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THE UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG



A Sequential Exploratory Study of the CogMed Working Memory Training Program

Research Report

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Plagiarism Declaration

A research project submitted in partial fulfilment of the requirements for the degree of MA (Clinical Psychology) in the Faculty of Humanities, University of the Witwatersrand, Johannesburg, on 12 January 2015.

I declare that this research project is my own, unaided work. It has not been submitted before for any other degree or examination at this or any other university.

_____ _____

Tyler Christopher Barberis Date

Table of Contents

Table of Contents III
Acknowledgements V
Abstract VI
1. Introduction 1
2. Literature Review 3
2.1. Baddeley's Multimodal Model of Working Memory 3
2.1.1. The Central Executive 4
2.1.2. The Phonological Loop 4
2.1.3. The Visuo-Spatial Sketchpad 5
2.1.4. The Episodict Buffer 5
2.1.5. The Functioning of Baddeley's Model 6
2.2. The Neurophysiology of Working Memory 6
2.3. The Neurophysiology of Schizophrenia 7
2.4. Schizophrenia and Associated Deficits in Working Memory 8
2.4.1. Rehabilitation of Working Memory and Schizophrenia 9
2.4.2. The CogMed™ Working Memory Training Program 11
3. Rationale 14
3.1.1. Research Question[s] 15
4. Methodology 16
4.1. Preliminary Comments 16
4.1. Research Aims 17
4.2. Sampling 17
4.3. Research Design 18
4.3.1. Variable Definitions 19
4.4. Research Instruments 24
4.4.1. The CogMed™ Working Memory Training Program 24
4.4.2. The CogMed Improvement Index 27
4.4.3. The CogMed Daily Max Index 27
4.4.4. The CogMed Daily Training time vs. Pause Time 27
4.4.5. The Weschler Adult Intelligence Scale – III, Letter-Number Sequencing Subtest 28
4.4.6. Weschler Adult Intelligence Scale – III, short form 28
4.4.7. The Pre-Intervention Interview Protocol 29
4.4.8. The Post-Intervention Interview Protocol 29
4.5. Data 30
4.6. Procedure 30

4.6.1. Pre-intervention 30
4.6.2. Intervention 31
4.6.3. Post-Intervention 32
4.7. Ethical Considerations 32
5. Results 36
5.1. Quantitative 36
5.1.1. Assessment Indices 36
5.1.2. CogMed Indices 38
5.2. Qualitative 41
5.2.1. Challenges of Implementation 41
5.2.2. The Role of Psychological Variables on Participant Experience 47
5.2.3. Particulars of the Program 71
6. Discussion 78
6.1. Quantitative 78
6.2. Qualitative 79
7. Limitations and Recommendations 96
8. Conclusion 99
9. Reference List 102
10. Appendices 116
10.1. Pre-intervention Interview Schedule 117
10.2. Post-intervention Interview Schedule 118
10.2.1. Content 118
10.2.2. Logistics 118
10.3. Letter of Request to CogMed ™ for Use of Program 120
10.4. Clearance Certification from Human Research Ethics Committee (Medical) 122
10.5. Letter of Request to Authorities at Tara Hospital 123
10.6. Invitational Pamphlet 125
10.7. Telephone Script 126
10.8. Letter of Informed Consent to Participants 127
10.9. Demographic Questionnaire 131
10.10. Letter of Informed Consent to Participant Coach 134

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Abstract

Working memory training remains a contentious issue in the general literature. This study aims to determine the effectiveness of CogMed™ Working Memory Training Program on the rehabilitation of working memory in outpatients with a diagnosis of paranoid schizophrenia in remission. It also seeks to explore participants' subjective experiences of the CogMed™ Working Memory Training Program; both in terms of content as well as logistical and contextual difficulties. The design for this program is a mixed method sequential exploratory study (Barnes, 2012) where an element of ethnographic observation was added as a means of enriching the evaluation. The sample consisted of four individuals who were obtained via convenience purposive sampling. Quantitative results of the study indicated a heterogenous trend in the selected measures of cognitive functioning. CogMed indices indicated a general upward trend in performance, but were not valid indicators of working memory. In terms of qualitative results, resources, material and psychological, played a significant role in facilitating or hampering the implementation and adherance to the program, accordingly. Psychological variables that impacted on performance were a second major theme, which included salience of cognitive deficits and motivation. Finally, particulars to the program were covered, which consisted of participants experiences of tasks, the program and the research aid. The discussion highlighted the impact of social support on attrition in rehabilitation programs. It also pointed to the sparsity in literature in the area of working memory training. Limitations of the study were also discussed.

Keywords: Sequential, Exploratory, CogMed, Working Memory, Schizophrenia

1. Introduction

The present investigation is following a cognitive training approach, which is based in the assumption that remediation of cognitive deficit is possible by excirse and practice (Wilson, 1997), which remains highly contentious as a therapeutic approach due to the lack of evidence of its effectiveness (Wilson, 1997) or the advocation for using this approach as the most effective one, especially in conditions such a schizophrenia (Penades et al., 2006). Some authors explain that, although the outcome of the implementation of these type of programmes remains inconsistent, the possibility to rehabilitate working memory depends on incresing and improving the remediation activities (Klingberg, 2012).

Klingberg's (2012) underlying assumption is that it is a necessity to find the best possible means of developing and refining interventions aimed at improving cognitive function, especially working memory. The CogMed™ Working Memory Training Program represents a form of intervention with the specific focus on working memory that has been designed and its value needs to be tested within specific contexts, especially because, even though there is a large support base for this intervention, it is also true that there exists substantial controversy regarding its efficacy in attaining the claims it sets out for. This document will set out a research study aimed at assessing the efficacy, and feasability with regard to implementation, of the CogMed™ Working Memory Training Program in a sample with a remitted diagnosis of paranoid schizophrenia. Methodologically, this research employed the sequential exploratory framework as a means of addressing the research question, using Baddely's (1998) model of working memory as the conceptual basis for understanding working memory and the training thereof.

This document presents a short literature review on working memory, using Baddeley's Model as the core of this section, followed by a review of working memory in the particular diganosis of schizophrenia. This section culminates by discussing findings on rehabilitation in schizophrenia and describing the program that was implemented for the purpose of this research

(CogMed) . The rationale serves as an introduction to the methodology employed, which is outlined in detail in the fourth chapter. Following this, the quantitative and qualitative results are presented, which are discussed in chapter 6. Finally, limitations and recommendations associated with the research are presented culminating the manuscript with a brief conclusion. In general terms, this research attempts to highlight a number of important facets to the implementation of CogMed and related interventions in a country such as South Africa.

2. Literature Review

The following literature review aims to provide a conceptual basis and rationale for the proposed study. The review will begin by outlining Baddeley's model of working memory as the framework this study will employ for understanding the concept. Following this author will engage in a discussion about working memory training and current research associated with this area. Finally the author will review basic topics on schizophrenia making special emphasis in the way associated deficits in working memory manifest in its presentation.

2.1. Baddeley's Multimodal Model of Working Memory

Baddeley and Hitch first proposed the multi-component model of working memory in their publication in 1974 where it was broadly defined as a short-term holding space integral in the processing and management of newly or previously stored information (Baddeley, 1981). Early conceptualizations of the model discuss three primary elements; the Central Executive, visuo-spatial sketch pad and phonological or articulatory loop (Baddeley, 1981). Baddeley (2000) later added the Episodic Buffer as a means of explaining the way in which visual and auditory information is integrated at a theoretical level. It is also important to note that within this framework a distinction may be made between the simple and complex aspects of the working memory system where this will be taken up in the literature. Alloway, Gathercole, Willis, & Adams (2004) tested 633 children between the ages of 4 to 6 years old. They assert that the measurement model which provides the best fit to data obtained corresponded to that outlined by Baddeley and associates. Similar results are reported by Gathercole, Pickering, Ambridge, & Wearing (2004), who note that working memory structures proposed by Baddeley seem to be present from the age of 6 and onwards, with some support for the idea that they may be present earlier. This research seems to suggest that these structures come in to formation in early childhood and develop over time in to more clearly measureable phenomena. These seem to be some debate in the literature regarding the localization of Working Memory structures in the brain. Some authors assert that Working Memory seems to be

localized to prefrontal cortices (Smith & Jonides, 1997) while others seem to suggest that working memory structures maintain a fluid organization throughout the brain including the prefrontal cortex, but also a network of other brain regions (D'Esposito, 2007). However, these authors still provide support for the relevance of the working memory model as a means of understanding neural function.

2.1.1. The Central Executive

The Central Executive is generally seen as a means by which control and peripheral processes and systems are manipulated and incorporated to engage specific information processing tasks (Baddeley, 1981). More specifically however, Baddeley (1996a; Repovs & Baddeley, 2006) denote four specific functions to it; these include a capacity for dual-task performance, selective-task performance, activation of long-term memory and a given maximum capacity for information being manipulated or processed at any given time. Dual-task performance refers to the ability to regulate the operation of two tasks occuring simultaneously while selective-task performance refers to its ability to focus processing on a single task (Baddeley, 1996a). Baddeley (1996a) also notes that the Central Executive plays a role in encoding and retrieval processes associated with long-term memory.

2.1.2. The Phonological Loop

The Phonological Loop acts as a slave system to the Central Executive and is geared toward processing acoustic and phonetic information (Repovs & Baddeley, 2006). Baddeley (2010) divides this system in to two elements; a passive phonological store which temporarily holds speech-like information and a rehearsal system, which may be either vocal or sub-vocal, which provides a means of maintaining this information within the store. Three seminal experiments were used to provide evidence for these features; the outcomes of which were termed the phonological similarity effect, the word length effect and articulatory suppression (Baddeley, 1984). Both the phonological similarity effect and word length effect provided a means of illustrating the presence of a limited

short term store in that they illustrate a capacity for storage limited both by time and character similarity while articulatory suppression is used to argue for the presence of a rehearsal system since encoding is inhibited when a subject is asked to rehearse a random word while trying encode new information to the store (Baddeley, 1981; Baddeley, 2010; Baddeley, 1984).

2.1.3. The Visuo-Spatial Sketchpad

The second sub-system proposed in Baddeley's model is that of the Visuo-Spatial Sketchpad. This is theorized to function as a means of processing visual data in terms of its respective spatial and physical characteristics (Baddeley, 1984; Repovs & Baddeley, 2006). Unlike the relatively clearly defined Phonological Loop, literature around understanding this sub-system in the model maintains a vague and underdeveloped character (Baddeley, 1996b; Sala, Gray, Baddeley, Allamano, & Wilson, 1999). Some authors present evidence for the existence of two separate sub-systems; one aimed at processing purely visual information such as patterns with another specialized for the processing of movement on spatially related data (Bruyer & Scailquin, 1998; Logie & Pearson, 1997; Pickering, Gathercole, Hall, & Lloyd, 2001; Baddeley, 1993). Bruyer and Scailquin (1998; Logie, 1995 as cited in Bruyer & Scailquin, 1998) present evidence for the division of this system in to a limited, passive store for visuo-spatial information and an active rehearsal component aimed at maintaining this information within the store. These elements have been dubbed the "visual cache" and "inner scribe" respectively (Logie, 1995 as cited in Bruyer & Scailquin, 1998).

2.1.4. The Episodict Buffer

The Episodic Buffer may be viewed in terms of its integrative character where it maintains the ability to manage, process and integrate visual, spatial and phonological data from both the Visuo-Spatial Sketchpad and Phonological Loop in to mental representations of the external world (Baddeley, 2000). While this is how it is conceptualized it still maintains a similar character to the other components proposed for the model in that it retains the ability to hold only a limited amount of information (Baddeley, 2000).

2.1.5. The Functioning of Baddeley's Model

The Central Executive can be seen as a system developed for the control of attentional resources and their distribution between the other components of the model (Zillmer, Spiers, & Culbertson, 2008). Heirarchically, it is situated above the Phonological Loop and Visuo-Spatial Sketchpad which function as slave systems in relation. Information in the form of either language, vision or both enters in to sensory memory via the related modalities and travels to the Central Executive where it is then passed on to the appropriate processing slave-system. The Central Executive further moderates attentional resources toward the given slave-system allowing for processing of the given information to take place. Upon the completion of the processing of information in each slave-system it is forwarded to the Episodic Buffer for integration, the Central Executive too moderates the levels of attentionally based resources available to this system in relation to its role (Zillmer, Spiers, & Culbertson, 2008). Visual and Auditory information are integrated in the Episodic Buffer before their integrated encoding in to long-term memory. Alternate, sub-routes proposed aside from the route of integration include routes directly from the Visuo-Spatial Sketchpad and Phonological Loop respectively where visual, spatial and languaged based information are seperately encoded in to long-term memory as adjunct to the encoding occuring at the primary level associated with the Episodic Buffer. None of these relationships are uni-directional in that information may travel both toward long-term memory and from long-term back to appropriate slave systems for later processing and manipulation. Similarly, information from long-term memory may inform the current processing of new information in each slave system and in the Episodic Buffer (Zillmer, Spiers, & Culbertson, 2008).

2.2. The Neurophysiology of Working Memory

Literature around working memory function contends largely that it remains localized within the prefrontal cortex with some activation being present in parietal regions of the brain (Cabeza & Nyberg, 2000; Xue, Dong, & Chen, 2004) while some authors also implicate sub-cortical structures

such as the basal ganglia and certain regions of of the hippocampus (Hung, Smith, & Taylor, 2013; Podell, et al., 2012). Lateralization of function also seems to be quite consistent with those functions relating to verbal processing being lateralized largely to left hemispheric regions (Xue, Dong, & Chen, 2004; Sepulcre, et al., 2009) while those relating to visual and spatial stimuli being lateralized to the right (Hong, Lee, Kim, Kim, & Nam, 2000).

The dorsolateral prefrontal cortex has been implicated in higher order working memory tasks involving manipulation of both visual and verbal data (Barbey, Koenings, & Grafman, 2012), however the specifics around its functional localization within the literature remain greatly varied. Some authors discuss it's role in terms of its implementation of attentional resources (Meiron & Lavidor, 2012) while others examine activation in relation to the presence of high load tasks (Hung, Smith, & Taylor, 2013; Suchan, Botko, Gizewski, Forsting, & Daum, 2006; Meiron & Lavidor, 2012), it has also be implicated in maintenance activities associated with rehearsal activities during delays (Xue, Dong, & Chen, 2004; Geier, Garver, & Luna, 2007). In contrast the ventrolateral prefrontal cortex has been implicated in tasks involving associative memory and concurrent coding to long-term memory (Tanabe & Sadato, 2009), specifically this region has been implicated in retrieval and post-retrieval activities involving comparisons and selection of stimuli from long term memory (Wolf, Vasic, & Walter, 2006; Badre & Wagner, 2007). Although an argument is made in the literature for the neuroanatomical localization of function, it must be noted that linguistically defined functional specifications may not correlate with neuroanatomical structures and their actual functional specification (Veltman, Rombouts, & Dolan, 2003; Cabeza & Nyberg, 2000).

2.3. The Neurophysiology of Schizophrenia

The literature seems to contend that individuals with schizophrenia show deficits in prefrontal activation (Driesen, et al., 2008) with a specific focus on deficits in activation of the dorsolateral prefrontal cortex (Barch, 2006; Wong & Van Tol, 2003; Egan & Weinberger, 1997). Barch (2006) notes that this pattern was not found to extend to other prefrontal structures such as the

ventrolateral prefronal cortex. Considering that the dorsolateral prefrontal cortex is implicated in so many control processes it is reasonable to assume that deficits in activation of this area would markedly affect working memory functioning in individuals with schizophrenia (Barch, 2006; Driesen, et al., 2008). Although literature seems consistent around this point, White, Hongwanishkul, and Schmidt (2011) present evidence to the contrary regarding deficits in activation of the prefrontal cortex in individuals with schizophrenia. The authors here find no difference between their schizophrenic population and a control group withou schizophrenia, they do however find increased activity in both the anterior cingulate and temporal lobe, both of which are consistently implicated by the literature (Wong & Van Tol, 2003; Egan & Weinberger, 1997). This then indicates that this area requires further empirical exploration as a means of fully understanding it within literature.

2.4. Schizophrenia and Associated Deficits in Working Memory

From the perspective of Baddeley's (1981; 1984; 1996a; 2000) multi-component model of working memory, the literature seems to be consistent around the idea that the Central Executive maintains a major role in explicating associated deficits in working memory. Junghoon, Ghlan, Nuechterlein, and Cannon (2004) showed that tasks requiring increased attention for multiple activities showed significant deficits in performance between patients and healthy controls where task load was increased. Oram, Geffen, Geffen, Kavanagh, and McGrath (2005) showed similar results where the outcome was specified to the performance associated in visually based tasks which required input from the Central Executive for processing. This seems to suggest that, individuals with schizophrenia struggle substantially more with maintaining attention relative to healthy subjects. This is eespecially apparent when tasks become more complex or when they are more numerous.

With regard to both the Visuo-Spatial Sketchpad and Phonological Loop respectively, current consensus in research too maintains that these areas of working memory are affected in schizophrenic patients. Park, Puschel, Sauter, Rentsch, and Hell (2003) found that patients with

schizophrenia presented deficits in the processing of novel visual stimuli where these deficits could be explained by their inability to inhibit irrelevant distractors during object choice. These deficits were present both during acute and chronic episodes of the disorder as well as being somewhat consistent in patients being in partial remission. Fleming, et al. (1997) showed somewhat contradictory results in their research where schizophrenic patients only differed from normal controls in the condition requiring maintenance of visual information, these findings were obtained after the authors controlled for the impact attention had on the maintenance task and consequently on working memory. Thus the results reported by Park, Puschel, Sauter, Rentsch, and Hell (2003) may be explained by the attentionally based deficits preventing patients from correctly selecting objects from a pool containing distractive elements. This position seems to be supported in the literature with authors such as Hahn, et al. (2010) demonstrating the impact of attentional deficiency in the processing of visuospatial data. With regard to the impact of an ability to maintain information, this idea too seems to be supported in the sense that schizophrenic patients present a deficient ability to maintain pertinent visuospatial information in the processing space resulting in the perceived deficits in visuospatial working memory (Badcock, Badcock, Read, & Janlensky, 2008).

2.4.1. Rehabilitation of Working Memory and Schizophrenia

This area of scientific investigation remains one of some controversy within the literary space with authors debating on the merits of arguments both for and against the possibility. Jausovec and Jausovec (2012) argue for the possibility of training working memory on the basis of increased neural activation after training activities assumed to correlate with working memory capacity. This result was directly contested by Chooi and Thompson (2012) who, after replicating the study, asserted that training results were task specific and did not translate in to increases in working memory and consequent fluid intelligence. The significance of these two studies is the way in which they address issues of rehabilitation in terms of abstract activities and their abilities to meaningfully improve working memory function and not simply train individuals on the activities

themselves. More specifically they address the question of whether training on abstract activities is generaliseable to other activities necessary for day-to-day function.

Klingberg (2012) argues for the potential to improve working memory through training activities. Klingberg (2012) further this argument noting that increased research in this area, although variable in outcome, presents the only way to properly further this area and refine its associated rehabilitative abilities. Rabipour and Raz (2012) support this idea with considerably noted conservatism with regard to the effects purported by programs in relation to their underlying scientifically based proof. The authors present a case substantiating a need for consideration of the possible outcomes with regard to short-term rehabilitative activities and their implications for long-term gains. Here there is recognition of the need for consideration of more longitudinal and inclusive types of training incorporated in to schooling activities through childhood. Thus, Rabipour & Raz (2012) support the notion of cognitive remediation, but maintain a level of skepticism toward short-term remediatory strategies. The idea of rehabilitation of working memory thus renders substantial support within the literature albeit with a view that it is important to be critical of intervention strategies that claim to improve its function. The basis of this idea, is a recognition of the need for viable scientific evidence aimed at substantiating the claims made around program efficacy for currently available programs, with special regard to their implications for long-term gains (Shipstead, Hicks, & Engle, 2012b).

Examining the literature in relation to schizophrenia specifically; Penades, et al. (2006) presents a case for cognitive remediation therapy as a means of addressing problems associated with schizophrenia. Here, the authors found that the therapy resulted in a marked improvement in test scores in the Weschler Adult Intelligence Scale-III, Rey Auditory Verbal Learning Test, The Wescehler Memory Scale-III, The Trail Making Test A and B and The Wisconsin Card Sorting Test. The authors also reported improvements on measures of social functioning such as communication and personal autonomy as represented by the Life Skills Profile (Penades, et al., Cognitive remediation

therapy for outpatients with chronic schizophrenia: a controlled and randomized study, 2006). Similarly, Kluwe-Schiavon, Sanvicente-Vieira, Kristensen, and Grassi-Oliviera (2013), in their review of different remediation strategies, present a case for cognitive remediation as a highly promising option within the current framework of rehabilitation in schizophrenia. They further this argument by noting that the computer-based interventions examined in the review presented showed the most favourable long-term outcomes for rehabilitation. Although neither of these authors address cognitive remediation in terms of its sole engagement within the realm of working memory; working memory was, in many instances, a factor forming part of the rehabilitation strategies engaged in thus rendering some support for the training of working memory in schizophrenia. In general however, research regarding the training of working memory in populations with schizophrenia remains somewhat sparse warranting increased empirical engagement in this area.

2.4.2. The CogMed™ Working Memory Training Program

The CogMed™ Working Memory Training Program consists broadly of a computer based set of activities aimed broadly at increasing the functionality of working memory in individuals who maintain some level of impairment in this area of functioning (Cogmed, 2012). Sessions take place over the course of five to eight weeks with one session of 30-35 minutes occurring each day allowing for two break days within the week. There are three possible version of this program which are visually different from one another but contain a similar basis for tasks. These are designed to appeal to individuals from different age groups, ranging from younger children through to adults. During the course of each session participants are allocated exercises to be completed. The exercises allocated and difficulty levels set depend on the previous session and a given participants level of performance therein. This provides a set of varied activities as well as maintains a difficulty level at the limit of what the participant has shown to be capable of (Cogmed, 2012). The online version of the program also includes a progress indicator which assesses participant's improvement, and progress on un-trained but related working memory tasks.

Much like the debates around working memory rehabilitation in general, the efficacy of the CogMed™ Working Memory Training protocol is also somewhat debated in current literature. Shipstead, Hicks, and Engle (2012a) present the argument against the efficacy reported around the CogMed™ program, the basis of this stands on the ideas that; much of the associated research aimed at assessing efficacy is not focussed at examining increases in working memory capacity over other related areas of improvement. Furthermore training and assessment engage only in simple-span tasks requiring forward and backword recall, the assumption here is that there remains a limited way in which these tasks can be constructed and as such testing and assessment tasks maintain an inherent similarity leading to decreased validity of working memory outcome measures (Shipstead, Hicks, & Engle, 2012a). Shipstead, Hicks, and Engle (2012a) advocate that sufficient assessment warrants that individuals be tested on a variety of different tasks shown to be representative of working memory as a means for demonstrating the validity of the rehabilitative procedure in improving the performance of working memory.

In response to this, Jaeggi, Buschkuehl, Jonides, and Shah (2012) interrogate the findings of Shipstead, Hicks, and Engle (2012a) concluding that the engagement in the review maintains a premature and biased nature. The authors here conclude that the review focussed largely on claims based in marketing as opposed to those made by the research articles listed on the CogMed™ website. They continue the critique by addressing the argument made regarding the use of simple-span tasks for training and assessment asserting that these tasks are infact varied sufficiently to validate assessment as indicative of working memory. Furthermore, the authors assert that simple-span tasks have been successfully used in predicting academic achievement along with symptoms associated with ADHD warranting their validity and applicability for assessment of working memory (Jaeggi, Buschkuehl, Jonides, & Shah, 2012). Jaeggi, Buschkuehl, Jonides, and Shah (2012) do however note two prominent weaknesses not addressed in the article they critique; they discuss the lack of specificity associated with the CogMed™ working memory training with regard to the specific contributions made by each of the integrated tasks toward working memory improvement, they also

discuss the general lack of explanatory framework associated with understanding how increases in working memory take place.

