

Fair- Individuals using this parameter inconsistently in the required circumstances.

Poor- This parameter is absent in the entire context of conversation.

a) Greets others and introduces self:

-By themselves----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

-In response to other's greeting----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

b) Starts a conversation----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

c) Asks information----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

d) Asks for assistance in understanding conversation----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

e) Criticizes the conversation by agreeing or disagreeing to a part in the conversation----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

f) Imagines events correctly----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

g) Understands advancers and blockers in the conversation----------→ ( )
[Score: 0-Poor, 1-Fair, 2-Good]

3) Coherence

a. Global coherence----------→ ( )

Good- Presence of good relationship between the meaning and context of verbalization with respect to the general topic of conversation.

Fair- Presence of partial relationship between the meaning and context of verbalization with respect to the general topic of conversation.

Poor- Relationship between the meaning and context of verbalization with respect to the general topic of conversation is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

b. Local coherence----------→ ( )

Good- Presence of good relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced either by interviewer or participant.

Fair- Presence of partial relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced either by interviewer or participant.

Poor- Relationship between the meaning and context of verbalization with that of the immediately preceding utterance produced either by interviewer or participant is completely absent.

[Score: 0-Poor, 1-Fair, 2-Good]

4) Topic management

a) Introducing topic----------→ ( )

Good- Correctly introducing the topic.

Fair- Partial but correct introduction to topic.

Poor- Irrelevantly introducing topic or no response.

[Score: 0-Poor, 1-Fair, 2-Good]

b) Topic shift----------→ ( )

Good- Staying within the given topic.

Fair- Gradual shift from the given topic.
Poor- Rapid shift from the given topic.
[Score: 0-Poor, 1-Fair, 2-Good]

c) Topic changes----------→ ( )
Good- Coherent topic change where the topic is within the context of verbalization.
Fair- Partially inappropriate topic change but still the topic is within the main context of verbalization.
Poor- Non coherent topic change is present.
[Score: 0-Poor, 1-Fair, 2-Good]

d) Perseveration in the topics----------→ ( )
Good- Perseveration not present.
Fair- Perseveration partially present.
Poor- Perseveration continuously present.
[Score: 0-Poor, 1-Fair, 2-Good]

e) Responses which expand topics----------→ ( )
Good- Responses which expand topics is consistently present.
Fair- Responses which expand topics is partially present.
Poor- Responses which expand topics is absent.
[Score: 0-Poor, 1-Fair, 2-Good]

f) Minimal responses (Giving only Yes/No responses)----------→ ( )
Good- Minimal use of yes/no response.
Fair- Yes/no responses partially present.
Poor- Only yes/no responses present.
[Score: 0-Poor, 1-Fair, 2-Good]

g) Minimal elaboration----------→ ( )
In presence of prompts from the investigator, the participants attempting to give yes/no responses along with very few sentential level discourse to elaborate the topic.
Good- Minimal elaboration appropriately present in all required circumstances
Fair- Minimal elaboration partially present in all required circumstances.
Poor- Minimal elaboration absent in required circumstances or minimal elaboration only present throughout the context of conversation.
[Score: 0-Poor, 1-Fair, 2-Good]

h) Elaboration of topics----------→ ( )
Good- Adequate elaboration of topic.
Fair- Partial elaboration of topic.
Poor- Extra elaboration of topic.
[Score: 0-Poor, 1-Fair, 2-Good]

5) Information adequacy

Good- Answers to all the questions during conversation at word level/ single sentence level/ multiple sentence level.
Fair- Answer to few questions during conversation at word level/ single sentence level/ multiple sentence level.
Poor- No answers / response to any of the questions during conversation.

a. Word level/ Single sentence level/ Multiple sentence level---------→( )
Underline the level at which the participant is positioned.
[Score: 0-Poor, 1-Fair, 2-Good]

6) Information content

Good- Meaningful and adequate information to all the questions in terms of initiating and/or sustaining conversation.

Fair- Meaningful and adequate information to only few question in terms of initiating and/or sustaining conversation or if you know what the person is talking about, even if the information doesn't appear to be available.

