THE EFFECT OF COMPUTER-ASSISTED COGNITIVE REHABILITATION ON THE MEMORY OF CLIENTS WHO ARE SEVERELY MENTALLY DISABLED

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ABSTRACT

THE EFFECT OF COMPUTER-ASSISTED COGNITIVE REHABILITATION ON THE MEMORY OF CLIENTS WHO ARE SEVERELY MENTALLY DISABLED

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Individuals who are severely mentally disabled have been found to have a multitude of cognitive deficits which decrease quality of life, as well as limit the effectiveness of therapy. This study investigated the effectiveness of computer-assisted cognitive rehabilitation on 13 clients of an outpatient community mental health agency who were diagnosed as having a severe mental disorder. The treatment group (7 clients) worked on personal computers using software from Psychological Software Services, Inc. called PSS Cog Rehab, the Memory I section only. The control group (6 clients) underwent a social skills therapy group which focused on communication skills. Both groups met one time a week for two hours for a total of 8 weeks. Before both groups began and after both groups ended, all participants were given the following measures to gather demographic information, assess symptomology, and to assess memory: the Demographic and Psychosocial History Questionnaire, the Self-Report Symptom and Affect Checklist and Questionnaire, the Symptom Distress Survey, the Weschler Adult Intelligence Scale-Third Edition Working Memory Index (the Arithmetic subtest, the Digit Span subtest, and the Letter-Number Sequencing subtest), and the Trail Making Test (Parts A and B). A 2 X 2 (group x time) repeated-measures analysis of covariance was computed for each of the eight memory related dependent variables. There was one significant interaction between the group condition and the pretest--posttest factors for the dependent variable Digit Span subtest. However, due to a lack of power, planned comparisons indicated that neither the observed experimental group mean increase nor the control group mean decrease was statistically significant. These results indicate that the individuals in the computer based cognitive rehabilitation program did not significantly improve their memory skills compared with the individuals in the control therapy group. Possible reasons for the lack of support for the hypothesis and recommendations for future studies in this area are discussed.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Oftentimes, individuals with severe mental disorders display cognitive impairments. In particular, a great deal of research has been conducted on the multiplicity of cognitive deficits found in people who have schizophrenia. To illustrate, individuals with schizophrenia often experience lapses of memory, lose focus on tasks, show poor planning and problem solving, display weak sustained and selective attention, have poor visuospatial skills, and suffer impaired perception, information processing, and conceptualization abilities (Burda, Starkey, Dominguz, & Vera, 1994). Furthermore, compared with other severe mental disorders, the clinical symptoms of schizophrenia seem to have an etiological primacy of cognitive deficits. In affective disorders, for example, cognitive impairments seem to be secondary effects of the affective abnormality. To illustrate, racing thoughts occurring during a manic episode appear to be related to psychophisological arousal, whereas, theories of schizophrenia have hypothesized that cognitive impairments drive other symptom expressions (Spaulding, Reed, Poland, & Storzbach, 1996). In sum, people who have severe mental disorders, particularly schizophrenia, are highly likely to experience cognitive deficits. In schizophrenia, it is hypothesized that cognitive deficits create other symptoms, while with many other disorders the symptoms cause people to have cognitive impairments.

Due to the development of new technology, investigators have begun to study the link between cognitive deficits and specific symptoms of schizophrenia more completely. One of the major areas which researchers have investigated is the area of language and thought. Some of the disturbances in language and thought found in people with schizophrenia are in part due to short-term memory and/or attentional problems. For example, excessive pauses at the end of phrases, inadequately specified references, and loose associations point to the fact that people with schizophrenia are susceptible to distraction and lapses in memory. Furthermore, complex communication tasks in which there are high degrees of uncertainty as to when to speak and what to say is especially difficult for people with schizophrenia because a great deal of information needs to be juggled requiring short-term memory. Also, lengthy conversations may be very difficult for people with schizophrenia because of deficits in sustained attention. (Steffy, 1993). Similarly, deficits in long-term memory where concepts, symbols which lead to larger bodies of information, are stored also lead to language and thought impairments found in people with schizophrenia. For example, many people with schizophrenia have been shown to have difficulty interpreting proverbs. Many researchers believe that because the long-term memory of people with schizophrenia has been impaired the individual is unable to manipulate conceptual information which would allow categorization of objects for further processing on the basis of common abstract characteristics. Also, some researchers advocate that erroneous logic when speaking is created partly by undue attention to the predicate of a sentence. (Spaulding, et al., 1996).

Cognitive impairments also play a role in delusions which are often times present in people with schizophrenia and other disorders such as certain personality disorders and disorders in which a person may have psychotic symptoms. Delusions are in part caused from information processing deficits. Basically, a perceptual overload of stimuli occurs, and it becomes very difficult to select pieces of information that are incongruent with the delusion because of the limited capacity to process information. In essence, the brain selects information for the individual which fits a pattern, or the delusion, so that the individual will not have to process as much information (Steffy, 1993).

Another major area of investigation for psychologists, neurologists, and biologists has been in the link between brain dysfunction and hallucinations. In auditory hallucinations, it seems that the brain may actually generate words. Consequently, people experiencing the auditory hallucination think that someone else is actually speaking to them. Similarly, in visual hallucinations the brain produces images which are seen by the individual experiencing the hallucination. Thus, individuals experiencing the visual or auditory hallucination often have a decreased ability to divide attention appropriately between internal and external cues. Furthermore, it becomes increasingly difficult for the individual experiencing the hallucination to focus his or her attention on stimuli other than stimuli which is congruent with the hallucination (Spaulding, et al., 1996).

Many researchers believe that the cognitive impairments and ensuing symptoms of schizophrenia are in part caused by some sort of brain injury or brain irregularity. Individuals with schizophrenia have been found to have enlarged ventricles and smaller frontal lobes, cerebrums, and craniums than people who do not have schizophrenia. Specifically, the cognitive impairments found in individuals with schizophrenia seem to be linked to metabolic underactivation of the frontal lobe of the brain, in other words, a decrease in blood flow in this area of the brain. Also, there appears to be abnormalities in neural pathways between the frontal lobe, the temporal lobe, and the limbic cortex (Spaulding, et al., 1996). To summarize, some of the symptoms such as disturbance in language and thought, delusions, and hallucinations may be generated by cognitive impairments which are in turn caused by brain injuries or brain irregularities in individuals with schizophrenia.

In addition to abnormalities of brain structures, medication also results in some of the cognitive impairments found in individuals with schizophrenia. Some evidence has been found which shows that some neuroleptics used to treat schizophrenia and other severe mental disorders can permanently impair mental functioning and may cause atrophy of the brain. For example, some clinical studies have confirmed the existence of dementia in association with neuroleptic use similar to the mental deterioration typical of individuals with chronic organic brain syndrome. Specifically, neuroleptic medications have been linked with decreased long term memory, short term memory, and attention span abilities. However, newer neuroleptic medications seem to have fewer of these negative cognitive impairments. Thus, the degree to which neuroleptics affect cognitive abilities depends on the dose level, type of drug, and severity and type of symptoms experienced by the individual (Breggin, 1997). In sum, while neuroleptics may alleviate some symptoms of schizophrenia some may also create unwanted cognitive deficits.