These two authors present a highly compelling case albeit one which they debate among themselves. Firstly, there is recognition of the necessity to ensure that claims in working memory improvement are based in scientific validation which would involve determining actual improvements in working memory as represented by tasks sufficiently varied from the training tasks themselves. Secondly, there is an acknowledgement of the necessity of inclusivity of theoretical positions, and the development thereof, aimed at explaining increases in working memory and how these are understood in relation to the scientific method.

3. Rationale

Both the novelty and promise of the area of working memory training and rehabilitation necessitate the need for increased empirical engagement as a means of increasing the knowledge base underlying the area (Klingberg, 2012; Rabipour & Raz, 2012). This research aims to contribute to the body of knowledge bridging the gap between interventions and the scientific evidence that credits their validity with a specific focus on the CogMed™ Working Memory Training Program. By examining the efficacy of the program, this project will contribute to knowledge in understanding whether or not CogMed does in fact train working memory in the selected population. Furthermore, current research has neglected other related aspects of the program; cost, access to information technology like computers and their accessories, tablets and even access to healthcare and transport to and from hospital. These resources represent important questions related to the accessibility associated with interventions such as CogMed in a country such as South Africa. This research is aimed at assessing the CogMed™ Working Memory Training program as a possible, viable intervention for treating patients with schizophrenia within the of South African public health context.

South Africa maintains a high level of poverty, Statistics South Africa's (2012) latest statistical release estimates that 64.8% of South African's have no access while only 8.6% had access from home. Furthermore, of a total population of 51 770 560 people, only 3 092 543 have access to a household computer. A qualitative assessment of the pragmatic implications of implementing the CogMed™ Working Memory Training Program at these hospital's may provide useful insight in to the further development of this intervention and interventions such as this for underdeveloped contexts such as South Africa.

3.1.1. Research Question[s]

3.1.1.1 Quantitative Questions

3.1.1.1.1 General question

Does CogMed™ Working Memory Training have an impact on Working Memory?

3.1.1.2 Qualitative Questions

3.1.1.2.1 Broad question

What are participants' subject experiences of the CogMed™ Working Memory Training Program?

4. Methodology

4.1. Preliminary Comments

It was necessary for the researcher to adapt the design of this project during the process of conducting the research due to limitations encountered as the research progressed. The design is therefore a hybrid between that of a mixed method sequential exploratory study (Barnes, 2012) where an element of ethnographic observation was added as a means of obtaining the necessary data for a full evaluation. The Letter-Number Sequencing Subtest which was originally part of the battery as an additional working memory measure, was substituted as the primary measure for working memory in the study. This did not affect the administration of the battery, but did impact on analysis. This was necessary as the primary measure, The Automated Working Memory Assessment, was taken offline due to inconsistencies in the norm data. This measure was also used as a means of controlling for pretest level of working memory, since it was taken offline before two participants were able to begin the program it was no longer possible to control for this variable. The researcher also, after consultation with their supervisor, began to include participants with histories of traumatic brain injury, two of these participants were included. This was necessary as it became apparent that many of the potential participants had histories that included this, excluding it would've rendered the study unfeasible. Another aspect of the study that required alteration was the use of a research coach. Given that many participants lived in halfway houses, they didn't have direct access to family members who were willing to act in this capacity. Making the research coach a requirement for the would've made the study impossible to complete. Given the difficulties in obtaining a sample, and the time frame associated with the research, only four participants were included in the study as opposed to the ten originally intended for inclusion. It was not possible to obtain a larger sample size.

4.1. Research Aims

To determine the effectiveness of CogMed™ Working Memory Training Program on the rehabilitation of working memory in outpatients with a remitted diagnosis of paranoid schizophrenia.

To examine the feasability of implementing such an intervention within the public healthcare system in contemporary South Africa

To explore participants' subjective experiences of the CogMed™ Working Memory Training Program.

4.2. Sampling

The sample population consisted of individuals with a fully remitted diagnosis of paranoid schizophrenia from halfway houses. Four individuals were included in the final sample.

General Exclusion Criteria. All participants were diagnosed with schizophrenia in remission as reported by themselves. They were expected to have proficiency in highschool english as determined by completion of matric in english. Participants were also expected to have access to a home-based personal computer or laptop with a functioning internet connection. Participants were between 26 and 49 years of age. Participants having presented illegal substance use or abuse were excluded from the sample.

The individuals in the sample were obtained by convenience, purposive sampling methods (Bornstein, Jager, & Putnick, 2013) at halfway houses.

Table 1

Participant Characteristics Summary

Participant Code	Age	History of TBI	Diagnosis	Highest Level of Education	Permanent Employment	Current Medication
P1	26	Yes	Paranoid Schizophrenia in Remission	Matric	No	Clorazil Epilim
P2	33	Yes	Paranoid Schizophrenia in Remission	Matric, Diploma in Guest Management (2 Years)	No	Clopixol Fluoxetine Epilim
P3	41	No	Paranoid Schizophrenia in Remission	Matric	Yes	Leponex Cipramil
P4	49	No	Paranoid Schizophrenia in Remission	Matric, Various Diploma Courses (Longest 6 months)	No	Leponex Disipal Convulex Risperdal Rivotril

4.3. Research Design

This research was mixed-methods in nature and was a sequential exploratory design (Barnes, 2012). This design was characterized by a phase of qualitative data collection assessing participant expectations, followed by quantitative data collection which included pre and post test measures as well as the CogMed indices that were measured during the study, followed by another phase of qualitative data collection aimed at assessing experiences of the intervention. The qualitative data was used to explain the results of the quantitative phase as well as enrich the understanding of program implementation, adherence and efficacy (Barnes, 2012). The data obtained was also used to inform the feasability of implementing such an intervention within the public healthcare system in contemporary South Africa.

The researcher conducted two assessment batteries on each participant over the course of this research, a pre-test battery which took place before the intervention and a post-test battery which took place at the end of the intervention. The pre-test and post-test scores were compared as

a means of determining whether or not participants have shifted in terms of their working memory functioning. The researcher conducted an interview with each participant who engaged in the intervention, the data from this was used as a means of better understanding the performance indicated on the qualitative measures. In addition to this it was also used as a means of understanding factors around program implementation and adherence.

4.3.1. Variable Definitions

4.3.1.1. Independent variable[s].

4.3.2.1.1 Working memory training.

Conceptual definition. The conceptual understanding applied to working memory training in this study is one consistent with that outlined by Otero and Sheitler (2001) where it is understood as neurocognitive training activities directed at the affected functions as a way to gradually restore the individual's functional skills and enhance recovery of more complex cognitive processes

Operational definition. The computerized COGMED™ intervention which is constructed from various sets of planned, systematic and sequential activities aimed at directly training and developing working memory capabilities over a period of 5 weeks; with 5 sequential, 35 minute sessions occurring once a day for 5 days each week.

4.3.1.2. Dependent variable[s].

4.3.2.2.1 Working memory.

Conceptual definition: “An attentional control system, the Central Executive that operates in conjunction with two subsidiary or slave systems: the Phonological Loop, which is concerned with auditory or speech-based information, and the visuospatial sketchpad, which maintains and manipulates visual and spatial information.” (Baddeley, 1998, p. 234)

Operational definition: Scaled scores on the Letter-Number Sequencing Test of the WAIS-III (Weschler, 1997) and the CogMed Improvement Index, Daily Max Index and Daily Training vs. Pause Time (Cogmed, 2012).

4.3.1.3. Extraneous variable[s].

4.3.2.3.1 Variables that will be controlled.

Participant diagnosis: This was indicated by a verbal report of participant diagnosis from participants. Only participants maintaining the diagnosis of Paranoid Schizophrenia in full remission were considered for inclusion in the study (The American Psychological Association, 2000). Selection of the paranoid subtype specifically eliminated the specific symptoms of disorganized speech, and disorganized or catatonic behaviour (The American Psychological Association, 2000) ensuring that participants maintained some level of functionality from a diagnostic perspective in terms of their engagement with the program. Finally, by selecting participants currently in full remission the assumption was made that these individuals would be functionally capable of engaging with the program as well as somewhat addressing the variable of different regimes of medication by assuming that these individuals would either be on a light or non-existent regime of pharmacologically based antipsychotics.

Access to a personal computer and internet: The technological intensiveness of the training program to be used necessitating access to internet from home will be maintained as one of the core variables determining selection for participant in this study. Only participants with a home based personal computer and access to internet from this device were considered for inclusion in the study.

4.3.2.3.2 Variables that will not be controlled

Pharmaceutical regime: Meltzer and McGurk (1999) found that studies reporting effects of antipsychotic drugs on cognition were variable dependant on whether or not the drug was a typical

neuraleptic or not. The effects ranged from impairment of cognition through to improvement on specific cognitive measures. Due to the variability for drug regimes associated with schizophrenia it was not possible to control for this variable in a feasible manner which would have ensured a reasonable sample size for the proposed study.

Socioeconomic status: Hackman and Farah (2009) found socioeconomic status to be a consistently implicated factor associated with neural development and cognitive performance with the outcome of their review illlustrating an empirical linkage showing a positive correlation between these factors. However, this variable becomes eespecially difficult to control within the context of this proposal because of its being situated in a country such as South Africa that maintains such high levels of inequality (Statistics South Africa, 2012).

Age: Authors such as Sander, Linderberger, and Werkle-Bergner (2012) show not only that the operant level of working memory is variable among individuals over the course of the lifespan, but too that there remains a general trend in a striking decline with increasing age. This variable was not controlled due to the impact this would have had on the feasability of the study. The researcher attempted to select participants within a range of 25-50 years of age so as to minimize the possible impact. The researcher also did this as a means of reducing risk of cognitive decline due to factors related to dementia.

Levels of Test and Training Motivation: Wolf and Smith (1995) found a correlation of 0.35 between level of motivation and test. This was not measured and not controlled for.

Level of Fatigue During Training: Veasey, Rosen, Barzansky, Rosen, and Owens (2002) found, in their review, that fatigue in individuals undergoing residency training was associated with deterioration of short-term recall abilities as well as reaction times to stimuli. Although the researcher was in contact with participants during the training process, it was impossible to control the level of fatigue present participants during training since the researcher maintained no control

over sleeping patterns or daily activities engaged in before cognitive training. It is plausible to assert that differences in level of fatigue may impact on training efficacy and consequently on the outcomes in terms of working memory measures.

Participant Feelings of Self-Efficacy: Salas and Cannon-Bowers (2001) assert that feelings of self-efficacy are directly associated with increased levels of learning and consequently increased performance on related measures. Although researchers have attempted to control for educational level, and factors that may have been indirectly linked to feelings of self-efficacy. It was impossible to control for and equate participants prior experiences and the impacts of these on their levels of self-efficacy during the course of the research and training.

Adherence to Pharmacological Treatment Regime: Novick, et al. (2010) found that non-adherence to antipsychotic medication in out-patients with schizophrenia increased the likelihood of relapse, hospitalization and attempted suicide were found to be significantly more likely in non-adherent patients while remission was found to be more likely in patients who were adherent. This indicates that individuals on a prescripted pharmacological regime who were non-adherent may experience regressive and negative symptoms which in turn may result in impacts on the training program and the associated outcome. The nature of treatment variability and whether or not patients adhere to treatment was beyond the control of the researcher in this study.

Previous Exposure to Technology: Salanova, Grau, Cifre, and Llorens (2000) lent support to the notion that the effects of technology on affect outcomes are variable depending on the type of prior exposure experienced by individuals, furthermore that low computer self-efficacy in terms of affectual experienced lead to an increase in burnout levels when level training was high. Due to the vast nature of types of experiences in relation to technology it was impossible to control this variable in the limited sample size proposed for this research.

Educational history and Quality of Education: Bedi and Edwards (2002) illustrated that quality of education in terms of teacher quality and access to resources were associated with levels of educational attainment and levels of later economic earnings. This research indicates that on some level socio-economic status is a factor of education history and the quality of education received, furthermore that quality of education maintains a level of impact on quality of life. In a country such as South Africa where the quality of education is highly variable it was impossible to control for educational history and the quality thereof in a limited sample such as the one proposed for this research project.

Level of education: Stratta, Prosperinin, Daneluzzo, Bustini, and Rossi (2001) were able to show a link between educational achievement and working memory in their study where educational level was seen to be correlated with the levels of working memory observed. Because of the limited nature of the sample this variable was not controlled other than to ensure participants have at least matric level of education.

Time since last psychotic episode: Ucok, Serbest, and Kandemir (2011) found that 71.5% of the schizophrenic patients in their study could not maintain their remission status after first follow up, but that of this number, 57% later met remission criteria again. While this points to the possibility to remission in schizophrenic patients is variable but positive, it can also be viewed in terms of the implication that symptomatology are varied and prone to return. Due to the nature of this and the characeristics of this study, this variable was not controlled.

Level of Intelligence: Grabner, Fink, Stipacek, Neuper, and Neubauer (2004) found an association between working memory performance and levels of fluid intelligence, where this difference was stronger in males than that observed in females. The scope of this study precluded the ability to control for this variable in a meaningful way, it was, however, measured and used as a means of contributing to the analysis and discussion of the quantitative results found.

Pretest level of working memory: Another variable for that was not controlled in this study was the pre-study levels of working memory maintained by participants. The Automated Working Memory Assessment (Alloway, 2013) was initially used in an attempt to screen participants. However, this was not possible for those who joined the program later (P3 and P4) and they were not screened as a result of the unavailability of the test. The removal of this tool made it difficult to adequately screen the sample for pretest levels of this variable.

4.4. Research Instruments

Four primary isnstruments were used in this research study as a means of addressing the research aims and associated questions. The CogMed™ Working Memory Training program as the intervention that was tested. The CogMed Indices, which are default measures included as part of the CogMed Program package. These consist of the Improvement Index, The Daily Max Index and The Daily Training Time vs. Pause Time. These indices were used to corroborate evidence for increases in working memory.The letter-Number Sequencing Test from the WAIS-III which was used as a measure of working memory. Also, the subtests of the Weschler Adult Intelligence Scale-III, short form (WAIS-III) which was used to examine any impacts the program may have had on specific measures of cognitive functioning.

4.4.1. The CogMed™ Working Memory Training Program

4.4.1.1. General description

The CogMed™ Working Memory Training Program (2012)consists broadly of a computer based set of activities aimed broadly at increasing the functionality of working memory in individuals who maintain some level of impairment in this area of functioning. Sessions took place over the course of five to eight weeks with one session of 30-35 minutes occurring each day allowing for two break days within the week. The program maintains three possible strains where, for this research project, the adult strain was used for training the working memory of the sample.

During the course of each session participants are allocated exercises to be completed. The exercises allocated and difficulty levels set depend on the previous progression of the participant in terms of performance where exercises and their difficulty are selected in such a way as to provide varied activities as well as maintain a difficulty level at the limit of what the participant has shown to be capable of.

There were twelve possible execises that participants would encounter during their completion of the program (Cogmed, 2012). These are described as follows:

Grid: A number of circles are displayed on the screen arranged in the form of a grid. The circles light up and the participant is expected to memorize the sequence in which they were lit. The circles then return to their initial state and the participant is expected to selected the same circles in their same sequential order of appearance.

Chaos: A number of moving shapes are present on the screen. The shapes light up in a specific sequential order which the participant must memorize. After the shapes return to their original state the participant must select the shapes, in order of appearance from the screen.

Twist: The requirements of this exercise are identical to those of the grid with the exception that the grid is rotated 90 degrees before participants are allowed to select the circles that appeared. Circles must still be selected in sequential order of appearance even though their positions may have changed as a result of the rotation of the grid.

3D Grid: This task is identical to the grid with the exception that the grid now maintains a 3 dimentional cube-like character. Panels on the cube are highlighted in a specific order, upon their return to normal participants are expected to selected, in the same sequential order, the panels that were highlighted.

Numbers: The computer reads out a number of digits to the participant with a grid of digits 1-9 displayed infront of them on the screen. The participant is expected to listen to and memorize

the digits read out in their sequential order. Participants are then expected to click on the digits they memorized in the reversed sequential order.

Hidden: This exercise is identical to the numbers exercise with the exception that the grid is not displayed while the reading of the numbers takes place.

Sort: A grid is displayed in front of participants. The exercise begins by revealing the position of specific numbers on the grid and then hiding them again. Participants are expected to click on the positions of the revealed numbers in numerical order.

Letters: A circular centre screen with 9 speech bubbles surrounding it is displayed on the computer screen. The exercise begins with the highlighting of a bubble which is concurrently associated with a letter displayed in the middle screen and read out to participants, letters are highlighted in this fashion in a non specific order. After all the letters are displayed and the shape has gone blank one of the displayed letters is again displayed in the centre screen, the participant is expected to click on the correct bubble to complete the exercise.

Assembly: A grid is displayed on the screen, letters a read out to the participant while corresponding bubbles light up in relation to the letters. A letter is then displayed on the left and the participant must select the corresponding bubble. The letters are always displayed in the same order in which they were read.

Cube: This exercise is an inverse version of the 3D grid with the panels being on the outside as opposed to inside of the cube.

Pop-up: Circles randomly appear on screen, once they have all appeared the participant needs to select them in the order of their appearance.

Rotating: A circular shape of small circles is displayed on screen and rotated. During the rotation some of the circles light up, the shape continues to rotate and participants must select the correct circles in the sequential order of their lighting up.

4.4.2. The CogMed Improvement Index

The CogMed Improvement Index is a measure of the participant's performance over the course of the program. It is calculated based on the difference between the start index, obtained on day 3, and the max index which a participant scores over the course of the program. This provides a numberic measure of participant's progress over the course of the program in relation to their initial performance calculated on the third day of participation. Increases in the value of the index represent an improvement in participant's performance on the program.

Currently there is no documented evidence to support the psychometric properties of this instrument. However, given it's specific link to the CogMed Program and associated tasks, it may provide a useful means of determining program specific improvement.

4.4.3. The CogMed Daily Max Index

The Daily Max Index is an indicator of the total number of items that a participant was able to remember for all of the tasks they completed on a given training day. It is calculated on a daily basis by the CogMed Program.

There is no evidence associated with the psychometric properties of this measure at present. It does however provide a useful means of tracking participant performance over the course of the program in terms of their performance each day.

4.4.4. The CogMed Daily Training time vs. Pause Time

The daily training time against the daily pause time are values that are indicated for each of the participants over the course of their participation in the program. This is a measure of the length

of time that participant spent engaged with the program each day in conjunction with the length of time that participants spend resting in between trials during and between tasks each day.

Similarly, there is currently no documented evidence related to the psychometric properties of this measure. It does provide an indicator of the amount of time that participant's spent in actual engagement with the program over the course of their participation.

4.4.5. The Weschler Adult Intelligence Scale – III, Letter-Number Sequencing Subtest

The Letter-Number Sequencing Subtest of the WAIS-III forms part of the broader Working Memory Index of the battery. It involves a sequential reading, by the examiner, of a predetermined set of scrambled sequences containing numbers and letters. After each reading of a given sequence, the examinee is expected to restate the sequence, reordering the numbers first, in to numerical order and then the letters in to alphabetical order. If the examinee successfully completes the trial, the examiner moves to the next sequence in the test and repeats the process. Sequences are increased in length after every three trials. An examinee is required to incorrectly state three sequential sequences, of the same length, in a given section before the test is terminated. This test is particularly suited to measurements of Verbal Working Memory.

Claassen, Krynauw, Paterson, & Waga-Mathe (2001) showed reliability coefficients of 0.72 for letter-number sequencing in South African populations. These were described as similar to US data which showed coefficients of 0.77. This indicates that this test reliably measures what it purports to measure.

4.4.6. Weschler Adult Intelligence Scale – III, short form

Blyler, Gold, Iannone, and Buchanan (2000) developed this configuration of subtests from the WAIS-III as a means of briefly and reliably testing for IQ level in populations with schizophrenia. It consists of the tests information, block design, comprehension and similarities. Although the authors note that this configuration consistently overestimated full scale IQ scores for schizophrenic

populations they assert that this combination remains the best for a brief assessment of IQ score. The letter-number sequencing subtest was later added as a means of providing a measure of working memory function.

When these four subtests were correlated with the full scale IQ scores from the WAIS-III correlations of 0.95 were found for the participants with schizophrenia while normal control scores were correlated at 0.93 (Blyler, Gold, Iannone, & Buchanan, 2000).

4.4.7. The Pre-Intervention Interview Protocol

This interview protocol was semi-structured in nature with an aim to examine participants expectations of the CogMed™ Working Memory Training (See Appendices, 10.1).

The questions were open ended with the researcher's usage of appropriate prompting aimed at exploring participants responses and experiences more deeply, as well as to clarify responses that were unclear. The interviews lasted between 5 and 20 minutes minutes and were conducted in face-to-face.

4.4.8. The Post-Intervention Interview Protocol

This interview protocol was semi-structured in nature with an aim to focus on the way in which participant's experience the content, logistics, pragmatics, effects of and contextual issues surrounding the CogMed™ Working Memory Training Program. It was divided in to two broad themes; content and logistics, under which a number of questions were designed to explore each of these aspects (See Appendices, 10.2).

The questions were open ended with the researcher's usage of appropriate prompting aimed at exploring participants responses and experiences more deeply, as well as to clarify responses that were unclear. The interview will last approximately 40 to 60 minutes and was conducted in face-to-face.

4.5. Data

Raw participant pre-test scores were visually compared against posttest scores as a means of determining a significant difference between pre- and posttest scores on the subtests of the WAIS-III, Shortform.

The qualitative data was analyzed through the use of a thematic analysis which required that the researcher engage in a process of familiarization with the data, develop a set of initial codes, pool the coded data together in to a set of themes, review these themes in relation to the data, refine the names and definitions associated with the themes and finally, produce the associated report (Braun & Clarke, 2006).

4.6. Procedure

4.6.1. Pre-intervention

The researcher first wrote the proposal for the study which outlined the procedures to be carried out before, during and after the intervention. A copy of this, along with a letter of request (see Appendices, 10.3), was submitted to the Research Relationship Manager at CogMed™ for approval. The proposal was also submitted to the Department of Psychology at the University of the Witwatersrand, Johannesburg. Two readers from the department read and assessed the merits of the project from ethical and methodological standpoints. Each reader provided feedback to the researcher regarding their assessment of the project and the changes they noted as necessary before approval. The project was accepted at the departmental level. It was then submitted to the Medical Ethics Committee for consideration and approval where it was approved (See Appendices, 10.4). The finalized proposal was then presented to colleagues and supervisors before being submitted as final to the main psychology office. The proposal along with a letter (See Appendices, 10.5) describing the research it proposes was sent to the CEO and Head of the Research Council at

the hospital requesting access to the sample. The researcher also contacted the halfway houses associated with the project. Access was granted by all of these institutions.

The researcher requested that the respective heads speak to individuals who they felt may be viable for the study through pamphlets (See Appendices, 10.6) to candidates. The heads of these institutions provided the researcher with contact details for participants who were willing to take part. The researcher called all potential participants (See Appendices, 10.7). Initial interviews were arranged, these took place at the halfway houses since most participants resided there. Where this was not possible, the researcher travelled to participants homes to conduct the interview. Each of the individual meetings with participants began with the administration of an information sheet and an informed consent form (See Appendices, 10.8) which participants signed. Separate consent was also be requested in writing for the audio recording of interviews (See Appendices, 10.8).

The researcher issued each participant with a participant code for their usage over the course of the research. Each participant then received a demographic questionnaire (See Appendices, 10.9). Participants also received the WAIS-III, short form. They also completed the Letter-Number subtest of the WAIS-III. Participants then engaged in a short interview (See Appendices, 10.1).