Poor- Nonmeaningful and inadequate information to all the questions in terms of initiating and or/sustaining conversation.

a. Meaningful and adequate information----------→( )
[Score: 0-Poor, 1-Fair, 2-Good]

7) Message Accuracy ----------→( )

Good- An attempted communication involving correct answers to the question without any confabulation or any inaccurate information within the same question frame.

Fair- An attempted communication involving correct answers to the question and few accurate information without any confabulation within the same question frame.

Poor- An attempted communication involving incorrect answers to the question with confabulation within the same question frame with all inaccurate information.

[Score: 0-Poor, 1-Fair, 2-Good]

8) Vocabulary specificity----------→ ( )

Good- Using specific vocabulary when specific information is required.

Fair- Partially using specific vocabulary when specific information is required.

Poor- Overuse of generic terms such as "thing" and “stuff" when more specific information is required.

[Score: 0-Poor, 1-Fair, 2-Good]

9) Linguistic fluency ----------→ ( )

Good- Fluent discourse without any repetition, unusual pauses or hesitations.

Fair- Partially fluent discourse with very few repetitions, unusual pauses or hesitations.

Poor- Presence of repetition, unusual pauses, hesitations

[Score: 0-Poor, 1-Fair, 2-Good]

10) Speech Style ----------→ ( )

Good- Appropriate use of any dialectal structural forms, code switching and style-shifting.

Fair- Inappropriate use of dialectal structural forms, code switching, style-shifting is partially present.

Poor- Presence of totally inappropriate dialectal structural forms, code switching, style-shifting.
[Score: 0-Poor, 1-Fair, 2-Good]

11) Intonation ----------→ ( )

Good- Absence of any inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of conversation.
Fair- Inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of conversation is partially present.
Poor- Presence of inappropriate or abnormal rising, falling, flat intonation with respect to a particular context of conversation.
[Score: 0-Poor, 1-Fair, 2-Good]

12) Gaze Efficiency ----------→ ( )

Good- Consistent use of appropriate eye gaze to the conversational context.
Fair- Partially consistent eye gaze to the conversational context.
Poor- Not appropriate or restricted eye gaze to the conversational context.
[Score: 0-Poor, 1-Fair, 2-Good]

13) Response time----------→ ( )

Time taken to respond to any questions during the conversation which is measured in terms of seconds.
Good- Response at 0.5-2sec.
Fair- Response at 3-5 sec.
Poor- Response delayed beyond 6-8 sec.
[Score: 0-Poor, 1-Fair, 2-Good]

<u>Non propositional or Interactional aspects of communication</u>

This is one of the important categories of social communication behavior. These behaviors reflect the reciprocal nature of conversation and the joint co-operation required of the participant.
The following subcategories are considered:

1) Turn taking

a) Initiation of turn----------→ ( )

Good- Present at required circumstances of the entire conversation.
Fair- Present at half of the required circumstances of the entire conversation.
Poor- No initiation of turn taking in any circumstances of the entire conversation.
[Score: 0-Poor, 1-Fair, 2-Good]

b) Time to start a turn----------→ ( )

Good- Not taking time to start a turn.
Fair- Partially taking time to start a turn.
Poor- Completely taking time to start a turn.
[Score: 0-Poor, 1-Fair, 2-Good]

c) Contingency of the turn ----------→ ( )

Good- Presence of contingent turns where it fulfills the semantic or informational expectation of the previous turn, but shares the same topic.

Fair- Partially non- contingent turns are present where it does not fulfill the semantic or informational expectation of the previous turn, but shares the same topic. This also includes "don't know," "yes," and "no" responses *when used to avoid* maintaining a topic, and echolalia.

Poor- Non-contingent turns present.

[Score: 0-Poor, 1-Fair, 2-Good]

d) Unable to take prosodic cues ----------→ ( )

Good- Able to take the prosodic cues in the entire conversational context for the purpose of turn taking.

Fair- Partially able to take the prosodic cues in some conversational contexts for the purpose of turn taking.

Poor- Unable to take the prosodic cues in the entire conversational context for the purpose of turn taking.

