ADAPTATION AND VALIDATION OF THE PROSPECTIVE AND RETROSPECTIVE MEMORY QUESTIONNAIRE IN MALAYALAM

Swaliha Shahama K A

Register No: 18SLP037

A Dissertation Submitted in Part Fulfilment of Degree of Master of Science

(Speech-Language Pathology)

University of Mysore

Mysuru

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI, MYSURU—570006

July 2020

CERTIFICATE

This is to certify that this dissertation titled **"Adaptation and Validation of The Prospective and Retrospective Memory Questionnaire in Malayalam"** is a bonafide work submitted in part fulfillment for the degree of Master of Science (Speech-Language Pathology) by the student holding Registration Number: 18SLP037. This has been carried out under the guidance of a faculty member of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru,

July, 2020

Dr. M. Pushpavathi
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysuru- 570006

CERTIFICATE

This is to certify that this dissertation entitled **"Adaptation and Validation of The Prospective and Retrospective Memory Questionnaire in Malayalam"** has been carried out under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru,
July, 2020

Dr. S P Goswami
Guide
Professor in Speech Pathology & Head
Department of Speech-Language Pathology
All India Institute of Speech and Hearing
Manasagangothri, Mysuru-570006

DECLARATION

This is to certify that this dissertation entitled **"Adaptation and Validation of The Prospective and Retrospective Memory Questionnaire in Malayalam"** is the result of my own study under the guidance of Dr. S. P. Goswami, Professor in Speech Pathology, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru, Registration Number: 18SLP037

July, 2020

Dedicated to…

My parents, Thahira Kunnil and Ameeruddeen Kodi, who has always supported me and encouraged me to pursue my dreams. Umma, Uppa… thank you for having faith in my abilities and for raising me to be a fiercely independent and confident person. Without your unconditional love and support, I would never reach the heights I set out to achieve.

To my siblings, Shakitha, Shibu, Ibu and Nihas Jiju and my lovely little nephew Nebhan for all their love and support.

Shakitha, you are nothing less than a blessing from God. Your kindness and generosity overwhelm me. You have always inspired me to be a better person since childhood. You are truly my role model! 😊

To Shaalu, for believing in me when I didn't believe in myself. I wouldn't be here writing this if it wasn't for you. You've been my rock, constantly supporting me and encouraging me to try harder, be better and never give up. I can't thank you enough for making me a better person that I am today.

ACKNOWLEDGEMENT

First and foremost, I thank the Almighty for protecting me and giving me the strength each day and blessing me with everything that I have.

My deep and sincere gratitude and indebtedness to Baapa for always wishing the best for me and guiding me to the right path.

I convey my sincere thanks to my guide, Dr. S. P. Goswami, for his meticulous guidance and continuous supervision which has led me to finish my dissertation well before time. I appreciate all his contributions of time, support and ideas.

I would like to thank Dr. M. Pushpavathi, Director (AIISH) for providing me with an opportunity to conduct this study. I am very grateful to you for your kindness, support and encouragement ma'am.

I thank Dr. M. S. Vasanthalakshmi, for her understanding nature and timely help with the statistical analysis of the study.

I owe my deepest gratitude to Dr. Abhishek B. P., for his ever willing help throughout the course of this study. Sir, you have been the greatest support at all times and your positivity is inspiring. Also, you are the coolest!

I also thank Mr. Darshan Acharya and Mr. Akshay Mendhakar, for taking their time off from their busy schedule to help me.

I thank my dissertation warriors, Ms. Riddhi Wadhwa and Ms. Akshaya Krishnan. You guys were wonderful partners anyone could ask for. We were there for each other at all times, and our unity made things much easier. We did it!!

I am also thankful to all the participants of my study for their time and co-operation. I would like to especially thank Lisie Hospital, Kochi for their support and encouragement.

Pratyashaa!! My burden-bearing, laughter-sharing, forever-caring friend…thanks for continuously nagging me and scaring me to death to finish my work. Thanks for helping me whenever I needed you at any point in time and for all your 'invisible' love. You really did take care of me like your own 'Dahej' :P

Safaa Jaan, thank you for helping me through all those tough times in life. Thanks for the constant support and for helping me to stay on track. I am really grateful for having you in my life.

Priya, my soul sister. You know me better than I know myself and having you around is a relief. For all the little and big ways you have pitched in to finish my dissertation and for your unconditional love...thanks!

Shalini, you are my biggest support system! A very happy, hug-filled, heartfelt thanks for always being so selfless and helping me even when I didn't ask you for any help. You are the best!

Cheyyu… my buddy!! Thanks for checking up on me every now and then and for being my 3 AM friend.

Thank you Jishu, for always being so incredibly thoughtful. I know you've got my back!

Thank you Hina, for never leaving my side and for always being so loving and understanding. I survived M.Sc because of you!

Aslin and Shana, my dear juniors…thanks for all the fun times and those movie nights during the lockdown.

I would like to thank the EWS #135 members, Aparna, Divya and Kishore for the hospitality and for helping me keep my sanity during the lockdown.

Last but not the least, I extend my heartfelt thanks to my dear crazy friends Rachi, Shreya, Setu, Chammu, Shabna, Shruthi and Sarfana for always being there for me. I don't know what I would do without you guys 😊

I would also like to thank all the frontline workers around the world working tirelessly during this COVID-19 pandemic.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Aphasia is a disorder of language that affects a person's ability to speak. Strokes occurring in the areas related to speech and language is one of the major causes of aphasia. Stroke is recognised as a significant reason of long-term physical problems in adult population and it is the second leading cause of cognitive disability and dementia. Cognitive impairment post-stroke is common and can impact up to one-third of stroke patients. Subtle cognitive impairment, however, may not seem evident, particularly when the stroke survivor seems to have functionally recovered in other aspects (Rasquin, Lodder, Ponds, Winkens, Jolles & Verhey, 2004). These deficits are persistent in most cases and have generally worsened progressively.

For those with recurrent strokes, cognitive impairment is common. Often it co-occurs with other neuropsychological impairments, such as language disorders, fatigue, depression and apathy. Stroke can be caused either by ischemic stroke, a clot in the brain obstructing the blood flow; or by haemorrhagic stroke, which is a rupture of blood vessels preventing the flow of blood to the brain (American Stroke Association, 2019).

Stroke and stroke-induced aphasia are well-known to affect memory (Tang, Amiesimaka, Harrison, Green, Price, Robinson, & Stephan, 2018). The mechanism by which the brain relays and stores information with or without conscious awareness for future use is known as the brain memory system. Depending on the location and severity of the stroke, memory deficits can occur in either one or many types of memory, finally resulting in complete decline and loss of memory. Currently, more attempts are made to determine the early-stage impact of stroke on the brain. According to previous studies, the prevalence of memory problems three months post-stroke varies from 23% to 55%. A year after stroke onset, it declines from 11% to 31% (Snaphaan & de Leeuw, 2007).

In day to day life, people make many plans but do not carry them out due to several reasons. It can be due to change in mind, physically unable to carry out the intention, or simply forget the intention. Forgetting intention is different from forgetting content. Psychologists have distinguished memory for intent and memory for content as prospective memory and retrospective memory, respectively (Kvavilashvili, 1987). A successful prospective memory performance needs memory to remember. However, there is no "pure" prospective memory task because all prospective memory tasks do have a retrospective element. (Maylor, 1990). Prospective memory (PM) involves framing a thought and then remembering it at a given time or later in response to a particular external prompt (Harris, 1984). Retrospective memory (RM), in contrast, is a memory of what a person has already done or encountered in the past.

PM is the memory for an activity that has to be done in the future, like making sure to take medicine after three hours. In contrast to PM, retrospective memory requires recollection of past information, like remembering a book's content. In the course of daily life, we require both to recollect the past (retrospective) and plans and goals for the future. It is clear that in our daily life, both kinds of memories are needed (Khan & Sharma, 2007). These two memory types differ qualitatively (Kvavilashvili, 1987). Prospective memory and retrospective memory vary in characteristics like "time orientation (future versus past), reference (intent versus content), prior orientation (no prior knowledge versus retrieval mode), and active involvement (planning, monitoring, and prioritising versus absence of these attributes)". Both types even demonstrate some commonalities with regard to the positive impact of incentives (Meacham & Singer, 1977) and the improved execution due to task significance (Kvavilashvili, 1992). In prospective memory, it is necessary to remember two different things: what needs to be done, and when or in what circumstances the action must be conducted. Hence, performance of prospective memory can rely on external cues or can be self-monitored.

According to research findings, two types of prospective memory are time-based and event-based. Researchers have therefore used two different types of tasks: “time-based prospective task and event-based prospective task”. In a time-based prospective task, an individual is required to remember to do some task at a particular time or after a certain time frame has passed (e.g., remembering to take part in a function at 10 a.m.). There is no clear and particular external activity that serves as a prompt to the action to be carried out. People should remember to track the passing of time and to take action by themselves, which means it has to be self-cued. Event-based prospective tasks are those in which the planned action is to be done when a particular external event takes place (e.g., giving a message to an individual when they see that individual), which means it is environmentally cued (Einstein, McDaniel, Richardson, Guynn & Cunfer, 1995).

Prospective memory problems can have different consequences as a broad range of daily activities rely on prospective memory being successful. Missing an expected television show might be frustrating, but failure to take medicine could be intense. Dysfunctions in this ability may, therefore, have a major effect on living independently. Due to the prevalence of such errors and their repeated occurrence in the healthy population (Dobbs & Rule, 1987), the systematic study of prospective memory is becoming increasingly involved.

PM is characterised by action and intent directed towards the future. It concerns with the actions to be performed and includes planning and monitoring, while RM is directed to the past and incidental. A clear difference exists between retrospective and prospective memory. In PM, there is an absence of evident and external signal that serves as prompt to an individual to retrieve the information (McDaniel & Einstein, 1993). There is, however, an external prompting present in RM for recalling information. Research has demonstrated divergent views on the association between prospective and retrospective memory (Meacham, 1988). Few studies have shown clearly that no correlation exists between prospective and retrospective

memory (Einstein & McDaniel, 1990; Kvavilashvili, 1987; Maylor, 1990), although others showed a significant connection amongst the two (Huppert, Johnson, & Nickson, 2000).

Recalling things to be done at the right time or in the light of a suitable prompt is just as significant in daily life as recalling things from the past. PM is about the timing of remembering events, whereas RM is about what should be remembered. It can very well be seen from this that PM will fail if a person remembers to do something at a given time, but not what that something was. Consequently, PM is distinguished from RM, but not completely different.

One approach to gaining insight into the difference in everyday life between the prospective and retrospective memory performance is through questionnaires. This will allow for a comprehensive analysis of the prospective or retrospective nature of failures (Smith, Della Sala, Logie, & Maylor, 2000) and analysis of the association with prospective versus retrospective failures of various variables.

The Prospective and Retrospective Memory Questionnaire (PRMQ) was developed by Smith, Della Sala, Logie and Maylor (2000) to quantify the prospective and retrospective memory problems in daily life through self-reporting or proxy reporting. PRMQ comprises of 16 items, eight concerning PM failures, and eight related to RM failures. The items are additionally intended to include an equivalent number that concerns with either self-cued memory or environmentally cued memory, and with short-term versus long-term memory. All these aspects are essential facilitators for use in persons with aphasia.

Self-reporting of errors in prospective memory is little researched in the literature. Smith et al. (2000) note that any prospective and retrospective memory differences were all ignored by prior research employing memory capacity. For instance, “The Cognitive Failures Questionnaire (Broadbent, Cooper, Fitzgerald, and Parkes, 1982)” contains only two out of 25

items that can be used to collect some information on prospective memory. “The Everyday Memory Questionnaire (Sunderland, Harris, and Baddeley, 1984)” also includes just three out of 25 items that test prospective memory capabilities whereas the PRMQ is intended to include eight items each in PM domain and RM domain.

Need for the study

Despite the decreased quality of life in PWA, less emphasis has been given to the magnitude of memory limitations when participating in activities of daily living (ADL). Studies on the evaluation of memory issues in PWA explicitly in the Malayalam language are minimal. A lot of linguistic and ethnocultural problems will emerge when a western assessment tool is used in the Indian population. Hence, a tool for measuring the extent of memory limitations in Malayalam is needed.

Aim of the study

To adapt and validate the Prospective and Retrospective Memory Questionnaire in Malayalam.

Objectives

1. To adapt the Prospective and Retrospective Memory Questionnaire to the Malayalam language.
2. To compare the prospective memory in neurotypical participants and PWA.
3. To compare the retrospective memory in neurotypical participants and PWA.
4. To compare the total prospective and retrospective memory in neurotypical participants and PWA.
5. To ascertain the difference between prospective and retrospective memory within neurotypical participants, if any.
6. To ascertain the difference between prospective and retrospective memory within PWA, if any.

Hypotheses

$H_0$1 There will be no significant difference in prospective memory between neurotypical participants and PWA.

$H_0$2 There will be no significant difference in retrospective memory between neurotypical participants and PWA.

$H_0$3 There will be no significant difference in the total prospective and retrospective memory between neurotypical participants and PWA.

$H_0$4 There will be no significant difference between prospective memory and retrospective memory within neurotypical participants.

$H_0$5 There will be no significant difference between prospective memory and retrospective memory within PWA.

Chapter 2: Review of Literature

The quality of life of an individual who has survived a stroke is significantly affected by cognition dysfunction and memory impairment. The various cognitive domains affected post-stroke are attention, memory, language, and orientation with attention and executive functions being the most affected. Memory deficits are also a prominent symptom after the diagnosis of stroke. It is essential to assess the mental processes of patients after stroke diagnosis, especially cognitive impairment and memory deterioration, to understand the vascular cognitive impairment spectrum stages. These patients run a higher risk of having disorders involving cognitive decline during the first year of recovery post-stroke. Thus, to reduce the prevalence of stroke, there is a requirement of immediate control through medical means of the possible risk factors that are variable in these stroke survivors.

The brain memory system is a multi-component framework with several complex functions, as displayed in Table 1 below.

Table 1

Types of memory systems

"Long-term memory"	"Episodic memory"
	"Semantic memory"
	"Procedural memory"
"Short-term memory"	"Working memory"

The frontal lobe controls the processing of "short-term memory" and "working memory" which are associated with the perceptual and learning areas of the cognitive domain. The parietal, medial temporal lobe and hippocampus process the areas responsible for memory, language, and visuospatial skills also referred to as episodic and semantic long-term memory.

The cerebellum and basal ganglia process the procedural memory, which is related to the procedural domain.