4.6.2. Intervention

Participants were accepted in to the study with or without a coach. Following this, the CogMed™ Working Memory Training Program was administered over the subsequent five weeks to all participants. Over the course of the intervention the researcher maintained weekly telephonic contact with all participants encouraging their continued and consistent participation in the intervention process. Some participants struggled to keep to the schedule of 5 training days per week, in these instances the researcher sent sms messages to try and encourage participation where possible.

Engagement with the Program each day involved approximately 40 - 50 minutes of activities selected by the program and dependant on the rate of progression and performance shown by the given participant. Activities were varied on a daily basis where participants were expected to complete all the activities allocated on a given day.

4.6.3. Post-Intervention

All participants were contacted with the intention of arranging a final meeting for debriefing as well as to take part in the final interview. The researcher was unable to contact one participant to set up this meeting. This test was arranged at the participant's earliest convenience. Participants who completed the intervention program engagedin a short semi-structured interview (See Appendices, 10.2). Participants again received the WAIS-III, short form as a means of assessing specific cognitive functions. They also completed the Letter-Number subtest of the WAIS-III.

Following the conclusion of the intervention program and associated data collection the researcher engaged in a process of collating and organising qualitative, quantitative and mixed methods data.The outcomes of the study were written up and discussed in the form of a research report with the findings disseminated on submission of the report to the psychology department at the University of the Witwatersrand, Johannesburg.

4.7. Ethical Considerations

In terms of the National Health Act (Act No. 61 of 2003), all research proposals and programs must be assessed and approved by an ethics committee at the given institution from which research is to be conducted where the committee maintains an active registration with the National Health Research Ethics Counsel (The Republic of South Africa, 2004). The reasons for this are above all to ensure the safety of all participants involved in the systematic study of a method[s] of treatment aimed at assessing associated safety or efficacy (The Republic of South Africa, 2004).

This principle refers to the idea that any harm done to research participants needs to be minimized so as to prevent unnecessary harm to that participant (HPCSA, 2008). Although it was expected that the research process and intervention procedure presented minimal risk to participants, the nature of the tests and tasks involved may have conscientized participants to their possible cognitive difficulties. Participants were provided contact details for free services they might contact to help them think about these factors. Participants were not expected to bear the costs of research participation, the researcher mitigated these by arranging meetings and assessments at participants places of residence which were sometimes the halfway houses associated with Tara. Furthermore, the researcher assisted participants with their internet usage associated with the program by reimbursing them to the value of R100.00.

Participants received no direct reward or incentive for their participation in the proposed study. This needed to be carefully considered since participation required much in the way of sacrifice and input in terms of both time and resources. Participants spent approximately 4 – 5 hours in individual consultation with the researcher for assessment, briefing and other processes associated with the research. They were furthermore expected to spend between 40 - 50 minutes each day, five days each week, for five weeks engaging with the intervention or control task where this culminates in a total of 17 – 21 hours over the course of the research. In total then they spent up to 26 hours over the course of the research process engaging with the necessary activities associated with the research where this represented a substantial time investment on behalf of each participant. However, given the nature of rehabilitation it was expected that participants were aware of the necessity of their own motivation and engagement.

Participants were also expected to invest in the research other resources such as internet data and its associated costs, transport costs to meetings with the researcher, and the usage of a computer to which they would need daily access. The researcher ensured that all meetings were kept as brief as possible without compromising the necessary content of the given meeting as well

as arranging any meeting at participant's place of residence. All participants were reimbursed up to R100.00 for their internet usage associated with the program.

The diagnosis of participants in this study leads to their definition as a vulnerable population in terms of their abilities to engage a fully autonomous decision making process. However, by having selected participants with the added diagnosis of single episode in full remission (The American Psychological Association, 2000) the assumption was made that participants had made the progression toward assimilation back in to society as well as toward an ability for full functionality which includes their abilities to competently make decisions with important implications for the self. Participants were fully briefed, in the form of a letter, regarding their roles in the stated study where the researcher obtained consent in writing for their participation in the project. Their right to withdraw was also made explicit during the consent procedure.

The proposed structure of the current study necessitated that the researcher maintain a constant level of communication with participants before, during and after the proposed study where this would necessitate the possession of their names and contact details in the form of a digital list. This list was kept in a password protected, encrypted document on the researcher's computer. At the conclusion of the study the document was deleted ensuring participant confidentiality. Access to the document in digital format was necessary since participants needed to be contacted periodically associated with their engagement with the program, the reason ranged from general motivation through to specific factors associated with the researcher's monitoring of participant performance and participation. The active recording and transcribing of interviews increases the risks that participants could be identified with regard to their roles and responsibilities in the current study. These items will be destroyed on completion of the research project.

Dissemination and reporting on of the research process and outcome necessitated discussion of participant scores, sometimes with reference to individual participants or their data. The researcher endevoured to keep all identifying personal information from interviews or the

demographic questionnaire out of the final report in an effort to maintain the confidentiality of research participants. Any discussion of individual results will entailed the usage of the given participant's code which was assigned during the pre-test procedure.

5. Results

5.1. Quantitative

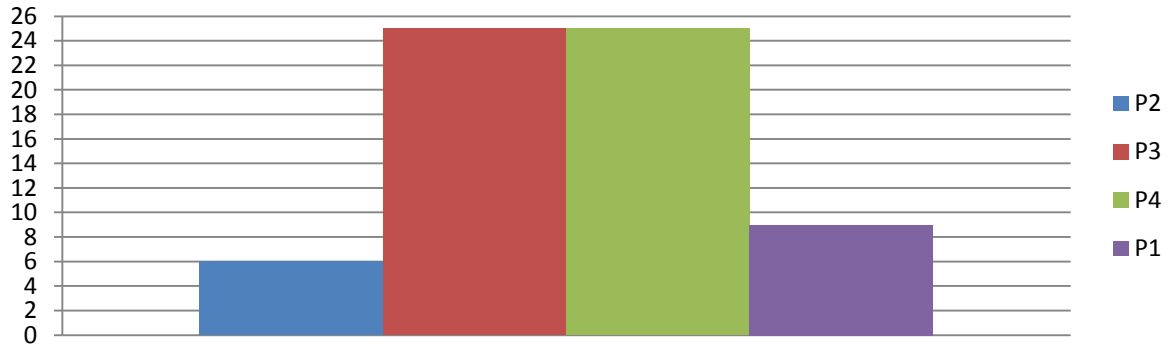
5.1.1. Assessment Indices

5.1.1.1. Total Number of Sessions Completed

Figure 1 denotes the total number of sessions completed by each participant over the course of the program. While participants 3 and 4 completed the program with 25 sessions each, Participants 2 and 1 did not with 6 and 9 sessions completed respectively.

Figure 1

Total Sessions Completed

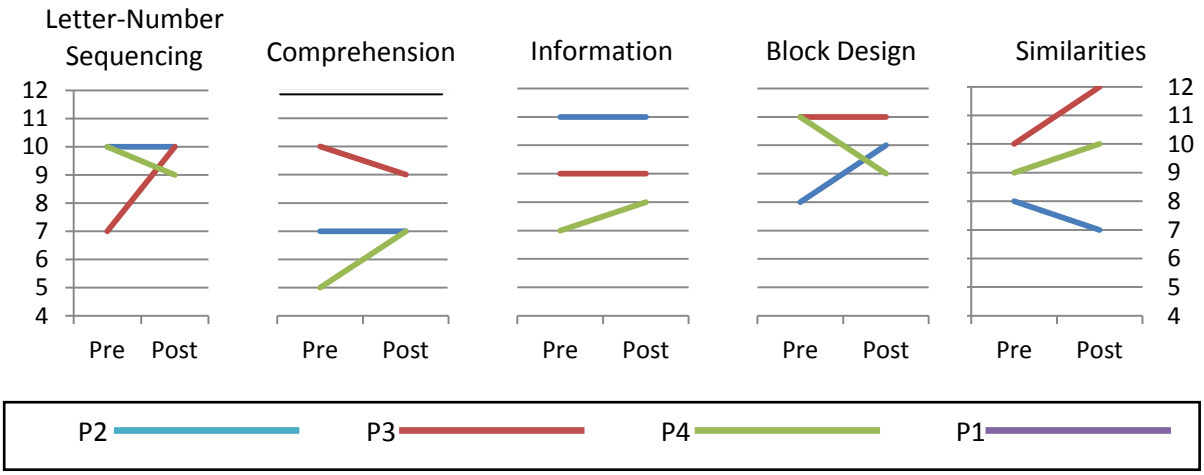


5.1.1.2. Scaled Scores of the WAIS Subtests

Table 2 illustrates the pretest and posttest scores for the selected battery of indices from the WAIS-III. Raw scores for each test were obtained and converted using South African Normative Data (Claassen, Krynauw, Paterson, & Waga-Mathe, 2001). Participant 1 declined to participate in the posttest procedure and his scores have thus been ommitted from results.

Figure 2

Scaled Scores of WAIS Subtests



All of the subtests, with the exception of information, present was a heterogeneous trend in terms of the distribution of scores. Its important to note that none of the participants showed any trends in terms of their performance over the range of subtests, even participant 3 and 4 showed variable performance within the context of completing the program. For the Information subtest, Participants 2 and 3 showed consistent performance between pre and posttest procedures while Participant 4 showed an increase from 7 to 8

On the Comprehension subtest, performance between participants was variable. Participant 4 showed an increase from 5 to 7 points. Participant 3 showed a converse performance with a decrease from 10 to 9 in this area. Participant 2 showed no change.

Participant performance on the Block Design subtest was variable as well, participant 2 showed an increase from 8 to points. The converse is true for participant 4 who showed a decrease from 11 to 9 points. Participant 3 showed no change in this area. On the Similarities subtest, participants 3 and 4 showed increases of 10 to 12 points and 9 to 10 points respectively. Participant 2 showed a declining trend here with a decrease from 8 to 7 points.

In terms of scores on the Letter-number Sequencing index, Participant 3 showed the largest increase of 3 points from 7 to 10 points. Response to the program was variable with participant 4

showing a 1 point decrease from 10 to 9, this indicates that verbal working memory function declined between pre- and postttest procedures. Participant 2 showed no change.

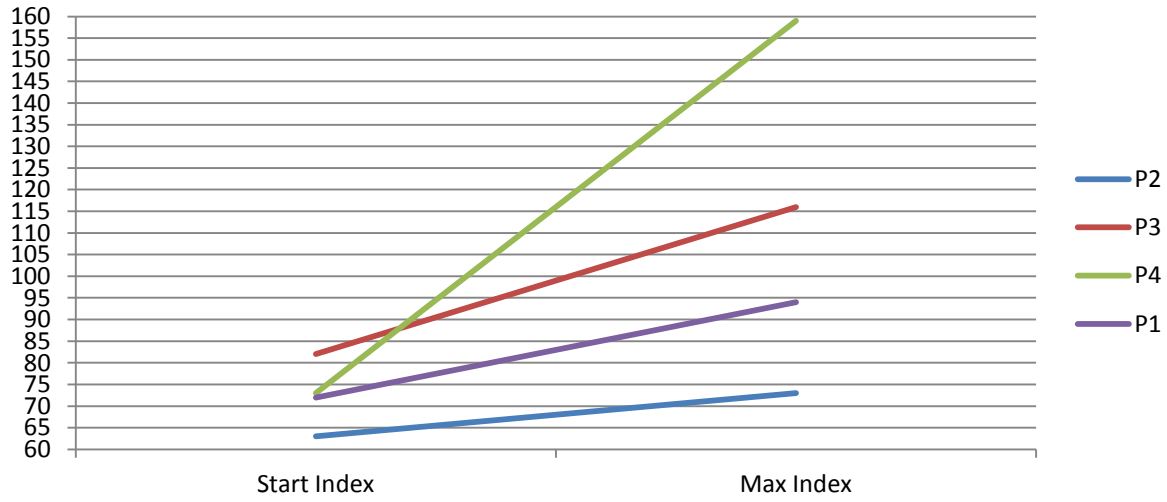
5.1.2. CogMed Indices

5.1.2.1. Improvement Index

Figure 3 illustrates the CogMed Improvement index, which is a measure of the participants performance over the course of the program. This is calculated based on the difference between the start index, obtained on day 3, and the max index which a participant scores over the course of the program.

Figure 3

CogMed Improvement Index



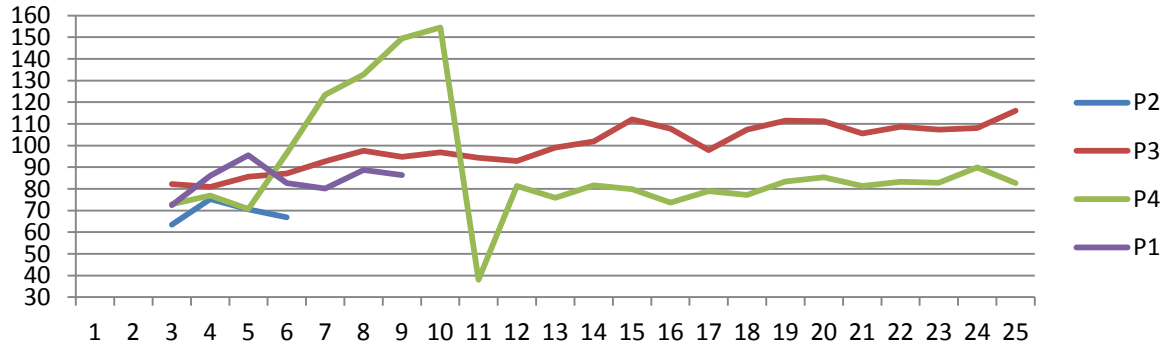
All participants show an increase in terms of their performance in the program. Participant 4 shows the greatest discrepancy, at 86, between start and max indexes indicating that she showed the most improvement while participant 2 showed the smallest discrepancy, at 10. Participant 4 showed an improvement index of 34 while participant 1 showed one of 22. Participants 3 and 4, who completed the program, showed the highest discrepancy between start and max index.

5.1.2.2. Daily Max Index

Figure 4 illustrates the daily max indexes that participants obtained over the course of the program. The daily max index is an indicator of the total number of items that a participant was able to remember for all of the tasks they completed on a given training day.

Figure 4

CogMed Daily Max Index



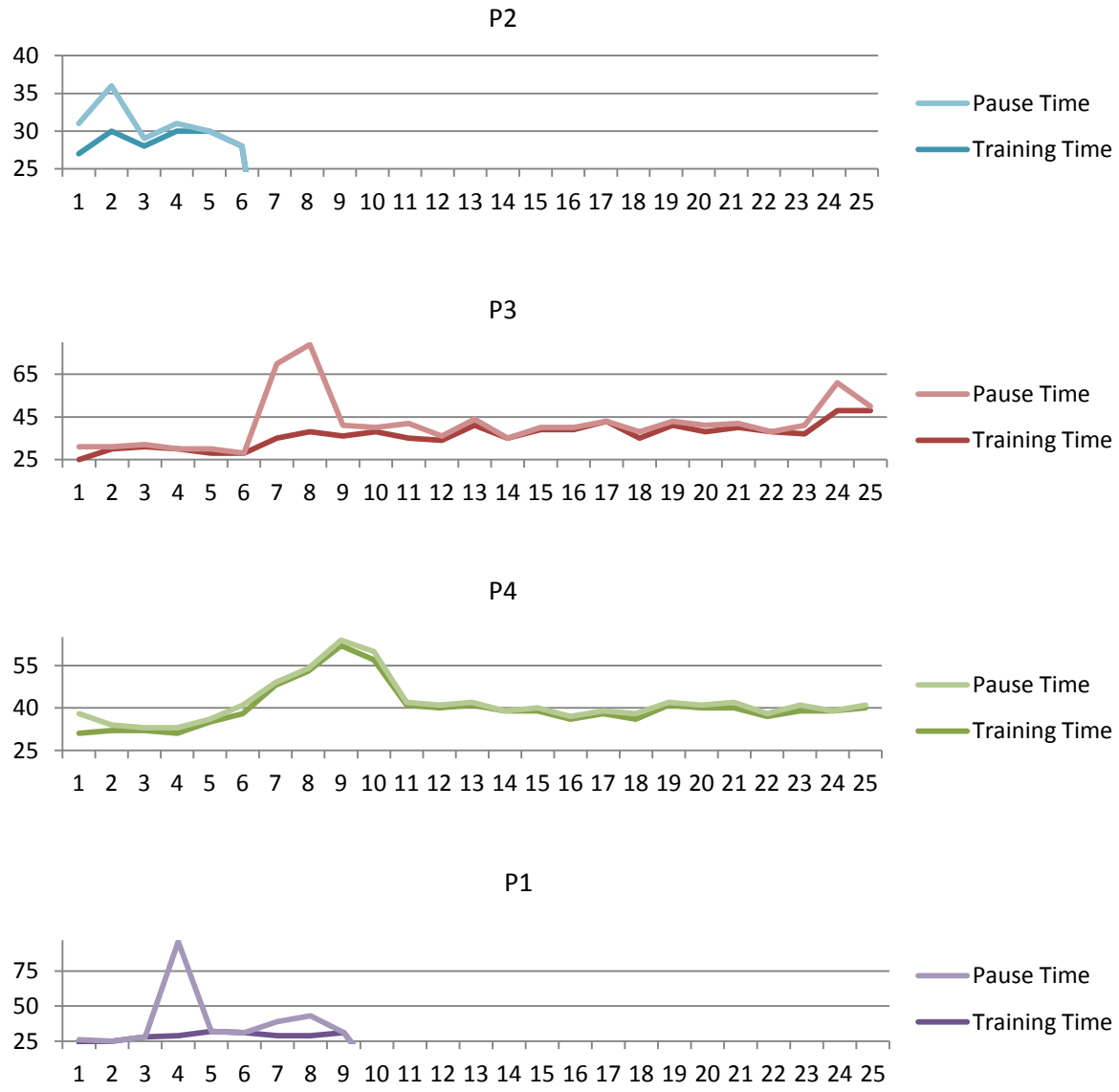
While all participants showed an upward trend in terms of their respective daily max index performances, participant 4 shows a anomaly between days 5 and 10 where her max index increases substantially to 154.4 and then drammatically drops to 38 on day 11. Her performance then stabilizes from days 12 through to day 25 where she showed a slight increase from 81.3 to 82.7. Participant 3 shows a consistent increase in her scores from 82.2 on her first training day to 116 on her final.

5.1.2.3. Daily Training Time vs Pause Time

Figure 5 shows that daily training time against the daily pause time for each of the participants over the course of their participation in the program.

Figure 5

CogMed Daily Training Time vs. Pause Time



All participants show a gradual increase in the daily time spent training during the program with a gradual decrease in the pause time. Two substantial anomalies are present in the graphs for participant 3 and 4. On days 7 and 8 participant 3 showed a drammatic increase in her pause time during training. Between days 5 and 9, participant 4 shows an increase in training time from 35 on day 5 to 62 on day 9. This drops down to 41 on day 11 where it remains on average around the 40 minute mark for the duration of her trianing.

5.2. Qualitative

5.2.1. Challenges of Implementation

5.2.1.1. General Variables

5.2.1.1.1. Computers and Internet Access for Health Care Users in Public Hospitals and Halfway Houses

Tara and Baragwanath Hospital, as well as two of the five halfway houses approached, serve low income communities, so healthcare users do not have access to personal computers and internet, this was indicated by the staff at these facilities. Even in instances where users do have access to these facilities, this access is limited. This puts the responsability on the patient to cover the internet costs, and in some cases, this can be difficult due to limitations on financial resources of the patients who use hospitals and halfway houses. During the second week of the program, participant 4 contacted the researcher to determine whether or not the internet costs would be reimbursed. She was concerned that her mother would be unable to afford the costs and that this would've stopped her from participating in the program. She questionned a few times to find out whether the researcher was covering the cost, despite multiple clarifications. This indicates how big a concern cost is, even in situations where individuals are able to afford an internet connection.

"my mom pays for the internet. I just thought, were you going to pay for it or… are you going to pay for it?" (P4)

In addition to resources such as computers or internet, the CogMed program also requires participants to have a mouse and headphones; these would also be aspects of the program that would limit their ability to participate. Tara, Baragwanath and and the halfway houses also do not possess the resources to allow individuals to participate in the program on premisis.

Overall, neither Baragwanath nor Tara were able to provide resources to allow participants to take part, this is important given that Tara is located in an affluent suburb while Baragwanath is

located in an area of extremely low socio-economic status, illustrating that this phenomenon is related to public hospitals in general. However, even if these resources were available at hospitals, the populations services by these hospitals would still be unable to afford transport costs to the hospital on such a frequent basis, still leaving the program inaccessible.

5.2.1.2. Specific Variables

5.2.1.2.1. Obstacles to Accessing the Program

Accessibility is understood, in the context of this research report, as the ease with which participants were able to access the program. Here it refers to the technological and social aspects of the program in terms of the requirement that it was performed from a personal computer in a space that was quiet and free from distractions. Participant 2 and 3 both discuss the difficulty around having to engage with the task on a laptop, showing consensus in feeling that the laptop could sometimes be a hinderance when they wanted to access the program.

Participant 2 notes that she could find the time to engage in the program, however, the idea of getting her laptop out left her feeling less willing to do this. The laptop thus becomes a hinderance to her because of the amount of effort associated with setting it up. This may provide evidence for a number of factors, including the negative symptomatology associated with her diagnosis as well as her own latent level of demotivation.

"I could find the time but I was like, just getting my computer out." (P2)

The difficulty of finding an appropriate space and time to do the programme was also identified as a limitation. She made reference in previous interactions to the frequency with which she was disturbed when working; both in terms of fellow housemates coming in to her room as well as in caretakers requesting that she perform tasks around the house. This made it physically difficult for her to find an area which was quite, that allowed her to successfully engage in the program without disturbance. Her reference to being able to concencentrate more inside may also provide

evidence for her wanting to have been able to engage in the program in different locales, but that she recognized that this could be difficult and that it was necessary to participate inside the house. She says;

> *"inside I could do it, and I suppose I'd concentrate more when I was inside but I don't know if I can always access my computer when no one's around to do it." (P2)*

It was suggested that the program be implemented on different device platforms, such as cellphones or tablets. While this seems like a contradiction in relation to the financial limitations expressed, it is important to consider that sometimes these devices are, currently, more accessible than computers to some people. This is eespecially true for people in a more stable or secure financial position.

> *"but that would've been nice, because you see I was normally sitting here and doing it. Um, sometimes I took the laptop there, in the living room and I was sitting there, but otherwise I could've lied on bed and doing that, if it was on the cellphone or tablet." (P3)*

> *"I was thinking if this software could've been available on a cellphone for example, as a cellphone app or a tablet app, that would've been quite easy, but now it's the laptop so it's a bit difficult. I mean, like lets say the one day I'm somewhere waiting, you know at least I would've been able to do it on the cellphone or whatever on the table, I think that would've been helpful." (P3)*

> *"But if it was on cellphone, like if it was at a place like where I was at the clinic waiting, um, then I could've done it there so, cellphone and tablet app would've been nice." (P3)*

5.2.1.2.2. Training Environment

All participants engaged in the training from their homes. Therefore, training environments differed and were and on participant's home environment. Due to the variability in terms of participants home environment, they show varying levels of satisfaction in relation to where their training took place. Participant 3 was the only participant who had a home of her own. She lived alone, and consequently did not make reference to many sources of distraction. Living alone seemes to be beneficial for participants in terms of exposure to distractions, however, there are still sources of distraction that make participation in the program difficult. It seems important to note that the level of distractibility improved over the course of the program and this made it easier for participants to cope with distractors.

"Like I said that one time, that I'm very distracted by noises, I've felt that that's somehow improved. I've got more focussed." (P3)

The presence of other people can be particularly disturbing for people with schizophrenia. This is why they appreciate having a solitary space to engage with the programme.