Due to the strong link between cognitive deficits and schizophrenia, a great deal of research has been conducted in the area. Less research has been conducted on the extent to which individuals with other severe mental disorders suffer from cognitive deficits. However, there is some evidence which shows that people who suffer from symptoms of severe depression or anxiety have difficulty with long term and short term memory as well as difficulty with attention span (Magaro, Johnson, & Boring, 1986). Furthermore, for some disorders cognitive impairments are actually symptoms of the disorder. For example, in the disorder termed dissociative amnesia the main disturbances include the inability to remember personal information, or dysfunction of long term memory (American Psychiatric Association, Diagnostic and statistical manual of mental disorders fourth edition, 1994).

The consequences of the cognitive impairments for individuals who have schizophrenia and other severe mental disorders are numerous. For example, interacting with other people becomes challenging. To illustrate, new relationships are difficult to begin if one is unable to maintain attention long enough to relate and effectively communicate with others. Similarly, if an individual is unable to recognize people whom he or she has met before, or can not remember the person's name or important information about the individual due to impaired long-term memory then establishing a relationship becomes problematic. Also, long-standing relationships may be affected in a like manner to new relationships due to memory and attention insufficiencies.

Furthermore, everyday activities which are taken for granted by most people become trying for individuals with cognitive impairments. It becomes difficult for individuals with cognitive deficits of memory and attention to take medication, go to doctor's appointments, eat meals, maintain personal hygiene, and drive a vehicle. Also, because of the cognitive demands of sustained focus, attention, and memory needed for many activities required in a work place or academic setting, having a job or attending school becomes very challenging (Steffy, 1993).

Another major consequence of cognitive impairments for people with a severe mental disorder is that the impairments may impede therapy. To explain, many clinical psychologists view psychotherapy as a kind of learning, or they at least agree that in order for psychotherapy to be effective, learning must take place. Therefore, psychotherapy involves learning and subsequently using new coping strategies that rely heavily on the cognitive skills of problem-solving, memory, integration, and abstraction (Fals-Stewart & Lucente, 1994). However, if these cognitive skills are somehow impaired, the processing of information is obstructed and learning may not take place (Berrol, 1990). Consequently, cognitive impairments or deficits become a major obstacle to effective psychotherapy. In sum, given that psychotherapy is a type of learning, the cognitive status of an individual who has a severe mental disorder is likely to be related to treatment response and outcome (Fals-Stewart & Lucente, 1994).

Cognitive impairments can have a detrimental effect on almost every aspect of an individual's life. Cognitive impairments may impede social interactions with family, friends, and peers. Furthermore, cognitive impairments may make everyday activities difficult to accomplish. Also, cognitive impairments may greatly impede therapy. All of these consequences of cognitive deficits have the potential to negatively affect the course and treatment of a severe mental disorder. Thus, it is necessary to examine ways to remedy the impairments.

The systematic attempt to improve cognitive deficits is termed *cognitive retraining*. Cognitive retraining focuses on individual functions, such as memory. Improving the deficits to the point of being able to perform functional cognitive tasks is termed *cognitive rehabilitation*. Cognitive rehabilitation focuses on many areas of functioning at once, for example, attention, memory, visual scanning, and problem solving. Thus, the goal of cognitive rehabilitation is to improve the cognitive deficits to the point that an individual can function well in every day life activities (Berrol, 1990). Similarly, Pepin, Loranger, and Benoit, (1995), describe cognitive rehabilitation as "part of a global approach whose objectives take the abilities and disabilities of the subject into account, as well as the personal and social factors susceptible to affect the expected results" (p. 10). Cognitive rehabilitation has also been described as the act of acquiring lost mental abilities which are necessary to accurately receive sensory input, process information, and behave in a manner as appropriately as possible following an injury to the brain or its functions (McGuire, 1990). In sum, cognitive rehabilitation is viewed as an overall treatment approach which includes cognitive retraining and other therapy techniques which aim to lessen cognitive impairments to a degree to which the client is able to function in everyday activities.

Theories Supporting the Use of Cognitive Rehabilitation

Most research on cognitive rehabilitation centers on neurological theories emphasizing functional organization of the brain. This functional model explains how the brain has the ability to reorganize itself in order to execute certain tasks following injury to a part of the brain. Thus, the brain uses intact cerebral areas to carry out the tasks that the injured part of the brain carried out previous to the injury or deficit (Luria, 1963). However, to gain the benefits of the plasticity of the brain, the targeted function must be stimulated. Consequently, many cognitive interventions are based on the repeated practice of exercises aimed at improving abilities such as attention, memory, and problem-solving (Pepin, et al., 1995).

Information processing theories also contribute to the understanding of how interventions in cognitive rehabilitation work. Specifically, various processing functions of the brain execute certain tasks. Many researchers describe distinct phases of cognitive processing (Magaro, et al., 1986; Reitan & Wolfson, 1988). The first phase involves attention and memory which correspond to the capacity of data selection. The second phase involves moving the data to the specific part of the brain. The third level of processing is the carrying out of the task by the appropriate parts of the brain. In sum, the information processing model allows the deficient phase of processing to be identified and the intervention to be directed more efficiently. Furthermore, the information processing model of cognitive rehabilitation does not conflict with the functional model of the brain (Pepin, et al., 1995).

Some researchers have looked at the role that learning theories play in cognitive rehabilitation. Specifically, Pepin, Loranger, and Benoit (1995) discuss the importance of the learning principles behind the theory of cognitive rehabilitation and believe the main objective of cognitive rehabilitation is to "teach again" certain abilities. Additionally, Pepin et al. (1995) propose that everyone is able to learn in varying degrees. Thus, cognitive rehabilitation is based on presenting learning activities to the individual with cognitive deficits. Pepin et al. (1995) suggest that specific assumptions about the underlying neurological mechanisms are not necessary in order to implement cognitive rehabilitation because it would be virtually impossible to identify all of the underlying neurological mechanisms occurring as the client was accomplishing each cognitive task. In summary no models fully explain the functioning of the brain, and relatively little is known about the process involved in the recovery of brain functions. Consequently, it is difficult to justify an intervention based on any one model (Pepin et al., 1995).

However, taking the main principles of the different models of cognitive rehabilitation into account, the computer as a tool in cognitive rehabilitation seems very useful. Recently, "cognitive rehabilitation" has relied heavily on the use of computers (Berrol, 1990). There are many advantages to using the computer to administer cognitive rehabilitation interventions. First, the computer as a cognitive trainer is endlessly patient--it can present stimuli continuously without fatigue or boredom. Second, the computer presents information that is engaging to most adults because the visual stimuli can be attractive, bright, colorful, and utilize sound effects that help to focus the patients attention. Third, the computer allows the therapist to work with more than one client at a time (Magaro et al, 1986). Fourth, compared with similar tasks administered manually, computer-assisted interventions are more cost effective (Burda et al., 1994). Fifth, the computer is flexible. For instance, the computer can present a variety of tasks based on the client's needs and abilities. Sixth, the computer is able to set the tasks at a level which will challenge but not frustrate the client, and feedback can be given immediately in a clear, consistent, and non-judgmental manner. Seventh, the client is able to work at his or her own rate. The feeling of having control of the situation can lead to increased motivation and feelings of self-worth (McGuire, 1990).