Impairment in the functioning of general memory after stroke is commonly reported by persons with stroke and their relatives (De Haan, Nys, & Van Zandvoort, 2006). Memory of a group of patients with the diagnosis of stroke admitted to a general hospital was investigated by Lincoln and Tinson (1989). These participants were below 80 years of age and were not severely aphasic. On administration of everyday memory questionnaires (Sunderland, Harris & Gleave, 1984) at one month post-stroke and seven months post-stroke, either filled by the patients or their relatives revealed significantly more significant memory deficits after stroke in them than for controls (orthopaedic patients). Forty-nine per cent of the total participants performed poorly on the "Rivermead Behavioural Memory Test (RBMT) (Wilson, Cockburn, Baddeley & Hiorns, 1989)" and test scores obtained corresponded well with questionnaire total scores. Responses on the RBMT were not influenced by the side of the stroke. The authors also found that family members reported a good recovery in the daily routine skills of the patients over the initial seven months, while patients complained of increased memory failures. This report from the participants was attributed to them developing an understanding of their problems over time.

Stewart, Sunderland and Sluman (1996) analysed the extent and course of memory deficits in 167 patients after one to three years of stroke occurrence. Out of the 167 patients, 113 had a history memory impairment immediately after the stroke. Seventy patients among them were evaluated on the "Everyday memory Questionnaire", and for words and faces they were evaluated on the adaptation of the "Rivermead Behavioural Memory Test" and "Warrington's Recognition Memory Test". Language and visuoperceptual processing were assessed using the "Token Test and the Benton Facial Recognition Test". Results revealed that 35 patients had impairments on more than one memory measures; 16 exhibited no evidence of

aphasia or visuoperceptual impairment, and 16 cases had memory deficits of mild to moderate degree, and only three cases performed poorly on all three tests. Finally, the study concluded that though the incidence of memory impairments is lower at a chronic stage when compared to the acute stage, it persists in a significant number of patients. Further, it also indicated the presence of a mixture of etiologies for below-average performance in everyday activities inclusive of aphasia and concluded that cognitive deficits, especially poor episodic memory were observed in less than half of those with difficulties in carrying out everyday activities.

Aphasia is a higher and more common consequence of stroke with an incidence rate of 34 to 38% (Bakheit, Shaw, Barrett, Wood, Carrington, Griffiths, Searle, & Koutsi, 2007) when compared to other stroke consequences like seizures and spasticity with 10.5% and 20% of incidence rate respectively (Sommerfeld, Gripenstedt, & Welmer, 2012). New cases with aphasia were estimated to be around 225,000 per year as a post-stroke condition by the National Aphasia Association in 2016. More recently, detailed research into this distressful disorder has revealed that it is much more than just a failure in the comprehension and production of speech (Parrish, 2014). Aphasia has been found to be co-occurring with dysfunctions in the cognitive domains like attention, executive functions and memory. These deficits exist not only in the severely affected cases but also occur even in the milder cases of aphasia (Turgeon & Macoir, 2008).

Murray (2012) conducted a study to analyse the relationship between attention deficits and communicative functions. For this, 78 subjects were split into two groups equally. Group one consisted of patients having different types and severity levels of aphasia, and group two consisted of individuals with no brain damage. They were matched with respect to age and levels of education. Assessment of attention, executive functions and memory were carried out for both the groups. Overall results of the various assessments revealed that group one

performed significantly poorer than group two on all the measures but showcased varied types and severity of deficits in each cognitive domain.

Planning and coordinating an idea or action involves a series of steps which are taken care of by the executive functions. Several studies have tried to explain how various cognitive functions enhance language skills in humans by analysing impairments in executive functions that affect language skills. Ramsberger (2005) reported that the combined actions of the higher-order cognitive functions influence the communicative success of clients with aphasia. Other identical studies in persons with aphasia (Conner L, MacKay A, & White, 2000; Bonini & Radanovic, 2015) have also demonstrated that there are deficits in different cognitive processes that come under the spectrum of executive functions. Executive functions allow interaction between the different cognitive processes like attention, perception and memory as it contains the storage and workspace for information. Information kept in the working memory is operated by the executive controller so as to use the information effectively. Therefore, poor executive functioning may lead to impairments in language functions in persons with aphasia (Jefferies & Lambon Ralph, 2006).

There have been several attempts also to examine the correlation between memory skills and aphasia. Evidence supports a potential correlation in persons with aphasia between comprehension skills and working memory abilities. Ronnberg, Larson, Fogelsjoo, Nilsson and Lindberg (1996) analysed the memory skills in adults with less severe aphasia. They used digit and word span tasks to evaluate the performance of short-term memory functions. The results reported that persons with mild aphasia had impaired verbal short-term memory skills. Identical findings have also been reported by other researchers such as Wright and Shisler (2005) and Seniow, Litwin and Lesniak (2009). A wide range of complex activities requires adequate working memory abilities. Understanding language requires an individual to recall previously

heard words in sentences (Acheson & MacDonald, 2009). Therefore, language outcomes are highly impacted by deficits in the components of working memory.

Salako and Imaezue (2017) did a detailed review of different qualitative research on the working mechanism of cognitive processes associated with linguistic functions. Information compiled uncovered that impairment in language almost always coexists with cognitive dysfunction. Moreover, this study recognised the most common deficits in cognitive functions in the skills of attention, working memory and executive functions post aphasia. It was established that language is an intricate cognitive process that plays a fundamental role in human cognition. Hence, it should not be assessed in isolation since it is directly associated with other higher cognitive abilities. Salako and Imaezue (2017) concluded that disruption of various cognitive processes might lead to deterioration of language components and if not intervened can hamper and delay recovery of communicative skills despite appropriate aphasia treatment.

Salthouse, Berish, and Siedlecki (2004) found that a person's prospective memory (PM) may be a more contributing factor to their independent living ability than their retrospective memory (RM). Baddeley (1990) states that a failure in such an aspect of cognition is the underlying cause for complaints of having a poor memory. Therefore, it is surprising that many studies are concentrated on the memory of past events and PM has relatively been neglected. Burgess and Shallice (1997) found that in order to perform a task on PM skill successfully, it is important not only to recollect what to do in the future, but also to recall what task to do. The latter component is associated with RM. Hence, many researchers have argued that the two types of memory are representations of dependent constructs.

Tasks of PM also include RM components, such that a certain extent of interaction exists between the two memory skills (Uttl, 2008). It is assumed that the cognitive system that

RM or declarative memory relies on is the same as the retrospective component of PM (Carlesimo, Formisano, Bivona, Barba & Caltagirone, 2009). Individuals with "multiple sclerosis (Bravin, Kinsella, Ong & Vowels, 2000), mild Alzheimer's disease (Martins & Damasceno, 2008), brain injury (Adda, Castro, Alem-Mar e Silva, de Manreza & Kashiara, 2008) and stroke (Cheng, Tian, Hu, Wang & Wang 2010; Kim, Craik, Luo & Ween, 2009)" have a deterioration in the retrospective components of PM tasks. Tests of RM and PM have been found to show correlations in a mixed neurological group (Groot, Wilson, Evans & Watson, 2002). Further, it was suggested by Kinch & McDonald (2001) that the interaction between executive functioning and RM always leads to successful performance on PM tasks.

Problems in memory skills post-stroke can be examined and analysed using different measures. Two types of memory measures are objective and subjective. An individual's performance in tasks engaging specific memory processes estimates the objective measures, whereas the individual's perceptions of his performance in real-life activities estimate the subjective measures. In multiple studies, subjective evaluation of one's own RM reflects the performance on objective RM skills (Jonker, Launer, Hooijer & Lindeboom, 1996; Treves, Verchovsky, Klimovitzky & Korczyn, 2005). Although, there are few contrary findings to this notion (Derouesne, Alperovitch, Arvay, Migeon, Moulin & Vollant, 1989; Troyer & Rich, 2002) as it has also been evidenced in numerous studies that objective performance and subjective evaluation of RM and PM indicate varied cognitive processes (Graf & Uttl, 2001; Kvavilashvili, Kornbrot, Mash, Cockburn, & Milne, 2009; Maylor, 1993; Uttl, 2008).

Memory should be assessed using a wide range of methods in psychological assessments. Assessment scales, both self-rated and proxy-rated forms, serve as very informative formats of evaluation along with other objective tools. The assessment of PM abilities in rating scales for memory skills is very limited (Smith et al., 2000). This led to the development of the "Prospective and Retrospective Memory Questionnaire (PRMQ)". The

PRMQ balances the prospective and retrospective items, and assesses these aspects in a systematic format with respect to different situations and thus has a substantial preference over other self-reporting tools. Provided the dearth of literature and diverse methods used in measuring PM and RM after stroke, using a stable and validated measurement like the PRMQ (Smith et al., 2000) is essential. The results of each subscale should be recorded separately, as they would be more useful. For example, PRMQ was administered by Barr (2011), to measure everyday memory function total in post-stroke individuals. He summed the retrospective and prospective components and interpreted the results separately. It was found that there was a clear delineation of PM from RM as there were no limitations in conclusions about PM.

In the British (Crawford, Smith, Maylor, Della Sala, & Logie, 2003), Brazilian (Piauilino, Beuno, Tufik, Bittencourt, Santos-Silva, Hachul, Gorenstein & Pompeia, 2010) and Swedish (Ronnlund et al., 2008) populations, it has been found that the PRMQ is a reliable instrument. The various designs of the covert structure of the PRMQ have been tested by applying the "confirmatory factor analysis" in these studies. The PRMQ was found to be best represented by a tripartite model, in which general memory, PM and RM were the latent factors, and the questionnaire items were the manifest variables. Ronnlund et al. (2008) also presented evidence of concurrent validity, along with the factorial validity of this questionnaire.

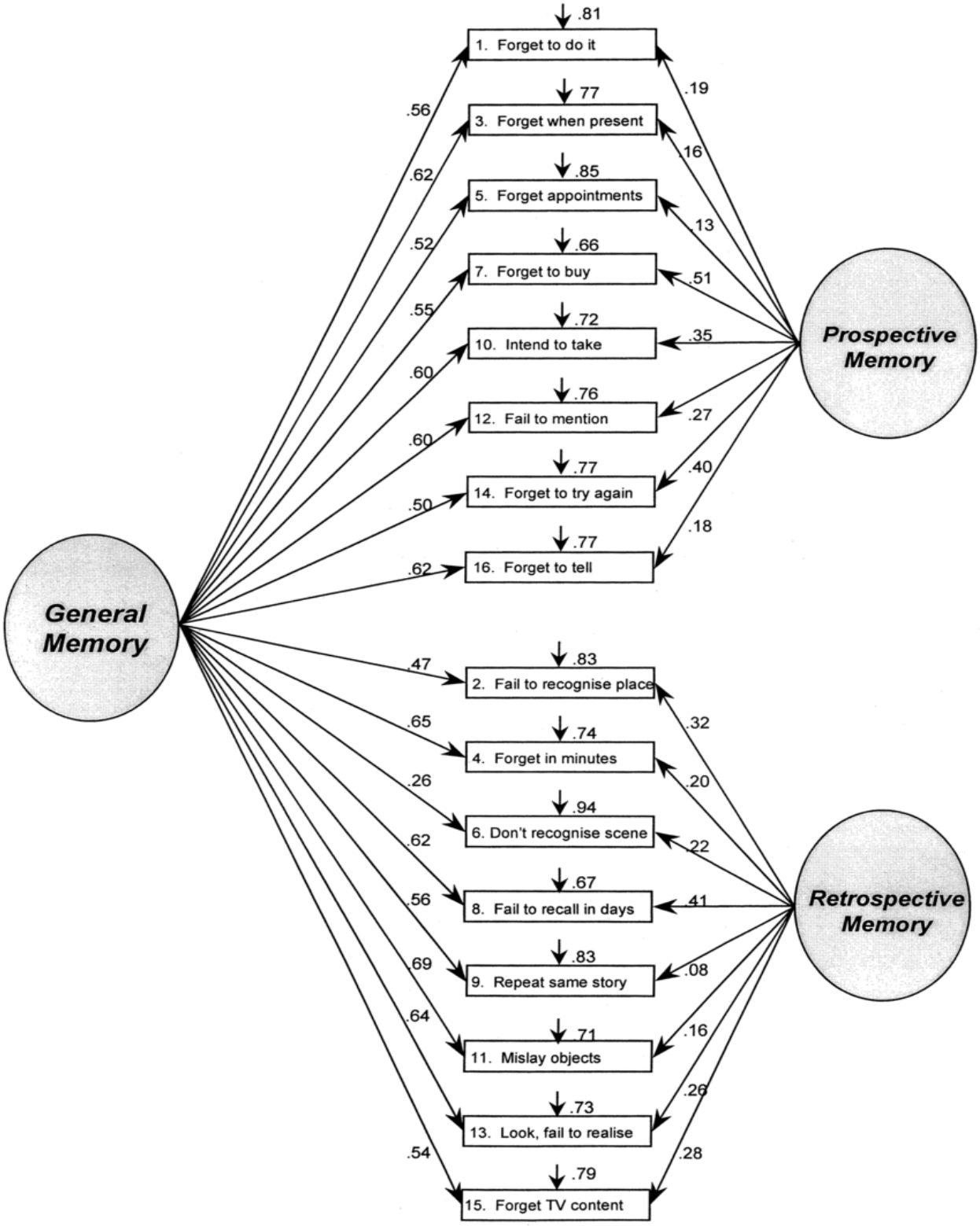

Figure 1: Graphical representation of the tri-factor model of the PRMQ. (Source: Crawford et al., 2003)

The research by Smith et al. (2000) further confirmed the predictive validity of PRMQ by analysing a group of participants diagnosed with Alzheimer's disease (as per ratings of their caregiver) compared to healthy elderly and young participants where it was found that both the groups had an elevated number of failures, particularly in prospective memory. Likewise, in a study by Mantyla (2003) wherein a cohort of female participants recognised as self-reporters of memory failures in comparison with a matched group of non-reporters showed a higher prevalence of RM and PM deficits as evaluated by the PRMQ subscales.

Construct validity for the PRMQ self-report version of the was given by Crawford et al. (2003). Furthermore, they established normative data using t scores for every scale of the PRMQ and also provided methods to determine whether differences exhibited among one's prospective and retrospective ratings were reliable or abnormal. Therefore, the reliability and construct validity required to be applicable in clinical practice have been shown by the PRMQ self-report version. Smith et al. (2000) in their research also used the PRMQ proxy-rated version and as acknowledged by Crawford et al. (2003) themselves that, in scientific investigations and clinical practice the proxy-rated scale is markedly more effective than the self-rated format of the questionnaire.