"I also think, to do this training in your own space, in your own environment was also nice." (P3)

"I think that would've also been on the motivation to go somewhere, because I'm quite a homely person I don't like going places." (P3)

"I think if there were people around me I wouldn't have been able to concentrate that much, it would've made me more a bit agitated." (P3)

"it went smoothly and also, I didn't have to travel anywhere, I didn't have to do anything. I could just come to my room, sit at my desk and open up my laptop and just do it." (P4)

"if I had to start working and you know, doing computer things. I'd have to, travel. But I mean that's a different issue, because you've got to travel." (P4)

Participants living in half way houses had higher levels of disatisfaction with the training enviroment, eespecially on particular days of the week. However, for some, the characteristics of the house mates and the house enviroment were facilitative of the program, while for other participants, the opposite was true. While participant 2 expressed dissatisfaction with her concrete, home environment; she also expressed dissatisfaction with the emotional evironment in the house. She feels as though she is surrounded by people who are demotivated and this leaves her feeling the same. This may be evidence of negative symptoms, which are worsened by the negative symptoms of those arround her. This means that the interpersonal environment contributes to the difficulty of participating in the program in some halfway houses. When participants were asked about the obstacles they found during the programme, they mentioned particular activities during the day, as well as environmental interruptions.

"Washing up, during the day. When it was my day to wash up, I felt a bit tired and then I'd lie down and set my alarm for about 9 o clock at night and then do it then. Have a bath at eight and then do it at nine." (P4)

"usually what happens is that I have the computer out, and I have the disk and everything's installed and then something will call me away. Like, I must go do this, I must go do that and something like that might stop me... If I go outside there's people so, and if I'm inside, then some ones always walking inside." (P2)

"I've been in a rehabilitation program for five years and um, I just felt this place has, like breaking me down. People aren't encouraged and um, it feels like encouragement or more positivity or more group work or more teamwork." (P2)

> *"it was difficult. It was difficult because usually I'm with people who are very high spirited and I'm high spirited and as soon as I get high spirited they're like uuuuuugh. I'm like, I'm just trying to make something of the situation I'm in." (P2)*

Participant 3 discusses something similar in relation to her work environment, here she expresses that, while she may have been able to engage with the program at work, that the level of distractors in terms of people and tasks that she was expected to do would've made this difficult for her. For this reason, it was better for her to be able to engage in the program at home. Unlike participant 3, participant 2 did not have an alternate environment that provided the ideal conditions for her to engage in the program, and this made it ostensibly difficult for her.

> *"one thing was out for me was to do it at work, was um, even though I could've done it, scheduled time at work. But you know a lot of people, even if you close your door, they just walk in or the phone rings, you know that would've been too distracting so that why I preferred to do it at home only." (P3)*

Two particular struggles were expressed by participants; anticipated distractions that may have impacted their motivation to do the program and their difficulty with working around unexpected changed in their daily routines. For participant 3, the addition of her sister and her sister's children made it difficult for her to work on the program while 2 discusses the possibility of visiting her family and having her birthday saying that these would make it difficult for her do the program. This seems to begin to point out the importance of routine and illustrates the difficulty that participants had in coping with the program during times when their routines were altered.

> *"so if I had to go somewhere else. Or if there was a big change, if my mom was around in town, or if they were taking me out or, because I don't see my parents very often. So if something had to distract me." (P2)*

"well I know, how long is five weeks? ***[it's a month and a week]*** *okay so that's September, so my birthday's coming up um, I don't know, I might be going overseas in September. Well not overseas, either to Nigeria or Zambia where my parents are, it's only just a maybe." (P2)*

"and that one weekend I had my sister from America here, so she and her sons and the sons didn't quite, I tried to do it one day here. But then they'd come in and ask a question, and I'd say I'm busy… And they didn't quite understand that I need to concentrate and whatever and if you asked me, questions in between I already lost the plot." (P3)

Other external factors also played a role such as lighting could also make it difficult or impossible for participants to do the program. Here inadequate lighting in the intended training environment might lead participants to want to do the program elsewhere, however other options for training locations were limited because of the presence of distractors.

"If I go outside there's people so, and if I'm inside, then someone's always walking inside. It's also with the lighting and stuff like that" (P2)

"but then the one day, lightning struck our house and we couldn't do anything for two days." (P4)

5.2.2. The Role of Psychological Variables on Participant Experience

Psychological variables are understood as those variables that relate to participant's internal worlds and the way that these influence their engagement with the program in terms of their beliefs regarding its necessity due to the salience of cognitive deficits, their desire and ability to participate, and how they participate.

5.2.2.1. Perception of Necessity of the Program due to the Salience of Cognitive Deficits

For participants to desire participation, they need to develop a sense that the program is necessary in aiding or improving their wellbeing. This is accomplished by their own level of awareness of their cognitive symptomatology. Participants expressed a sense that their cognitive abilities have deteriorated over time, here they express memories of a prior periods in their lives where they were able to perform similar tasks, which now seem far more difficult.

> *"I used to be able to do these sorts of things and it was easy for me and now, just seeing my life change and just really, it's sad." (P2)*

> *"eespecially with my brain and socializing and figuring out numbers and like I feel now, that I haven't done it in a long time that it's deteriorating." (P2)*

> *"I do, uh, I tend to try and be perfect but I can't be perfect anymore. Eespecially when I was at school I was always competing to be first or second, you know, and I cannot do that anymore because I haven't got the brain power." (P4)*

Participants therefore, are aware of cognitive deficits that are present and hindering their abilities to do thing in their everyday lives. They sometimes link this to their diagnosis and medication regime while remaining uncertain of the actual cause.

> *"I have real memory problems, I don't know if it's because of my medication or, if it's just because of the schizophrenia" (P3)*

> *"I've got a blockage, there's like a blockage in my head. It's like a blockage that stops me from doing something to the best of my ability." (P4)*

However, participants presented a worry that the program would worsen this awareness for them. This would happen by it either placing more stress on them than they were able to handle, or

by it increasing their awareness of cognitive symptomatology and thus also increasing their anxiety levels. In relation to this, they expressed a fear that they would not be able to cope and this left them feeling less willing to want to take part in the program.

> *"Ag ya, I'm a bit apprehensive; worried about it being a bit too stressful and a bit, impacting on me negatively and that sort of thing." (P1)*

> *"Like putting too much stress on me, making me feel bad about myself for not being clever enough to figure out the answers or, you know…" (P1)*

> *"Not really, maybe a bit. I might actually discover exactly how bad my memory really is." (P3)*

It could be expected then, that positive experiences during the program would alleviate these feelings while negative ones would reinforce them and leave participants feeling less likely to want to participate in the program.

> *"It depends how it goes, if it's positive then it's not a problem but if it's impacting on me negatively then it will be a very big problem." (P1)*

The salience of cognitive deficits may then have a negative impact on the perceptions of the necessity to do the program given that participants worried that the program may either make them more aware, or worsen symptoms that they were experiencing.

5.2.2.2. Desire to Participate

If the program was deemed necessary, the next aspect for consideration would be whether or not participants wanted to participate in it. This was mediated by their own expectations of what it would deliver, their motivation level as well as barriers to communication.

5.2.2.2.1. Expectations

This theme is defined as the outcomes participants expected to receive from taking part in the program. Participants expressed it in different ways, these ranged from purely cognitive improvements through to hopes that the program would improve areas of daily living. When asked about their expectations of the program, participants generally refered their memory as a problematic area. They hoped that the program would improve their ability to remember and retrieve information. Participant 3 linked the improvement of her memory and concentration to productivity at work, saying that she hoped it would lead to this as well.

> *"Um, I'll be hoping I can remember things, because what happens with me is that I'll remember something and then if I don't write it down in five seconds I'll forget it and I can't remember it again. Or if I have a thought and I can think about it for like ten minutes and if I don't think about it for a while then I'll forget completely what it is. When I'm talking I forget people's name's, even if it's like my brother, I'll forget his name when I'm talking to him. So I don't want to do stupid things like that anymore." (P1)*

> *"Um, I think memory and concentration also goes hand in hand. My, with my work specifically, I mean I need to remember things. Um, so it will also help improve me on my productivity at work." (P3)*

> *"Ya, well say now they ask you one of the presidential features of a government you've got to know what's in your head, you've got to know what you've learnt in your head to bring it out." (P4)*

> *"Retrieving information so that I can bring it back." (P4)*

Other participants also expressed hopes that the program would assist them in other areas of their lives. These included hopes to further educational level and allow them to obtain a more

stable lifestyle. While these areas are still linked in some way to improvements in cognitive ability, they illustrate the difficulties that these participants have in terms of being able to function in their daily lives. Consequently, it seems that they hope that the program will be able to improve more general functions and increase their quality of life.

> *"I'm looking for work at the moment, I mean I've got like five years experience working in a kitchen and doing guest house. I'm studying, busy trying to pass my guest house management assignment it took me two years to study, I'm also thinking of doing my brokers exam. Just ya, um, short term, just pass my learners so I can get my drivers licence, long term is to just finally have my own place and just settle down." (P2)*

> *"I'm expecting to increase my marks, I'm doing a diploma in law and it's taken me a long time to decide to go back to it because I was studying a ### degree in 1983 and I got anorexia and had a breakdown, and that when everything went wrong for me and I was wondering if it would help me sort out my things in my head. Eespecially when I'm writing exams, um, to think quicker than I do and to write quickly. I want to, be able to understand the questions." (P4)*

5.2.2.2.2. Motivation

This is understood as participants' willingness to do the program, its comprised of their own perceived level along with factors which they attributed to increases or decreases in this level. When asked about this, most participants had a positive assessment about their levels of motivation. There was some variability in the beginning of the program. This might relate to the difficulty some participants experienced in initially adapting to the program, consequently their anxiety was increased and they felt less willing to participate. Alternatively, the novelty of the program may have left participants feeling excited in the beginning leaving them feeling more motivated.

"Um, it was very good. In the beginning I was very motivated" (P2)

"I think, quite a bit." (P3)

"I think in the beginning it was maybe a bit less." (P3)

"I was very motivated, I did it every day without fail." (P4)

Participants also spoke about their expected level of motivation during the program and how this might impact on whether or not they delayed completing it. In these instances they were likely to leave the program until later. The frequent procrastination may relate to negative symptoms associated with their diagnosis, altertenatively they may also illustrate cognitive symptomatology in terms of their decreased level of executive control over their lives.

"I must say um, sometimes I do get a bit lazy so I must probably. You know I see myself, I can do it, but I must really put my mind to it, um not my mind, but I must really set out a time of day and I have the time" (P2)

"Procrastination ya, but I will get it done. I will do it, I do get it done but I'll most probably lay it off until later on in the evening or something like that" (P2)

"I don't know, I just didn't want to do it the day [laughs] **[So it felt like it was just a little too much to do the program…]** *Ya, I just felt like, bugger this [laughs]." (P4)*

3.2.3.2.1.1 Factors Which Increased Motivation

These were aspects of the program that left participants feeling more willing to want to participate. Participants discussed the fact that the tasks provided them with challenges that they needed to beat, the experience of beating these challenges increased their willingness to want to continue engaging in the program. This may be related to feelings of increased self-efficacy brought about by the sense of accomplishment of successfully completing a task.

"the challenge behind that, because I liked that." (P2)

"it showed me my weak points and my strong points and gave me challenges to do, to practice to work my mind, and giving me motivation to see if I can get the next level higher and the points and everything to see if I can get more points, and score on the high score and ya" (P2)

"its almost like competitive. I couldn't wait to push myself to do better, better, better. You know like when you try to play a game and you try and beat your high scores? It felt like that, so it was that type of motivation, competitiveness that pushed me." (P3)

"liked the games, you know the activities. I liked the challenge, if I can put it that way, to me it was a challenge." (P3)

Participants also expressed the possibility, that adding the competative aspect of being able to score themselves against other players may have increased their experience of the program. The presence of other pplayers may have increased the challenge which would've left participants feeling more willing to engage.

"Maybe playing against someone else, making it more competitive." (P3)

Routine seemed to be another important aspect associated with increased motivation to participate in the program. This was understood as having a set schedule of tasks that could be followed everyday. Where participants were not able to do this for themselves, they indicated that they would've been more able to engage in the program if this structure had been provided for them.

"if I'm working it's like a set timetable, I mean I know that if I have to do it then I would've done it." (P2)

"But I need to put the responsibility on myself, because if I wanted it, I really, I need a structure." (P2)

"But if you said to me, ### come on you must do it ten o' clock everyday, I need it done, I need that deadline. You know, then I'd be more motivated to do it" (P2)

Being presented with an opportunity for recovery also seemed to help to motivate participants. With increased levels of salience in relation to their cognitive symptomatology, participants showed increases in their perceptions of the necessity of tasks that would help improve their memories. This may explain the increase in motivation toward wanting to participate in CogMed, with the CogMed program providing them with a more formal means of doing this.

"I really aim a lot towards my recovery and I do feel that, um, I wont be 100% but at least I'll be like, 50 or 60 or 70%." (P2)

"And I've always liked working on my memory, when I packed something away I'll count how many plates, I will, I will count my steps, I'll practice like memory games with myself, so that's what I do." (P2)

"I really enjoyed doing it when I was doing it, I really enjoyed it; because it did help me" (P2)

"I find it easy to take part in these things because I know they're going to help me in the end." (P4)

"I just found it very satisfying and you know, taking an hour and a half of my day and really helping me cope with life." (P4)

Participants also expressed that the game-like format in which the program was presented was appealing to them. Playing games such as these was readily part of the normal activities that

some participants performed. However, knowing that the games in the program were targeted toward their rehabilitation left them feeling more willing to play them, because the activities had a constructive basis. This may be evidence of participants aiming toward recovery, that the joining of recovery exercises in a fun format left participants feeling more willing to engage.

> *"I liked the fact that it was games. I like playing games." (P2)*

> *"You see what was so, a lot of on the weekend. Ag, I play games, other games. So, for me, this was now keeping my game playing as in the past, more in a productive manner, that's more beneficial to me, like the other games that I used to play on a weekend, so I just replaced this with those… It wasn't like I wasted my, so you see it was something constructive and productive." (P3)*

It is possible that the game format of the program also presented a highly stimulating environment for participants. This is important given that attention problems are associated with schizophrenia. The stimulating game environment presented by the program, may have helped participants to remain involved and focussed on the activities. This happened in two ways; participants were engaged by displays that were not static and that required them to interact in an entertaining way. The second was related to content material, where one participant spoke about how the focus on space was particularly interesting for her. When participants were asked about the game format of the program, they responded;

> *"I liked things moving from left to right and in like that format. It was also like nice to see the robot and the different displays and it was very nice." (P2)*

> *"the asteroids, the asteroids were very intriguing. Oh, and the space whack, space whack ya, that was very intriguing." (P4)*

"Well I just enjoyed squashing the man every time he came out the tunnel; 'prrrt' 'splat' [laughs] and the asteroids, I find it interesting because I've always been interested in space and the stars and the southern cross." (P4)

An aspect of motivation, unrelated to the program, that participants who completed the program expressed, was their own identity and how the way they viewed themselved played in to their interactions with the program. For them it was important to complete the program because, if they didn't, this would provide them with a conflicting sense of who they were. This also impacted on how they performed during the program. It made it necessary for them to try to do their best, because their doing less than this would also leave them with decreased feelings of self-efficacy.

"I think it's also related to who the person is. I'm the kind of person who, if I start something I must follow it through. Even if I feel it's difficult, you know and I, I always push myself to complete whatever I do. So I think that kind of helped my determination to complete something, because I would feel like a failure if I quit. Not so much for the program but for me, as a person." (P3)

"I tend to be a perfectionist because it's good to be like that because it motivated and to do the things properly instead of just jumping in to things you know." (P4)

Finally, participants discussed the feedback they received from the program. This also related to their own feelings of self-efficacy in that the positive reinforcement that they obtained from the program left them feeling more able to do it. One participant talks about how she'd initially thought that the program was a person who was encouraging her. This illustrates the importance of the research coach and research aid during the program, that these individuals become integral in helping to increase participants feelings of self efficacy, thereby leaving them more willing to

complete the program. This quite may also evidence some residual positive symptomatology inherent in her diagnosis.

> *"Someone was, was like this robot kept talking back to me, and because the robot was talking back to me I thought it was someone else on the other side, talking to me and saying look, 'you can do better than this.' 'You can try this.' 'Do better than this.' 'Have a break.' 'Take a break.' 'You're doing very well.' '3 in a row!' Things like that.* **[so it was encouraging?]** *it was encouraging! It was encouraging." (P4)*

3.2.3.2.1.2 Factors Which Decreased Motivation

These were factors that left participants feelings less willing to do the program. Fear of failure seemed to be a major factor that demotivated participants. This relates to participants experiences of anxiety in relation to the program where the prospect of performing badly left them feeling less willing to participate.

> *"I suppose in a way I was a bit threatened, in a way. Um, like of failing." (P2)*

Underperformance, or the experience of this in relation to difficult tasks acts to discourage participation. This experience also seems to leave participants feeling overwhelmed, as though the participation in the program is beyond their own capabilities.

> *"I just felt the computer won. Um, I didn't feel that I was achieving enough, I mean I was achieving, I just felt like the stuff that I wanted to get done, and the challenges that were ahead I didn't* **[you just felt like they were a bit too much?]** no *not too much, maybe a bit too much um." (P2)*

> *"but the thing is, the last two, I felt the more I did, the more deteriorated I was." (P2)*

"I started off doing very well, but I just got worse and worse and worse at it." (P4)

Tasks that maintain this high level of difficulty leave them less willing to try to achieve higher scores.

"I didn't like that circle thing, because I could never do it. I liked the window pane, but the ones that I couldn't do I felt like really, eespecially near the end I get like demotivated, where the things turns like that and you have to get the things as well and then you just think well let me just push in anything you know." (P2)

This experience was significant in the beginning of the program when participants were still int the process of trying to adapt to it. Here, they felt intensely overwhelmed by new tasks, and this made participation particularly difficult. This may also evidence the importance of routine and structure for participants, since the program had not yet been incorporated in to particcpants usual daily activities and this made it difficult given that participants struggle to adapt to changes in their routine. This period also acted to discourage participation, while two participants completed the program, it seems important to note that the two who were unable to complete terminated participation within the first ten sessions of the program.

"um…I think in the beginning but not so much later; it was quite draining. It was almost like it took a hell of a lot of energy from me, you know, after I'd done it I felt tired, my mind was completely tired. That I would say was also in the first week, and maybe a bit in to the second week." (P3)

"I think in the beginning it was maybe a bit less, because it became quite difficult. You know, I think I was maybe struggling a bit to adjust to the activities, it was almost like bombarding my mind with these things." (P3)

"Um, my experience was that I found it very taxing to start off with. I hadn't done something like it for a long time, and I'm now 48 and um, I found it difficult to cope when I first started." (P4)

"Only about my first five times, **[Okay so your first week.]** *Ya, my first week was difficult." (P4)*

Some participants also reference format as an aspect that could demotivate their participation. Activities that did not appeal to participants interests were less likely to evoke interest and consequently were more likely to be avoided. This was particularly evident during the roboracing reward game, where participants felt that the racing format of the game was uninterresting, and did not appeal to them.

"I didn't enjoy it, so I didn't, I never did it [roboracing]." (P4)

"That kind of things doesn't appeal to me." (P4)

5.2.2.2.3. Barriers to Communication

Communication with participants could also be difficult, when asking about the expectations of the program a participant said that they didn't understand what purpose of the training was, later the participant recanted saying that she did know. This may evidence difficulty with memory and attention, it may also be evidence of communication difficulty present in schizophrenia. This could potentially have a negative impact on adherence to the program.

"to tell you honestly, I don't even know what cognitive training is about.I is that like a memory thing? Um, I know that my friend went for cognitive training, but she doesn't really have a memory, oh ya she does, she does." (P2)

"I think if it's more like a building product for my memory. Um, sorry I do actually know what cognitive training is about. I was a bit, I wasn't sure if it was the same that my friend went for, that's why I was a bit uncertain." (P2)

5.2.2.3. The Need for Psychological Space as an Enabler for Completing the Program

Another factor which related to their participation was around participants own experiences of whether or not they had the psychological capacity to do the actual program, this was determined largely by whether or not they possessed the psychological space to participate. One of the primary ways that this was expressed was in the form of having some sort of routine or ritual before engaging in the program. For some people it was hard to incorporate the programe into their lives, for one reason or another, for those who manage to make space for it, wether it was in their routine or in their mind, the programe adherence was better.

"I'm used to having a routine, like working everyday like six till five um, ya so. I think, I'm not saying it's the place but I'm saying that I can't do it with my own strength." (P2)

"what I also found was when I get home and I'm that tired; Ag I'll just take a bath, feed the birds, and just chill a bit and drink coffee and then later at night, before I go to bed, then I'll do that and I found that, that was better for me

"sometimes it was difficult, when uh, lets say I had a tough day at work, you know a very tiring day. I remember there were a few days, where I was so tired neh, that my eyes, you know I was almost lost, it didn't want to focus nicely." (P3)

"I knew that I had to do it properly, and I had to be ready. I had to be ready for what was expected of me." (P4)

"It was like a routine, I'd have a long bath and think about things in the bath or the shower, whichever I was having, and washing my hair, drying off and getting ready to start, having had a cup of coffee and a cigarette and I'd come and do it." (P4)

"I'll just take a break, I'll take a break and then come back to it. Go and have a cigarette or something." (P4)

The presence of routine was not automatic, it seemed to be something that participants developed over time in relation to their experiences of the program. There was a definite sense of it's importance though in that it helped them more directly in terms of being able to do the program.

"Directly coming from work and then directly doing it. That is also something that I changed, you'll probably see that in the beginning I used to do that, but then I tended to rather do it later at night. So that also helped." (P3)

In the context of their pre-program routine being disrupted, participants felt that they were not able to perform as well while engaging in the program. They were left feeling unprepared and also frustrated and this hampered their performance.

"there was not much change, but I wasn't as good as I was when I'd, uh [not having routine]…" (P4)

"I felt frustrated [not having routine]." (P4)

Participants who did not have the psychological space to engage in the program felt less motivated to do it on any given day. The lack of psychological space is expressed by the perception that the program is too long, this indicates a lower tolerance for the frustration brought about by participation in the program. It is possible that it was harder to make the daily commitment when participants perceive that the program was too much of an investment, in this case of time.

"Or the fact that it's an hour long a day, which really irritates me because if it was twenty minutes I'd be much more happy about it." (P2)

"no. I don't think it should be as long though." (P2)

Frustrtion also seemed to be expressed through cheating. One participant used a pen and paper to assist her in the numbers task as a way of helping her manage the frustration she developed due to the difficulty of the task, this helped to decrease her level of frustration and resulted in her ability to continue with the program.

"I think, if uh, as it was going along, it was going more and more difficult. It was getting more and more difficult [laughs], so what I did was, I got a pencil and a piece of paper and I wrote down all the numbers [laughs] **[really?]** *and I scored 17% [laughs] I know I did that, just so that I could get used to the fact of, remembering numbers, it was just on the two programs, the input programs, those two input programs, you know." (P4)*

5.2.2.4. Means by which Participants Engage

This themes is understood as the different ways in which participants did the task, or the things which they employed that allowed them to do it. It is made up of their own feelings of duty, the perceived environment and their metacognition during task performance.

5.2.2.4.1. Dutiful Feelings

These feelings are understood as a sense of expectation, or commitment to an external point which participants use, psychologically, to motivate their participation. Feeling a sense of duty toward the researcher became one way that participants used as a means of motivating their participation in the program. It was important for them, to know that the researcher expected them to engage in and complete the program.