Some specific features of cognitive rehabilitation lend themselves well to computer-assisted training. These features include the idea that learning results from repeated activity. To illustrate, computers can present materials in a manner in which the client can repeatedly manipulate the same stimuli with minimized boredom. Another feature of cognitive rehabilitation which fits well with the assistance of the computer is that retraining should be deficit specific. The computer is able to assist in this feature by allowing a customized training program for each individual depending on his or her deficit. A final feature is that consistent and direct feedback to patients is essential. In computer training, results on how the patient did with the cognitive tasks can be calculated immediately (McGuire, 1990). Thus, not only does the computer possess a number of qualities which make it appealing from a practical standpoint, but many of the principles and features of cognitive rehabilitation can be accomplished through using computer-assisted intervention.

Research on Computer-Assisted Cognitive Rehabilitation

The majority of research using computer-assisted cognitive rehabilitation interventions has been conducted on people who have had a traumatic brain injury. Furthermore, the multimedia cognitive rehabilitation software has primarily been used to improve attention, memory, and problem-solving skills. Many studies have shown positive results using computer-assisted cognitive rehabilitation on brain injured patients (e.g., Chen, Thomas, Glueckauf, & Bracy, 1997; Finlayson, Alfano, & Sullivan, 1987; Ruff, Baser, Johnston, Marshall, Klauber, Klauber, & Ninteer, 1989).

Finlayson, Alfano, and Sullivan (1987), describe a case example using a computer-assisted procedure in cognitive rehabilitation with one patient who had received a severe brain injury and showed cognitive impairment. There was no comparison subject or group in this case example. Neuropsychological tests were given to the patient to determine the exact nature of the cognitive deficits and then a computer-assisted cognitive rehabilitation program was designed specifically for this patient. This patient's rehabilitation program consisted of working on logical analysis, visual-spatial manipulatory skills, attention, orientation, self-regulation, and memory. The results of this study not only showed that the patient improved on the computer exercises but that the patient also had significant gains in new-learning and problem-solving skills, mental flexibility, and psychomotor functioning.

Another study with head-injured patients showed reduced cognitive deficits after the patients used computer-assisted training. In this study, (Ruff, Baser, Johnston, Marshall, Klauber, Klauber, & Ninteer, 1989), head-injured patients were randomly divided between a control group and an experimental group. The control group consisted of group therapy emphasizing psychosocial adjustment, leisure, and activities of daily living. The experimental group used computer programs that focused on attention, spatial integration, memory, and problem-solving. The therapy group and the cognitive training group lasted 8 weeks. Both groups were administered a pre-test before the start of the group and a post-test after 8 weeks and again at 12 weeks. Analyses of pretreatment and post-treatment data showed that there were significant improvements for both the control and experimental groups. However, the experimental group demonstrated more gains on measures of memory skills, especially, visuo-spatial tests.

Another quasi-experimental study by Chen, Thomas, Glueckauf, and Bracy (1997) looked at the effect of a computer assisted cognitive rehabilitation approach using a hierarchical approach instead of the task-specific approach. In other words, this computer-assisted technique trained individuals on a sequence of programs that were arranged hierarchically from fundamental to more complex cognitive functions (as compared to the task-specific technique that targets specific cognitive deficits). The experimental group in this study received computer-assisted cognitive rehabilitation using the hierarchical approach, and the control group did not receive any computer-assisted rehabilitation. The four main areas that the experimental group worked on were attention, visual-spatial abilities, memory, and problem-solving. The results showed that individuals using the computer-assisted cognitive rehabilitation program made significant cognitive gains, but did not improve significantly more than those individuals in the control group. Consequently, whether or not the computer-assisted rehabilitation program was effective is undeterminable since the positive results found in the computer-assisted group could have been accounted for by regression to the mean.

Another study examined the effect of computer-assisted and noncomputerized treatment techniques on patients who had a severe closed-head-injury. In this study both the control and experimental groups had the same training procedures but differed in the modality through which the treatment was delivered (i.e., computer-assisted vs. non-computer assisted). Both conditions contained the same cognitive treatment:

training in verbal and visual retention strategies and activities designed to promote organization, planning, flexibility, concept formation, reasoning, and problem-solving. The results of this study showed that there were no significant differences between the post-test scores of the computerized and non-computerized cognitive rehabilitation programs, and that both groups significantly improved from the pre-test to post-test (Batchelor, Shores, Marosszeky, Sandanam, & Lovarini, 1988).

Similar to the deficits in brain-injured patients, research has found a variety of neuropsychological deficits in persons with chronic alcohol consumption. These deficits include impairments in abstract reasoning ability, visuospatial and visuomotor ability, and learning and memory skills (Gordon, Kennedy, & McPeake, 1988). Furthermore, studies of computer-assisted cognitive rehabilitation programs conducted on clients who are alcoholic with neurological deficits show results similar to those studies with brain-injured subjects. For example, Fals-Stewart and Lucente (1994) found that patients in an inpatient drug abuse treatment center receiving computer based cognitive rehabilitation demonstrated a faster rate of cognitive recovery after two months of treatment than did patients who received progressive muscle relaxation, patients who were taught typing on a computer, or patients who received no treatment beyond that provided by the treatment center (Fals-Stewart & Lucente, 1994).

Similar to individuals with a brain injury and persons with neurocognitive deficits due to chronic alcohol abuse, those who have chronic psychiatric disorders also display problems in attention, perception, concentration, information processing, memory, and problem solving. Although there have been reports of successful efforts to improve the cognitive functioning of individuals who have psychiatric disorders, only one study has investigated computer-assisted cognitive training with individuals who have severe psychiatric disorders. Burda, Starkey, Dominguz, and Vera (1994) conducted a study using inpatients at a Veterans Affairs Medical Center who had severe psychiatric disorders. All patients were diagnosed with either undifferentiated type schizophrenia, paranoid type schizophrenia, or schizoaffective disorder. The 69 patients were randomly assigned to either the experimental group which used a computer-assisted cognitive rehabilitation program or the control group which did not use computers in any way. The experimental group worked on the computer program for 1 ½ hours each week for eight weeks, on training tasks which included exercises in attention, memory visuospatial skills, visuomotor skills, and conceptualization. All patients in both groups participated in the regular therapeutic activities of the medical center, including medication. Both groups were administered the same pre-tests and post-tests which included the original Wechsler Memory Scale, the Trailmaking Test (Parts A and B) from Halstead-Reitan Neuropsychological Battery, the Shipley Institute of Living Intelligence Scale, and a brief demographic information questionnaire. The results of the study showed that the patients who received the computer-assisted intervention significantly improved their memory skills (Weschler Memory Scale scores) relative to those patients who did not receive the computer-assisted intervention. Also, the experimental group significantly improved on the Trailmaking Test, a measure of visuomotor sequencing skill, although the control group did not improve. However, no significant post-test difference were found between the groups on the Shipley Intelligence scores (Burda, Starkey, Dominguz, & Vera, 1994). In sum, patients who had severe psychiatric disorders and participated in cognitive exercises on a computer improved some cognitive abilities compared to patients who did not participate in computer-assisted cognitive exercises.