Even though it is noticed that self-report tools have almost always shown to have high accuracy, it is also observed that a person’s understanding of their own memory functions or metamemory, might not match their performance on real memory tasks when measured by objective memory tools and clinical reports (Craik, Anderson, Kerr, & Li, 1995). The usual explanation is that individual’s with memory impairments have poor awareness of their own problems (Herrmann, 1984), especially those who have suffered a brain injury. Several possible reasons have been postulated to justify this relationship. Moreover, people with memory failure lack specificity in reporting the number of failures experienced as they forget about these errors in their own memory as a result of their problem (Cohen, 1996).

After having considered the aforementioned difficulties, it is definite that researchers or clinicians should consider the reports of the family members or friends who know the patient well regarding circumstances of memory decline that the patient themselves are not aware of, as the caregivers are at a better state to identify the patient's memory failures (Hickox & Sunderland, 1992). Thus, memory rating scales are usually restructured so that they are more apt to be completed by the caregivers. As these proxy-rating formats have shown a significant amount of correlation with standard objective tools than the self-rating tests (Sunderland et al., 1988), their usage is given further weightage.

Metamemory is one of the essential variables which may influence PM performance (McDonald-Miszczak, Gould, & Tychynski, 1999). Research findings on RM have pointed out that metamemory affects memory. However, the relationship between PM and metamemory is still not very clear. Khan and Sharma (2007) studied the role of metamemory in PM and RM in neurotypical individuals and reported a substantial difference between the two. Further, both PM and RM were found to be increasing with metamemory. Results suggested that metamemory is a better predictor of PM than RM. This can be due to the reason that both metamemory and PM are based on high monitoring of knowledge and intended action.

The relationship among the performance on objective tests and metamemory rating was modest in magnitude according to (Mantyla, 2003). However, in order to assess the disparities in individual self-reports of problems in episodic memory, it was found that metamemory for future intentions were a much better criterion compared to memory for past events (Mantyla, 2003). This further contributed to the certainty that few memory breakdowns like forgetting appointments, taking medicine or forgetting to turn off the oven can have dire consequences and will possibly hinder independent living (Bisiacchi, Tarantino, & Ciccola, 2008).

It was noted that, compared to the younger counterparts in a systemic review (Henry, Macleod, Phillips & Crawford, 2004) of healthy ageing individuals, older participants performed much better on PM tasks than on RM measures. This suggested that ageing has a different effect on the two types of memory. Impairments on the two types of memory are separable, according to Wilkins and Baddeley (1978). The study reported that participants having better performance on RM tasks were less accurate on tasks of PM when compared to the performance of participants with limited RM. Therefore, a greater understanding of the distinction between the two domains of memory, as well as the importance of certain failures of PM along with their recurrence in healthy individuals has resulted in more investigations related to PM (Dobbs & Reeves, 1996).

Ronnlund, Mantyla, & Nilsson (2008) found a slight decline in self-reported PM failures as age increased on investigating the elderly population. Contrastingly, other research findings (Maylor, 1993; Reese & Cherry, 2006) concluded that healthy elderly participants report more problems in RM than PM when compared with the younger age group. This is evident from responses on two items out of 25 concerning PM in the "Cognitive Failures Questionnaire (Broadbent et al., 1982)". More complaint of PM failures is reported by younger individuals than the elderly in the investigation done by Reese and Cherry (2006). This affirms the conclusion that elderly individuals perform better in some naturalistic PM functions when compared to their younger counterparts, though the latter group performs much better than the former in PM tests based on the laboratory settings (Uttl, 2008).

Social variables determine not only beliefs about memory but prospective and retrospective memory too. There is a possibility that people with an active lifestyle will show relatively better monitoring and consequently better PM than those who lead a passive style of life. Place of residence affects social variables. Khan and Sharma (2007) did a study to determine whether gender and residence influence PRMQ scores. Results revealed that

demographic variables influence both the prospective and retrospective memory: women outperformed men. However, the effect was more prominent for RM than PM. Urban people tended to be better at remembering in both types of memory (prospective and retrospective) than rural people, though the difference was not significant. However, there is conflicting evidence in the case of PM performance by males and females. Some studies have shown that women outperform men, while others showed that there did not exist any difference between men and women in the successful performance of PM tasks.

Men reported more enormous RM deficits than women (minor effect) on the PRMQ (Crawford et al., 2003), other metamemory instruments (Jonker, Geerlings & Schmand, 2000) show otherwise. Whereas Mendes, Gino, Ribeiro, Guerreiro, Sousa, Ritchie and de Mendonça (2008) found no gender effects. Further, research on episodic memory, autobiographical memory, and everyday memory have exhibited more consistent gender differences. Females perform better in many episodic and verbal memory tasks than do males (Halpern, 2000; Herlitz, Nilsson, & Backman, 1997).

Objective and subjective PM does not change during the pre-menopausal stage of females (Devi, Hahn, Massimi, & Zhivotovskaya, 2005), but perceived retrospective cognitive difficulties are well determined by hormonal status. Piauilino et al. (2010) studied the effects of hormonal status in women who has PM and RM complaints. The PRMQ was administered, and it was found that women before menopause had lesser complaints of general memory slips when compared to women within five years post-menopause; with greater failures in PM than RM. Particularly during the menopause transition, affective problems have been related to metamemory problems (Freeman, Sammel, & Lin, 2009). This indicated that women who are middle-aged utilise more PM support than men (Long, Cameron, Harju, Lutz, & Means, 1999). It is an indication of them resolving their inadequate metamemory skills.

Several studies show that women perform better than men on formal retrospective episodic memory tests (Andreano & Cahill, 2009), but what is surprising is the fact that women self-rate their RM and PM abilities, lower than that of men. A possible explanation for the variation in memory problems can be that males and females vary in their styles of memory (Sehulster, 1995). Furthermore, females are more involved in household and childcare duties along with work commitments outside of the home. The presence of either domestic responsibilities (Musshauser, Bader, Wildt, & Hochleitner, 2006) or as everyday multitasking involves a higher memory load leading to a broader dissatisfaction with memory performance. Piauilino et al. (2010) concluded that the PRMQ is a valuable tool in regions that have different social features for evaluating reports of prospective and retrospective memory failures.

PM impairment is noted in many neurological disorders such as: "traumatic brain injury (Carlesimo et al., 2009); multiple sclerosis (Kardiasmenos, Clawson, Wilken, & Wallin, 2008); Parkinson's disease (Raskin, Woods, Poquette, McTaggart, Sethna, & Williams, 2011) and early-stage or mild dementia (Kinsella, Ong, Storey, Wallace, & Hester, 2007)". Some investigations have tried to understand the manner in which memory functions in stroke patients, though assumptions made do not differentiate these functions with other conditions.

A study by Brooks, Rose, Potter, Jayawardena and Morling, (2004) reported impairments on activity, time and event-based PM tasks in stroke patients compared to controls. However, the time-based task had a lesser magnitude of impairment than the other tasks. Contrastingly, an experimental procedure with "Time-Based Prospective Memory (TBPM) and Event-Based Prospective Memory (EBPM)" components and RM components was carried out by Cheng et al., (2010) on 18 thalamic stroke patients and compared it with age and education matched 18 healthy controls. It also included ongoing activities (number selection and word selection) as embedded PM tasks. It was found that patients had impairment on TBPM but not EBPM. Scores on the RM and PM components of a TBPM task was

significantly lower for thalamic stroke patients than controls. On the other hand, scores on the PM component of the EBPM was the same for both the groups, despite reduced performance on the retrospective component. However, RM deficit could not explain the TBPM impairment. This provides only a provisional idea that the type of PM dysfunction may vary depending on the stroke type as the sample was restricted to only thalamic stroke patients. Analysing a relatively small sample without using valid and reliable measures of PM were the drawbacks of this study. Thus, indicating the requirement of more research and exploration related to PM.

Kim, Craik, Luo and Ween (2009) assessed two lab-based entities of PM ("Virtual Week: Rendell & Craik, 2000; Memory for Intentions task: Cohen, West, & Craik, 2001") and a well-designed clinical estimate of event-based memory, "Remembering a Belonging subtest from the Rivermead Behavioural Memory Test (RBMT; Wilson, Cockburn, & Baddeley, 1985) and the PRMQ" between community-dwelling persons with stroke and healthy controls. Performance on the RBMT subtest did not show any difference between the groups. Stroke patients performed poorly on the 'prospective' factor of the "Memory for Intentions test", which is an event-based segment. For analysis, test scores of the PRMQ were converted to T-scores, and it was found that T-scores between the groups had no significant difference, though slightly lower scores were obtained on both components for the patients than controls.

The Virtual Week is a board game task carried out over a number of circuits for both time-based and event-based. Three conditions under which PM is assessed are: "*regular* (same four time-based and event-based tasks), *irregular* (different four time-based and event-based tasks) and *time-check* (when two specific time periods collapse)". Poor performance on the *time-check* condition was identified but not in the other two *conditions* by the stroke patients than controls. Clearly, not all but only a few time-based tasks were poorer in stroke patients than controls. In short, analysis by Kim et al. (2009) revealed that some measures of EBPM and one measure of TBPM were impaired in stroke patients.

The research findings of Brooks et al. (2004), Kim et al. (2009) and Cheng et al. (2010) showed up to be highly inconsistent due to a range of methodological constraints. To understand in detail, Cheng et al. (2010) only investigated a restricted sample of stroke patients, the ones with 'thalamic' lesions while the study by Kim et al. (2009) had a majority of patients with 'frontal' lesions. Moreover, a robust, valid and reliable measure was used only in Kim et al., 2009 study. The other two studies (Brooks et al., 2004; Cheng et al., 2010) were limited in their neuropsychological assessment of other cognitive functions. None of the studies controlled for low mood and anxiety, although literature evidence on acquired brain injury show that they may influence PM (Cockburn, 1996; Kinch & McDonald, 2001). Therefore, further research has to carried out on this note.

Barr (2011) compared a sample of community-dwelling stroke survivors who are fluent in English on a standard test of PM functioning and a subjective assessment of RM and PM performance with a group of healthy controls. There were 22 participants in each group. Besides, 20 caregivers participated by substituting for the stroke patients when required. PM performance was assessed using "The Cambridge Prospective Memory Test (CAMPROMPT; Wilson, Emslie, Foley, Shiel, Watson, Hawkins, Groot & Evans, 2005)" and subjective measure of everyday memory was assessed using "The PRMQ (PRMQ; Smith et al., 2000)". Less insight into stroke patients' memory abilities was determined by exploring the correlation between performance on objective tests and self-reporting scales of memory problems.

A series of distracter puzzles were to be completed by the participants over a period of 20-minutes. They were requested to finish four TBPM and four EBPM tasks simultaneously. Further, the PRMQ self-rated and proxy-rated tool was administered. Self-reports of stroke participants were compared with the relatives/caregiver's ratings. The above findings helped in understanding the link between self-reports of PRMQ and objective measures on the CAMPROMPT.

It was found that even in less demanding situations, the time-based tasks are vulnerable to stroke patients with significant reductions in them. It was observed that their score on the PRMQ and the CAMPROMPT performance had a medium correlation. A range of RM and executive functioning measures were found to be having a relationship with PM performance. However, patients' responses on everyday memory skills did not differ much from controls though evidence of their performance on objective tests of PM and RM shows otherwise. No definite correlation was established between self-reports and objective measures of PM performance on analyses of the prospective and retrospective subscales. Similarly, objective RM ability was not associated with retrospective PRMQ ratings. It was also found that there was no difference between patient self-reports and proxy report. Self-report ratings and proxy ratings also had a significant correlation between them.

Physical and language impairments are apparent in individuals who have had a stroke; the main aims of rehabilitation are to treat these using restorative or compensatory strategies. Daily functioning is also influenced by cognitive impairment post-stroke (Caplan, 2006). Impairment of different cognitive processes was reported, especially in the areas of attention and executive functions (Andrews, Halford, Chappell, Maujean & Shum, 2014).

PM performance is reported to be more influenced by the impairments in executive functioning. Reduction in PM, independent of retrospective abilities, is seen due to deficits in executive functioning. Kliegel, Eschen, and Thöne-Otto (2004) analysed the PM functioning of participants with intact RM, but poor executive functioning skills in a traumatic brain injury sample. Participants who had better executive functioning skills did a better performance on PM tasks, regardless of RM abilities.

Failure to recollect information of prior intentions may also be possible by individuals for reasons unrelated to RM. Costa, Perri, Serra, Barban, Gatto, Zabberoni, Caltagirone, and

Carlesimo (2010) found that there was an equal impairment in persons with *amnestic* and *dysexecutive mild cognitive impairment (MCI)* in the skill to recollect certain steps to be exhibited in a PM task. The authors suggested that poor performance of the dysexecutive group could be explained by the limited ability to utilise specific retrieval processes while the failure to perform well by the amnestic group could be attributed to a pure memory deficit.

RM functioning is likely to have an interaction with executive functioning. However, the correlation between the number of recalled intentions and two tests of verbal declarative memory was found by Carlesimo et al. (2009), according to whom only the memory difficulties cannot explain the results.

They suggested that poor performance on the retrospective component could be caused by a limited understanding of the task instructions as a result of executive functioning impairment in combination with a pure declarative memory deficit. Supporting this explanation, Kinch and McDonald (2001) suggested that interaction between executive functioning and RM results in a successful performance on PM tasks.

The action of the "apolipoprotein E (APOE) and catechol-O-methyltransferase (COMT)" genes in PM and RM traits were examined (Donges, Haupt, Lea, Chan, Shum & Griffiths, 2012) on 197 healthy adults between 16-51 years of age. Participants had varying levels of education and were mainly of Caucasian ethnicity. They also examined the APOE ε4 allele, a known risk factor for dementia, and the "COMT Val 158" polymorphism, earlier suspected to cause schizophrenia by using molecular genetics and psychological expertise. Memory type was assessed using a series of memory assessment tools of both PM and RM, including the PRMQ. "Restriction Fragment Length Polymorphism (RFLP)" analysis was used to determine the genotypes. Results revealed that PM failures were significantly the effect of the APOE ε4 polymorphism and the semantic memory of RM were found to have a significant

combined effect of polymorphism of both the alleles. Genotypic investigation of these two alleles in connection with memory skills in healthy adults was done for the first time in this study. It also provides essential information on how human memory is affected by genetic determinants. The main limitation of this study was that rather than examining the difference in their memory scores individually, homozygous and heterozygous ε4 carriers were examined by grouping them together due to small sample size.

Normative data for PRMQ

The PRMQ has been adapted and translated into many western languages like Dutch, German, Spanish, Swedish, Italian, French, and Portuguese etc. Indian normative has been developed only in two languages, namely, Hindi and Tamil. Normative data for the PRMQ in Hindi has been developed by Khan and Sharma (2007). The sample consisted of 395 adults (206 males; 189 females) recruited from both rural (185) and urban (210) population near Kanpur, India. Within-subject factors were stratified as *paradigm* (prospective vs retrospective), *cue* (self vs environment) and *term* (short-term vs long-term). The study found that RM errors were rated less frequent than PM failures and short-term impairments were found to be greater than long-term errors in both the memories.