[Score: 0-Poor, 1-Fair, 2-Good]

e) Mode of conversation ----------→ ( )

Good- Using appropriate verbal or non verbal mode without any abrupt/rapid shift from verbal and non verbal mode during turn taking.

Fair- Partially using appropriate verbal or non verbal mode with abrupt/rapid shift between verbal and non verbal mode during turn taking.

Poor- Not using appropriate verbal or non verbal mode with rapid shift between verbal and non verbal mode during turn taking at all.

[Score: 0-Poor, 1-Fair, 2-Good]

f) Listeners or speakers mode----------→ ( )

Good- Appropriate change from speaker to listener mode or listener to speaker mode with reference to the entire context of conversation.

Fair- Partially appropriate change from speaker to listener mode or listener to speaker mode with reference to some contexts of conversation.

Poor- Inappropriately persistent in speaker or listener mode with reference to the entire context of conversation.

[Score: 0-Poor, 1-Fair, 2-Good]

2) Revision behaviors ----------→ ( )

Good- Absence of false starts and self interruptions in the entire context of conversation.

Fair- Presence of false starts and self interruptions in some contexts of conversation.

Poor- Continuous presence of false starts and self-interruptions in the entire context of conversation.

[Score: 0-Poor, 1-Fair, 2-Good]

3) Conversation repair

This parameter can be evaluated using frequency count, so check for the presence or absence. If present, make a note whether an individual use this parameter only in required circumstances or in all the circumstances.

Good- Individuals using this parameter in all required circumstances.

Fair- Individuals using this parameter inconsistently in the required circumstances.

Poor- Individuals not using this parameter at all in the entire context of conversation.

a) Use of self repair through repetition----------→ ( )
   Repeating themselves and correcting the discourse without the investigators help.
   [Score: 0-Poor, 1-Fair, 2-Good]
b) Use of revisions through clarification----------→ ( )
   Requesting the investigator to modify the discourse and use the corrected version of discourse to continue the topic of conversation.
   [Score: 0-Poor, 1-Fair, 2-Good]
c) Use of other initiated repair ----------→ ( )
   Participants not able to find the right word, so the investigator fills it with the correct word to continue the topic of conversation.
   [Score: 0-Poor, 1-Fair, 2-Good]

Finally, one can find discourse quotient, using the total score on propositional and non-propositional aspects of communication which should be divided by total scores of all the features of propositional and non-propositional aspects of communication. This must be multiplied with hundred to get the score in percentage.