In conclusion, most research that has been conducted on the effectiveness of computer assisted cognitive rehabilitation has centered on people who have a severe brain injury. Furthermore, the literature on computer-assisted cognitive rehabilitation studies mostly contains single case studies and group studies which are not properly controlled. However, within this literature there have been some positive results. For example, Finlayson, Alfano, and Sullivan (1987), reported that a single subject improved significantly in new-learning and problem-solving skills, mental flexibility, and psychomotor functioning. A controlled group study by Ruff, Baser, Johnston, Marshall, Klauber, and Ninteer (1989) show that a group receiving computer assisted cognitive rehabilitation improved significantly over a group receiving therapy within the specific area of memory. In contrast, in a study by Chen, Thomas, Glueckauf, and Bracy (1997) subjects in a computer assisted cognitive rehabilitation group improved on cognitive abilities but not significantly more than a control group. Similarly, in a study by Batchelor, Shores, Marosszeky, Sandanam, and Lovarini (1988) in which cognitive rehabilitation was compared in a computerized group versus a non-computerized group, significant gains in cognitive abilities were made within each group but not between the groups. A study by Fals-Stewart and Lucente (1994) conducted on individuals with chronic alcohol consumption who had cognitive deficits found that individuals who had computer-assisted cognitive rehabilitation had a faster recovery rate than individuals who did not have cognitive rehabilitation. Correspondingly, one study by Burda, Starkey, Dominguz, and Vera (1994) utilized individuals with schizophrenia and compared a computerized cognitive rehabilitation group with a non-computerized control group. The group which received computer assisted cognitive rehabilitation improved significantly on many cognitive abilities over the control group. Thus, there is mixed support for the use of computer assisted cognitive rehabilitation.

The Present Study

Overall, there is a dearth of research investigating the use of computer-assisted cognitive rehabilitation techniques on individuals with severe mental disorders. Because cognitive deficits decrease quality of life as well as limit the effectiveness of therapy, it is important that the cognitive limitations of people who have a severe mental disorder be addressed. Furthermore, in light of the research conducted by Burda et al. (1994), evidence suggests that computer-assisted cognitive rehabilitation programs can positively affect the cognitive performance of people who have severe mental disorders. Therefore, the present study examined the effects of a computer-assisted cognitive rehabilitation program on clients of an outpatient community mental health facility. More specifically, the study used a group therapy format in which the experimental group used a computer-software package designed for cognitive rehabilitation. The group utilized only the memory section of the software package. Memory was chosen over the other sections of the computer software for several reasons. First, given the limited amount of time available for the group training (8 weeks), focusing on one section of the computer program would increase the likelihood of improvement in an area of cognitive functioning. Second, past research conducted on people with cognitive deficits has demonstrated that computer-assisted rehabilitation programs have been more successful in improving memory skills compared to other areas of cognitive functioning (e.g., Burda et al., 1994; Ruff et al., 1989). Third, memory skill deficits are common among individuals with severe mental disorders such as major depression, anxiety disorders, and schizophrenia.

It was hypothesized that clients of an outpatient community mental health agency who are severely mentally disabled and who receive computer-assisted cognitive training focusing on memory would show significant improvement on cognitive performance tasks designed to measure memory compared to similar clients who are severely mentally disabled but do not receive computer-assisted cognitive training.

CHAPTER II

METHOD

Participants

The participants originally included 16 (8 in the experimental group and 8 in the control group) clients of an outpatient community mental health agency located in Dayton, Ohio. During the second to the last week of the experimental group, one participant dropped out of the study, and during the last week two participants from the control group dropped out of the study. Thus, 13 clients completed the study (7 in the experimental group; 6 in the control group) including 9 males and 4 females ranging in age from 25 to 54 years ($\underline{M}$ = 43, $\underline{Mdn}$ = 44). The study included one African-American (in the control group) and 12 Caucasians. These were clients who at the time of the study were severely mentally disabled as indicated by GAF scores (global assessment of functioning scores) which ranged from 60 to 35 ($\underline{M}$ = 50, $\underline{Mdn}$ = 50) indicating moderately severe to serious symptoms. The clients in the study were diagnosed by a psychiatrist as follows: 54% with an anxiety disorder, 46% with a mood disorder, 38% with schizophrenia, and 23% with a personality disorder. Furthermore, 46% of the clients in the study had a dual diagnosis. At the time of the study all participants were receiving group therapy and other treatment interventions offered by the community mental health agency, including individual therapy, psychopharmacological interventions, and case management.

The treatment group consisted of 7 clients (5 males and 2 females) who expressed an interest to participate in a group to improve memory and were willing to volunteer to participate in the study. The control group consisted of six clients (4 males and 2 females) who volunteered to participate in the study and also expressed an interest to participate in a group to improve memory, but were initially placed in a social skills therapy group at the same community mental health agency. The clients were randomly divided between the treatment and control group, and the participants in the control group were told that they would be able to participate in the memory improvement group at a later date.

Measures

Global Assessment of Functioning Score. The DSM-IV global assessment of functioning score, GAF, was obtained from each participant's case record from the community mental health agency. The GAF scores were given to each subject by a psychiatrist from the community mental health agency.

Demographic and Psychosocial History Questionnaire. A demographic and psychosocial history questionnaire (Cummings-Hill & Taylor, 1999a) was administered to collect information regarding each subject's age, sex, race, marital status, level of education, difficulty with reading or writing, current and past occupations, and prior computer-usage (see Appendix B). This questionnaire took approximately 5 minutes to administer.

Self-Report Symptom and Affect Checklist and Questionnaire. A self-report checklist was used to collect information on positive and negative affective states and clinical symptoms that the individual experienced almost every day (Cummings-Hill &

Taylor, 1999b). Also, 4 items assessed the client's perceived ability to remember things on a 1 (Always) to 5 (Never) scale, and item 5 assessed the client's memory in general on a 1 (Very Poor) to 5 (Excellent) scale (see Appendix C). The five scores were added together for a total score with a range of 5 to 25. Items 1 and 4 were reverse scored (1=5, 2=4, 3=3, 4=2, and 5=1). Higher scores indicated greater perceived ability to remember things. This checklist/questionnaire took approximately 5 minutes to administer.