Further, the results revealed that self-cued retrieval was rated as more error-prone than environmentally cued retrieval. The study showed a strong and positive correlation between PM and RM. Khan and Sharma (2007) concluded that PM is different from RM. Nevertheless, the results also indicated that there is a similarity between the two.

Standardisation of the PRMQ in Tamil has been developed by Paulraj, Kumar, and Vetrayan (2011). It was administered on a group of 552 healthy adults of Chennai, India. The accuracy of the total, prospective and retrospective scales was acceptable. It was found that there was a substantial difference in age and gender when they were analysed with respect to

the PRMQ scores. Paulraj et al. (2011) concluded that the Tamil version of the PRMQ was found to be highly reliable and it produces an essential measure for application in clinical practice and scientific research with respect to everyday memory skills. Since the PRMQ has not been translated to Malayalam language, it is adapted and validated in this study.

Chapter 3: Method

The aim of the current study was to adapt and validate the Prospective and Retrospective Memory Questionnaire (PRMQ) in Malayalam. It was also aimed to compare the prospective and retrospective memory in PWA with that of the neurotypical individuals.

Procedure

The procedure for conducting the study was divided into the following phases: Adaptation of questionnaire in Malayalam, data collection and data analysis. Each of these phases are described in detail below:

Phase 1: Adaptation of PRMQ to Malayalam

It comprises of reviewing, revising and appropriately adapting the Prospective and Retrospective Memory Questionnaire (PRMQ) to Malayalam. Before the adaptation of the material, a written consent via email from the authors of the PRMQ (Smith, Della Sala, Logie, and Maylor 2000) was obtained to adapt the PRMQ to Malayalam.

Test material: The PRMQ-Malayalam was an adaptation of the PRMQ-English (Smith et al., 2000) which has two subsections: prospective memory and retrospective memory. The questionnaire was developed to enable the participants to rate the frequency of different types of memory failures through 16 items. Participants have to rate how frequent each type of memory error occurred. Each item is followed by a five-point Likert scale: Never, Rarely, Sometimes, Quite often, Very often.

The questionnaire is divided into eight categories based on different facets of memory, with two questions for each category. The eight categories are: “prospective short-term self-cued, prospective short-term environmentally cued, prospective long-term self-cued, prospective long-term environmentally cued, retrospective short-term self-cued, retrospective

short-term environmentally cued, retrospective long-term self-cued and retrospective long-term environmentally cued."

This questionnaire was translated to Malayalam, keeping in mind the socio-cultural appropriateness of items. The translated questionnaire was given to three experienced Speech-language Pathologists to judge the appropriateness of the questionnaire in terms of its translation and aptness of the items. The questions which were not socially and culturally accepted was removed and substituted by more socially relevant questions.

Phase 2: Validation of the Questionnaire

For the validation of the material, a feedback questionnaire (Goswami, Shanbal, Samasmitha & Navitha, 2012) containing 20 parameters like simplicity, familiarity, relevance, and generalisation was utilised. Ten SLPs who are well versed in Malayalam were given with the developed material for validation using the feedback questionnaire. Appropriateness rating was done on 13 parameters as they were most appropriate and most suited parameters to rate the questionnaire. The SLPs were asked to judge each item and suggest modifications if required. The items in the questionnaire were modified based on the suggestions provided by the SLPs.

Ratings of judges, using "Feedback Questionnaire for Aphasia Management Manual" are tabulated in Table 2.

Table 2

Results of the validation of the questionnaire

Serial No.	Parameters	Very Poor	Poor	Fair	Good	Excellent
1.	Simplicity				3	7
2.	Volume				3	7
3.	Presentation				4	6
4.	Familiarity				3	7
5.	Relevancy				3	7
6.	Accessibility				2	8
7.	Flexibility			1	6	3
8.	Trainability				7	3
9.	Stimulability				6	4
10.	Feasibility				2	8
11.	Generalisation				7	3
12.	Scope of practice				6	4
13.	Scoring pattern				1	9

Few parameters from the feedback questionnaire were removed as they were not relevant for the current study, such as the size of the picture, colour, appearance, arrangement and iconicity.

Phase 3: Administration of the Questionnaire

***Participants*:** A total of 40 participants of the age range 35 to 75 years were recruited in this study. These participants were sub-grouped into two groups. Group 1 consisted of 20 neurotypical individuals, and Group 2 consisted of 20 persons with aphasia. The participants

included in Group 2 were individuals who are the native speakers of Malayalam (a south Indian regional language) who have incurred aphasia due to damage to the dominant hemisphere primarily as a result of a stroke.

Various types of aphasia were represented in this group (Eight Broca's aphasia, four Anomic aphasia, three Wernicke's aphasia, and four Global aphasia). Neurotypical individuals in Group 1 were included in the study to serve as a comparison group.

Table 3 below includes details of demographic data which include age, gender, type of aphasia and cause of the problem.

Table 3

Demographic details of PWA

Sl. No.	Type of Aphasia	Age/Sex	Site of lesion	Education level	Socio-economic status
1.	Broca's aphasia	55y/M	Left MCA territory subacute infarct	Graduate	Middle class
2.	Broca's aphasia	35y/M	Intracranial haemorrhage	Postgraduate	Upper class
3.	Broca's aphasia	64y/F	Left MCA infarct	Primary education	Lower class
4.	Broca's aphasia	60y/M	Acute infarct in the left parietal lobe	Primary education	Middle class
5.	Broca's aphasia	43y/M	Left MCA territory infarct	Graduate	Middle class
6.	Broca's aphasia	52y/F	Infarct in left gangliocapsular region including posterior insular cortex	Primary education	Upper class
7.	Broca's aphasia	38y/M	B/L MCA territory infarct	Secondary education	Middle class
8.	Broca's aphasia	71y/M	Left MCA territory infarct	Primary education	Middle class

9.	Anomic aphasia	48y/M	Infarct in left occipitoparietal region	Secondary education	Lower class
10.	Anomic aphasia	56y/M	Infarct in the parasagittal parietal region	Postgraduate	Middle class
11.	Anomic aphasia	68y/M	B/L cerebellar acute infarct	Secondary education	Upper class
12.	Anomic aphasia	36y/M	Acute infarct left cerebellum extending on to vermis	Graduate	Middle class
13.	Wernicke's aphasia	64y/M	Posterior superior temporal gyrus	Secondary education	Lower class
14.	Wernicke's aphasia	70y/M	Left MCA infarct & embolism in temporoparietal region	Primary education	Middle class
15.	Wernicke's aphasia	38y/M	Left MCA territory infarct	Postgraduate	Upper class
16.	Global aphasia	72y/M	B/L MCA territory infarct with haemorrhage in the left side	Primary education	Lower class
17.	Global aphasia	61y/M	Perisylvian cortex and left inferior frontal gyrus	Graduate	Middle class
18.	Global aphasia	67y/F	Intraparenchymal haemorrhage involving left gangliocapsular region.	Secondary education	Middle class
19.	Global aphasia	74y/F	B/L periventricular region. Thrombosis of left MCA beyond distal M1 segment	Primary education	Middle class
20.	Global aphasia	58y/M	Acute infarct in left frontal and temporal lobes (MCA territory)	Graduate	Middle class

The inclusion criteria for both populations are as provided below:

Inclusion Criteria for PWA:

- Premorbid: Native speaker of Malayalam Language.
- No obvious history of degenerative disorder such as dementia or any other neuropsychiatric conditions.
- Received a diagnosis of aphasia using WAB Malayalam.
- Preferably a score of >5 in auditory comprehension task on WAB.
- No visual or hearing deficits/with corrected vision or aided hearing.

Inclusion Criteria for Neurotypical Individuals:

- No history of neurological insult.
- Native speaker of Malayalam Language

Procedure for Test Administration:

Persons who have incurred damage to dominant hemisphere were identified and subjected to standard Aphasia assessment using Western Aphasia Battery in Malayalam. After obtaining informed consent, participants who met the inclusion criteria were recruited for the study, as specified by the AIISH ethical committee. Neurotypical individuals who were willing to participate were also selected after obtaining informed consent. Preferably caregivers of PWA who satisfied the inclusion criteria were taken; however, it was not limited to them. The caregivers are preferably chosen in the control group to suit the communicative environment and socio-economic status of both groups.

The participants were instructed in Malayalam to rate their performance on the PRMQ. As per the original version, the authors have provided a proxy version as well. Hence, this was

also used wherever it was necessary. Each participant/caregiver received a PRMQ form and form to record demographic variables. The PRMQ was described as a set of questions about everyday memory failures common to all people. Participants received guidance on how to complete the instrument by rating how frequent they experienced each of the items in the questionnaire on a 5-point Likert scale: Never, Rarely, Sometimes, Quite Often, Very Often. Numerical values of 1 (Never) to 5 (Very Often) were subsequently allocated to the ratings. The maximum score is 80 points and reflects a high self-reported rate of memory failures. The minimum score is 16 points and corresponds to a low self-reported rate of memory failures. Subsequently, scores for prospective and retrospective items, short-term and long-term memory, as well as self-cued and environmentally-cued items were calculated separately. High scores indicate poor memory and low scores indicate good memory.

Phase 4: Test-Retest Reliability of the Questionnaire

10% of the participants recruited in the study were re-tested by another SLP to establish the reliability of the adapted PRMQ in Malayalam.

Phase 5: Analysis of the data

This phase of the study involved analysing the data collected. Analysis of their responses on the rating scale was scored individually for all the participants. This provided quantitative scores for the PMRQ in Malayalam. The raw scores were tabulated for the statistical analysis. Using SPSS software, the tabulated raw scores were analysed. Mean (X), Median (X), and Standard Deviation (SD) were used as statistical measures to arrive at normative scores for each domain. This data was subjected to appropriate statistical analysis to compare the performance of neurotypical individuals and persons with aphasia on various domains of the PMRQ.

Chapter 4: Results

The Prospective and Retrospective Memory Questionnaire (PRMQ) was developed to provide a measure of prospective and retrospective memory difficulties in daily life through self-report or proxy report. The main purpose of the study was to focus on how often each type of memory error took place. The questionnaire has been adapted to many languages worldwide including two Indian languages like Hindi and Tamil. Thus, the present study was aimed at adapting and validating The Prospective and Retrospective Memory Questionnaire to Malayalam (PRMQ-Malayalam). It was also aimed to identify the memory problems in neurotypical individuals and in persons with aphasia. After translating the material to Malayalam, appropriateness rating was done on 13 parameters like simplicity, familiarity, relevance, and generalisation. Ten Speech-Language Pathologists (SLPs) were given with the PRMQ to rate the appropriateness of the questions using the feedback questionnaire. This scale was an adaption of the "Feedback Questionnaire for Aphasia Treatment Manual" developed by Goswami, Shanbal, Samasthitha, and Navitha in 2012. These parameters were selected as they were most appropriate and most suited parameters to rate the questionnaire to establish its meaningfulness for individuals belonging to the cultural society of Kerala.

A detailed rating on the questionnaire given by ten SLPs is presented below:

Parameters concerned with the stimuli of the test like simplicity, familiarity and relevancy, seven out of ten SLPs rated as 'excellent' and three of them rated it as 'good'. This indicated that the questionnaire has maintained commonality and has good relevance to the cultural dimensions of the population that is intended to assess. For the parameters related to the test makeup like accessibility and feasibility, eight out of ten SLPs rated 'excellent' and two of them rated 'good'. For volume and relevancy, seven out of ten SLPs rated 'excellent' and three of them rated 'good'. For the parameter stimulability, four SLPs rated 'excellent' and

six SLPs rated ‘good’. This indicated that the test is good enough to sever its purpose in assessing the memory difficulties in the population. Parameters concerned with the output of the test like the scoring pattern was rated as ‘excellent’ by nine SLPs and one SLP rated it as ‘good’. In the scope of practice, four out of ten SLPs rated ‘excellent’ and six of them rated it as ‘good’. This indicated that in its scope of practice the PRMQ has good implications. For the parameter generalisation, three SLPs rated ‘excellent’ and seven SLPs rated it as ‘good’. This indicated that the PRMQ could be generalised and be used in other adult language disorders and various settings.

In the present study, the PRMQ-Malayalam was administered on 20 neurotypical individuals and 20 persons with aphasia in the age range of 35 to 75 years. Participants in the control group were of different aphasia types and varied in severity. Using SPSS software (version 21), the results obtained from the data were analysed on various aspects. Normality of the data was checked by administering the Shapiro-Wilk test. Normality test showed that the data was not normally distributed, i.e., $p < 0.05$. Hence, a non-parametric test was administered. Mean, Median, Standard Deviation (SD) and 95% confidence interval for mean were obtained for each domain using descriptive statistics. Further, the Mann-Whitney test was used to compare between groups and Wilcoxon Signed Ranks test was used for comparison within the group.

The findings of the present study are presented under the following headings:

I. Comparison of prospective memory of neurotypical individuals with persons with aphasia.
II. Comparison of retrospective memory of neurotypical individuals with persons with aphasia.

III. Comparison of total prospective and retrospective memory of neurotypical individuals with persons with aphasia.

IV. Comparison between prospective memory and retrospective memory in neurotypical individuals.

V. Comparison between prospective memory and retrospective memory in persons with aphasia.

I. Comparison of prospective memory of neurotypical individuals with persons with aphasia.

Prospective memory (PM) scores for neurotypical individuals and persons with aphasia (PWA) were calculated. To compare the scores across the groups, descriptive statistics was carried out. The Mean, Median and Standard deviation values are presented as below in Table 4 and Figure 1.