"if someone's relying on me to do something then I will do it, you know so and I know you're relying on me to do this, so, because I know you're helping me and I'm helping you kind of thing." (P2)

"if you'd told me that you really needed this project to be done, then um, then I would've really tried it. But I felt that you said it wasn't necessary, and then if you said it was necessary I would've been more motivated to do it. I know that's looking at the finer detail, I know." (P2)

"Well, I knew you were waiting for me to finish so I had to finish. So, I had to, you know, knuckle down and work and finish the program." (P4)

"Knowing that I had to finish it. I had to finish it, I had signed a contract and I had to finish it." (P4)

In some cases these feelings were expressed toward society as a whole, that participation in the project would provide larger social benefit. This became a motivating factor for engaging in the program.

"I think I'll kind of feel good. Because you know with research I'm kind of very in to, for research because I think without research you can't really improve on anything. So, being part of anything like that is important." (P3)

5.2.2.4.2. Perceived Improvement

The experience of having improved in the context of the task was an important indicator of whether or not participants felt as though the program was helping them. Feeling as though their performance on the task was improving allowed participants to continue their participation in it. These experiences helped participants cope with the frustrations associated with the program and lead to an increased level of willingness to want to continue.

"In the beginning I was very motivated, I felt, a lot of my memory coming back, my brain was very active, something happened during, I actually saw while I was working that it helped me think more and I could actually feel like, my memory was sparking up again" (P2)

"when I did do it, I used to do it everyday, I would like doing it because I felt like it was doing me the world of good and I still think it does good" (P2)

"I think training my memory, the whole aspect of training. You know, taking time, what was it…? It normally took me around 45 minutes a day. Taking that time, specifically focussing on training my mind, I think that helped." (P3)

"Actually, I really enjoyed it. I really enjoyed it. I mean there was time when you get frustrated, um, but I could actually feel that I have improved. Like I said that one time, that I'm very distracted by noises, I've felt that that's somehow improved. I've got more focussed." (P3)

"You know, someone would phone, a client for example and give me information, where they live, and what year they were born and what year they were diagnosed, you know all that and before I had to write everything down and now it's like, I remember what they client, after I put the phone down, I can actually remember those numbers and the, you know the details that the client is giving me." (P3)

"I found it very useful, but also, if I didn't reach the top five I found that I hadn't concentrated well enough." (P4)

Feelings associated with improvement also lead to increased levels of self-efficacy within participants. This happened because old beliefs around their own capacity to improve were challenged by their experiences, thereby leaving them feeling that it was possible to develop

memory related areas of weakness. This experience was sometimes generalized to other area of life as well. This also left them feeling more motivated toward doing the program which aided their participation.

> *"you see I always, thought in the past, I always struggled with concentration problems and memory. I always thought I'll never get any better because of the probably the medication, so this kind of proved to me, I think it made me, how can I say, more motivated. You know, I can't just say something is impossible, I mean this was proof to me that some things can change if you really put your mind to it, it's not just giving up and saying that's the way it is." (P3)*

> *"actually elsewhere, in my work. Work as well. I use to be, always distracted very quickly, I always struggled to focus on something and cut out, you know, what's going on and I think ya, I definitely improved in that. In a way I think the program taught me to focus in some way, to focus and concentrate. You know, to stop my mind from being lazy, to really put everything in to concentration." (P3)*

> *"Well, it's not only because of. I think it's because of CogMed because once you sit down and you concentrating and you doing these different things, and then you go and lie on your bed when you're finished and then you know your brain starts telling you things and; you know, you think about your life, you think about what you want to do." (P4)*

> *"I just, uh, it got me thinking about my life. I just started thinking about things that were important to me, and that I wasn't to throw my life away because." (P4)*

Additional benefits that may have been obtained also played in to these feelings, where the program was sometimes seen as one which would help in other area of participants lives. This aspect

also acted to increase their motivation for wanting to participate since it lead to a greater level of perceived utility in relation to the program.

"I stopped smoking so much **[okay and you feel like that was related to the program?]** *I buy 7 to 8 cigarette's a day, instead of smoking 30…" (P4)*

"Well, one day I'm going to have to get a job and it helped me because I'm a teller, and it's similar. You have to remember figures, you have to use the computer as well, and click on this and that, and click on that and this, and um…" (P4)

"Ya, it helped me like a work program." (P4)

"I started to use my mind and my brain again." (P4)

The program was also attributed to direct changes in participants emotional experiences. Here participants attributed changes in their depressed mood toward participation in the program, which also lead to increased levels of motivation. These changes may have also been as a result of the sudden increased usage of the areas of their brain associated with training; which lead to increased activitation and by consequence increased capacity to think. In the context of this interaction, this particular participant described her use of the word "Foggy" in two ways; the first being associated with an experience of depression and the second associated with an inability to think. When questioned about whether or not there had been any differences in her experience of this before the program she replied by saying that she had been a lot more foggy and consequently she felt happier and more able once the program had reached completion.

"I have got a very clear head today. I don't know why.."(P4)

The interviewer then clarified by asking: **"But I mean, in general after the program?"**

To which the participant responded: " I think it's after the program, I have this clear, clear head. It's just so clear, it's uh…Well foggy is, when you get depressed. When you can't generally think straight…Oh, I was very foggy…I'm just happier…I'm brighter in my head."

5.2.2.4.3. Metacognition

This category refers to participants abilities to reflect and adapt on their own cognition in relation to the tasks that were required of them. It was a prominent strategy used by participants to help them better partake in daily activities.

3.2.3.2.1.3 Development

Participants expressed how the develoment of ways of interacting with tasks took time, initially it came as an awareness of difficulties that they experienced during tasks. This seemed to motivate their approaches to try and find easier ways of doing the activities. Generally, this process seemed to happen by trial and error.

"I noticed you know, it takes a bit of time in the beginning for my mind to get in to that activity, but once I'm there, I noticed sooner that, my mind gets in to those things sooner than before. So, I could also see kind of like an improvement in that." (P3)

"for example, lets say I did the one activity with those dots, and then when I'm done there I go to the next one. It's like in the beginning I struggled so because my mind was still stuck in to that one, so I had to get my mind much quicker in to focussing because this is now a different activity so I need to set my mind differently. To look at things differently, because now to remember, this thing's going to turn this way." (P3)

"It's kind of to find the problem, why did I make this mistake. And then why do I make these mistakes, them I'm like okay, every time when I lose where it started. So I try to, it's almost like problem solving in a way as well. So I find ways, it's almost like solving the problem in a way." (P3)

"I hadn't really got my bearings, I hadn't found a way of sieving, you know, using my head like a sieve. Like you take that block, you know, if you don't concentrate on which block it's actually going to, you're not going to get it right." (P4)

Participants attributed its development to their own personal approaches, there seemed to be a realization that they'd needed to approach different tasks in different ways as this would assist them in their experience.

"I think I'm a very experimental person, you know I think I tried to find ways of doing it, and I noticed you know, like um, because I kept losing, you know where it started with the dots for example, you know let me keep my eye on where it started I'll just keep my eye on it and then find a way to trace the others." (P3)

"I've just got to put my mind to it, I've got to create some type of a theory which I can follow, you know." (P4)

3.2.3.2.1.4 Strategy

A common strategy used by participants was to consciously control physical aspects of their bodies as a means to focus their attention toward the given task. This was accomplished through efforts where they would consciously limit eye and head movement so as to remain focussed. Following this they would often attempt to input figures as quickly as possible after the memorization aspect of the task had ceased.

"also a strategy is, I mustn't move my head, I must keep my eye on where it started, so keep my eye while I follow the rest. So I concentrate hard on where It started so that I don't forget that because then I remember the letters there that I associated with something and then the last, ja" (P3)

"I noticed you know, like um, because I kept losing, you know where it started with the dots for example, you know let me keep my eye on where it started I'll just keep my eye on it and then find a way to trace the others." (P3)

"I just looked straight at the picture and just watched each one as it moved, and then quickly shot them, before they moved any further." (P4)

"Well I just watched where the, smoke came out the volcano and then just quickly, as quickly as possible just splattered them, you know. But um, I did it as quickly as possible, that was my…" (P4)

*"I marked on the board, like I marked the ball, whichever…***[Did you actually, physically mark it?]** *With my eyes." (P4)*

Another strategy used to help task engagement was visualization, here participants would attempt to identify the sequential pattern that stimuli were presented in with an attempt then to simply follow the pattern in reverse. This may indicate the use of a stronger visuospatial working memory system to compensate for a weaker verbal working memory system.

"I had to adjust in terms of using different ways, how can I say, mechanisms to remember. For example, that, lets say the numbers on the keyboard of that one, where it says the numbers and then you have to do it backwards. So what I've done, I mean a lot of the time I've seen, I mean, I follow the pattern of the keyboard. That's how I remembered it and then I'd just follow it backwards. So it wasn't as much as remembering the numbers, it was about

remembering the pattern. But then the one where it's closed, and it's just words. I mean that demanded a lot of concentration, now I had to picture in my head the keypad notes and how the numbers go. But what helped in my head was, I focussed intensely on the first, five numbers, and I keep repeating it in my head, but slightly less concentration on the last four, for example. So, once it stopped I had to quickly do the last four, and then I got the five that I fully concentrated on." (P3)

"And then, the one where the um, what is that smoke coming out, with that gremlin coming out of the ground? **[space whack]** *ya, there again I also remembered patterns where it started, so I kep[t in mind the pattern that it followed." (P3)*

Participants also discussed in brief the use of association as a means of remembering verbally based information, here information would be paired in memory with common sayings or phrases that would help participants retreive it later. This seems to rely much on the verbal working memory system, but is highly dependant on a participants ability to derive semantic information from the stimuli presented.

"eespecially with the letters as well. Like you would associate it with different things, you know like IOU. You know it's easy, I owe you. So I would make that so I would remember it that way and then quickly again I would divide it up and then the last part." (P3)

The use of these strategies seemed to fail in certain tasks, these were reported to be around tasks that required a more spatial element to memory where stimuli moved around in a three-dimentional environment. Here, strategies such as the attempt to visualize patterns seemed

inadequate. It seems that the complexity of the visuospatial task, in terms of the addition of the third spatial dimention, rendered it substantially more difficult to adapt to.

> *"It's like the view moves up, and when It selects one at the bottom then all of a sudden it moves down. Now with my strategy, to focus on one spot when it started, it made it very difficult for me to follow from there. Eespecially when it started at the top and then all of a sudden go to the bottom. So that made it difficult, so that was a bit confusing." (P3)*

5.2.3. Particulars of the Program

Program particulars refers to the more program specific experiences that participants had, these generally consist of the experience of the tasks that they were expected to engage in as well as their experience of having or not having a research aid.

5.2.3.1. Experience of Tasks

Participants' experiences of the program tasks are generally broken down in to the technical aspects that they found problematic along with any limitations that they identified during their term of participation.

5.2.3.1.1. Technical

Technical experiences generally relate to any technical issues that participants identified while engaging with the program. One of the more disruptive was expressed to happen during the general startup of their personal computers, where the menus of programs on their computers would appear and sometimes hinder their ability to interact with the program.

> *"there was one thing, with that laptop, when I put in the 3g, then all these flippin pop up menus come over the software, then I missed, there was a few times. So later on, what I did later on is, first let all the pop-up menus, you know*

like update this and update that, let that just get over and I close all of those before I, you know went in to the software." (P3)

Another issue reported was around the notifications that participants were presented with when selecting their options after stimuli had been presented. Here, the sound that would go off to indicate their having made a selection, would sometimes not activate. This left participants uncertain as to whether or not they had in fact made the selection, this may have lead to some incorrect responses.

"There was actually one thing that I also picked up but it didn't happen all the time. When you clicked it makes a sound, sometimes when you clicked it didn't make a sound, then I wasn't sure did it select it or not. I think it is the software itself, I don't think it will be the laptop." (P3)

Another technical aspect experienced was around the setting up of the program. Participants received a compact disk with the program on board, while they generally coped with being able to set it up, some participants struggled to get in running on their computers. This was generally attributed to their own levels of computer literacy and experience.

"Well, #### had to help, I didn't really know how to do it [setting the program up on her computer]." (P2)

"definitely related to my level of computer skill [inability to set up the program]." (P2)

Participants reported a similar difficulty in relation to the roboracing task, where some were uncertain as to what was required of them during this activity. This consequently decreased the level of stimulation they received from it and left them feeling less willing to engage in it. When asked what made roboracing unenjoyable, participants reported not knowing what they were expected to do.

"I didn't do any robot racing, because I didn't know how to do it." (P4)

"I didn't know what the hell was going on [laughs] so I just said get off, I get no." (P4)

5.2.3.1.2. Limitations

Limitations that were expressed covered a range of aspects with the program, they were generally understood as aspects of the program which participants felt might be improved or alternatively, aspects that they felt were missing. When questioned around this, participants expressed a desire to see more colours integrated in to the program, this may indicate that participants felt unstimulated by the current colour scheme and needed a scheme that was more likely to increase their interest in the content presented on screen.

"Um, more colours." (P2)

Another limitation that participants expressed was the inability they had in terms of choice. While they were able to choose the order in which they engaged with programs, it seemed that they would have liked to have had this taken further by being able to choose the actual programs that they did on a particular day from given training categories. This may indicate an attempt to try and avoid doing tasks that they enjoyed less while focussing on those tasks that they found stimulating.

"Maybe if you could select, on the day from the different ones. If you could group like the ones that test you this way, like the numbers and that, I don't know. Like if you can have liked different ones and you can categorize, so if you feel like today I want to do the numbers one but I want to do this one in the numbers one, or the letters one. You know, that focuses on specific areas and you can select your choice from there." (P3)

5.2.3.2. Research Aid

Another general experience participants had was around the research aid and the contribution that this made toward the program. This was made up of three aspects; their feelings around its necessity, their experiences of support and the ease with which they were able to access this portion of the program.

5.2.3.2.1. Necessity

This theme was defined by participants comments around whether or not they though that the research coach was a necessary feature of the program and how this assisted them during their participation. Participants showed varying views on whether or not they felt a research coach was necessary for participation in the program. Some felt that the presence of a coach was useful; this seemed to be because of the role that the coach would play in attempting to provide structure and encouragement in relation to the program. In the instance where participants didn't have a coach, they felt that a coach would help by being there to encourage them to do the program each day. They felt that they needed this level of support as they were not able to stick to the program themselves. This may have been related to the diagnosis and their inherent struggles with executive functions around lifestyle.

> *"I did do it without a facilitator and um, that was very difficult, most of the time I was busy because I was working and um, also because I was very lazy. I wasn't demotivated, I wanted to do it, but um, I was just lazy, ja." (P2)*

> *"I think it's useful because I have, I had, I had encouragement from her." (P4)*

> *"I have someone pushing me to do it. But I can do it, I suppose that facilitator is actually a good idea." (P2)*

> *"I'm saying that I can't do it with my own strength." (P2)*

Other participants felt differently, here they expressed the possibility that a coach might leave them feeling irritated when asking them to engage in tasks. This seemed to stem from participants' desires to maintain some level of their own autonomy, where they were able to decide where and when they did the program. However, its important to note that this was specific to participants who were older, and who completed the program, this might indicate a longer time in remission and consequently a higher level of functionality.

> *"You know I won't say I needed anyone to motivate me or support me or anything like that, I think I'm quite driven on my own. They might've just irritated me so." (P3)*

> *"She's very sweet but she nags me." (P4)*

> *"Well, I said to her I'm doing it at 7 o clock tonight. She said 'no you must do it early in the morning.* ***[and did you do it early in the morning?]*** *No, I did it at 7 o clock anyway." (P4)*

5.2.3.2.2. Support

One of the primary functions that participants attributed to the research coach was that of the individual acting as a support structure for them. This was expressed in many ways, one of which was the function of providing a set schedule according to which they were able to do the program.

> *"if I had someone giving me a set timetable. I mean I can, if I'm working it's like a set timetable, I mean I know that if I have to do it then I would've done it." (P2)*

> *"say to me #### you must do it at ten o clock today or #### you must do it at three, or in the morning I prefer working in the morning" (P2)*

This was furthered in a desire to have had somebody to enforce the schedule, seemingly indicating that some participants may have struggled to keep to these types of schedules themselves.

> *"But if you said to me, #### come on you must do it 10 o clock everyday, I need it done, I need that deadline." (P2)*

Another aspect of the support was around the emotional support that participants may have derived from this individual. Here there was a clear desire to have had increased contact with somebody who would check in on them and listen to their experiences.

> *"Or like, visitations from you once a week or something or twice a week or something, ya." (P2)*

> *"She did phone everyday and find out if I was coping and, if I'd done my training." (P4)*

> *"she would ask me how it's going and uh, how I'm feeling and am I tired am I worn out." (P4)*

> *"Not having someone to do it with, even though #### was doing it. He's not the type of person I want to connect with and that's about it ya." (P2)*

5.2.3.2.3. Access

Some participants struggled to access individuals who might act in the capacity as research aid for the duration of the program. Many lived in the halfway house setting and this meant that fellow housemates may have been unreliable or unable to act in this capacity. Furthermore, family members were not always available to them in a either a supportive or instructive capacity.

"but, that person is, I can't rely on that person because he'll say oh, ah when you want to, when you wanna do this. So I can only rely on myself, so I'll do it, ya I'll do it by myself." (P2)

"Well not overseas, either to Nigeria or Zambia where my parents are, it's only just a maybe." (P2)

Not all participants completed the program. Those who did reported an improvement in the measures intrinsic to the program. It was not possible to report on this in the results section given the limitations of the current study though. There were many challenges faced, both by participants and facilitators, over the course of the program. These impacted both on the implementation of, and adherence to the program and were highlighted above.

6. Discussion

The following discussion aims to examine the results of the current study in relation to literature available with regard to rehabilitation and related literature. A brief summary of the results section has been included, following which, comparisons were made between reported results and available literature. The comparison's were the discussed in relation to their implications for the outcomes of the present study.

6.1. Quantitative

The quantitative analysis performed in the current research was a single-case pre and post test comparison of scores (Kazdin, 2003). While participants 2125 and 2126 completed the full program, participants 2124 and 2122 completed only 6 and 9 sessions respectively. (Brand & Jungmann (2014) found that factors associated with the retention of mothers in a home-based early intervention program included the presence of individuals who were able to provide support to the mothers and context relevant content. Among factors that negatively impacted participant retention were unsuccessful visit attempts and low maternal engagement in the program. This seems to suggest that attrition in rehabilitation programs is multifaceted, but also emphasizes the importance of social support structures. Related to this, all participants showed an upward trend in terms of daily training time and a downward trend in daily pause or rest time. Research that looks at the effect of the amount of time necessary for positive training effects is sparse. This makes it difficult to account for the impact of this variable on the outcome measures of the study.

In general, participant's performance on the selected WAIS subtests was heterogeneous in nature in terms of the distribution of pre- and posttest scores. While the tests were selected as an indicator of general functional level, and thus not expected to exhibit any major changes, it's important to note that none of the participants showed any significant trends over the range of subtests administered. This is particularly important with regard to the Letter-Number Subtest since

this was primarily indicated as a measure of working memory. This test also illustrated a heterogenous trend. Research support around the impact of working memory on intelligence is controversial, some authors advocate that there is no impact (Colom, et al., 2010; Chooi & Thompson, 2012; Sprenger, et al., 2013) while others advocate that training does result in some impact (Penades, et al., 2006). The current study certainly provides some evidence that the training of working memory provides limited impact on general cognitive functioning, and this may extend to more general measures of intelligence as well.

All participants showed an upward trend in performance on the CogMed Improvement Index and Daily Max index. One explanation for this might be the presence of training effects, where participants were being trained to improve on the tasks themselves. Given that the both indices are reliant on measures obtained from training tasks, these measures may only assist in determining improvements on the actual program tasks and not on underlying working memory structures. Another possible way of understanding this may be related to extraneous variables such as cheating. It is possible for participants to use aids such as pencil and paper during training as a way of improving their performance during tasks, while this is discouraged it can be difficult to enforce. As in the case of participant 2126, who admitted to using these aids during the digit-span task. The use of such aids may impact on the outcome of the CogMed improvement and daily max indices because of their reliance on the outcome measures of the tasks during which the participant used the aid.

6.2. Qualitative

The qualitative data was broadly summarized in 3categories:challenges to implementation, the role of psychological variables on participant experience and the particulars of the program. Some of the more general challenges that the researcher encountered were around the access that public healthcare users had to computers and internet. These individuals and institutions lacked or have limited access to computers and internet resources which can be used for interventions such as CogMed. This seems to be supported by Statistics South Africa's General Household Survey (2014)

which indicated that only 40.9% of South African households had at least one member who had access to the internet from home, work, place of study or internet cafés. This figure drops to 10% with regards to individuals who have direct internet access from home in any form. In terms of statistics for Gauteng specifically, the number of individuals with internet access from home was approximately 15.7%. In this study, 'home' indicated internet access via both cell phones, and similar mobile connective devices, and landlines. These figures indicate that access to the internet in South Africa is limited. By association, internet based interventions in South Africa are limited to the more affluent areas of the population, rendering them inaccessible to the vast majority.

Even if these resources such as computers and internet connectivity were provided at an institutional level, healthcare users would not have been able to access them as a result of the cost of daily transport that would have been necessary to participate. The high cost of transportation limits the possibility for participants having access to potential services on a regular basis. Cognitive rehabilitation requires daily engagement with the activities, hence, it elevates the costs for the user. This then reduces the possibility that those from lower socioeconomic backgrounds have for taking part in such interventions. Such was the case for participants, who consistently reported limited resources as one of the main obstacles for engaging in the CogMed program. This situations is further complicated for mental health care users who seem to face more significant barriers to employment than individuals with other disabilities.

In terms of employment, barriers range from intrinsic, such as the internalization of the 'sick' or 'patient' role, through to extrinsic factors such as, disincentives in the form of benefits from social welfare systems (Boardman, Grove, Perkins, & Shepherd, 2003), along with stigma and the reluctance to employ these individuals due to fear of workplace failure (Boardman, Grove, Perkins, & Shepherd, 2003; Marwaha & Johnson, 2004). Without employment, individuals with mental health difficulties, financial support is restricted to that provided by families and state organizations. However, state resources allocated to mental health care are often under-funded in low to middle

income countries (Saxena, Thornicroft, Knapp, & Whiteford, 2007). With mental healthcare services under-resourced, further limitations are placed on their capacities to assist and support families of mentally ill users. This results in either minimized or insufficient support from families over time, as well as ill health consequences such as depression in family caregivers (Saunders, 2003).

Other more specific challenges that participants encountered were the training environment and aspects associated with training such as the use of a laptop. In terms of general obstacles, the use of a laptop seemed to hinder some participants in their attempts to do the program. This occurred largely because of their own feelings toward the laptops, they were experienced as cumbersome. Participants suggested the possibility that the program would become more accessible if offered on a cellphone or tablet. While this seemed counterintuitive given difficulties in resource accessibility, it was noted that these devices may be more accessible than laptops to people with stable income sources. Statistics South Africa (General Household's Survey, 2014) indicates that 94.75% of South African households have cellphones as opposed to 19.14% who have access to laptops or desktop computers. Furthermore, the proportions of household who own laptops or destops relative to province, 40.59% of owners reside in Gauteng with 19.26% residing in the Western Cape, the remaining 40.15% of owners are distributed between the other 7 provinces. Looking at the statistics for cellphones, the distribution is far more equal at 28.01%, 16.27% and 10.16% distributed between the top three provinces. This indicates that cellphones are generally more accessible to South African citizen’s than computers, and furthermore that they are more equally distributed within the population indicating than less wealthy citizen’s have similar rates of access to more wealthy citizens. While there is no comment on the distribution of smart phones in terms of these statistics, since these would be necessary for running the program, these stats may indicate support the assertion that such devices would be more accessible to wealthier individuals or those with more stable incomes.

Computer literacy also presented a challenge in this regard. Participants received a compact disk with the program on board, some participants struggled to set up the program and get it running on their computers. Even though these participants had access to the resources, they still struggled to use them. Given the statistics on computers in South Africa, this finding is both consistent and supported by the low levels of exposure to computing devices and consequently, the difficulties individuals may experience when using them (Statistics South Africa, 2014).