Symptom Distress Scale. The Symptom Distress scale is a brief symptom inventory containing 15 items. It is a combination of a shortened version of the Symptom Checklist 90, SCL-90, (Derogatis, 1977) and a few items from the Brief Symptom Inventory, BSI, (Overall, 1974). The Symptom Distress Scale is a standard measure used by the Ohio Department of Mental Health (ODMH) for research purposes. The Symptom Distress scale is one of the outcome assessment measures created for the Mental Health Report Card, a brief standardized form of profiling used to compare mental health care providers (Eisen & Dickey, 1996). A task force of mental health professionals and consumers, the Mental Health Statistics Improvement Project (MHSIP), advocated for the Symptom Distress Scale as one way of evaluating the performance of public health providers (Rosenheck & Cicchetti, 1998).

The SCL-90 is a self-report instrument intended to measure severity of psychiatric symptoms on a number of different subscales. The reliability of the SCL-90 ranges from .83 to .94 for the individual factors and is .97 for the total scale (Hoffman & Overall, 1978). Furthermore, each of the nine SCL-90 dimensions have significant correlation coefficients with the Beck Depression Inventory ranging from .46 to .73 and with all but two MMPI clinical scales ranging from .12 to .64 (Brophy, Norvell, & Kiluk, 1988). The SCL-90 has not been found to consistently define independent dimensions of psychopathology, but rather appears to measure a general complaint dimension (Hoffman & Overall, 1978).

The Symptom Distress Scale includes ten SCL-90 items known as the Symptom Checklist 10 (SCL-10). The items chosen loaded the highest on the three most important factors of the SCL-90 identified by Hoffmann and Overall (1978), which include “dysphoria”, “demoralization”, and “neurotic anxiety.” The reliability coefficient of the SCL-10 is .88. The inter-item correlation coefficients ranged from .26 to .63, and the correlation coefficients between the individual items and the total scale ranged from .48 to .70. Five other items from the Brief Symptom Inventory, reported to load on the SCL-90 “Anxiety” dimension (Derogatis & Cleary, 1977), were added to the SCL-10 to create the 15 item Symptom Distress Scale.

The inventory asks subjects to rate their distress level on different symptoms on a scale of 1 (not at all), 2 (a little bit), 3 (moderately), 4 (quite a bit), or 5 (extremely) (see Appendix D). The total symptom distress score was obtained by summing scores across all 15 items with a possible range of 15 to 75. The inventory asks for a report of symptoms from the past 7 days. The inventory took approximately 5 minutes to administer (see Appendix D).

Trail Making Test--Parts A and B. The Trail Making Test (Parts A and B) is one of the subtests of the Halstead-Reitan Neuropsychological Battery. Part A of the test consists of a pattern of 25 numbers spread over a sheet of paper in circles. The subject must draw a line from 1 to 2, 2 to 3 and so on until 25 and work as quickly as possible. The subject is timed, and his or her score is recorded in seconds. Part B of the test consists of 13 numbers in circles and 12 letters in circles spread over a sheet of paper. The subject must draw a line as quickly as possible from 1 to A, A to 2, 2 to B, B to 3 and so on to 13. The subject's score is the time it takes to finish in seconds for Part A and Part B. Thus, there are two subscores for each subject. Both Parts A and B of the Trail Making Test have a practice test. The Trail Making Test took approximately 5 minutes to administer.

The purpose in developing the Halstead-Reitan Battery was to compare control subjects to persons known to have diverse types of cerebral damage, and, based on these comparisons, identify the tests which were sensitive to the general condition of the cerebral hemispheres. Many reports documenting the value of the Halstead-Reitan Battery have appeared in the literature (see Reitan & Wolfson, 1985). Reitan (1958) conducted a study of 200 individuals with brain damage and 84 individuals who were not brain damaged and found that the individuals who were brain damaged performed at a significantly poorer level on the Trail Making Test (Parts A and B) than individuals who were not brain damaged. Furthermore, the Trail Making Test has been found to have a test-retest reliability coefficient of .66 for Part A and .84 for Part B (Klove, 1974). The Trail Making Test Part B requires the recognition of the symbolic significance of numbers and letters, the ability to scan the page constantly to identify the next number or letter, and completion of these tasks with the pressure of time. Thus, the test is considered one of the best measures of general brain functions and is a good indicator of damage in the left cerebral hemisphere of the brain (Reitan & Wolfson, 1985).

Wechsler Adult Intelligence Scale-Third Edition Working Memory Index. The WAIS-III Working Memory Index includes the Digit Span subtest, the Arithmetic subtest, and the Letter-Number Sequencing subtest. In the Arithmetic subtest participants are asked a series of 20 arithmetic problems that the subject solves mentally and responds to orally. As outlined in the WAIS-III instruction manual, the participant starts with item 5. If the participant obtains a perfect score of 1 point on both items 5 and 6 then he or she receives 1 point for each for items 1-4. If the participant scores 0 on either item 5 or 6 then items 1-4 are administered in reverse sequence until the participant receives a perfect score on two consecutive items, and when this criterion is met, the participant receives a point for each preceding items that was not administered. There is a time limit for each item varying from 15 to 120 seconds depending on the difficulty level of the problem. If the participant responds with the correct numerical quantity within the specified time limit then the participant receives 1 point for items 1-18 , and for items 19 and 20 participants receive 2 points for each correct response provided in 1-10 seconds or 1 point for a correct response provided in the time limit but over 10 seconds. The subtest is discontinued after 4 consecutive scores of 0. The points are then added for a final score with a maximum possible score of 22. This task took approximately 5 minutes to administer (The Psychological Corporation, 1997a).

The Digit Span subtest consists of two tasks which are administered independently of each other: Digits Forward and Digits Backward. In Digits Forward, participants are orally presented with 8 items of 2 trials each or 16 number sequences that he or she must repeat verbatim. In Digits Backward, participants are orally presented with 7 items of 2 trials each or 14 number sequences that he or she must repeat in reverse order. Each task begins with trial 1 of item 1, and both tasks are discontinued after a score of 0 on both trials of any item. For both tasks, the participant receives 1 point for each correct response. The number of correct responses is summed for a total score on each task with 16 possible for Digits Forward and 14 possible for Digits Backward. The total score for Digits Forward is added to the total score on Digits Backward to equal a total Digit Span score with a maximum possible score of 30. This task took approximately 5 minutes to administer (The Psychological Corporation, 1997a).

In the Letter-Number Sequencing subtest the participant is orally presented with 7 items of 3 trials each or a 21 series of letters and numbers. The participant simultaneously tracks and orally repeats the numbers and letters, with the numbers in ascending order and the letters in alphabetical order. The task begins with trial 1 of item 1 and is discontinued after scores of 0 on all three trials of an item. For each trial of an item the participant receives 1 point for each correct response. Then the trial scores are summed to obtain the total score with a maximum possible score of 21. This task took approximately 5 minutes to administer (The Psychological Corporation, 1997a).

Each subject had 3 subtest scores (Arithmetic, Digit Span, and Letter-Number Sequencing) which were converted to 3 scaled scores by using the WAIS-III Administration and Scoring Manual (Tables A.1 and A.2). Each subject also had a Working Memory Index score which was obtained by summing the 3 scaled scores previously described, and using Table A.8 of the WAIS-III Administration and Scoring Manual to find the converted score (The Psychological Corporation, 1997a).