Table 4

Mean, Standard deviation and Median of prospective memory in neurotypical individuals and persons with aphasia

	Neurotypical	PWA
N	20	20
Mean	14.1000	22.5500
Standard deviation	3.69779	8.12064
Median	14.0000	21.5000

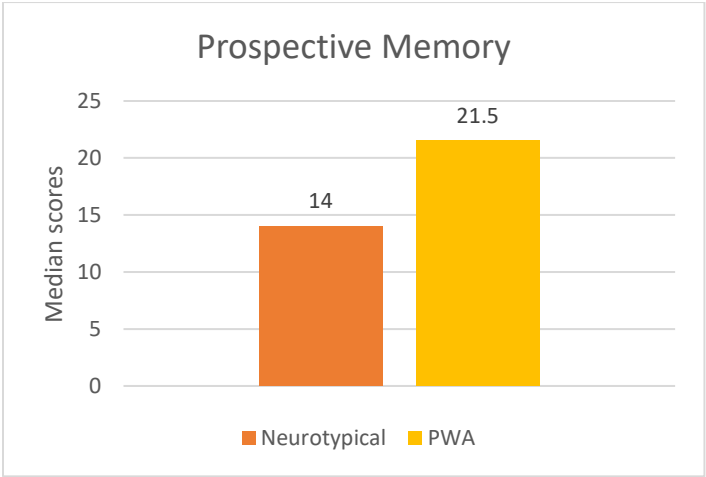

Figure 2: Prospective memory scores in Neurotypical individuals and PWA

Table 4 has two groups. One group is of neurotypical individuals with N=20, and the other group is of persons with aphasia with N=20. Neurotypical individuals had a mean score of 14.1 (SD: 3.69) while PWA had a mean score of 22.55 (SD: 8.12) in the prospective memory domain. The median values also followed the same direction; the median scores were higher for the PWA group (21.5) compared to the neurotypical group (14.0). It is clear that PWA has a mean score higher than neurotypical individuals. This means that PWA has reported more errors than neurotypical individuals in prospective memory. The standard deviation was slightly more for PWA group compared to the neurotypical group.

A more detailed comparison among question types was made in PWA under prospective memory domain. It included the variables term (short-term/long-term) and cueing (self/environmental). The variable term pertains to memories that are to be recalled for short periods of time or after long delays. It is measured by retention time: short-term and long-term. The variable cueing is for cues that prompt one to recall an incident or an action. Self-cueing requires free recall, while environmental cueing requires recognition. This is relevant for both prospective memory and retrospective memory, and for both short-term and long-term

remembering. The mean scores for each question under different question types are shown in Table 5.

Table 5

Means of memory error frequency ratings as a function of question category under Prospective Memory in PWA and neurotypical individuals

		Short-term				**Long-term**			
		Self-cued		**Envt. Cued**		**Self-cued**		**Envt. Cued**	
PWA	N	20	20	20	20	20	20	20	20
	Mean	3.45	2.85	2.50	2.70	2.70	2.40	2.55	2.10
	SD	1.09	1.38	1.43	1.30	1.62	1.14	1.27	1.16
Neurotypical individuals	N	20	20	20	20	20	20	20	20
	Mean	1.95	2.35	1.45	1.70	1.40	1.50	1.50	1.15
	SD	0.88	0.87	0.82	0.65	0.75	0.60	0.60	0.48

Note: The questions are from categories reflecting different aspects of memory, with two questions for each category. In the PRMQ, short-term self-cued category includes question nos. 1 & 16, short-term environmentally cued category includes question nos. 3 & 10, long-term self-cued category includes question nos. 5 & 14, and long-term environmentally cued category includes question nos. 7 & 12.
Envt. cued= environmentally cued.

Analysis of results using descriptive statistics revealed that, the highest number of ratings were of short-term self-cued category in both PWA (question no. 1: Mean=3.45, SD=1.09; question no. 16: Mean=2.85, SD=1.38) and neurotypical individuals (question no. 1: Mean=1.95, SD=0.88; question no. 16: Mean=2.35, SD=0.87) followed by ratings belonging to short-term environmentally cued category in both PWA (question no. 3: Mean=2.50, SD=1.43; question no. 10: Mean=2.70, SD=1.30) and neurotypical individuals (question no. 3: Mean=1.45, SD=0.82; question no. 10: Mean=1.70, SD=0.65), then long-term self-cued

category in both PWA (question no. 5: Mean=2.70, SD=1.62; question no. 14: Mean=2.40, SD=1.14) and neurotypical individuals (question no. 5: Mean=1.40, SD=0.75; question no. 14: Mean=1.50, SD=0.60) and lastly ratings belonging to long-term environmentally cued category in both PWA (question no. 7: Mean=2.55, SD=1.27; question no. 12: Mean=2.10, SD=1.65) and neurotypical individuals (question no. 7: Mean=1.50, SD=0.60; question no. 12: Mean=1.15, SD=0.48). Since high rating means poor memory, the results indicated that on prospective memory domain, both PWA and neurotypical individuals had highest errors in the short-term self-cued category and second highest errors were observed in the short-term environmentally cued category while the long-term self-cued category had third highest errors and the least errors were observed in the long-term environmentally cued category.

As it is clear from the Table 5, in PWA, the highest error was rated on question number 1, which says “Do you decide to do something in a few minutes' time and then forget to do it?” with a highest mean score of 3.45 among all the set of ratings. Whereas in neurotypical individuals, the highest error was rated on question number 16, which says “Do you forget to tell someone something you had meant to mention a few minutes ago?” with a highest mean score of 2.35 among all the set of ratings. Both questions come under the short-term self-cued category in prospective memory. At the same time, in both PWA and neurotypical individuals the lowest error was rated on question number 12, which says “Do you fail to mention or give something to a visitor that you were asked to pass on?” with lowest mean scores of 2.1 and 1.15 respectively. This question number 12 comes under the long-term environmentally cued category.

Further, in order to verify if there was any significant difference in prospective memory between PWA and Neurotypical individuals, Mann-Whitney test was applied to the data. The results revealed that there was a significant difference in prospective memory ($|Z| = 3.490$, p

<0.01) between neurotypical individuals and persons with aphasia. Thus, it was evident that PWA had more problems in prospective memory when compared to neurotypical individuals.

Summing up, in prospective memory when the performance of PWA and neurotypical individuals were compared across all the question categories such as short-term self-cued, short-term environmentally cued, long-term self-cued and long-term environmentally cued, it was found that PWA performed poorer than neurotypical individuals in all the categories. It also revealed that short-term self-cued category had the worst scores and long-term environmentally cued category had the best scores in both the groups. It was concluded that PWA performed significantly poorer than neurotypical individuals in prospective memory domain. Hence, the first null hypothesis, which says that there is no significant difference in prospective memory between neurotypical individuals and persons with aphasia, is rejected.

II. Comparison of retrospective memory of neurotypical individuals and persons with aphasia.

Retrospective memory (RM) scores for neurotypical individuals and persons with aphasia (PWA) were calculated. The scores compared across groups using descriptive statistics are shown in Table 6 and Figure 2.

Table 6

Mean, Standard deviation and Median of retrospective memory in neurotypical individuals and persons with aphasia

	Neurotypical	PWA
N	20	20
Mean	9.7500	15.8000
Standard deviation	2.46822	6.46936
Median	9.0000	15.0000

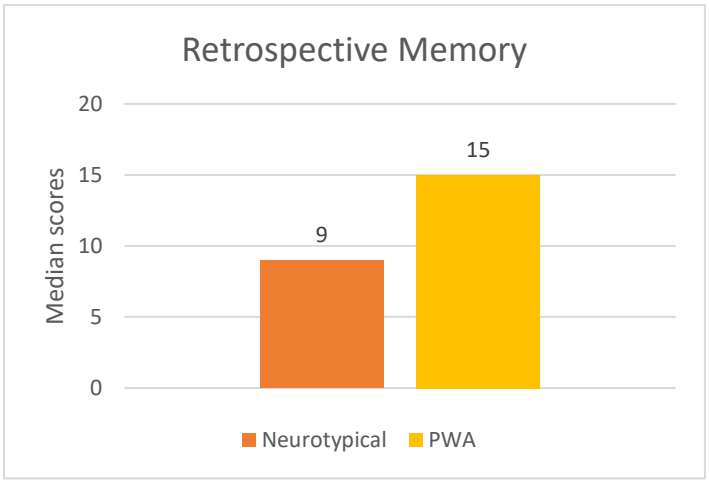

Figure 3: Retrospective memory scores in Neurotypical individuals and PWA

The total mean, standard deviation and median scores were compared across retrospective memory domain of the PRMQ in neurotypical individuals and persons with aphasia. Neurotypical individuals had a mean score of 9.75 (SD: 2.46), and persons with aphasia had a mean score of 15.80 (SD: 6.46). The median values were also in a similar line; it was 15.0 for PWA group and 9.0 for the neurotypical group. It is evident that PWA has a mean score higher than neurotypical individuals. This means that, in retrospective memory, PWA has reported more errors than neurotypical individuals.

Under retrospective memory domain, a more thorough comparison between question types was made in PWA. Variables included were term (short-term/long-term) and cueing (self/environmental). The mean scores for each question under different question types are shown in Table 7.

Table 7

Means of memory error frequency ratings as a function of question category under Retrospective Memory in PWA and neurotypical individuals

		Short-term				**Long-term**			
		Self-cued		**Envt. Cued**		**Self-cued**		**Envt. Cued**	
PWA	N	20	20	20	20	20	20	20	20
	Mean	2.15	2.55	1.40	1.45	1.95	1.65	1.60	2.25
	SD	1.30	1.31	0.82	0.60	1.35	0.87	0.94	1.33
Neurotypical	N	20	20	20	20	20	20	20	20
individuals	Mean	1.15	1.50	1.00	1.25	1.10	1.05	1.00	1.00
	SD	0.36	0.76	0.00	0.44	0.30	0.22	0.00	0.00

Note: Short-term self-cued category includes question nos. 4 & 11, short-term environmentally cued category includes question nos. 6 & 13, long-term self-cued category includes question nos. 8 & 15, and long-term environmentally cued category includes question nos. 2 & 9.
Envt. cued= environmentally cued.

Results of descriptive statistics showed that, in neurotypical individuals the highest scores were reported in short-term self-cued category which included questions 4 (Mean=1.15, SD=0.36) and 11 (Mean=1.50, SD=0.76) followed by scores of short-term environmentally cued category which included questions 6 (Mean=1.00, SD=0.00) and 13 (Mean=1.25, SD=0.44), and then long-term self-cued category which included questions 8 (Mean=1.10, SD=0.30) and 15 (Mean=1.05, SD=0.22), and lowest scores were reported in long-term

environmentally cued category which included questions 2 (Mean=1.00, SD=0.00) and 9 (Mean=1.00, SD=0.00).

Concurrently, the highest scores in PWA was reported in short-term self-cued category which included questions 4 (Mean=2.15, SD=1.30) and 11 (Mean=2.55, SD=1.31) followed by scores of long-term environmentally cued category which included questions 2 (Mean=1.60, SD=0.94) and 9 (Mean=2.25, SD=1.33), long-term self-cued category which included questions 8 (Mean=1.95, SD=1.35) and 15 (Mean=1.65, SD=0.87) and least scores were reported in short-term environmentally cued category which included questions 6 (Mean=1.40, SD=0.82) and 13 (Mean=1.45, SD=0.60).

This suggested that the highest errors in both PWA and neurotypical individuals on retrospective memory domain was observed in the short-term self-cued category. While long-term environmentally cued category in PWA had the second highest errors, in neurotypical individuals, the short-term environmentally cued category had the second highest errors. Third highest errors were observed in the long-term self-cued category in both PWA and neurotypical individuals. Least errors in PWA were observed in the short-term environmentally cued category, whilst in neurotypical individuals least/no errors were observed in the long-term environmentally cued category.

It is obvious in Table 7 that, on retrospective memory domain, both PWA and neurotypical individuals had the highest errors rated on question number 11, which is “Do you mislay something, that you have just put down, like a magazine or glasses?”. This question falls under the category short-term self-cued, with a highest mean score of 2.55 in PWA and 1.50 in neurotypical individuals. Meanwhile, the lowest error in PWA was rated on question number 6 from short-term environmentally cued category with a lowest mean score of 1.4, which is “Do you fail to recognise a character in a radio or television show from scene to

scene?", no errors were rated on question numbers 2 and 9 of the long-term environmentally cued category with the same mean score 1.0. The questions 2 and 9 are as follows "Do you fail to recognise a place you have visited before?" and "Do you repeat the same story to the same person on different occasions?".

Further, the Mann-Whitney test was carried out to verify if there was any significant difference in retrospective memory between PWA and Neurotypical individuals. Results of the statistical test revealed a significant difference in the retrospective memory scores between Neurotypical individuals and PWA ($|Z| = 3.613$, $p < 0.01$). The performance of the PWA group was found to be poorer than Neurotypical individuals.

In summary, the performance of PWA and neurotypical individuals in retrospective memory and the question categories under it like short-term self-cued, short-term environmentally cued, long-term self-cued and long-term environmentally cued indicated that PWA performed significantly poorer than neurotypical individuals. It was also found that, like in prospective memory, the short-term self-cued category had the worst scores in both the groups. On the contrary, the best scores were found in the short-term environmentally cued category in PWA, while neurotypical individuals had the best scores in the long-term environmentally cued category. Thus, with the above-mentioned findings, the second null hypothesis stating that there is no significant difference in retrospective memory between neurotypical individuals and persons with aphasia is rejected.

III. Comparison of total prospective and retrospective memory of neurotypical individuals with persons with aphasia.

The total prospective and retrospective memory scores for neurotypical individuals and persons with aphasia (PWA) were calculated. Scores were compared across the groups using

descriptive statistics. The Mean, Median and Standard deviation values are demonstrated in Table 8 and Figure 3.

Table 8

Mean, Standard deviation and Median of the total prospective and retrospective memory in neurotypical individuals and persons with aphasia

	Neurotypical	PWA
N	20	20
Mean	23.85000	38.3500
Standard deviation	6.01117	14.30228
Median	23.0000	34.5000

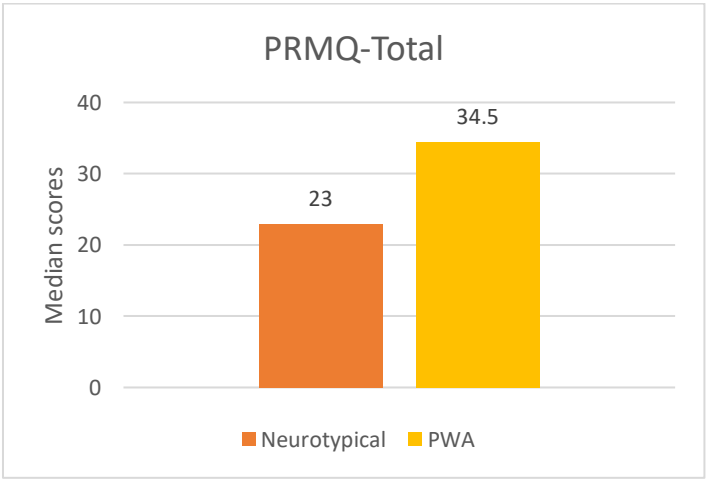

Figure 4: PRMQ-Total scores in neurotypical individuals and PWA

Note: PRMQ= prospective and retrospective memory questionnaire

Analysis of results for the performance of neurotypical individuals with PWA on the total prospective and retrospective memory scores employing descriptive statistics revealed that the mean score for the neurotypical group was 23.85 (SD: 6.01), whereas PWA had a mean score of 38.35 (SD: 14.3). The median score for the neurotypical group was 23.0, while it was 34.5

for the PWA group. This means that PWA has reported more errors than neurotypical individuals in the total prospective and retrospective memory questionnaire.