The need for appropriate space and time presented as another obstacle to participants. Training requires a room with necessary requirements for rehabilitation such as light, silence and appropriate furniture. Participants often resided in environments that contained high levels of distracters in the form of other individuals or activities. This illustrates that the addition of distractors in the context of training can hamper a participants ability to engage successfully. These distractors may range in intensity from interruptions by colleagues or housemates, or changes to usual routine. Other external factors also played a role. Siguado, et al. (2014) discuss how current antipsychotic treatments show decreased efficacy in treating conceptual disorganization and cognitive impairment. This may be consistent with the observation that participants struggled to reorganize their lives following disruptions, given that disorganization is associated with the residual symptoms in stable schizophrenia, it's possible to assume that this was one of the factors that impacted on participant's capacities to engage with the program.

In the contextual setting of the halfway house, participants experienced difficulty with being able to do the program while ensuring that their weekly responsibilities were maintained. They experienced these as distracters that inhibited their participation. Similarly, participants reported this for their work environments. These seemed to relate to their difficulties in dealing with unexpected changes to their routine, where routine became an important aspect of allowing training to take place.

The presence of other people was also considered by the participants as impacting negatively. Individuals with schizophrenia may struggle particularly in situations where they are expected to be around other people due to factors such as shyness, and limited sociability (Goldberg & Schmidt, 2001). Subclinical paranoia may also impact on functioning in this regard. Combs & Penn (2004) indicated that individuals with high subclinical paranoia showed increases in depression, social anxiety, self-consciousness and presented with lower levels of self-esteem. Furthermore, these individuals were more likely to perceive negative or threatening evaluations from individuals in their environments, which may then impact on their capacities to perform. Given the settings in which the training took place this became an aspect that some participants struggled with substantially. The presence of others in the form of housemates and extended visits from family impacted on their abilities to engage with the program.

Psychological variables also impacted on their experiences of the program. In order to develop a sense of the necessity of the program, it seemed important that participants were aware of their own cognitive symptomatology. This was accomplished by participants in their own comparisons between their current levels of functionality and what they previously felt they were able to do in the past. This view was supported by Ownsworth & Clare (2006) who indicated that literature reports that awareness of cognitive symptomatology was correlated with more positive rehabilitation outcomes.

While awareness of cognitive deficits was useful in allowing participants to develop a sense of the necessity of the program, they also expressed worries that the program might increase their anxieties around this awareness by increasing their perception of cognitive difficulties. Literature indicates that individuals with schizophrenia and their families were more likely to underestimate cognitive difficulties than the treating team overseeing their care (Poletti, et al., 2012; Seco, et al., 2010; Medalia & Lim, 2004). While literature on the impact of cognitive rehabilitation on awareness of cognitive impairment is sparse, given the nature of rehabilitation it is relevant to consider that

participants may indeed be more exposed to their difficulties and consequently, that both awareness as well as anxieties around awareness would increase. This presents program developers such as CogMed with a paradox, since awareness is beneficial in terms of positive rehabilitation outcomes, but also seems to correlate with increased anxiety toward participation and consequently increases in avoidance or avoidance behaviours. This is consistent with research by (Bardeen, Tull, Stevens, & Gratz (2014) who showed the association between avoidance of positive and negative emotions and increasing anxiety, where both negative and positive emotions were a product of participant's experiences. This indicates that participant's experiences moderated the relationship between avoidance of negative emotions. In the current study, tasks which evoked negative experiences from participants were more likely to be avoided or left to the end. Participants were also more likely to cheat on these tasks.

Their desire to participate influenced positively by their expectations of the program outcomes and their general motivation levels. It was influences negatively by the barriers to communication that occurred between them and the researcher. Participant expectations ranged from purely cognitive, where they identified constructs such as memory and attention as problematic. Based on participants' comments, it seems that the expectations associated with the program are very high. They identify memory and attention as the core of important activities in their lives, such as work and studying. Even the future is reliant on these constructs. This is very important because it puts a lot a meaning in to the program. This may mean that it becomes a space wherein participants act out issues such as not wanting to face challenges. The higher the expactation, the more difficult it becomes to be successful at the program because too much has been put at stake. Currently, there is very little research in this area. It may be important for the scientific community to address this in future research related to rehabilitation and participant expectations. This also indicates that the training of these and associated constructs are necessary to address therapeutically since they can be experienced as limiting. The presence of attention and memory difficulties as deficits in schizophrenia are well supported in the literature (Junghoon,

Ghlan, Nuechterlein, & Cannon, 2004; Oram, Geffen, Geffen, Kavanagh, & McGrath, 2005; Park, Puschel, Sauter, Rentsch, & Hell, 2003; Hahn, et al., 2010; Badcock, Badcock, Read, & Janlensky, 2008).

Aspects that were reported to increase motivation were the challenges that the program provided, this seemed to be dependent on their being able to successfully complete challenges. Where participants were successfully able to completed tasks, increases in self-efficacy were evident which consequently lead to higher levels of motivation. This is consistent with Wilson, Spink, & Priebe (2011) who reported that self-regulatory efficacy was an important predictor of action during periods where there were increased demands on participants. Similar findings were reported by Gaston, Cramp, & Prapavessis (2012) who discussed the link between self-efficacy and exercise behaviour in pregnant women, where factors that lead to increases in self-efficacy consequently lead to increases in exercise readiness and exercise behaviours. Similar results have been reported for individuals with schizophrenia, however insight in to illness mediated this relationship since the positive association between self-efficacy and functional status was only salient when this was present (Kurtz, Olfson, & Rose, 2013).

Related to this was the perception that mastery of tasks equated with improvements in cognitive symptomatology. Therefore, participant's reported that having the opportunity to master these challenges and improve their cognitive symptoms left them feeling more motivated to engage in the program. However, the impact of encountering tasks that were perceived as too difficult for participant's seemed to be increases in fear of failure. Given that the program increases difficulty based on success, participants get immediate feedback which they interpret as successful or nonsuccessful performance on the program. This may explain the paradoxical effect actual participation has, since participants have immediate feedback on performance.

Fear of failure, developed over the course of the program, constantly needed to be managed by participants. An inability to manage this, impacted on participants' motivation to engage in the

program. Bartels & Magun-Jackson (2009)and Michou, Matsagouras, & Lens (2014) report that fear of failure negatively impacts participants levels of motivation, while the need for achievement and experiences of achievement seemed to positively impact on levels of motivation. This subsequently impacts on participants capacity for self-regulation. This seems to support the idea that challenges need to be perceived as manageable by participants; since their perceived ability to overcome or complete them seems to correlate with internal representations of their capacity to manage further tasks. This further seems to act as a factor impacting on their motivation toward progressing in the program.

Participants also discussed slight fluctuations in motivation which were dependent on the phase of the program that they were in. For some participants, motivation was negatively affected because of the difficulties of trying to incoporate the programme in the their daily routines, for others the level of motivation decreased once the novelty of the program decreased and the difficulty began to increase. What this illustrates is that maintaining constant levels of motivation over the course of the program was a challenge for participants in general. There is evidence to suggest that self-management in individuals with schizophrenia is problematic and that the presence and intervention from caregivers is essential in this regard (Zou, Li, Nolan, Wang, & Hu, 2013). Furthermore, self-management in patients with schizophrenia has been found to be dependent on patient insight and their ability to recognize symptomatology associated with the disorder (Kennedy, Schepp, & O'Connor, 2000; Kurtz, Olfson, & Rose, 2013). These ideas seem to link strongly to executive dysfunction and it’s impact on activities of daily living in patients with schizophrenia. This is consistent with Semkovska, Bedard, Godbout, Limoge, & Stip (2004) who indicate that individuals with schizophrenia are more likely to make planning, sequencing, repetition and omission errors on a cooking task than control subjects. These individuals struggle substantially more in their ability to maintain succesful engagement with activities of daily living.

In terms of routine, this seemed to aid in recruiting cognitive resources such as attention and memory, that may otherwise be spent in aid of functioning in more chaotic environments. it assisted participants in their preparation to do the program each day. One example of this was the pre-program routine. This seemed to act as a transitional space between their usual day and the program; it allowed participants to recruit available cognitive resources and focus them on program tasks. When this routine was impaired or not present, participants found it substantially more difficult to take part in the program, generally this was evident in lower levels of motivation as well as in a feeling of underperformance on the given day. This is consistent with Wijnia, Loyens, & Derous (2011) who purported that elements such as intrapsychic uncertainty represented important factors which had detrimental effects on motivation. Similar findings were reported by Wu (2003) who implicated a predictable learning environment and the management of interpretations of failure as factors associated with competence, which, along with perceived autonomy, were elements impacting on intrinsic motivation. This seems lend some support to the notion that routine, and the consequent predictability it provides, leads to increases in intrinsic motivation and participant's abilities to engage in the program. Participants who did not have a structured daily routine said that this would've assisted them in taking part.

Given that individual's in remission still maintain some residual symptoms associated with the disorder (Siguado, et al., 2014), it's possible to assert that self-management in the form of routine or structure may be problematic in this population. Routine was not simply automatic in most cases, it was necessary for participants to work on and develop for themselves, those who were unable to do this found the program implicitly difficult. This may also point to difficulties around training environment, participants who are unable to maintain a routine in their own capacities, may have relied on caretakers to take responsibility for this. Given the difficulties with resources at institutions such as halfway houses, caretakers may not always be in a position to provide more individualized care, or more structured living spaces. This is highly relevant as

Cicerone, et al (2005) asserts that the inclusion of self-management techniques may augment the efficacy associated with memory enhancement methods.

The novelty associated with the program during the early stages of engagement seemed to act as a protective factor against decreases in motivation. Related to this, there seemed to be other links around the impact of participant's self-attributed personality variables and their motivation toward the program. Those that were novelty seeking and enjoyed video games seemed to engage with the program with higher levels of motivation than those that were not. Furthermore, those who struggled with changes in routine also seemed to show decreased motivation toward the program. Some participant's reported that failure to complete would've left them feeling bad about themselves because they partially identified who they were by their ability to follow through on commitments. This seems to further the argument regarding the importance of personality factors and program engagement and may also be another area of investigation for future research on CogMed and similar interventions.

Furthermore, the immediate feedback received by the participants when conducting the training played a positive role. Sun & Hsu (2013) assert that perceived interactivity moderates user satisfaction and perceived learning in web-based instruction. This seems to support the idea that program feedback, such as that provided by the voice in the CogMed program that responds to user performance, leads to improvements in user experiences of the program and consequently may result in better compliance and engagement. The Roboracing task was developed as a reward which aimed to reinforce participant compliance through an interactive reward system. This seemed to be ineffective form of feedback to participants since many struggled to make sense of what they were expected to do and what the purpose of the task was. This may also be related to a gendered presentation to the type of task presented as a reward. Given that the majority of participants were female, it's possible that a racing task reward may not have been experienced as appealing or stimulating following completion of the program.

Barriers to communication were the final set of psychological factors that impacted on participants' experience of the program. Here, the researcher sometimes found it difficult to convey necessary information to participants in a way that they would understand. Some participants seemed to struggle to understand the purpose of the program, even though this was both explained to them verbally as well as in writing via the consent documents. It appeared to be related to the way in which participants were able to make sense of the information they were presented with as well as their ability to remember intructions or fact about the program. Information could sometimes be misinterpreted or distorted. There is research evidence supporting the notion that Impairments are generally found in the processing of language at semantic level in schizophrenia. This ranges from the processing of more concrete aspects of language through to the more figurative and socially based aspects of language (Liemburg, et al., 2012; Jamader, et al., 2011; Stephane, Kuskowski, & Gundel, 2014; Gavilan & Garcia-Albea, 2011). There is also some evidence to suggest, that the way in which patients with schizophrenia organize and process language is stable over time and independent of illness severity (Razafimandimby, et al., 2007). Given that a large part of the CogMed program relies on user interactivity, both with a research coach as well as a research aid, and furthermore, that tasks are communicated verbally via a voice which participants hear from their computers. Language becomes an important factor for consideration. Miscommunication and misunderstanding may be more prevalent in populations such as these. This may mean that individuals in these populations are more prone to negative experiences of the program, since engagement with the program involves a latent level of technical knowledge, both in terms of the web-based and desktop versions.

Working memory and attention deficits in schizophrenia (Junghoon, Ghlan, Nuechterlein, & Cannon, 2004; Oram, Geffen, Geffen, Kavanagh, & McGrath, 2005) also need to be considered here as these further impact on these individual's capabilities to both perceive and process language. This may have important implications in terms of the way in which instructions and program objectives are communicated to individuals within these populations. It emphasizes the need to simple, clear,

communication that facilitates processing by individuals who suffer from schizophrenia or similar psychotic disorders.

Another aspect associated with psychological space is the presence of frustration. The experience of frustration during training elicits the need for additional coping mechanisms. This is due to increasing anxiety as a consequence of experiencing failure in the exercises. Yu, Mobbs, Seymour, Rowe, & Calder (2014) discuss how frustration may induce an energizing effect which may translate unfulfilled emotion in to aggressive impulses. They relate this to the neural circuitry associated with processing of frustration and emotion. This becomes particularly important in relation to the expectations which participants associated with the program. Higher expectations may mean that task failures are associated with increased levels of frustration, given the association between frustration and energized aggressive impulsivity, this creates the potential for acting out within the program. Acting out may then take the form of cheating such as that exhibited by participant 4, who used a pen and paper to assist her in the digit span task. It may also take the form of avoidance or non-compliance such as that which may have been exhibited by the two participants who dropped out of the program. This becomes an important consideration for program designers, since it may be necessary to include activities which act to alleviate the build-up of frustration during engagement with the intervention.

In terms of strategies that the participant use in order to stay engaged with the program, these both acted to increase motivation as well as to decrease program difficulty. Generally they were categorized in to feelings of duty, experiencing improvements in memory or other daily living activities and participants' metacognition during task performance. In terms of feelings of duty, participants reported feeling as though they had a duty either to the researcher or to more general society to both partake in, and complete the program. This seemed to be used as a motivating factor to keep them engaged. This seems to indicate the presence of a strong external locus of control in participants. Leong, Molassiotis, & Marsh (2004) found that 37.5 % of the total variance in

adherence to healthy diets following myocardial infarctions could be attributed to a linear relationship between adherence and family member support and encouragement. In a similar vein, Harkapaa, Jarvikovski, Mellin, Hurri, & Luoma (1991) discuss how stronger beliefs in personal control over back pain, as a consequence of internal health locus of control, lead to increased frequency in patient's engagement with exercise. This literature seems to point to a link between locus of control and adherence to different forms of rehabilitation. While the patients in the current study seemed to, in part, be illustrating some of the impacts of an external locus of control, it seems as though internal and external factors seem to play a role in collectively acting as motivators toward compliance and engagement. Furthermore, that the presence of these factors is integral for successful participation. This seems to highlight the relevance of the coach as a motivational tool during the program.

Another related factor was participants' experiences of improvement within the context of the program. This could generally be divided in to program specific improvement, or improvements that may have been tied in to increases in working memory, or generalized improvement, which was related to tasks beyond the scope of the program. In terms of program specific improvements, when participants engaged in their work or daily living activities, and found that they were better able to remember phone numbers or tasks they needed to do, they used this as a means of motivating themselves to continue the program. Similarly, when they found they could block out external distractors while engaging in the program, such as one participant who said she could focus more toward the end of the program and not be distracted by the traffic outside her home, as opposed to what she experienced in the beginning of the program. In terms of generalized improvement, improvements in daily living such as decreasing the number of cigarette's smoked or being able to adopt a better diet, were also used as ways of increasing motivation toward the program. While these improvements may not be as closely tied in to improvements in working memory, participant's reported that they came as a result of the program. It was necesarry for participants to feel that they were improving, as they used this to encourage further participation.

This seems to be consistent with results by Morale, Parker, LaGasse, Dostaler, & Polk (2010) who found that subjective improvements in quality of life and well-being, as opposed to measurable increases in physical function, lead to decreases in depression during a cardiac rehabilitation program. This may indicate that the reported improvements experienced by participants over the course of the program may in part be a factor of the interplay between subjective experiences of improvement in cognitive abilities, and the consequent relationship these experiences have with their perceptions around quality of life. Similar results are reported by Lee, et al., (2013) who implicate improved health and quality outcomes with higher levels of subjective well-being, making it a suitable measure of valuing the impact of healthcare on both users as well as associated support structures such as family and caregivers. This may indicate that measures of subjective improvement should be included as a means of understanding the impact of programs such as CogMed. While this doesn't indicate that actual improvement in working memory is inconsequantial, it does emphasise the importance of subjective experiences of improvement and the impact that they have on participant engagement.

The final means that participants used to engage in the task was that of metacognition. The program seemed to have an indirect impact on the development of metacognitive awareness. Here, it elicits reflection, by participants, on their cognitive abilities and consequently results in the development of compensatory mechanisms. Kelly, et al. (2014) discuss how most trials and reviews limit their outcomes to memory measures alone, while results may indicate that executive outcome measures may provide more definitive evidence on the effects of cognitive training. Adaptive strategies such as those depicted in this study may evidence another aspect of training that may have been somewhat unintended; training of planning abilities and other executive functions. In order to develop the strategies used above, it is necessary that participants develop them over time, consciously varying their methods of engagement. This indicates some level of planning and executive abilities which assist in modification of the self so as to perform more optimally.

These strategies consistent of visualization, rehearsal and associative techniques aimed at making stimuli in tasks more meaningful. Generally they were adapted and utilized in specific ways in relation to tasks. During tasks where metacognitive strategies could not be developed, participants reported negative experiences. This is consistent with Turley-Ames & Whitfield (2003) who discuss the importance of controlling memory strategies such as rehearsal, sematics and imagery during working memory assessment, since these strategies can account for performance in working memory measures that it greater than participant's actual ability. Programs such as CogMed may not always target the working memory system. They may also assist participants in developing compensatory strategies that help them to circumnavigate deficits in memory and attention via the developing of more sophisticated coping mechanisms.

Participants also experiences some technical problems associated with the program. One of the more disruptive was expressed to happen during the general start-up of their personal computers, where the menus of programs on their computers would appear, after they had launched the program. These would sometimes cover the program and make it difficult to use. Another issue reported was around the notifications that participants were presented with when selecting their options after stimuli had been presented. Here, the sound that would go off to indicate their having made a selection, would sometimes not activate. This left participants uncertain as to whether or not they had in fact made the selection, this may have lead to some incorrect responses.

Participants experienced the program as bland and noted that they would've preferred to have had more colour to improve their experience. Furthermore, participants felt that they would've enjoyed the possibility to choose what tasks they would've liked to have done each day. There is some research that suggests that the provision of opportunities for choice promotes physical activity in students (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009). The rationale for this is about the existence of a correlation between free choice activities and self-determined motivation.

The research purports that self-determined motivation is important in context where individuals are expected to perform unsupervised (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009). The provision of choice may in fact have allowed participants the option to select tasks that they enjoyed more, resulting in increased engagement with the CogMed program. The difficulty here is around the potential that this element creates for avoidance of difficult or unpleasant tasks.

Participants presented varying views toward necessity of the research aid. The argument for the presence of the research aid was grounded in the capacity that this individual would have to provide concrete structure to assist in participants being able to manage the program. Family member support and encouragement accounted for 37.5% of variance in adherence to healthy diets (Leong, Molassiotis, & Marsh, 2004). While this research evidence isn't directly related with the current study, it does substantiate an argument toward the importance of familial support structures in rehabilitation. This may be true for both concrete support in the form of daily routine and assistance in maintaining this, as well as emotional forms of support. Participants in the current study showed a clear desire to have had somebody on whom they may have been able to rely for emotional support over the course of the program. This individual would've performed two major roles; providing participants with the space to discuss their difficulties or difficult feelings or encouraging them when their level of motivation decreased.

The converse argument was that these individuals might act to leave participants feeling frustrated or stripped of their autonomy, which would leave them less willing to participate. This may be a factor of variance associated with participant personality types. There is some research to support the notion that controlling elements, such a mandatory presence, in learning environments can become detrimental to participant motivation (Wijnia, Loyens, & Derous, 2011). This may support the findings here where participants reported that feelings associated with loss of control or autonomy may have lead to less willingness toward participation. These two areas seem to illustrate

the importance of adequate definition of the role of the training aid, since it both seems to be a necessary but potentially detrimental aspect of the program.

Finally, in terms of access to a research aid, participants expressed their difficulties with this due to separation from family or the lack of supportive individuals at their place of residence who may have been able to fulfil this role. Most individuals approached for this study lived away from significant family members who may have been able to take on the role of research aid. They were also unable to rely on friends since many of these struggled with similar difficulties to their own. This made the aspect of including a research coach a difficult one for implementation since it required the presence of an individual who would be able to remain actively involved and present in the lives of participants. However, given the difficulties experienced with compliance, a trainined coach may have been able to assist participants in terms of their continued participation in the program, this would be eespecially beneficial if the coach takes responsabilities on in terms of some of the executive functions that are deficient (such as planning, time management, self-motivation, etc).

7. Limitations and Recommendations

During the data collection process the primary measure intended for use in this study, The AWMA, was recalled from use due to inconsistencies in the norm sample. Therefore, this research advocates for the inclusion of a quantitative measure of working memory such as the AWMA or equivalent in future research. Related to this, the rehabilitation programme and assessment tools were not design here in South Africa. Cultural appropriateness of the stimuli used should be explored in future research.

The current research was also low in ecological validity. In this regard, there were no measures to assess the impact of the training in participants everyday activities. While cognitive measures of working memory are useful in assisting researchers in understanding the measurable increases in the construct, what remains of importance is whether or not these improvements translate in to greater quality-of-life experiences for participants. it is recommended that such measures be included in future research in the area of rehabilitation of working memory.

One of the major limitations in terms of the implementation of the CogMed intervention in the current research was funding. The researcher was unable to financially support members of the sample in terms of internet connectivity, access to information technology in the form of computers and peripheral equipment, or in the form of transport to or from a designated training facility. It is possible that resources such as these may have improved the feasibility of this study by ensuring that participants had greater access to the resources that neither they nor state facilities could provide. It is recommended that future research that involves resources such as computers, transport, and dedication on the part of participants, should be funded so that participants don't incur any of these expenses.

Related to resources was the aspect of social support. All of the participants in the current research were largely separated from family members and individuals who could act to support

them over the course of the research endeavour. This meant that participants struggled to access practical elements of the intervention such as the training aid. Furthermore, this also meant that participants were often without more stable individuals to whom they would be able to vent frustration and difficult emotions. This may have created an increased likelihood that these emotions would have been acted out over the course of the program. Further programs could assess the impact of social support on the CogMed intervention as a more specific variable of interest with regard to its impact on compliance. An institutional figure, such as a staff member in the halfway houses, could be trained as the training aid in order to carry this role without relying on family members.

Another limitation associated with the current study was the size of the sample. Studies exploring programme effectiveness should rely on group designs, preferably with random assignation of participants to each group. Methodologies such as this one are sometimes difficult to implement due to the characteristics of the sample. This would be recommended for future studies. Furthermore, strict control of the extraneous variables will allow a clearer exploration of the relationship between the independent and dependent variables. This may also yield results which surface important aspects of the study that current participants did not discuss or experience themselves due to a larger sample base. This limitation severely affected the potential generalisability of the results. Further research should also aim to reduce the selection bias and efforts should be made for the sample to be representative of the South African population.

Sample characteristics in terms of gender, level of education, levels of motivation, medical history, current medication, and other internal factors that affect test performance and participation in the programme were not controlled for. Therefore, future research should endeavour to improve the control of this variables. The setting for the assessment and the programme was also, not controlled for and was highly variable across participants. This potentially had an impact on

participant's performance. Further research should make the assessment and rehabilitation setting homogeneous for all participants.

All participants were aware that they were being studied and they had comprehensive information about the project. This could potentially have affected their performance. Future research should keep in mind potential reactivity with experimental arrangements when designing interventions. Implementing rehabilitation programmes in clinical settings as part of a clinical service could reduce this effect.