The WAIS-III Working Memory Index is one of the four factors of the WAIS-III. The concept of working memory is described as the capacity in which calculations and manipulations of information occur and then are stored and subsequently transformed (Daneman & Carpenter, 1980). Therefore, the subtests of the Working Memory Index measure 1) the storage of information, as in the Digits Forward part of the Digit Span subtest, and 2) the simultaneous practice of storage and processing of information, as in the Arithmetic subtest, the Digits Backward of the Digit Span subtest, and the Letter-Number Sequencing subtest. The test-retest reliability coefficients for the Working Memory Index is .94, .90 for the Digit Span subtest, .88 for the Arithmetic subtest, and .82 for the Letter-Number Sequencing subtest. The WAIS-III Working Memory Index has moderate correlation's (ranging from .26 to.82) with most of the subtests of the Wechsler Memory Scale-Third Edition (The Psychological Corporation, 1997b).

Apparatus

Computer. Four 486 IBM compatible computers with 8 by 11 in. monitors, standard keyboards with a standard mouse and mouse pad, and Labtec speakers with adjustable volume and treble were used to administer the cognitive rehabilitation software. All computers were operating at 33 mhz with 8 megabytes of RAM, had VGA graphics capability within Microsoft Windows 3.11, a sound card, and a floppy disk drive.

Program software. The software used in the cognitive rehabilitation program was from Psychological Software Services, Inc., copyright 1994. The software, called PSS CogReHab, Version 95 was developed by Odie L. Bracy III, Ph.D. of Clinical

Neuropsychology at the University of Indiana. This software was developed at the NeuroScience Center of Indianapolis and has been tested over the past 15 years in clinical use with over 1000, patients including those with traumatic injury, stroke, tumor, disease, learning disability, and attention deficit disorders.

The specific part of the CogReHab, 95 program which was utilized in the current study was Memory I. Memory I contained the following tasks: spatial memory, visual/spatial memory (shapes and places), sequenced recall (words--visual), sequenced recall (digits--visual), sequenced recall (graphics--visual), sequenced recall reversed (digits--visual), sequenced recall reversed (graphics--visual), sequenced recall (digits--auditory), sequenced recall reversed (digits--auditory), nonsequenced recall (digits--visual), and nonsequenced recall (graphics--visual). A description of each of these can be found in the Appendix E.

Each task was performed with a standard Microsoft mouse. Within each task there was an instructions screen which gave a detailed description of the task. Also, each individual task had a parameters screen which allowed participants to decrease or increase the difficulty level of a particular task. Thus, each participant was able to work at his or her own pace, depending upon individual skill level. Each task had a results screen which allowed an individual to see the progress made on the task and allowed for the participant to print out a graph of his or her progress.

Procedure

Subjects were randomly divided between the treatment and control groups. Subjects placed in the control group (social skills therapy group) were given an opportunity at a later time to participate in a computer group at the community mental health agency. Two therapists, a student therapist and another therapist from the community mental health agency, co-facilitated the treatment group which utilized the cognitive rehabilitation software. The group met once a week for two hours for a total of eight weeks. Clients were shown how to use the computer and the interactive computer program. The clients were also taught how to save their data onto their own individual disks so that each person could work on the memory tasks at his or her own pace. During the course of the group, encouragement and support were provided to make the therapy group a pleasant learning environment.

Furthermore, in the treatment group two clients worked together on each computer. Clients alternated working on the computer program every half-hour, while one client gave support, encouragement, and suggestions. This was done in an attempt to decrease frustration on the part of the client and to help teach the clients appropriate ways of helping others. The clients were explained at the beginning of the group that each person had two goals for the group: 1) to improve his or her memory and 2) to learn to help each other in an appropriate manner. These goals were tracked by way of an attendance log (see Appendix F). Specifically, for each group session, the following were recorded: who attended, the specific tasks on which each person worked, the length of time spent on each task, attention given to a task (ranging from a score of 1 to 5), and degree of assistance given to his or her partner (ranging from a score of 1 to 5). Furthermore, if a client missed a group session he or she was given the opportunity to make up the hour session; however, no score for helping others was given at the make up session since the client was working on the computer tasks without his or her partner.

Participants who were assigned to the control group participated in a social skills therapy group. In this group clients met once a week for two hours for a total of eight weeks. A therapist from the community mental health agency who was not a part of the cognitive rehabilitation therapy group facilitated the control group. This therapy group was offered to clients at the community mental health agency on a regular basis. In the group the therapist discussed ways to communicate more effectively with other people including how to be assertive instead of passive or aggressive, how to use statements expressing one's desires and needs ("I" statements), and how to actively listen to other people. Furthermore, the therapist used role-plays as a medium for the clients to practice these skills. The clients discussed difficult situations that they had encountered when attempting to communicate with others. Also, the therapist gave the clients hypothetical situations in which they would have to role-play social situations. The goal for each client in the group was to improve each person's ability to interact with other people in socially appropriate ways.

Each participant was administered the Demographic and Psychosocial History Questionnaire, the Self-Report Symptom and Affect Checklist and Questionnaire, the Symptom Distress Survey, the WAIS-III Working Memory Index (the Arithmetic subtest, Digit Span subtest, and the Letter-Number Sequencing subtest), and the Trail Making Test (Parts A and B) one week prior to the first day of the group. These measures were administered under the supervision of Dr. John Korte and Laura Taylor. One week following the last session of the group, the same set of measures (excluding the demographic and psychosocial history questionnaire) were administered to each subject. The same series of measures was administered to a control group at a time similar to the experimental group, i.e., one week before the group began and one week after the eight weeks of the usual group therapy program provided by the community mental health agency. All instruments for both the experimental group and the control group were administered by the author. During the pre-test, the measures were administered as follows: the Demographic and Psychosocial History Questionnaire was always presented first; the remaining measures were counter-balanced between two blocks; the two blocks were a) the Symptom Distress Survey and the Self-Report Symptom and Affect Checklist and Questionnaire with the Symptom Distress Survey always presented first and b) the Trail Making Tests (Parts A and B) which was always presented first and the WAIS-III Working Memory Index (the Arithmetic subtest, Digit Span subtest, and the Letter-Number Sequencing subtest). During the post-test, the measures were administered in the same manner as the pre-test except the Demographic and Psychosocial History Questionnaire was not presented.

After each participant finished with the post-test measures, he or she was debriefed orally about the nature of this study. Furthermore, each participant was given a debriefing statement further explaining the features of the study including some basic facts about memory and the hypothesis of the study (see Appendix G). Additionally, each participant was given an evaluation form which assessed what each person liked and disliked about the group (see Appendix H). In order to assure anonymity, the participants were asked to not put names on the evaluation form and to put the forms in a box which would be emptied after all participants had filled out the form.