A detailed comparison across question types was made in PWA, which included the variables: memory (prospective memory/ retrospective memory), term (short-term/long-term) and cueing (self/environmental). The mean scores for each question type under both domains in PWA and neurotypical individuals are shown in Table 9.

Table 9

Means of memory error frequency ratings as a function of group and question category in PWA and neurotypical individuals

		Prospective				**Retrospective**			
		Short-term		**Long-term**		**Short-term**		**Long-term**	
		Self	**Envt**	**Self**	**Envt**	**Self**	**Envt**	**Self**	**Envt**
PWA	**Mean**	3.15	2.60	2.55	2.32	2.35	1.42	1.80	1.92
	SD	1.27	1.35	1.39	1.22	1.31	0.71	1.13	1.18
Neurotypical individuals	**Mean**	2.15	1.57	1.45	1.32	1.32	1.12	1.07	1.00
	SD	0.89	0.74	0.67	0.57	0.61	0.33	0.26	0.00

Note: Self= self-cued; Envt= environmentally cued

It is clear from the Table 9 that, in neurotypical individuals, when categories under PM and RM domains were compared it was found that the total short-term errors (M=1.54) were rated more frequently than total long-term errors (M=1.21) and total self-cued errors (M=1.49) were rated more frequently than total environmentally-cued errors (M=1.25). It was interesting to note that even in neurotypical participants, errors were reported in both PM and RM

domains. It was also noted that more errors were reported in PM domain than RM domain. Although the errors reported in neurotypical participants were much lesser when compared to PWA. It was worth noting that in RM domain, the long-term environmentally cued category had reported no errors at all in the neurotypical group.

In PWA, for both PM and RM domains the total short-term errors (M=2.38) were rated more frequently than total long-term errors (M=2.14), and total self-cued errors (M=2.46) were rated more frequently than total environmentally-cued errors (M=2.06). Although from individual category scores, it was observed that in RM long-term category, self-cued errors (M=1.80) were rated less frequently than environmentally cued errors (M=1.92). Results of descriptive statistics also indicated that only the means for prospective memory short-term errors (M=2.87) and retrospective memory long-term errors (M=1.86) differed substantially from each other. As it is previously noted, it is needless to mention that PM was rated more frequently than RM in persons with aphasia. To conclude, in both neurotypical individuals and PWA, short-term errors were reported more than long-term errors, and self-cued errors were reported more than environmentally cued errors.

Mann-Whitney test was used to analyse the data for the presence of a significant difference between the mean scores of Neurotypical individuals and PWA on the total prospective and retrospective memory. It was found that there was a significant difference in the total prospective and retrospective memory ($|Z| = 3.688$, $p < 0.01$) between the two groups. Thus, it was evident that PWA performed poorer in the total prospective and retrospective memory scores as compared to neurotypical individuals.

In summary, the PRMQ-Total scores revealed that PWA performed significantly poorer than neurotypical individuals in all domains and all question categories. Hence, the third null

hypothesis is rejected, as it states that there is no significant difference in the total prospective and retrospective memory between neurotypical individuals and persons with aphasia.

IV. Comparison between prospective memory and retrospective memory in neurotypical individuals.

Prospective memory scores and retrospective memory scores were calculated separately in neurotypical individuals. The scores compared within the neurotypical group using descriptive statistics are exhibited in Table 10 and Figure 4.

Table 10

Mean, Standard deviation and Median of prospective memory and retrospective memory within neurotypical individuals.

	Prospective Memory	Retrospective Memory
N	20	20
Mean	14.1000	9.7500
Standard deviation	3.69779	2.46822
Median	14.0000	9.0000

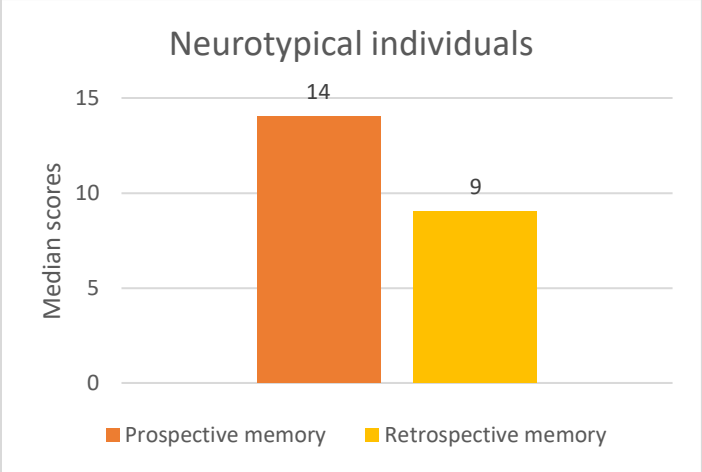

Figure 5: Prospective and retrospective memory within neurotypical individuals

The mean, standard deviation and median scores of the two domains of PRMQ, i.e., prospective memory domain and retrospective memory domain were compared within the neurotypical group. Results revealed that neurotypical individuals had a mean score of 14.1 (SD: 3.69) in the prospective memory domain, while a mean score of 9.75 (SD: 2.46) was observed in the retrospective memory domain. Following the same direction, a median score of 14.0 was observed in prospective memory and 9.0 in retrospective memory. This means that, in neurotypical individuals, more problems were reported in prospective memory than retrospective memory.

A more detailed comparison was made across question types in Neurotypical individuals under both PM and RM domains which included the variables term (short-term/long-term) and cueing (self/environmental). The mean scores for each question under different question types in neurotypical individuals are shown in Table 11.

Table 11

Means of memory error frequency ratings as a function of group and question category in Neurotypical individuals

		Short-term				Long-term			
		Self-cued		Envt. Cued		Self-cued		Envt. Cued	
Prospective	**N**	20	20	20	20	20	20	20	20
memory	**Mean**	1.95	2.35	1.45	1.70	1.40	1.50	1.50	1.15
	SD	0.88	0.87	0.82	0.65	0.75	0.60	0.60	0.48
Retrospective	**N**	20	20	20	20	20	20	20	20
memory	**Mean**	1.15	1.50	1.00	1.25	1.10	1.05	1.00	1.00
	SD	0.36	0.76	0.00	0.44	0.30	0.22	0.00	0.00

Note: In PM, short-term self-cued category includes question nos. 1 & 16, short-term environmentally cued category includes question nos. 3 & 10, long-term self-cued category includes question nos. 5 & 14, and long-term environmentally cued category includes question nos. 7 & 12.
In RM, short-term self-cued category includes question nos. 4 & 11, short-term environmentally cued category includes question nos. 6 & 13, long-term self-cued category includes question nos. 8 & 15, and long-term environmentally cued category includes question nos. 2 & 9.

It was concluded before in Table 10 that, retrospective memory errors were rated less frequently than prospective memory errors in neurotypical individuals. Further, mean scores of each question under different categories were compared across both domains and it became apparent that, in both the domains the largest number of errors were reported in short-term self-cued category which included question numbers 1 (Mean=1.95, SD=0.88) and 16 (Mean=2.35, SD=0.87) in PM and question numbers 4 (Mean=1.15, SD=0.36) and 11 (Mean=1.50, SD=0.76) in RM followed by errors reported in short-term environmentally cued category which included questions 3 (Mean=1.45, SD=0.82) and 10 (Mean=1.70, SD=0.65) in PM and

question numbers 6 (Mean=1.05, SD=0.22) and 13 (Mean=1.20, SD=0.41) in RM, and then long-term self-cued category which included questions 5 (Mean=1.40, SD=1.75) and 14 (Mean=1.50, SD=0.60) in PM and question numbers 8 (Mean=1.10, SD=0.30) and 15 (Mean=1.05, SD=0.22) in RM and least errors were reported in long-term environmentally cued category which included questions 7 (Mean=1.50, SD=0.60) and 12 (Mean=1.15, SD=0.48) in PM and question numbers 2 (Mean=1.00, SD=0.00) and 9 (Mean=1.00, SD=0.00) in RM. This indicated that, in neurotypical individuals, on both PM and RM domains largest errors were observed in the short-term self-cued category and the second largest errors were observed in the short-term environmentally cued category while the third largest errors were observed in the long-term self-cued category and only minimal errors were observed in the long-term environmentally cued category.

It is very clear from the Table 11 that, on prospective memory domain the maximum errors were rated on question number 16 of short-term self-cued category, which is “Do you forget to tell someone something you had meant to mention a few minutes ago?”. While, minimum errors were rated on question number 12 of short-term environmentally cued category, which is “Do you fail to mention or give something to a visitor that you were asked to pass on?”. Concomitantly, on retrospective memory domain, the maximum errors were rated on question number 11 of short-term self-cued category, which is “Do you mislay something, that you have just put down, like a magazine or glasses?”. While, no errors were rated on question numbers 2 and 9 of long-term environmentally cued category, which are “Do you fail to recognise a place you have visited before?” and “Do you repeat the same story to the same person on different occasions?” respectively. It was also noted that on RM domain, there were no errors observed in neurotypical individuals on question number 6 of short-term self-cued category, which is “Do you fail to recognise a character in a radio or television show from scene to scene?”. Hence, in neurotypical individuals, similar results were observed on both PM

and RM domains. To conclude, in both PM and RM: Short-term self-cued category> short-term environmentally cued category> long-term self-cued category> long-term environmentally cued category.

Wilcoxon Signed Ranks test was further carried out to verify if there was any significant difference between prospective memory and retrospective memory within neurotypical individuals. Analysis of the results revealed that there was a significant difference ($|Z| = 3.874$, $p < 0.01$) between prospective memory and retrospective memory within neurotypical individuals. Therefore, it was clear that neurotypical individuals had significant problems in prospective memory when compared to retrospective memory. It was noted that, while there were errors present in prospective memory, errors were rarely observed in retrospective memory.

To summarise, the short-term self-cued category had the worst scores in both the PM and RM domain, and the long-term environmentally cued category had the best scores in both domains. The results for the performance of neurotypical individuals also revealed that better scores were obtained in retrospective memory domain than prospective memory domain. Hence, the fourth null hypothesis stating that there is no significant difference between prospective memory and retrospective memory in neurotypical individuals is rejected.

V. Comparison between prospective memory and retrospective memory in persons with aphasia.

Performance of PWA on prospective memory domain and retrospective memory domain were analysed and calculated separately. Descriptive statistics was performed to compare the scores within the group and are displayed below in Table 12 and Figure 5.

Table 12

Mean, Standard deviation and Median of prospective memory and retrospective memory within PWA.

	Prospective Memory	Retrospective Memory
N	20	20
Mean	22.5500	15.8000
Standard deviation	8.12064	6.46936
Median	21.5000	15.0000

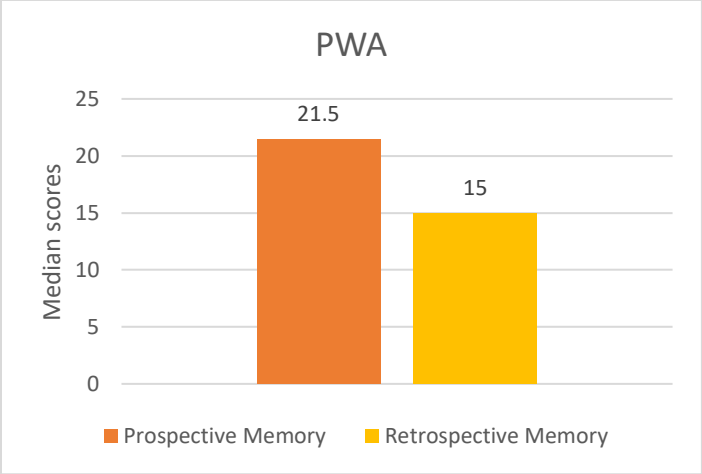

Figure 6: Prospective and retrospective memory within PWA

Results of the descriptive statistics of prospective memory domain and retrospective memory domain of the PRMQ were compared within the PWA group. It was found that mean scores obtained in prospective memory domain was 22.55 (SD: 8.12), whereas mean scores obtained in retrospective memory domain was 15.8 (SD: 6.46). It is clear that prospective memory has slightly higher mean scores than retrospective memory. The median values also followed a similar pattern as the median scores were slightly higher in prospective memory (21.5) when compared to retrospective memory (15.0). This means that the PWA group has

reported problems in both prospective and retrospective memory, but more problems were reported in prospective memory.

A more detailed analysis was made in PWA across question types under both PM and RM domains, which included both the term (short/long term) and cueing (self/environmental) variables. The mean scores for each question in PWA are shown in Table 13, under different question types.

Table 13

Means of memory error frequency ratings as a function of group and question category in PWA

		Short-term				**Long-term**			
		Self-cued		**Envt. Cued**		**Self-cued**		**Envt. Cued**	
Prospective	**N**	20	20	20	20	20	20	20	20
memory	**Mean**	3.45	2.85	2.50	2.70	2.70	2.40	2.55	2.10
	SD	1.09	1.38	1.43	1.30	1.62	1.14	1.27	1.16
Retrospective	**N**	20	20	20	20	20	20	20	20
memory	**Mean**	2.15	2.55	1.40	1.45	1.95	1.65	1.60	2.25
	SD	1.30	1.31	0.82	0.60	1.35	0.87	0.94	1.33

Note: In PM, short-term self-cued category includes question nos. 1 & 16, short-term environmentally cued category includes question nos. 3 & 10, long-term self-cued category includes question nos. 5 & 14, and long-term environmentally cued category includes question nos. 7 & 12.
In RM, short-term self-cued category includes question nos. 4 & 11, short-term environmentally cued category includes question nos. 6 & 13, long-term self-cued category includes question nos. 8 & 15, and long-term environmentally cued category includes question nos. 2 & 9.

As discussed earlier in Table 12, prospective memory errors were rated more frequently than retrospective memory errors in PWA. Further, comparisons of mean scores of each

question under different categories across both domains were made. Mean scores in PM domain highlighted that, the short-term self-cued category had the greatest number of errors with a mean score of 3.45 and 2.85 in question numbers 1 and 16 respectively, followed by scores belonging to the short-term environmentally cued category of question numbers 3 and 10 with mean scores 2.50 and 2.70, respectively. This was followed by the long-term self-cued category with mean scores of 2.70 and 2.40 in question numbers 5 and 14 respectively, and the minimal ratings belonged to the long-term environmentally cued category with mean scores of 2.55 and 2.10 in question numbers 7 and 12.