8. Conclusion

The aspect of working memory training remains a contentious issue in the general literature. Some authors argue that it is possible while others argue the opposite. While the area of working memory training and the capacity that instruments such as the CogMed program have in intervening and contributing in this area is currently under scrutiny by the scientific community; one area which has been neglected to some extent has been the experiences that participants have of programs such as these. The current research aimed to assess what these experiences were and how they further impacted on the feasability of introducing such instruments in to a country such as South Africa in a population such as those who are in remission from paranoid schizophrenia. Given it's mixed method design, the current research also sought to explore the efficacy of the CogMed program in terms of it's capacity to train working memory. Finally, it attempted to examine the impact of participant experiences on program efficacy.

The findings of the current study were numerous with some important highlights. Firstly, internet based interventions in South Africa are limited to the more affluent areas of the population, rendering them inaccessible to the vast majority. While this is somewhat important to consider with regard to South Africa's history of systematized segregation and the racial divide that this created in terms of wealth and access to resources. It becomes important to consider this in terms of this population group in particular since many individuals with this diagnosis struggle to find employment and are consequently, financially dependent on others or on the state. Furthermore, Families of these individuals are also spent in terms of financial resources. This means that these individuals struggle to gain access to important interventions such as CogMed that may assist in improving their quality of life. Successful implementation of a program such as CogMed may necessitate the presence of an external funder which would provide individuals with access to the program.

Beyond resources, another important aspect of consideration is the impact that program's such as CogMed have on participants. What may be of importance here is the assessment of participant suitability for the program or the manner in which programs should be adapted to cater for lower functioning individuals. Of particular importance here are the areas of salience of cognitive deficits paradoxical relationship this has on motivation. Here individual's cognitive difficulties need to be salient so that they are aware of their need for the program. However, increasing levels of salience through the use of the program also results in anxiety and increased avoidance behaviours which impacts on compliance. Access to social support and structured living environments were also notably significant. Many participant's struggled to find individual's who could assist as training aids, since the majority lived in halfway houses or away from family. Finally, structure in the form of routine was important for participants. This allowed them to recruit cognitive resources for use in the program and prevented the use of these resources for coping in chaotic environments. These three areas seem to impact quite significantly on the way in which participants engage with the program. Other areas of the program that should also be addressed include the consistency of program experience for users and the manner in which the program interacts with the computing environment to create a minimally distracting experience from program content.

The sample size, problems with the AWMA and attrition impeded any conclusions regarding effectivity of the program. The program seems to have no impact on the selected cognitive measures, but this is certainly an area which requires further investigation. In a similar regard, the limitations associated with the quantitative data also limits any conclusions regarding the impact of participant experiences on program efficacy. It is important to note however, that there was some evidence for working memory improvement in one of the two participants who completed the program, this should be further investigated in future research. Similarly, both participants who completed reported general improvement in mood, wellness and lifestyle. The two participants who did not complete both held dual diagnoses and may be exhibiting outcomes predictable of their diagnoses. What is important here is the manner in which program efficacy and impact are

decreased as a result of the macro and micro resource limitations of a developing country such as South Africa. The CogMed program is therefore quite limited in terms of the number of people who would be able to access it and experience the potential benefits it may provide.

9. Reference List

Alloway, T. P. (2013). *The Automated Working Memory Assessment 2.* London: Pearson.

Alloway, T. P., Gathercole, S. E., Willis, C., & Adams, A. (2004). A structural analysis of working memory and related cognitive skills in young children. *Journal of Experimental Child Psychology*, 85-106.

Badcock, J. C., Badcock, D. R., Read, C., & Janlensky, A. (2008). Examining encoding imprecision in spatial working memory in schizophrenia. *Schizophrenia Research, 100*(1), 144-152.

Baddeley, A. (1981). The concept of working memory: A view of its current state and probable future development. *Cognition, 10*(1), 17-23.

Baddeley, A. (1984). Exploring the articulatory loop. *The Quarterly Journal of Experimental Psychology, 36A*, 233-252.

Baddeley, A. (1993). Verbal and visual subsystems of working memory. *Current Biology, 3*(8), 563-565.

Baddeley, A. (1996a). Exploring the central executive. *The Quarterly Journal of Experimental Psychology, 49A*(1), 5-28.

Baddeley, A. (1996b). The fractionation of working memory. *Proceedings of the National Academy of Sciences of the United States of America. 93*, pp. 13468-13472`. USA: The National Academy of Sciences.

Baddeley, A. (1998). Recent developments in working memory. *Current Opinion in Neurobiology, 8*, 234-238.

Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417-423.

Baddeley, A. (2010). Working Memory. *Current Biology, 20*(4), 136-140.

Badre, D., & Wagner, A. D. (2007). Left ventrolateral prefrontal cortex and the cognitive control of memory. *Neuropsychologia, 45*, 2883-2901.

Barbey, A. K., Koenings, M., & Grafman, J. (2012). Dorsolateral prefrontal contributions to working memory. *Cortex, In Press*, 1-11.

Barch, D. M. (2006). What can research on scizophrenia tell us about the cognitive neuroscience of working memory? *Neuroscience, 139*, 73-84.

Bardeen, J. R., Tull, M. T., Stevens, E. N., & Gratz, K. (2014). Exploring the relationship between positive and negative emotional avoidance and anxiety symptom severity: Teh moderqating role of attentional control. *Journal of Behaviour Therapy and Experimental Psychiatry, 45*, 415-420.

Barnes, B. R. (2012). Using mixed methods in South African psychological research. *South African Journal of Psychology, 42*(4), 463-475.

Bartels, J. M., & Magun-Jackson, S. (2009). Approach-avoidance motivation and metacognitive self-regulation: The role of need for achievement and fear of failure. *Learning and Individual Differences, 19*, 459-463.

Bedi, A. S., & Edwards, J. H. (2002). The impact of school quality on earnings and educational returns - evidence from a low-income country. *Journal of Developmental Economics, 68*, 157-185.

Blyler, C. R., Gold, J. M., Iannone, V. N., & Buchanan, R. W. (2000). Short form of the WAIS III for use with patients with schizophrenia. *Schizophrenia Research, 46*, 209-215.

Boardman, J., Grove, B., Perkins, R., & Shepherd, G. (2003). Work and Employment for people with psychiatric Disabilities. *The British Journal of Psychiatry, 182*, 467-468.

Bornstein, M. H., Jager, J., & Putnick, D. L. (2013). Sampling in developmental science: Situations, shortcomings, solutions and standards. *Developmental Review, 33*, 357-370.

Brand, T., & Jungmann, T. (2014). Participant characteristics and process variables predict attrition from a home-based early intervention program. *Early Childhood Research Quarterly, 29*, 155-167.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77-101.

Bruyer, R., & Scailquin, J. (1998). The visuo-spatial sketchpad for mental images: testing the multicomponent model for working memory. *Acta Psychologica, 98*, 17-36.

Cabeza, R., & Nyberg, L. (2000). Imaging cognition II: An empirical review of 275 PET and fMRI studies. *Journal of Cognitive Neuroscience, 12*(1), 1-47.

Chooi, W., & Thompson, L. A. (2012). Working memory does not improve intelligence in healthy young adults. *Intelligence, 40*, 531-542.

Chooi, W., & Thompson, L. A. (2012). Working memory training does not improve intelligence in healthy young adults. *Intelligenceq, 40*, 531-542.

Cicerone, K. D., Dahlberg, C., Malec, J. F., Langenbahn, D. M., Felicetti, T., Kneipp, S., . . . Catanse, J. (2005). Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. *Arch Phys Med Rehabil, 86*, 1681 - 1691.

Claassen, N. C., Krynauw, A. H., Paterson, H., & Waga-Mathe, M. (2001). *A Standadisation of the WAIS-III for English Speaking South Africans.* Pretoria: Human Science Research Council.

CogMed. (2012). *CogMed Working Memory Training.* New York: Pearson.

Colom, R., Quiroga, M. A., Shih, P. C., Martinez, K., Burgaleta, M., Martinez-Molina, A. R., . . . Ramirez, I. (2010). Improvements in working memory is not related to increases in intelligence scores. *Intelligence, 38*, 497-505.

Colquitt, J. A., LePine, J. A., & Noe, R. A. (2000). Toward an integrative theory of training motivation: A meta-analytic path analysis of 20 years of research. *Journal of Applied Psychology, 85*(5), 678-707.

Combs, D. R., & Penn, D. L. (2004). The role of subclinical paranoia on social perception and behaviour. *Schizophrenia Research, 69*, 93-104.

D'Esposito, M. (2007). From cognitive to neural models of working memory. *Philosophical Transactions of the Royal Society B*, 761-772.

Driesen, N. R., Leung, H. C., Constable, R. T., Gueorguieva, R., Hoffman, R., Skudlarski, P., . . . Krystal, J. H. (2008). Impairment of working memory maintenance and response in schizophrenia: functional magnetic resonance imaging evidence. *Biological Psychiatry, 64*, 1026-1034.

Egan, M. F., & Weinberger, D. R. (1997). Neurobiology of schizophrenia. *Current Opinion in Neuobiology, 7*, 701-707.

Fleming, K., Goldberg, T. E., Binks, S., Randolph, C., Gold, J. M., & Weinberger, D. R. (1997). Visuospatial working memory in patients with schizophrenia. *Biological Psychiatry, 41*(1), 43-49.

Gaston, A., Cramp, A., & Prapavessis, H. (2012). Enhancing self-efficacy and exercise readiness in pregnant women. *Psychology of Sport and Exercise, 13*, 550-557.

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology*, 177-190.

Gaudiano, B., & Miller, I. W. (2013). The evidence based practice of psychotherapy: Facing the challenges that lie ahead. *Clinical Psychology Review*, 813-824.

Gavilan, J. M., & Garcia-Albea, J. E. (2011). Theory of mind and language comprehension in schizophrenia: Poor mindreading affects figurative language comprehension beyond intelligence deficits. *Journal of Neurolinguistics, 24*, 54-69.

Geier, C. F., Garver, K. E., & Luna, B. (2007). Cirtcuitry underlying extended spatial working memory. *Neuroimage, 35*, 904-915.

Goldberg, J. O., & Schmidt, L. A. (2001). Shyness, sociability, and social dysfunction in schizophrenia. *Schizophrenia Research, 48*, 343-349.

Grabner, R. H., Fink, A., Stipacek, A., Neuper, C., & Neubauer, A. C. (2004). Intelligence and working memory systems: evidence of neural efficiency in alpha band ERD. *Cognitive Brain Research, 20*, 212-215.

Hackman, D. A., & Farah, M. J. (2009, February 8). Socioeconomic status and the developing brain. *Trends in Cognitive Neuroscience, 13*(2), pp. 65-73.

Hahn, B., Robinson, B. M., Kaiser, S. T., Harvey, A. N., Beck, V. M., Leonard, C. J., . . . Gold, J. M. (2010). Failure of schizophrenic patients to overcome salient distractors during working memory encoding. *Biological Psychiatry, 68*(7), 603-609.

Harkapaa, K., Jarvikovski, A., Mellin, G., Hurri, H., & Luoma, J. (1991). Health locus of control beliefs and psychological distress as predictors for treatment outcome in low-back pain patients : results of a 3-month follow-up of a controlled intervention study. *Pain, 46*, 35-41.

Hong, K., Lee, S. K., Kim, J., Kim, K., & Nam, H. (2000). Visual working memory revealed by repetative transcranial magnetic stimulation. *Journal of Neurological Sciences, 181*, 50-55.

HPCSA. (2008, May). *Ethical Guidelines.* Retrieved from The HPCSA Home: http://www.hpcsa.co.za

Hung, Y., Smith, M. L., & Taylor, M. J. (2013). Functional dissociations in prefrontal-hippocampal working memory systems. *Cortex, 49*(4), 961-967.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Shah, P. (2012). CogMed and working memory training - Current challenges and the search for underlying mechanisms. *Journal of Applied Research in Memory and Cognition, 1*(3), 211-213.

Jamader, S., Powers, N. R., Meda, S. A., Gelernter, J., Gruen, J. R., & Pearlsen, G. D. (2011). Genetic influences on cortical gray matter in language related regions in healthy controls and schizophrenia. *Schizophrenia Research, 129*, 141-148.

Jausovec, N., & Jausovec, K. (2012). Working memory training: Improving intelligence - changin brain activity. *Brain and Cognition, 79*, 96-106.

Junghoon, K., Ghlan, D. C., Nuechterlein, K. H., & Cannon, T. D. (2004). Maintenance and manipulation of information in schizophrenia: further evidence for impairment in the central executive component of working memory. *Schizophrenia Research, 68*(2), 173-187.

Junghoon, K., Ghlan, D. C., Nuechterlein, K. H., & Cannon, T. D. (2004). Maintenance and manipulation of information in schizophrenia: further evidence for impairment in the central executive component of working memory. *Schizophrenia Research, 68*(2), 173-187.

Kazdin, A. E. (2003). *Research Design in Clinical Psychology* (4th ed.). Boston: Allyn and Bacon.

Kelly, M. E., Loughrey, D., Lawlor, B. A., Robertson, I. A., Walsh, C., & Brennan, S. (2014). The impact of cognitive training and mental stimulation on cognitive and everyday functioning in healthy older adults: a systemic review and meta-analysis. *AGeing and Research Reviews, 15*, 28-43.

Kennedy, M. G., Schepp, K. G., & O'Connor, F. W. (2000). Symptom self-management and relapse in schizophrenia. *Archives of Psychiatric Nursing, 14*(6), 266-275.

Klingberg, T. (2012). Is working memory capacity fixed? *Journal of Applied Research in Memory and Cognition, 1*, 194-196.

Kluwe-Schiavon, B., Sanvicente-Vieira, B., Kristensen, C. H., & Grassi-Oliviera, R. (2013). Executive functions rehabilitation in schizophrenia: A critical systematic review. *Journal of Psychiatric Research, 47*(1), 91-104.

Kurtz, M. M., Olfson, R. H., & Rose, J. (2013). Self-efficacy and functional status in schizophrenia: Relationship to insight, cognition and negative symptoms. *Schizophrenia Research, 145*(1-3), 69-74.

Lee, H., Vlaev, I., King, D., Mayer, E., Darzi, A., & Dolan, P. (2013). Subjective well-being and the measurement of quality in healthcare. *Social Sciences and Medicine, 99*, 27-34.

Leong, J., Molassiotis, A., & Marsh, H. (2004). Adherence to health recommendations after a cardiac rehabilitation program in post-myocardiac infarction patients: the role of health beliefs, locus of control and psychological status. *Clinical Effectiveness in Nursing, 8*, 26-38.

Liemburg, E. J., Vercammen, A., Ter Horst, G. J., Curcic-Blake, B., Knegtering, H., & Aleman, A. (2012). Abnormal connectivity between attentional, language and auditory networks in schizophrenia. *Schizophrenia Research, 135*, 15-22.

Logie, R. H., & Pearson, D. G. (1997). The inner eye and the inner scribe of visuo-spatial working memory: Evidence from developmental fractionation. *European Journal of Cognitive Psychology, 9*(3), 241-257.

Lonsdale, C., Sabiston, C. M., Raedeke, T. D., Ha, A. S., & Sum, R. K. (2009). self-determined motivation and students' physical activity during structured physical education lessons and free choice periods. *Preventative Medicine, 48*, 69-73.

Marwaha, S., & Johnson, S. (2004). Schizophrenia and Employment: A Review. *Social Psychiatry Psychiatric Epidemiology, 39*, 337-349.

Medalia, A., & Lim, R. W. (2004). Self-awareness of cognitive functioning in schizophrenia. *Schizophrenia Research, 71*, 331-338.

Meiron, O., & Lavidor, M. (2012). Unilateral prefrontal direct current stimulation effects are modulated by working memory load and gender. *Brain Stimulation, In Press*, 1-8.

Meltzer, H. Y., & McGurk, S. R. (1999). The effects of clozapine, risperidone, and olandzipine on cognitive function in schizphrenia. *Schizophrenia Bulletin, 25*(2), 233-256.

Michou, A., Matsagouras, E., & Lens, W. (2014). Dispositional acheivement motives matter for autonomous versus controlled motivation and behavioural or affective educational outcomes. *Personality and Individual Differences, 69*, 205-211.

Morale, D. C., Parker, B., LaGasse, B., Dostaler, E., & Polk, D. (2010). subjective rather than physical improvements mediate the reduction in depression associated with the participation in a cardiac rehabilitation program in women. *Journal of American College of Cardiology, 55*(10).

Novick, D., Haro, J. M., Suarez, D., Perez, V., Dittman, R. W., & Haddad, P. M. (2010). Predictors and clinical consequences of non-adherence with antipsychotic medication in the outpatient treatment of schizophrenia. *Psychiatry Research, 176*, 109-113.

Oram, J., Geffen, G. M., Geffen, L. B., Kavanagh, D. J., & McGrath, J. J. (2005). Executive control of working memory in schizophrenia. *Psychiatry Research, 135*(2), 81-90.

Oram, J., Geffen, G. M., Geffen, L. B., Kavanagh, D. J., & McGrath, J. J. (2005). Executive control of working memory in schizophrenia. *Psychiatry Research, 135*(2), 81-90.

Otero, J. L., & Scheitler, L. F. (2001). La rehabilitacion de los trastornos cognitivos. *Rev Med Uruguay, 17*, 133-139.

Ownsworth, T., & Clare, L. (2006). The association between awareness deficits and rehabilitation outcome following acquired brain injury. *Clinical Psychology Review, 26*, 783-795.

Park, S., Puschel, J., Sauter, B. H., Rentsch, M., & Hell, D. (2003). Visual object working memory function and clinical symptoms in schizophrenia. *Schizophrenia Research, 59*(2), 261-268.

Penades, R., Catalan, R., Salamero, M., Boget, T., Puig, O., Guarch, J., & Gasto, C. (2006). Cognitive remediation therapy for outpatients with chronic schizophrenia: a controlled and randomized study. *Schizophrenia Research, 87*(1), 323-331.

Penades, R., Catalan, R., Salamero, M., Boget, T., Puig, O., Guarch, J., & Gasto, C. (2006). Cognitive remediation therapy for outpatients with chronic schizophrenia: a controlled and randomized study. *Schizophrenia Research, 87* (1), 323-331.

Pickering, S. J., Gathercole, S. E., Hall, M., & Lloyd, S. A. (2001). Development of memory for patterns and path: further evidence for the fractionation of visuo-spatial memory. *The Quarterly Journal of Experimental Psychology, 54a*(2), 397-420.

Podell, J. E., Sambataro, F., Murty, V. P., Emery, M. R., Tong, Y., Das, S., . . . Mattay, V. S. (2012). Neurophysiological correlates of age-related changes in working memory updating. *Neuroimage, 62*, 2151-2160.

Poletti, S., Anselmetti, S., Riccaboni, R., Bosia, M., Buonocore, M., Smeraldi, E., & Cavallaro, R. (2012). Self-awareness of cognitive functioning in schizophrenia: patients and their relatives. *Psychiatry Research, 198*, 207-211.

Rabipour, S., & Raz, A. (2012). Training the brain: Fact and fad in cognitive and behavioural remediation. *Brain and Cognition, 79*, 159-179.

Razafimandimby, A., Maiza, O., Herve, P., Lecardeur, L., Delamillieure, P., Brazo, P., . . . Dollfus, S. (2007). Stability of functional language lateralization over time in schizophrenia patients. *Schizophrenia Research, 94*, 197-206.

Repovs, G., & Baddeley, A. (2006). The multi-component model of working memory: explorations in cognitive psychology. *Neuroscience, 1*(139), 5-21.

Sala, S. D., Gray, C., Baddeley, A., Allamano, N., & Wilson, L. (1999). Pattern span: a tool for unwelding visuo-spatial information. *Neuropsychologia, 37*, 1189-1199.

Salanova, M., Grau, R. M., Cifre, E., & Llorens, S. (2000). Computer training, frequency of usage and burnout: the moderating role of computer self-efficacy. *Computers in Human Behaviour, 16*, 575-590.

Salas, E., & Cannon-Bowers, J. A. (2001). The science of training: A decade of progress. *The Annual Review of Psychology, 52*(4), 71-499.

Sander, M. C., Linderberger, U., & Werkle-Bergner, W. (2012). Lifespan age differences in working memory: a two-component framework. *Neuroscience and Behavioural Reviews, 1*(36), 2007-2033.

Saunders, J. C. (2003). Families living with severe mental illness: A literature review. *Issues in Mental Health Nursing, 24*, 175-198.

Saxena, S., Thornicroft, G., Knapp, M., & Whiteford, H. (2007). Resources for Mental Health: Scarcity, Inequity and Inefficiency. *The Lancet, 370*, 878-889.

Seco, R. B., Sanz, D. G., Modamio, M. F., Rodriguez, M. A., Calleja, R. S., Solis, R. P., . . . Soltero, A. A. (2010). Cognitive complaints in schizophrenia: Relationship with insight and other cognitive measures. *Revista de Psiquiatria y Salud Mental, 3*(2), 55-60.

Semkovska, M., Bedard, M., Godbout, L., Limoge, F., & Stip, E. (2004). Assessment of executive dysfunction in activities of daily living in schizophrenia. *Schizophrenia Research, 69*, 289-300.

Sepulcre, J., Masdeu, J. C., Pastor, M. A., Goni, J., Barbosa, C., Bejarano, C., & Villoslada, P. (2009). Brain pathways of verbal working memory: a lesion correlation study. *Neuroimage, 47*, 773-778.

Shipstead, Z., Hicks, K. L., & Engle, R. W. (2012a). CogMed working memory training: Does the evidence support the claims? *Journal of Applief Research in Memory and Cognition, 1*(3), 185-193.

Shipstead, Z., Hicks, K. L., & Engle, R. W. (2012b). Working memory training remains a work in progress. *Journal of Apllied Research in Memory and Cognition, 1*, 217-219.

Siguado, M., Crivelli, B., Castagna, F., Giugiario, M., Mingrone, C., Montemagni, C., . . . Rocca, P. (2014). Quality of Life in Stable Schizophrenia: the relative contributions of disorganization and cognitive dysfunction. *Schizophrenia Research, 153*, 196-203.

Smith, E. E., & Jonides, J. (1997). Working memory: a view from neuroimaging. *Cognitive Psychology*, 5-42.

Sprenger, A. M., Atkins, S. A., Bolger, D. J., Harbison, J. I., Novick, J. M., Chrabaszcz, J. S., . . . Dougherty, M. R. (2013). Training working memory: limits of transfer. *Intelligence, 41*, 638-663.

Statistics South Africa. (2012). *Census 2011: statistical release.* Pretoria: Statistics South Africa.

Statistics South Africa. (2014). *General Household's Survey.* Pretoria: Statistics South Africa.

Stephane, M., Kuskowski, M., & Gundel, J. (2014). Abnormal dynamics of language in schizophrenia. *Psychiatry Research, 216*, 320-324.

Stratta, P., Prosperinin, P., Daneluzzo, E., Bustini, M., & Rossi, A. (2001). Educational level and age influence spatial working memory and Wisconsin Card Sorting Test performance differently: a controlled study in schizophrenic patients. *Psychiatry Research, 102*(1), 39-48.

Suchan, B., Botko, R., Gizewski, E., Forsting, M., & Daum, I. (2006). Neural substrates of manipulation in visuospatial working memory. *Neuroscience, 139*(1), 351-357.

Sun, J., & Hsu, Y. (2013). Effect of interactivity on learner perceptions in web-based instruction. *Computers in Human Behaviour, 29*, 171-184.

Tanabe, H. C., & Sadato, N. (2009). Ventrolateral prefrontal cortex activity associated with individual differences in arbitrary delayed paired association learning performance: A functional magnetic resonance imaging study. *Neuroscience, 160*, 688-697.