CHAPTER III

RESULTS

Means and standard deviations for all dependent variables used in this study are presented in Table 1. The mean performance time for the entire sample of 13 subjects on the pretest for Trails A task was 45.07 seconds (SD = 12.26), and on the pretest for Trails B task the mean time was 154.31 seconds (SD = 111.03). Both times are deemed to be in the "borderline" range between "normal" and "mildly impaired" cognitive functioning, based on norms given by Russell (1987). Furthermore, the mean performance on the pretest of the Wechsler Working Memory Index Scale for the entire sample of 13 subjects was 86.08 (SD= 23.04). According to the norms table provided by The Psychological Corporation. (1997a), the subjects, on average, performed better than 18% of the population, and the experimental group performed better than 9% of the population; while the control group performed better than 31% of the population. Thus, compared with the general population the participants in this study appeared to be below average on the cognitive abilities that were measured in the study.

The pretest means of the treatment and control groups were compared using a one-way analysis of variance (ANOVA) with group (experimental vs. control) as the between-subjects factor. No significant differences emerged between the experimental and control groups on the pretest variables of age, self-estimated computer experience, Global Assessment of Functioning Scale (GAF), self-perception of memory, Symptom

Distress Scale, Trail Making Test Part A, Arithmetic subtest of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III), Digit Span subtest of the WAIS-III, Letter-Number Sequencing subtest of the WAIS-III, or the Working Memory Index score of the WAIS-III. However, a significant difference was found between the two groups on the dependent variable of education: $F(1, 11) = 7.95$, $p < .05$, with the control group having completed a higher grade level than the experimental group. A significant difference also was found between the two groups on the dependent variable of the Trail Making Test Part B: $F(1, 11) = 4.87$, $p = .05$, with the control group performing more favorably on the measure. Thus, in order to control for differences in the educational background, as well as the difference in the initial performance on the Trail Making Test Part B, education and the pre-test score for Trail Making Test Part B were used as covariates in subsequent analyses.

Table 1

Mean Demographic and Memory Measures as a Function of Time and Group

	Pretest				Posttest			
	Experimental		Control		Experimental		Control	
Measure	M	SD	M	SD	M	SD	M	SD
Age	42.86	10.09	43.67	8.43				
Education	12.00	2.08	15.16	1.94				
Computer Exp	2.57	1.13	3.00	1.41				
GAF	48.57	8.52	51.67	7.52				
Perception	18.14	6.47	20.33	4.37	17.00	6.40	18.50	4.18
Sx Disturbance	34.00	12.53	30.17	10.06	30.00	12.38	29.33	10.42
Trails A	50.57	8.60	38.67	13.44	46.14	11.26	49.83	31.47
Trails B	209.00	125.46	90.50	40.27	108.86	52.46	111.50	74.59
Arithmetic	6.00	3.05	9.00	2.37	6.57	3.35	9.00	1.55
Digit Span	7.86	1.87	9.83	2.14	10.28	1.70	8.50	1.38
L-N Sequence	6.71	2.81	7.83	2.48	9.14	3.38	8.00	3.03
Working Memory	80.57	12.73	93.17	11.11	91.86	14.50	90.67	10.53

Note. Education = highest grade completed; Computer Exp = self-rating on amount of computer experience using a scale of 1 (none) to 5 (quite a bit); GAF = Global Assessment of Functioning Scale; Perception = self-perception of memory abilities; Sx Disturbance = Symptom Distress Scale. Experimental group N = 7, control group N = 6.

A 2 X 2 (group x time) repeated-measures analysis of covariance (RM-ANCOVA) was computed, with group (experimental vs. control) as the between-subjects factor and time (pretest vs. posttest) as the within-subjects factor for each of the eight memory related dependent variables (self-perception of memory, Symptom Distress Scale, Trail Making Test Part A, Trail Making Test Part B, Arithmetic subtest, Digit Span subtest, Letter-Number Sequencing subtest, and Working Memory Index). Education and Trail Making Test Part B (pretest) were used as the covariates. Tables 2 to 9 show the results of these analyses.

The RM-ANCOVA analyses revealed a significant interaction effect between the group condition and the pretest--posttest factors for the dependent variable Digit Span subtest F (1, 9) = 5.43, $p < .05$ (see Table 7). However, planned comparisons indicated that neither the observed experimental group mean increase from 7.86 to 10.28 nor the control group mean decrease from 9.83 to 8.50 was statistically significant, F (1, 9) = .31 and F (1, 9) = .03, respectively. Furthermore, contrary to prediction there were no other significant interaction effects on any of the other dependent variables.

There was a significant main effect of group for the dependent variable Arithmetic Subtest F (1, 9) = 8.41, $p < .05$ (see Table 4). The overall mean score on the Arithmetic Subtest was significantly higher for the control group (M = 9.00, SD = 1.91) than the experimental group (M = 6.29, SD = 2.72) across pretest—posttest times.

Furthermore, there was a significant main effect of time on the Trail Making Test Part A F (1, 9) = $p < .05$ (see Table 4). Overall, subjects performed better at the pretest (M = 45.07, SD = 5.19) than at the posttest (M = 47.85, SD = 21.80) on the Trail

Making Test Part A. Although, a review of the group means indicates that individuals in the control group appear to be contributing most to this group effect.

A review of the written program evaluation form (See Appendix H) indicated that out of the 7 participants in the experimental group, 5 members answered question 1 and indicated that he or she liked using computers. Furthermore, only one person responded to question 2. Out of the 5 participants who responded to question 3 of what should be changed about the group, the comments centered around having more computers with better technology. All of the participants answered question 4, "Overall, how would you rate the group?" This revealed that the mean rating for the group on a scale from 1 (Excellent) to 5 (Terrible) was 1.86, indicating an overall favorable rating. Additionally, only one person answered question 5, and no people answered question 6, 7, or 8. All of these questions were open-ended questions dealing with how to improve the computer group in the future.

Table 2

ANCOVA Summary Table for the Self-Perception of Memory

Source	SS	df	F
Group	32.74	1	.51
Within-group error	572.93	9	(63.66)
Time	.35	1	.08
Time X Group	.46	1	.10
Time X within-group error	40.52	9	(4.50)

Table 3

ANCOVA Summary Table for the Symptom Distress Scale

Source	SS	df	F
Group (adj.)	3.17	1	.01
Within-group error (adj.)	2450.96	9	(272.33)
Time	59.85	1	3.60
Time X Group	.14	1	.01
Time X within-group error	149.69	9	(16.63)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$.

Table 4

ANCOVA Summary Table for the Trail Making Test Part A

Source	SS	df	F
Group	19.60	1	.04
Within-group error	4409.20	9	(489.91)
Time	502.29	1	5.99*
Time X Group	72.90	1	.87
Time X within-group error	754.46	9	(83.83)

Table 5

ANCOVA Summary Table for the Trail Making Test Part B

Source	SS	df	F
Group	2873.12	1	2.83
Within-group error	9143.57	9	(1015.95)
Time	138.75	1	.14
Time X Group	2873.12	1	2.82
Time X within-group error	9143.57	9	(1015.95)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$.