On the other hand, the mean scores of RM domain displayed that the highest number of errors were reported in short-term self-cued category (question no. 4= 2.15 and question no. 11= 2.55) which was similar to PM domain, but the second highest rated errors were in long-term environmentally cued category (question no. 2= 1.60 and question no. 9= 2.25), unlike the PM domain. The next highest rated errors were rated on the long-term self-cued category (question no. 8= 1.95 and question no. 15= 1.65) which was similar to PM domain and the poorest scores were rated in short-term environmentally cued category (question no. 6= 1.40 and question no. 13= 1.45), unlike PM domain.

Since the highest score means more errors reported, it suggested that on prospective memory domain the maximum errors were rated on question number 1 of short-term self-cued category, which is “Do you decide to do something in a few minutes’ time and then forget to do it?”. Whilst, minimum errors were rated on question number 12 of short-term environmentally cued category, which is “Do you fail to mention or give something to a visitor that you were asked to pass on?”. Simultaneously, on retrospective memory domain, the maximum errors were rated on question number 11 of short-term self-cued category, which is “Do you mislay something, that you have just put down, like a magazine or glasses?” and lowest errors were rated on question number 6 of short-term environmentally cued category,

which is “Do you fail to recognise a character in a radio or television show from scene to scene?”. To conclude, in PM: short-term self-cued category> short-term environmentally cued category> long-term self-cued category> long-term environmentally cued category. In RM: short-term self-cued category> long-term environmentally cued category> long-term self-cued category> short-term environmentally cued category.

Further, in order to verify if there was any significant difference between prospective memory and retrospective memory within PWA, Wilcoxon Signed Ranks test was carried out. The results revealed that there was a significant difference between prospective memory and retrospective memory ($|Z| = 3.931$, $p < 0.01$) within PWA. Thus, it was evident that PWA had significantly more problems in prospective memory than in retrospective memory.

In summary, the PM domain had the best scores in the long-term environmentally cued category and worst scores in the short-term self-cued category. In RM domain, the short-term environmentally cued category had the best scores, and short-term self-cued category had the worst scores. The results also revealed that PWA had significantly poorer scores in prospective memory domain than retrospective memory domain. Hence, the null hypothesis for objective 5, which says that there is no significant difference between prospective memory and retrospective memory in PWA, is rejected.

Chapter 5: Discussion

The present study aimed at adapting and validating the Prospective and Retrospective Memory Questionnaire (PRMQ) in the Malayalam language. Validation of the PRMQ-Malayalam done by administering it on a sample of 20 neurotypical individuals and 20 persons with aphasia (PWA). The age range for both groups was ≥35 years to ≤75 years. PRMQ-Malayalam comprises a total of 16 questions divided into two major domains, namely prospective memory (PM) and retrospective memory (RM). Each item of PM and RM is further categorized according to two subcategories, such as time (short-term and long-term) and track (self-cued and environmentally cued). Each of the 16 items has three dimensions; for example, item 7 "Do you forget to buy something you planned to buy, such as a birthday card, even if you see the store?" evaluates prospective, long-term memory, with a clue in the external environment. Prospective and retrospective memory was assessed and compared between neurotypical individuals and persons with aphasia to check the severity of memory problems among them. The responses obtained from the participants were calculated, analyzed and processed using SPSS version 21.0. The findings of the study are discussed under the following headings:

1. Comparison of prospective memory and retrospective memory in neurotypical individuals
2. Comparison of prospective memory and retrospective memory in PWA
3. Comparison of prospective and retrospective memory between neurotypical individuals and persons with aphasia.

5.1. Prospective and retrospective memory in neurotypical individuals

The findings of the study revealed that neurotypical individuals rated higher errors in PM than RM, though the difference was modest. This finding is consistent with most of the earlier findings (Smith et al., 2000; Crawford et al., 2003; Khan & Sharma, 2007; Ronnlund et al., 2008; Piauilino et al., 2010). Smith et al. (2000) accounted for this disparity due to the greater impact of PM loss on life, which makes it more perceptible and thus more likely to report. Another possible reason could be that since the retrieval processes are more vulnerable to failure when an external cue is absent, PM failures are reported more. This supports the hypothesis stated by Craik (1986) that the discrepancies between PM and RM arise because they are confounded respectively with self-generated and environmentally-cued retrieval. Hence, the performance differences between PM and RM are justified.

In the subcategories, the findings of this study also indicated that short-term errors were reported more than long-term errors in both the memories (Smith et al., 2000; Crawford et al., 2003). Again, this may be because short-term errors impact more on daily life and are therefore more noticeable. It was also noticed that short-term errors in prospective memory were more than short-term errors in retrospective memory. The probable explanation for higher errors in short-term prospective memory could be that memory task in day to day life is performed while doing other concurrent tasks. It creates heavy demands on cognitive resources of an individual. This results in larger errors in short-term prospective tasks. Also, as pointed out by Harris (1980), various memory aids, such as calendars and diaries, are more likely to support tasks that are not to be carried out immediately. This does not make heavy demand on cognitive resources; rather, the individual performs the task according to the priority of the task. This results in relatively lesser errors in long-term prospective tasks.

Further, the results revealed that self-cued errors were reported more than environmentally cued errors in both the memories. These findings are in line with the findings by Smith et al. (2000). This could be attributed to the fact that self-cued recalling requires greater self-initiation than environmentally cued recalling. Fewer errors in environmentally cued memory can be due to the possibility that the cue itself was sufficient enough to trigger the retrieval of memory. Again, it can be explained on the basis of an individual's cognitive load (Craik, 1986). Self-cued requires larger cognitive capacity in processing of information than environmentally cued.

The results of the current study also highlighted that for both the memories, short-term self-cued errors were rated higher than long-term and environmentally cued. Equivalent findings on PRMQ was evidenced by several other studies (Smith et al., 2000; Khan & Sharma, 2007). A possible reason could be that retrieval failures are observed more in self-cued tasks and also the higher cognitive load required for short-term memory makes it more difficult to recall short-term self-cued memory. Therefore, participants rated higher errors on short-term self-cued memory. Further, it can be explained as "momentary lapses of intention" in the case of prospective memory. While for the retrospective memory, this failure can be regarded as a failure at encoding (Craik & Kerr, 1996; West & Craik, 1999).

5.2. Prospective and retrospective memory in PWA

PM and RM was assessed on PWA, and the results indicated that PWA had much higher errors in PM than RM. In the subcategories, short-term errors were rated much higher than long-term errors, and self-cued errors were rated higher than environmentally cued errors. These factors were not investigated in the previous studies of PRMQ in Aphasia population. Since it is a novel study, there is not enough data to directly compare along the same lines of this study. Having said that, PRMQ studies done on stroke patients and other cognitive

disorders are available. Research findings of post-stroke aphasia assessing memory problems using other test materials are extrapolated to the PWA group of this study. The findings from some of these studies fit the findings obtained from the current research, and there are studies which refute the finding of this study.

The results of this study revealed that in persons with aphasia, PM was affected much more than RM and the possible reason for which might be that PM requires greater self-initiated retrieval than RM. There is no external agent which prompts a person to perform the task under prospective memory condition. Whereas, unlike prospective memory task, under retrospective memory, there is an external agent (experimenter who acts as an external cue to perform a task) who prompts the subject for initiation of the action. Therefore, due to the nature and condition of PM, cognitive load is high when performing the task, leading to greater error. This can reflect either a real difference in performance between PM and RM or various levels of discomfort caused by PM and RM errors. It was reported by Smith et al. (2000) that PM problems cause more stress in carers than RM problems. Thus, the findings of this study are inconsistent with the argument of Dobbs and Reeves (1996), that PM is not any different from RM. From the results of this study, it is clear that PM is of a different system of cognition than RM.

The finding of this study is supported by an investigation done by Man, Yip, Lee, Fleming and Shum (2015) as they could differentiate the self-reported PM failures of two stroke groups (an older group and a younger group) and their corresponding age-matched control groups using the test materials such as “Brief Assessment of Prospective Memory (BAPM), Basic Activity of Daily Living (BADL) and Lawton Instrumental Activities of Daily Living (Lawton IADL) Scale”. In conformity with the current study, PM performance of the stroke patients were poorer than controls, and the results also indicated that the older group of stroke patients considered their PM failure considerably more frequent than the younger group of stroke patients. On the similar lines, a study by Tinson and Lincoln (1987) found that the stroke

patients reported significantly more memory failures than orthopaedic controls on the Everyday Memory Questionnaire by Sunderland et al. (1984). This was also supported by a systematic review done by Tang et al. (2018) on stroke survivors wherein cognitive decline, including memory loss, was observed post-stroke. A narrative review made by Salako and Imaezue (2017) supports this study since the authors concluded that post-stroke aphasia always co-occurs with cognitive impairments like attention deficits, memory deficits and executive function deficits.

Another study by Kim et al. (2009) investigated whether stroke affects PM and RM in chronic stroke survivors who are non-demented and living in the community independently. The PRMQ scores were compared with the performance of PM and RM measured on laboratory tests. The results on the laboratory measurements were in accordance with the findings of this study as the stroke patients performed significantly poorer than controls on PM than associative RM. However, the PRMQ scores on stroke patients revealed that RM had higher errors than PM errors, which was in contrast to the present study. Also, stroke patients scored only marginally lower than controls on PM and RM scores. This can be attributed to the fact that stroke patients included were the ones without any language deficit or cognitive deficit. Similar results were found in the PRMQ scores of Alzheimer's disease (Smith et al., 2000); however, the prospective-retrospective difference was not very evident. A study by Hsu, Huang, Tu and Hua (2014) also yielded similar results on Early Alzheimer's disease (AD) through a proxy-report of the PRMQ. This supported the view that PM assessments are susceptible to the early stages of dementia (Huppert & Beardsall, 1993) and that PM performance contributed independently to the diagnosis of AD beyond that of RM performance (Jones, Livner & Backman, 2006). It was thus concluded that PM failures resulted in a greater impact on life and it was more noticeable to the informants rather than RM.

Short-term errors were found to be greater than long-term errors in both the memories. This result is consistent with the general findings in short-term and long-term memory (Smith et al., 2000; Khan & Sharma, 2007; Hsu et al., 2014). The results also exhibited that self-cued errors were reported more frequently than environmentally cued errors in both the memories, but higher errors were reported in PM. In prospective memory with an external clue, the memory of the intention is linked to an indicator in the environment, such as a reminder or a sign that represents the content of the intention which makes it easy to remember. This is in support of the experimental study by Cherry, Martin, Simmons-D'Gerolamo, Pinkston, Griffing, and Drew Gouvier, 2001. Whereas, studies with an internal clue require the realization of an intention after a certain period of time using a self-generated indicator, which makes it difficult to remember. This is supported by the study by Einstein et al. (1995). It has been suggested that PM processes with an external clue are more automatic and spontaneous and that PM processes with an internal clue depend more on self-initiation and conscious processing (Einstein et al., 1995). Findings from previous stroke studies are also consistent with the findings (Brooks et al., 2004; Cheng et al., 2010; Kim et al., 2009). Time-based tasks were harder than event-based tasks in prospective memory for both the stroke patients and the control group.

The results of the subcategories caught attention due to the marked difference between PM and RM for short-term environmentally cued tasks. It was found that in PWA, the short-term environmentally cued category in RM had the least errors. In contrast, the short-term environmentally cued category in PM had the most errors. This result is in agreement with the results of the study by Smith et al. (2000). It is no surprise that such errors have been rare for RM as the recognition tasks are insignificant and not demanding over short time delays. On the contrary, short-term environmentally-cued PM tasks are vulnerable to failure as the errors in an environmentally-cued task can be attributed to either the failure of the individual in

recognizing the cue or the possibility that the cue was not sufficient to trigger the initiation of action. This is to say that, an environmental cue may suffice for a RM task but not for a PM task that still needs some degree of self-initiated action (although obviously less than for a self-cued task).

5.3. Prospective and retrospective memory between neurotypical individuals and persons with aphasia.

The results revealed that neurotypical individuals reported significantly lesser errors in both PM and RM when compared to PWA. Neurotypical participants also had significantly lesser errors across all the subcategories. It was also noticed that the PWA group had significantly higher errors in PM when compared to RM. This is in accordance with a study by Barr (2011), where the community-dwelling stroke patients in comparison with healthy controls performed significantly lower on the objective measures of PM. In contrast, when the self-rating version of PRMQ was assessed, it was found that healthy controls and stroke patients had no difference in PM and RM (Barr, 2011). This can be because the selected stroke patients were fluent speakers living independently in the community and had no reported post-stroke impairments.

A proxy-report study of PRMQ by Thompson, Henry, Rendell, Withall, Henry and Brodaty, (2015) is in compliance with the results of the present study as it indicated that the dementia group had poorer performance relative to both the control group and the MCI group. The MCI group also had significantly poorer performance than the control group. PM errors were reported more than RM errors in all three groups. Duchek, Balota, and Cortese (2006) also showed an evident PM deficit in older adults with very mild AD compared to healthy controls. The authors did not specifically compare the participants' prospective and

retrospective memory results but showed that the PM performance helped to differentiate between the very mild AD patients and healthy controls far beyond RM performance.

In contrast, a study by Eschen, Martin, Gasser and Kliegel (2009) found that dementia patients reported more RM problems on the PRMQ than PM, while healthy older participants and MCI patients reported both prospective and retrospective memory problems equally. Another contrastive study by Maylor, Smith, Della Sala, and Logie (2002) reported that when PM and RM was assessed, individuals with mild to moderate AD performed poorer than healthy controls on RM than on PM. This can be because the selected patients with AD had up to moderate severity and hence will have less insight into their memory problems unlike in PWA.

In a nutshell, it is concluded that PWA have more significant memory problems than neurotypical individuals and their problems are higher in prospective memory than retrospective. One of the main reasons for this is that PM impairment has a greater impact on life which makes it more noticeable and therefore more likely to report. Another possible reason could be that since the retrieval processes are more vulnerable to failure in the absence of an external cue, more failures are reported in prospective memory. Short-term errors were found to be greater than long-term errors in both the memories. This is because short-term tasks have to be carried out immediately, unlike long-term tasks, and that creates a cognitive load on an individual. The cues, external or internal, are responsible for stimulating the memory of an action (PM) or an event (RM). Self-cued memory was found to be poorer than environmentally cued memory. The reason for this could be that self-cued memory demands greater self-initiation, and it also needs conscious processing, whereas environmentally cued memory is more automatic and spontaneous, which makes it easier to retrieve. Thus, these are the possible reasons for the differences in PM and RM in both PWA and neurotypical individuals.

Chapter 6: Summary and conclusion

The present study was intended to adapt the Prospective and Retrospective Memory Questionnaire (PRMQ) given by Smith et al. (2000) to Malayalam and to validate it on PWA. The objectives of the study were to compare the prospective and retrospective memory in neurotypical individuals, to compare the prospective and retrospective memory in PWA, and to compare the prospective and retrospective memory between neurotypical individuals and PWA.