The American Psychological Association. (2000). *The Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Washington DC: The American Psychological Association.

The Republic of South Africa. (2004, July 23). The National Health Act, 2003. *Government Gazette, 469*(26595), pp. 1-48.

Turley-Ames, K. J., & Whitfield, M. M. (2003). Strategy training and working memory task performance. *Journal of Memory and Language, 49*, 446-468.

Ucok, A., Serbest, S., & Kandemir, P. E. (2011). Remission after first-episode schizophrenia: results of a long-term follow up. *Psychiatry Research, 189*, 33-37.

Veasey, S., Rosen, R., Barzansky, B., Rosen, I., & Owens, J. (2002). Sleep loss and fatigue in residency training: A reappraisal. *Journal of the American Medical Association, 288*(9), 1116-1124.

Veltman, D. J., Rombouts, S. A., & Dolan, R. j. (2003). Maintenance versus manipulation in verbal working memory revisited: an fMRI study. *Neuroimage, 18*, 247-256.

White, T., Hongwanishkul, D., & Schmidt, M. (2011). Increased anterior cingulate and temporal lobe activity during visuo-spatial working memory in children and adolescents with schizophrenia. *Schizophrenia Research, 125*, 118-128.

Wijnia, L., Loyens, S. M., & Derous, E. (2011). Investigating the effects of problem-based versus lecture based learning environments on student motivation. *Contemporary Educational Psychology, 36*, 101-113.

Wilson, K. S., Spink, K. S., & Priebe, C. S. (2011). self-regulatory efficacy and activity: examining gradations of challenge. *Psychology of Sports and Exercise, 12*, 579-582.

Wolf, L. F., & Smith, K. J. (1995). The consequence of consequence: Motivation, Anxiety and test performance. *Applied Measurements in Education, 8*(3), 227-242.

Wolf, R. C., Vasic, N., & Walter, H. (2006). Differential activation of ventrolateral prefrontal cortex during working memory retrieval. *Neuropsychologia, 44*, 2558-2563.

Wong, A. H., & Van Tol, H. H. (2003). Schizophrenia: from phenomenology to neurobiology. *Neuroscience and Behavioural Reviews, 27*, 269-306.

Wu, X. (2003). Intrapsychic motivation and young language learners: The impact of the classroom environment. *System, 31*, 501-517.

Xue, G., Dong, Q., & Chen, C. (2004). Mapping of the verbal working memory in nonfluent chinese-english bilinguals with functional MRI. *Neuroimage, 22*, 1-10.

Yu, R., Mobbs, D., Seymour, B., Rowe, J. B., & Calder, A. J. (2014). The neural signature of escalating frustration in humans. *Cortex, 54*, 165-178.

Zanello, A., Curtis, L., Ba, M. B., & Merlo, M. C. (2009). Working memory impairments in first episode psychosis and chronic schizophrenia. *Psychiatry Research, 165*(1), 10-18.

Zillmer, E. A., Spiers, M. V., & Culbertson, W. C. (2008). Chapter 9: Memory, Attention, Emotion and Executive Function. In Zi, E. A. mer, M. V. Spiers, & W. C. Culbertson, *Principles of Neuropsychology* (2nd ed., pp. 224-268). Belmont: Wadsworth Cengage Learning.

Zou, H., Li, Z., Nolan, M., Wang, H., & Hu, L. (2013). Self-management among chinese people with schizophrenia and their cargivers: a qualitative study. *Archives of Psychiatric Nursing, 27*(1), 42-53.

10. Appendices

10.1. Pre-intervention Interview Schedule

What are your expectations of the CogMed™ Training?

Is there anything that you are particularly hoping for?

What are your worries about taking part in the intervention?

What do you think about the way the intervention is structured? What do you feel this will mean for your taking part?

What do you think will make it easier for you to take part in the intervention? What might make it more difficult for you to take part in the intervention?

Do you think there are any factors that might make it so difficult for you to take part that you are unable to continue in the intervention? (Discuss that this will not impact whether or not they are chosen, rather that it will be very useful in evaluating the intervention)

10.2. Post-intervention Interview Schedule

10.2.1. Content

Tell me about your experience of the CogMed™ Program?

How motivated did you feel during the intervention? Please elaborate? What do you think had you feeling this motivated/unmotivated? What could've increased your level of motivation?

What was good about it? Were there any tasks that you enjoyed? Why?

What did you not like about it? Were there any tasks that you didn't enjoy? Why?

What did you think about the format of the intervention? (Playing games) Do you think this could be improved? Did the exercises appeal to you? What would you change about the exercises?

How difficult did you find the tasks?

Did you notice any changes in you abilities to perform tasks?

Have you begun to notice any changes in your everyday life? Where?

Is there anything you would recommend should be added or taken away from the program?

10.2.2. Logistics

What would you change about the logistic element of the research? What would you keep the same?

What was it like having a research coach? Do you feel this was useful? In what way? Was there anything about this that you didn't like?

What was it like having to complete the intervention at home?

Did you have a set time each day that you would go and do your exercises? Or did the times change? If the times changed each day what was it that resulted in this? If you managed to do it at the same time was it easy to do so? Was there anything that might've made it difficult?

Did you manage to do the intervention each day? What do you think helped you to do this? Or what do you think stopped you from doing this?

How was it to set up the program on your computer? What would've made this easier for you? How did you find the instruction manuals for setting up the program? Is there any way you feel these could be improved?

If you could think of anything that might've lead you to quit the intervention what would this have been? Why? What do you think helped you continue with the program to the end?

What do you feel made it difficult for you to continue taking part?

What do you think might've helped you to keep taking part?

NB! Questions that do not apply to certain participants will be ommitted, i.e. questions about dropping out of the intervention with participants who had completed and vice versa

10.3. Letter of Request to CogMed ™ for Use of Program

Mr. Tyler C. Barberis
Researcher
Department of Psychology
Umthombo Building
The University of the Witwatersrand, Johannesburg
2001
21 January 2013

Mrs. Kathryn Ralph
Research Relationship Manager
CogMed Working Memory Training
CogMed Systems Inc

RE: Permission to use the CogMed Working Memory Training to Conduct to a Research Study

Dear Mrs. Ralph:

I am writing to request permission **use the** CogMed Working Memory Training to conduct a research study at Tara hospital. I am a Master's student at the University of the Witwatersrand. As part of my completion of my Masters degree in Clinical Psychology I am researching the effects of the CogMed Working Memory Training on working memory for adults with a remitted diagnosis of schizophrenia.

My research proposal is based on the premise that working memory deficits have been found to be one of the major contributing factors toward the presentation of schizophrenia. This study seeks to demonstrate that CogMed Working Memory Training can be effectively used as a rehabilitation programme for people living with HIV, taking into consideration the South African context.

The research proposal will go through the formal process of the University of the Witwatersrand. Approval of the Medical ethical clearance from the will be obtained before commencement of the study and permission from Tara hospital to engage patients in their schizophrenia outpatient programme will also be requested. Please see attached research proposal for more information.

The CogMed training Program will be followed as recommended by CogMed**.** The study will require a maximum of 10 individuals to go through the intervention and the testing procedures. It is expected that the study will run for two months beginning in June and ending in July. This research will be conducted in accordance with the approved research Program and guidelines of the Health Professions Council of South Africa's (HPCSA) Ethical Guidelines in Health Research.

Prospective participants will be subjected to a selection process to determine suitability for participation in the study. The assessment tools to be used are the AWMA to test working memory and the CPT II to test sustained attention. Assessments before and after the CogMed intervention of the programme will be conducted to firstly establish a baseline measure for attention and working memory of each individual participant, and secondly to determine extend of change brought about by the programme.

Interested participants will be given a briefing, an information letter and a consent form to sign. Due to the nature of the study, I will also recruit “support coaches”, this has to be someone living with the participant who can motivate and ensure that the participant does their training around the same time every day of the week. “Support coaches” who agree to participate will also be given consent forms to be signed (Copies of the letters are enclosed).

The study will be conducted over a period of 2 months, expected to start in May and complete end of June 2013. All information will be kept confidential in accordance with ethical and professional conduct guidelines and will be obtained by means of interviews, observations, records, and assessments. All data gathered will be statistically manipulated to determine if any significant change was brought about by the program. The survey results will be pooled for the thesis project and individual results of this study will remain absolutely confidential and anonymous.

Your approval to use CogMed Working Meory Training to conduct this study will be greatly appreciated.

Sincerely,

Tyler Barberis

Researcher
(Cell) 076 097 6129
(Email) tyler.barberis@students.wits.ac.za

Aline Ferreira Correia

Research Supervisor
(Office) 011 717 4527
(Email) aline.ferreiracorreia@wits.ac.za

10.4. Clearance Certification from Human Research Ethics Committee (Medical)

M130553

R14/49 Mr Tyler Barberis

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130553

NAME: (Principal Investigator)	Mr Tyler Barberis
DEPARTMENT:	School of Human & Comm Dev/Psychology Main Campus/Umthombo Building
PROJECT TITLE:	Effect of the CogMed(TM) Working Memory Training Protocol on Working Memory
DATE CONSIDERED:	31/05/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Aline Correia-Ferreira
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 23/07/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

10.5. Letter of Request to Authorities at Tara Hospital

Mr. Tyler C. Barberis
Researcher
Department of Psychology
Umthombo Building
The University of the Witwatersrand, Johannesburg
2001
21 January 2013

Dr. Florence Otiano
Chief Executive Officer
Tara Hospital
50 Saxton Road
Hurlingham
2196

RE: Permission to Conduct Research Study

Dear Dr. Florence Otiano:

I am writing to request permission to conduct a research study at Tara hospital. I am a Master's student at the University of the Witwatersrand. As part of my completion of my Master's degree in Clinical Psychology I am researching the effects of the CogMed Working Memory Training on working memory in patients with a remitted diagnosis of paranoid schizophrenia

Working memory and attention has been found to be an area of deficit in individuals suffering from different forms of schizophrenia. The observed working memory impairment may partially explain decline in every day functioning that is sometimes observed in the individuals living with schizophrenia. Research has shown that cognitive rehabilitation programmes can be effective in improving cognition for people across different age groups and a wide range of conditions e.g. ADHD, schizophrenia, HIV, stroke survivors with cognitive impairments etc.

CogMed Working Memory Training is a computer based working memory rehabilitation program. It is administered over 25 sessions. Users practice on both visuo-spatial and verbal working memory exercises for 5 days per week for 5 weeks. The sessions lasts about 30- 40 minutes. Daily monitoring of the participant's progress will be done by the researcher using the administration module of the CogMed Programme and weekly progress reports will be emailed and discussed with participants.

In order to conduct this study, volunteers from the Schizophrenia out-patient program willing to participate are required. However, participants must first comply with certain criteria, and all prospective participants will be subjected to a selection process to determine suitability for participation in the study. Assessments before and after the CogMed intervention of the programme will be conducted to firstly establish a baseline measure for attention and working memory of each individual participant, and secondly to determine extend of change brought about by the programme.

Interested participants will be given a briefing, an information letter and a consent form to sign. Due to the nature of the study, I will also recruit a "support coach", this has to be someone living with the participant who can motivate and ensure that the participant does their training around the same time every day of the week. "Support coaches" who agree to participate will also be given consent forms to be signed (Copies of the letters are enclosed).

The study will require a maximum of 10 individuals to go through the intervention and the testing procedures. It is expected that the study will run for two months beginning in June and ending in July. All information will be kept confidential in accordance with ethical and professional conduct guidelines and will be obtained by means of demographic questionnaire and assessments. All data gathered will be statistically manipulated to determine if any significant change was brought about by the program. The survey results will be pooled for the thesis project and individual results of this study will remain absolutely confidential and anonymous.

Participation in this study is completely voluntary. Volunteers are free to refuse to participate and to withdraw at any time during the study. They will not be penalised or disadvantaged in any way. If the CogMed intervention is followed as recommended the participant may benefit from improved attention and working memory.

Unfortunately due to the nature of applications, hospital approval is required for submission to the medical ethics committee at the University. This research will contribute to both a body of knowledge on computer-based rehabilitation programmes, as well as to the University of the Witwatersrand and to Clinical Psychologist currently practising in the South African context.

Your approval to conduct this study will be greatly appreciated.

Sincerely,

Tyler Barberis

Researcher
(Cell) 076 097 6129
(Email) tyler.barberis@students.wits.ac.za

Aline Ferreira Correia

Research Supervisor
(Office) 011 717 4527
(Email) aline.ferreiracorreia@wits.ac.za

10.6. Invitational Pamphlet



10.7. Telephone Script

Participant:	(Greets Researcher)
Researcher:	Good Morning/Afternoon, My name is Tyler Barberis and I'm a researcher from Wits University. I received your contact information from Tara Hospital and I'm contacting you to invite you to take part in my study. Do you have a moment?
Participant:	OK. Could you tell me what it is about?
Researcher:	Basically, you'll be invited to take part in a trial aimed at assessing the effectiveness of computer-based tasks on improving working memory. Working memory is an aspect of memory that allows you to manipulate and work with information in your mind. By improving it, researchers have shown that other areas of living also improve due to increased ability to work with new and previously memorized information. Because of the way the study is structured there is a risk that you won't receive the actual intervention during the first trial but if it proves effective we will give you access to it later at your convenience. You'll also have the right to withdraw from the study at any time without any negative consequences toward you. The study will take place over 5 weeks and you'll need roughly 40 minutes each day to complete a set of tasks. Would you be interested in taking part? And do you own a personal computer with internet access which you can use every day?
Participant:	OK. Yes I do.
Researcher:	Great. I will still need to do some assessment with you to determine whether or not you will be suitable to take part. I'm going to need to organise a day and time to meet with you at the hospital to give you more information and to properly assess this. When would be most convenient for you? *(Researcher organises to meet with participant and the engages with the rest of the project as stated)*

If participant declines at any point the researcher will reply. Ok, thank you so much for your time. Good bye.

10.8. Letter of Informed Consent to Participants

Mr. Tyler C. Barberis
Researcher
Department of Psychology
Umthombo Building
The University of the Witwatersrand, Johannesburg
2001
21 January 2013

Dear Sir or Madam

RE: Consent Form for Participation in the Research Study Titled: The Effects of The CogMed™ Working Memory Training Program on Working Memoy

Good day,

My name is Tyler Barberis and I am doing research on the CogMed™ Working Memory training Program and whether or not it will improve working memory. This research will not form part of your normal treatment at Tara Hospital.

I would like to invite you to take part this research study.

What is involved in this study?

1. Participation in an initial meeting. This is the procedure that you are currently participating in. You will need to fill out a short demographic questionnaire and complete two tests aimed at assessing your current level of working memory and cognitive capacity. There will also be a short interview at the end which will look at your expectations of the program.

2. Participation in the program. This program will take place over weekdays (Monday to Friday) over five weeks for 40 minutes each day in your own home.

3. Finding a research coach. To participate in this research I will need you to select a member of your family, somebody who lives with you, to be your research coach.This person will help you stay motivated when the research becomes difficult.

4. Participation in a second test. After you have completed the program you will need to come back to the hospital for another test to see if you've improved. I will also spend some time interviewing you here to discuss how you felt about the program. This will be arranged at a time when you are scheduled to be at the hospital anyway.

5. If at any point during the research, you find it is too difficult and cannot continue, I will contact you to have a short discussion about what resulted in you being unable to continue.

6. I will need to audio record our interview session and will need your permission to do this. These recordings will be kept for a period of 5 years in a locked cupboard at the university for a period of 5 years.

What risks are involved in participation?

Unfortunately, due to the very limited nature of funding for the current project, you will not be reimbursed for transport expenses. I will however only arrange our meetings at times when you are expected to be at the hospital for follow-up treatment anyway. I will reimburse you for the cost of the internet you use.

If during the study you experience anything that upsets you or makes you feel as though you need to talk to someone you can contact the following person to put you in touch with free counselling services:

Nthabiseng Modikoane
The Emthonjeni Community Clinic
Emthonjeni Centre
The University of the Witwatersrand, Johannesburg
011 717 4513

You might sometimes become frustrated or upset at the tasks because they are quite difficult and this may bring up other negative feelings for you. I have provided contact details for a centre with free counselling should this happen.

Other important information.

Participation is completely voluntary. Refusal to take part won't harm you in any way. You may also decide to stop taking part at any time during the research. If you do decide not to take part I may call you to ask you about what made you decide this. This will also help me in my research.

I will make every effort to keep your personal information private and not to present anything in my report that will allow anybody to identify you. You'll receive a code at the beginning of the study and will only ever refer to you with this code, we will never use you name on any documents. I will also not include anything in my report that might identify you as a participant. The audio recording from the interview and any other identifying documents will be destroyed at the end of the research study.

Certain organizations may inspect and/or copy your research records for quality assurance and data analysis. These include groups such as the Research Ethics Committee and the Medicines Control Council.

For more information please feel free to contact myself or my supervisor. Also, please detach and keep this sheet.

Tyler Barberis

Researcher
(Cell) 076 097 6129
(Email) tyler.barberis@students.wits.ac.za

Aline Ferreira Correia

Research Supervisor
(Office) 011 717 4527
(Email) aline.ferreiracorreia@wits.ac.za

Prof. Peter Cleaton-Jones

Chairperson of the Human Research Ethics Committee
(Office) 011 717 2635
(Email) peter.cleaton-jones@wits.ac.za

Declaration of Informed Consent For Participation

I,_____(FULL NAME), agree that I have read and understood the letter of informed consent associated with this research project. I fully understand the details of my participation and what this will mean regarding the possible risks of my participation.

These include:

- My not being reimbursed for expenses such as transport
- That I might become frustrated or upset during the intervention because of the difficulty of the tasks
- That my participation is voluntary and I may withdraw from the research at any time without any negative consequences affecting me. If I do this the researcher might contact me to explore my decision but not to convince me to keep going.
- That my data will be kept confidential and that all information identifying me as a member of the study will be destroyed at its conclusion
- That I have the right not to answer any questions that make me feel uncomfortable.

I hereby consent, in writing, to my participation in this project and am aware that I may at any stage withdraw without any negative implications being associated with my withdrawal.

Signed,

_____	_____
(Print Name)	**Signature**
Research Participant	**Research Participant**
_____	_____
Tyler Barberis	**Date**
Researcher	

Declaration of Informed Consent For Audio Recording of Interview

I,_____(FULL NAME), agree that I have read and understood the letter of informed consent associated with this research project. I fully understand that I am agreeing to have my interview audio recorded and that:

- My confidentiality is gauranteed and the recording and any transcripts will be kept for 5 years in a locked cupboard at the University of the Witwatersrand and then destroyed.
- Access to the recording will be restricted to myself and my supervisor.

I hereby consent, in writing, to my interview being audio recorded and am aware that I may at any stage withdraw without any negative implications being associated with my withdrawal from the interview.

Signed,

_____	_____
(Print Name)	**Signature**
Research Participant	**Research Participant**
_____	_____
Tyler Barberis	**Date**
Researcher	

10.9. Demographic Questionnaire

It would be appreciated if you could take some time to complete this questionnaire. All information given will be treated as **strictly confidential.**

Name: _____
Address: _____
Email address_____
Telephone: h: _____ cell: _____
Name of person nominated as coach: _____
Their contact details _____

Please answer the questions below by placing an X in the appropriate box.

1. Gender: M ☐ F ☐
2. Age ☐
3. Home Language
   - ☐ English
   - ☐ Afrikaans
   - ☐ Zulu
   - ☐ Sesotho
   - ☐ Tswana

   Other Please Specify _____
4. Proficiency in English
   - ☐ Very Good
   - ☐ Good
   - ☐ Average
   - ☐ Bad
   - ☐ Very Bad
5. Academic Qualifications:
   - ☐ Grade 10
   - ☐ Grade 11
   - ☐ Grade 12/ Matric
   - ☐ Diploma
   - ☐ Degree

   Other Please Specify _____

6. How would you describe your current employment status?

- ☐ Employed full time
- ☐ Employed part time
- ☐ Unemployed / Looking for work
- ☐ Student
- ☐ Homemaker
- ☐ Retired

7. Have you ever suffered a traumatic brain injury (Hitting your head or having something penetrate you skull to the extent that you had to go to hospital)?

Yes ☐ No ☐

If you answered "Yes", please explain the injury

_____

8. Are you currently using any prescribed medication?

Yes ☐ No ☐

If you answered "Yes", please state the medication you are currently using

_____

9. Have you ever been diagnosed as having a learning disability? (E.g. Dyslexia, Dyscalculia)

Yes ☐ No ☐

If you answered "Yes", please explain the nature of the learning disability

_____

10. Generally speaking, how comfortable do you feel using a computer?

- ☐ Very comfortable
- ☐ Somewhat comfortable
- ☐ Not very comfortable
- ☐ Not at all comfortable

11. How often do you use the Internet?

- ☐ Once or more a day
- ☐ A few times a week
- ☐ A few times a month
- ☐ Hardly ever
- ☐ Never

12. Do you live with someone who can be part of the rehabilitation program with you?

Yes ☐ No ☐

10.10. Letter of Informed Consent to Participant Coach

Mr. Tyler C. Barberis
Researcher
Department of Psychology
Umthombo Building
The University of the Witwatersrand, Johannesburg
2001
21 January 2013

Dear Sir or Madam

RE: Consent Form for Participation as a Research Coach in the Research Study Titled: The Effects of The CogMed™ Working Memory Training Program on Working Memory

Good day,

I, Tyler Barberis, am trying to find out what effect the CogMed™ Working Memory Training Program will have on working memory in people with schizophrenia in full remission.

I would like to invite you in to our project as a research coach for the person who asked for your participation.

What is involved in this study?

Your participation in this study will entail the following:

1. A short phonecall during which I will discuss the details of your participation with you.
2. Coaching of your research participant during the program. This program will take place over weekdays (Monday to Friday) over a period of five weeks. It will require a maximum of 50 minutes from your participant each day for which you will be expected to ensure that the participant continually and consistently completes the tasks for the day.

What risks are involved in participation?

I expect that this study will be of low risk to you.

During the course of the study it will be necessary that I have a list of your name and contact details. This list will be in a digital format on my own computer and on the computer of my supervisor. The list will be password protected and will be deleted once the study has been completed.

There will be no direct benefits for participation as a supervisor in the study.

Unfortunately, due to the very limited nature of funding for the current project, participants and supervisors will not be reimbursed for the time associated with their participation.

Other important information.

Participation is completely voluntary. Refusal to participate will involve no penalty or loss of benefits you. However, it may mean that your participant may not be able to take part.

Every effort will be made to keep personal information confidential. Personal information may be disclosed if required by law.

Certain organizations may inspect and/or copy your research records for quality assurance and data analysis. These include groups such as the Research Ethics Committee and the Medicines Control Council.

For further information or reporting of study related adverse events. Please detach and keep this sheet.

Tyler Barberis

Researcher
(Cell) 076 097 6129
(Email) tyler.barberis@students.wits.ac.za

Aline Ferreira Correia

Research Supervisor
(Office) 011 717 4527
(Email) aline.ferreiracorreia@wits.ac.za

Declaration of Informed Consent For Participation as a Research Coach

I,_____(FULL NAME), agree that I have read and understood the letter of informed consent associated with this research project. I fully understand the details of my participation and what this will mean regarding the possible risks of my participation.

These include:

- The time commitments associated with sufficiently carrying out this role
- That I may withdraw in this capacity from the study at any time without any negative consequences being experienced by myself or the individual over whom I will supervise
- That all of my personal information will be kept confidential and that any personally identifiable information linking your participation to this study as a participant supervisor will be destroyed after a period of 5 years after the completion of the research.

I hereby consent, in writing, to my participation in this project and am aware that I may at any stage withdraw without any negative implications being associated with my withdrawal.

Signed,

_____	_____
(Print Name) **Research Coach**	**Signature** **Research Coach**
_____	_____
Tyler Barberis **Researcher**	**Date**