Example: The participant's score is 54

Discourse Quotient = 54/58+20= 54/78 x 100= 69.23

nts	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
nt	2	2	1	1	2	1	1	1	1	1	2	1	1	1	1	1	2	1	1	2	1	1	1	2	2	1	2	2	2
Picture Description																													
re	2	0	2	2	2	4	2	2	0	1	3	2	3	0	3	3	2	4	2	2	0	2	2	1	3	3	0	3	2
ntent	5	3	3	4	4	7	7	7	5	4	7	5	5	4	4	7	6	8	5	1	2	5	1	1	7	7	2	7	5
	2	0	4	2	2	4	2	3	1	2	2	2	4	0	4	4	2	4	2	2	0	3	0	1	3	4	0	3	2
nt	5	6	8	6	6	10	6	6	6	6	6	6	9	4	8	7	6	12	5	1	4	6	0	0	4	7	6	4	5
l	3	2	3	3	5	6	3	5	3	3	5	3	5	0	6	6	3	6	3	1	2	4	0	0	4	5	0	4	3
	4	4	5	3	6	6	4	6	4	3	8	6	7	1	7	8	8	10	5	0	2	7	0	0	6	6	0	6	5
r	2	1	2	1	1	2	2	1	1	2	1	1	2	1	1	1	2	2	1	2	0	1	0	2	2	2	2	2	1
	4	1	8	5	7	8	8	7	7	6	5	4	4	1	0	7	6	6	4	5	1	2	0	8	5	7	6	5	4
al	20	16	25	20	25	37	25	29	19	19	31	24	33	9	32	35	27	44	22	7	10	27	3	3	27	32	2	27	22
l Total	6	2	10	6	8	10	10	8	8	8	6	5	6	2	1	8	8	8	5	7	2	3	0	10	7	9	8	7	5
e	46	32	63	46	59	84	63	66	48	48	66	52	70	20	59	77	63	93	48	25	21	54	63	23	61	73	18	61	48
Narration																													
re	0	1	2	2	2	4	1	2	0	3	2	2	2	0	1	4	2	4	2	2	0	2	1	1	2	3	1	2	2
ntent	2	3	3	4	4	5	3	4	3	4	3	3	4	2	3	4	5	5	3	3	3	5	1	2	5	5	0	5	5
	2	0	2	1	2	2	1	2	1	3	2	2	4	0	2	4	2	4	2	2	0	2	0	0	3	2	0	3	2
nt	4	0	3	4	6	9	5	6	5	8	6	6	9	0	7	10	6	12	6	4	0	6	0	0	5	4	0	5	6
l	3	0	3	3	3	6	3	3	3	3	3	3	5	0	2	6	3	6	3	1	1	3	2	0	3	3	1	3	3
	4	0	3	3	5	6	2	3	2	5	4	5	5	3	6	9	4	8	5	0	0	6	0	0	5	4	0	5	4
r	1	2	1	0	2	2	2	2	1	2	1	1	2	1	0	2	1	2	1	2	1	1	1	2	2	2	2	2	1
	1	7	9	2	6	8	8	8	5	6	4	4	5	1	1	5	4	6	2	6	4	2	3	7	5	4	7	5	4
al	15	4	16	17	22	32	15	20	14	29	20	21	29	5	22	37	22	39	21	12	3	24	4	3	23	21	2	23	22
l Total	2	9	9	2	8	10	10	10	6	8	5	5	7	2	1	7	5	8	3	8	5	3	4	9	7	6	9	7	5
rse	33	25	48	37	58	81	48	58	39	71	48	50	69	13	23	85	52	90	46	38	15	52	15	23	58	52	21	58	52
Conversation																													
re	2	1	2	1	2	3	2	3	1	1	2	2	4	0	1	4	2	4	2	2	0	2	1	0	2	2	0	2	2
ntent	7	4	12	8	7	15	13	10	8	8	7	10	12	4	4	12	12	15	8	6	8	10	7	7	11	12	5	11	11
	2	0	2	1	2	4	1	2	1	2	2	2	4	0	2	4	2	4	2	2	0	2	1	0	2	3	0	2	2
nt	8	0	6	8	9	14	7	8	7	8	8	8	16	0	7	16	8	13	8	3	0	8	2	0	4	8	0	4	4
l	3	0	3	3	3	4	3	3	2	3	3	3	3	0	3	6	3	6	2	3	0	3	1	1	3	3	2	3	3
	7	0	5	5	4	6	4	5	5	4	6	6	9	2	7	11	6	10	6	6	0	7	1	0	6	6	2	6	6
r	1	2	1	0	2	1	2	2	1	1	1	2	2	1	1	2	2	2	1	1	1	1	1	2	2	2	2	2	2
air	3	5	2	2	6	6	6	6	5	3	3	3	3	0	0	4	4	6	1	4	1	3	1	6	3	3	4	3	3
	6	8	8	4	11	11	9	10	12	6	7	7	10	4	2	12	12	12	12	9	3	8	6	12	10	12	11	10	10
al	28	5	30	26	27	48	30	31	24	26	28	31	48	6	24	53	33	55	28	18	8	32	13	8	28	34	9	28	28
l Total	10	15	11	6	19	18	17	18	18	10	11	12	15	5	3	18	18	20	14	14	5	12	8	20	15	17	17	15	15
course	49	26	53	41	59	85	60	63	54	46	50	55	81	14	35	91	65	96	54	41	17	54	27	36	55	65	33	55	55

APPENDIX H– INDIVIDUAL SCORES OF 30 INDIVIDUALS WITH APHASIA – Picture Description, Narration and Conversational discourse