The PRMQ-Malayalam includes 16 questions which are equally divided into two major domains including prospective memory and retrospective memory. These two domains are further categorised into two sub-categories: time (short-term and long-term) and cueing (self-cued and environmentally cued). The scales of prospective and retrospective memory failures have the same number of items on all the sub-categories. A total of 40 participants of age range 35-75 years were involved in this study, of which 20 belonged to the neurotypical group, and 20 belonged to the persons with aphasia group. The PRMQ was adapted in Malayalam and appropriateness rating was done by 10 Speech-Language Pathologists who are well versed in Malayalam. It was then administered on all the 40 participants for validation of the questionnaire. The participants were asked to rate on a five-point Likert scale: never (1), rarely (2), sometimes (3), quite often (4), and very often (5). The maximum score is 80 points and the minimum score is 16 points.

The data obtained were tabulated and subjected to statistical analysis using SPSS software (version 21.0). Mean, Standard deviation, Median and confidence interval were calculated separately for both neurotypical individuals and persons with aphasia. Further, to explore the significance of the difference in performance Mann Whitney U test and Wilcoxon Signed Ranks test was carried out for both the groups. The findings indicated that PWA

performed statistically significantly poorer than neurotypical individuals in both the domains (prospective and retrospective) and all the sub-categories (short-term/long-term and self-cued/environmentally cued). It was also found that prospective memory (PM) was significantly poorer than retrospective memory (RM), short-term memory was poorer than long-term memory and self-cued memory was poorer than environmentally cued memory in both the groups.

Further, in neurotypical individuals, under both PM and RM domains the greatest errors were found to be primarily in the short-term self-cued category followed by short-term environmentally cued, long-term self-cued and the least errors in the long-term environmentally cued category. In persons with aphasia, under PM domain a pattern similar to neurotypical individuals was found in which short-term self-cued category had the highest errors followed by short-term environmentally cued, long-term self-cued and the long-term environmentally cued category. Whereas, in RM domain, although the principal errors were found to be in the short-term self-cued category itself, the second highest errors were observed in the long-term environmentally cued category. Errors in the short-term environmentally cued category were notably minimal. Thus, the overall pattern of errors under RM domain in PWA was short-term self-cued followed by long-term environmentally cued, long-term self-cued and short-term environmentally cued category. Thus, based on the overall findings, it can be concluded that there existed a difference in the pattern of errors in the prospective and retrospective memory of PWA when compared to neurotypical individuals.

Implications of the study

This study enabled one to understand that prospective and retrospective memory difficulties in aphasia are prevalent and should be evaluated routinely in clinical practice. The current results also indicate that the problems faced by PWA occur in circumstances where

environmental cues do not well support the required action. Retrieval processes must, therefore, be 'self-initiated' by the subjects themselves. This calls for the need that memory issues in PWA be evaluated before intervention as it will help in guiding intervention focusing on prospective and retrospective memory in PWA. The PRMQ does seem to be a useful tool in countries that differ in social characteristics to assess reports of prospective and retrospective memory deficits. Individuals with larger deficits in prospective memory may be more susceptible to anxiety and depression as prospective memory is pivotal for performing a wide variety of daily activities. Therefore, at the assessment stage, clinicians should screen for low mood and anxiety routinely, and closely monitor individuals throughout rehabilitation. The outcome of this study thereby provided an insight into the additional cognitive problems observed in PWA. Aphasia therapy, therefore, must tackle comorbid cognitive problems in addition to language deficits in order to be more successful in recovering aphasia.

Limitations of the study

The present study included a limited sample size in each group; nonetheless, the results showed substantial differences between the clinical group and the control group. However, a replication of this study's findings with larger samples would be worthwhile. The results were also not compared across gender as the sample contained much fewer data. Also, the type of aphasia for the clinical group was not controlled, which could be indicative of heterogeneity in the sample.

Future directions

- The present research provides only perceived memory and not real performance of the memory. Researching the PRMQ questions on the basis of experimental studies will provide more insight into prospective and retrospective memory.

- Further research is required to explore the interactive impact of cognitive impairment and aphasia therapy on language recovery in patients with aphasia following a stroke.
- The utility of other external (e.g., smartphone applications) and internal compensatory rehabilitation approaches in PWA could be investigated in future

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APPENDIX I

PROSPECTIVE AND RETROSPECTIVE MEMORY QUESTIONNAIRE

P.R.M.Q (പി. ആർ. എം. ക്യൂ)

Malayalam Version by:

Swaliha Shahama K A

S P Goswami

AIISH, Mysore-570006

Email: swaliha.shahama@gmail.com

ചില ആളുകൾക്ക് സാധാരണ ദൈനംദിന ജീവിതത്തിൽ ചില ഓർമ്മ കുറവുകൾ വരാറുണ്ട്. ഈ ചോദ്യാവലിയിലൂടെ ഞങ്ങൾ നിങ്ങളുടെ ഓർമ്മ ശക്തിയെ പരിശോധിക്കാൻ പോകുകയാണ്. താഴെ കൊടുത്തിരിക്കുന്ന ചെക്ലിസ്റ്റിൽ നിങ്ങൾക്ക് സംഭവിക്കുന്ന ഓർമ്മ കുറവുകൾ ഉണ്ടെങ്കിൽ ഉചിതമായ ബോക്സിൽ ടിക്ക് ചെയ്തുകൊണ്ട് ദയവായി സൂചിപ്പിക്കുക.

നിങ്ങളുടെ സാഹചര്യത്തിന് പൂർണ്ണമായും ബാധകമല്ലെന്ന് തോന്നുന്നില്ലെങ്കിലും, ഷീറ്റിന്റെ ഇരുവശത്തുമുള്ള എല്ലാ ചോദ്യങ്ങൾക്കും നിങ്ങൾ ഉത്തരം നൽകുന്നുവെന്ന് ഉറപ്പാക്കുക.

പേര്: _____ വയസ്സ്: _____ പുരുഷൻ/സ്ത്രീ: _____

വിദ്യാഭ്യാസം: _____

വിലാസം: _____

	എല്ലായ് പോഴും	കൂടു തലും	ചില പ്പോൾ	അപ്പൂർ വ്വമായി	ഒരിക്ക ലും ഇല്ല
1. നിങ്ങൾ ചെയ്യാൻ ഉദ്ദേശിച്ച ഒരു കാര്യം കുറച്ചു സമയത്തിനുള്ളിൽ മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐

	എല്ലായ് പോഴും	കൂടു തലും	ചില പ്പോൾ	അപ്പൂർ വ്വമായി	ഒരിക്ക ലും ഇല്ല
2. മുമ്പ് സന്ദർശിച്ച ഒരു സ്ഥലം നിങ്ങൾ പിന്നീട് മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
3. നിങ്ങൾ കുറച്ചു സമയം കഴിഞ്ഞു ചെയ്യാൻ വിചാരിച്ച കാര്യങ്ങൾ, ഉദാഹരണത്തിന് മരുന്ന് കഴിക്കുക അല്ലെങ്കിൽ സ്റ്റോവ് ഓഫ് ചെയ്യുക എന്നിവ മുന്നിൽ ഉണ്ടായിട്ടും ചെയ്യാൻ മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
4. കുറച്ചു മിനിറ്റുകൾക്ക് മുമ്പ് നിങ്ങളോട് പറഞ്ഞ കാര്യങ്ങൾ നിങ്ങൾ മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
5. മറ്റൊരാൾ ഓർമിപ്പിക്കാതെയോ അല്ലെങ്കിൽ ഡയറിയുടെയോ കാലെൻഡറിന്റെയോ സഹായം ഇല്ലാതെയോ നിങ്ങൾ അപ്പോയ്ന്റ്മെന്റുകൾ മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
6. റേഡിയോയിലോ ടീവിയിലോ വരുന്ന പ്രോഗ്രാമുകളിലെ കഥാപാത്രങ്ങളെ ഒരു സീൻ കഴിഞ്ഞു അടുത്ത സീൻ ആകുമ്പോഴേക്കും മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐

	എല്ലായ് പോഴും	കൂടു തലും	ചില പ്പോൾ	അപ്പൂർ വ്വമായി	ഒരിക്ക ലും ഇല്ല
7. നിങ്ങൾ വാങ്ങാൻ ഉദ്ദേശിച്ച എന്തെങ്കിലും, ഉദാഹരണത്തിന് പഴം പഞ്ചസാര എന്നിവ ആ കട കണ്ടാലും വാങ്ങാൻ മറന്ന് പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
8. കുറച്ചു ദിവസങ്ങൾക്കു മുമ്പ് നിങ്ങൾക്ക് സംഭവിച്ച കാര്യങ്ങൾ ഓർത്തെടുക്കാൻ ബുദ്ധിമുട്ട് ഉണ്ടാവാറുണ്ടോ?	☐	☐	☐	☐	☐
9. നിങ്ങൾ ഒരേ കാര്യം ഒരേ ആളോട് വേറെ വേറെ സന്ദർഭങ്ങളിൽ വീണ്ടും വീണ്ടും ആവർത്തിക്കാറുണ്ടോ?	☐	☐	☐	☐	☐
10. ഒരു മുറിയിൽ നിന്നും ഇറങ്ങുന്നതിനോ പുറത്തു പോകുന്നതിനോ മുമ്പായി എന്തെങ്കിലും സാധനം എടുക്കാൻ ആലോചിച്ചിട്ട്, മിനിറ്റുകൾക്ക് ശേഷം അത് മുന്നിൽ കണ്ടിട്ടും എടുക്കാൻ മറക്കാറുണ്ടോ?	☐	☐	☐	☐	☐
11. നിങ്ങൾ എന്തെങ്കിലും സാധനം, ഉദാഹരണത്തിന് കണ്ണട അല്ലെങ്കിൽ മാഗസിൻ എവിടെയെങ്കിലും വച്ചതിന് ശേഷം, അത് ഉടനെ തന്നെ മറന്ന് പോകാറുണ്ടോ?	☐	☐	☐	☐	☐

	എല്ലായ് പോഴും	കൂടു തലും	ചില പ്പോൾ	അപ്പൂർ വ്വമായി	ഒരിക്ക ലും ഇല്ല
12. നിങ്ങൾ കാണാൻ പോകുന്ന വ്യക്തിക്ക്, എന്തെങ്കിലും പറയാനോ അല്ലെങ്കിൽ കൊടുക്കാനോ ഏല്പിച്ച കാര്യം മറന്ന് പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
13. നിമിഷങ്ങൾക്കു മുമ്പ് കണ്ട ഒരു സാധനം, അത് കണ്ടിട്ടുണ്ടെന്ന് മനസ്സിലാക്കാതെ നിങ്ങൾ വീണ്ടും വീണ്ടും നോക്കാറുണ്ടോ?	☐	☐	☐	☐	☐
14. പുറത്തു പോയ ഒരു സുഹൃത്തിനെയോ ബന്ധുവിനെയോ ഫോൺ വിളിച്ചു കിട്ടിയില്ലെങ്കിൽ, പിന്നീട് വീണ്ടും ശ്രമിക്കാൻ നിങ്ങൾ മറന്നു പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
15. തലേ ദിവസം ടി.വി യിൽ കണ്ടത് എന്താണെന്ന് അടുത്ത ദിവസം മറന്ന് പോകാറുണ്ടോ?	☐	☐	☐	☐	☐
16. നിങ്ങൾ എന്തെങ്കിലും കാര്യം ഒരാളോട് പറയാൻ ഉദ്ദേശിച്ച്, നിമിഷങ്ങൾക്കുള്ളിൽ അത് പറയാൻ മറന്ന് പോകാറുണ്ടോ?	☐	☐	☐	☐	☐

APPENDIX II

PROSPECTIVE AND RETROSPECTIVE MEMORY QUESTIONNAIRE (PRMQ)

REMEMBERING TO DO THINGS

Prospective-Retrospective Memory Questionnaire as described in:

Smith, G., Della Sala, S., Logie, R.H. & Maylor, E.A. (2000). Prospective and Retrospective Memory in Normal Aging and Dementia: A Questionnaire Study. *Memory*, 8, 311-321.

In order to understand why people make memory mistakes, we need to find out about the kinds of mistakes people make, and how often they are made in normal everyday life. We would like you to tell us how often these kind of things happen to you. Please indicate by ticking the appropriate box.

Please make sure you answer all of the questions on both sides of the sheet even if they don't seem entirely applicable to your situation.

Please provide the following details about yourself. Age: _____ Male/Female_____

How many year of formal education have you had? _____

Have you suffered from brain or head injury resulting in hospitalisation (Y/N) _____

Please give brief details _____

Please answer all of the questions as accurately as possible.

	Very Often	Quite Often	Sometimes	Rarely	Never
1. Do you decide to do something in a few minutes' time and then forget to do it?	☐	☐	☐	☐	☐
2. Do you fail to recognise a place you have visited before?	☐	☐	☐	☐	☐

	Very Often	Quite Often	Sometimes	Rarely	Never
3. Do you fail to do something you were supposed to do a few minutes later even though it's there in front of you, like take a pill or turn off the kettle?	☐	☐	☐	☐	☐
4. Do you forget something that you were told a few minutes before??	☐	☐	☐	☐	☐
5. Do you forget appointments if you are not prompted by someone else or by a reminder such as a calendar or diary?	☐	☐	☐	☐	☐
6. Do you fail to recognise a character in a radio or television show from scene to scene?	☐	☐	☐	☐	☐
7. Do you forget to buy something you planned to buy, like a birthday card, even when you see the shop?	☐	☐	☐	☐	☐
8. Do you fail to recall things that have happened to you in the last few days?	☐	☐	☐	☐	☐
9. Do you repeat the same story to the same person on different occasions?	☐	☐	☐	☐	☐
10. Do you intend to take something with you, before leaving a room or going out, but minutes later leave it behind, even though it's there in front of you?	☐	☐	☐	☐	☐

	Very Often	Quite Often	Sometimes	Rarely	Never
11. Do you mislay something that you have just put down, like a magazine or glasses?	☐	☐	☐	☐	☐
12. Do you fail to mention or give something to a visitor that you were asked to pass on?	☐	☐	☐	☐	☐
13. Do you look at something without realising you have seen it moments before?	☐	☐	☐	☐	☐
14. If you tried to contact a friend or relative who was out, would you forget to try again later?	☐	☐	☐	☐	☐
15. Do you forget what you watched on television the previous day?	☐	☐	☐	☐	☐
16. Do you forget to tell someone something you had meant to mention a few minutes ago?	☐	☐	☐	☐	☐