Table 6

ANCOVA Summary Table for the Arithmetic Subtest

Source	SS	df	F
Group	47.84	1	8.41*
Within-group error	51.22	9	(5.70)
Time	.01	1	.03
Time X Group	.00	1	.00
Time X within-group error	18.28	9	(2.03)

Table 7

ANCOVA Summary Table for the Digit Span Subtest

Source	SS	df	F
Group	5.35	1	1.13
Within-group error	42.61	9	(4.74)
Time	.17	1	.13
Time X Group	7.14	1	5.43*
Time X within-group error	11.84	9	(1.32)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$.

Table 8

ANCOVA Summary Table for the Letter-Number Sequencing Subtest

Source	SS	df	F
Group	17.20	1	2.36
Within-group error	65.60	9	(7.29)
Time	.47	1	.16
Time X Group	6.04	1	2.09
Time X within-group error	25.98	9	(2.89)

Table 9

ANCOVA Summary Table for the Working Memory Index

Source	SS	df	F
Group	1.50	1	.01
Within-group error	1277.39	9	(141.93)
Time	9.46	1	.18
Time X Group	106.63	1	2.07
Time X within-group error	462.07	9	(51.34)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$.

CHAPTER IV

DISCUSSION

The results of the present study failed to support the hypothesis that individuals who were severely mentally disabled and received computer-assisted cognitive training, as employed in this study, would show improved memory abilities compared to individuals who were severely mentally disabled but did not receive computer-assisted training. Only one of the dependent variables, Digit Span, resulted in a significant interaction. However, follow-up analyses did not indicate that the individuals in the experimental group significantly improved their performance from pretest to the posttest compared with individuals in the control group.

The lack of support of the hypothesis in the current study could be due to a number of reasons. First, because of a lack of time and space in the computer lab at the mental health agency, a small number of clients participated in the current study. The small number of subjects greatly limited the statistical power to detect results in the study which could explain a lack of support for the hypothesis. Thus, more participants should be employed as subjects either by having more computers for the clients to use or by running several consecutive groups.

Second, there is a possibility that the hypothesis was not supported because the computer hardware was insufficient for the use of the cognitive training computer software. Specifically, in the current study, the group leaders directly observed that individuals had some difficulty on a few of the training tasks because of the computer hardware. For example, in two of the auditory tasks (See Appendix E, tasks H and I) many participants struggled to differentiate the numbers which were read off by the computer through the speakers and therefore had difficulty remembering what numbers were read off and in what order. Although the participants stated that they were able to complete the task, many participants stated that the difficulty in hearing the numbers clearly affected their performance on the auditory task. Furthermore, better graphics capability would only enhance the computer experience for the participants. Thus, higher technology computers with bigger monitors and higher quality sound and graphics are very important due to the multi-media nature of the software.

Third, it is possible that the setting in which the study was conducted affected the results. In the current study, the computer room was very small, and many participants stated that this environment added to their anxiety. Although some anxiety or arousal is necessary for peak performance on a task, most of the subjects already had a high amount of anxiety or arousal associated with his or her mental disorder. Consequently, too much arousal decreases the participants ability on a task. Therefore, it is important that the room in which the participants are using the computers is large enough to accommodate sufficient personal space.

Fourth, perhaps the hypothesis of this study was not supported because individuals who are severely mentally disabled may not be capable of improving their memory due to the nature of their disorders, whereas, people with severe brain injury may have the capacity to improve their memory. To illustrate, a person with a severe brain injury may have an isolated area of cognitive dysfunction due to a specific injury which can then be targeted in a cognitive rehabilitation program, making the injury easier to overcome. By contrast, a person with a mental disorder is facing a disease process which may have more far reaching effects on cognitive functioning making, cognitive rehabilitation a more difficult goal. Similarly, computer-assisted cognitive training may not be more effective for improving memory compared with other forms of cognitive training. To illustrate, some of the past studies in the area of computer assisted cognitive rehabilitation that used control groups which underwent some form of alternate, non-computerized therapy showed a statistically equally amount of improvement in cognitive functioning as the computerized group (Batchelor et al., 1988; Chen et al., 1997).

Furthermore, similar to the studies using computer assisted cognitive rehabilitation in which the computer assisted group performed better than the control group (Burda et al., 1994; Ruff et al., 1989; Fals-Stewart & Lucente, 1994), the current study employed the use of the pretest—posttest design, as well as random assignment to the experimental and control groups. However, the current study had a smaller sample size of 13 compared with the aforementioned studies which had 69, 66, and 72 subjects respectively. Also, the current study showed a significant interaction for the Digit Span subtest, and even though the simple effects analyses were not significant, there is a suggestion of improvement for the experimental group. This finding is similar to the aforementioned studies in which the experimental group significantly performed better on the posttest measures than the control group. In all of the aforementioned studies, it was found that memory was the area that was most improved, in particular, short-term memory. From the measures that were utilized in the current study, Digit Span probably requires the greatest use of short-term memory. Whereas, many of the other measures such as the Arithmetic subtest and the Letter-Number Sequencing subtest used in the current study require the use of problem-solving and transformation of data as well as short-term memory. Thus, the significant interaction for the Digit Span subtest found in the current study suggests that there was an improvement in short-term memory for the experimental group similar to the aforementioned studies. In sum, the current study is similar in many ways to past studies which found that cognitive abilities were improved after computer assisted cognitive rehabilitation. However, the current study had a much smaller sample size and therefore a lack of statistical power compared with these studies.

Despite the lack of support for the hypothesis in the current study, several benefits of the computer-assisted cognitive training program were discovered. Almost all of the participants offered the training were able to complete all of the required sessions. Furthermore, observations from the group leaders revealed that the participants genuinely liked working on the computers, felt a sense of accomplishment that they were able to use a computer, and were highly motivated to improve their performance on the computer training tasks. While participants occasionally felt stress and frustration, they were able to employ relaxation techniques to relax, and were able to give support and help to their partners. Also, the group leaders observed that the group as a whole bonded together by individuals giving group suggestions on how to relax when feeling frustrated and some techniques for the training programs. The questionnaire given after the end of the computer-assisted group training revealed that almost all participants liked the group. All but one participant stated that he or she felt that his or her memory had improved. These positive findings are similar to the findings of the study by Burda et al., 1994 in which patients with schizophrenia who underwent a computer-assisted cognitive rehabilitation program had a drop in cognitive complaints compared with the control group.

While the current study did not show any significant results for the improvement of memory for people who are severely mentally disabled using a computer-assisted cognitive rehabilitation program, future research may be able to improve upon the methodology of the study in several ways. The main areas in which the study's methodology could be improved include: increasing the size of the sample, using the most up to date computer hardware, and conducting the study in an atmosphere which minimizes stress and anxiety by having a large enough computer work area. Furthermore, future research might exclude the Arithmetic subtest because it did not seem to be a precise a measure of memory skills. In the current study, the control group and the experimental group had equivalent arithmetic subtest means from the pretest to the posttest.

In conclusion, cognitive impairments are common among individuals who are severely mentally disabled and create many difficulties for these individuals. With the rapid increases in the technology of computers and the utilitarian value that computers exert, it seems valuable to use computers in treating impairments such as cognitive deficits. While the present study did not indicate that therapy using a computer-assisted cognitive rehabilitation method was more effective than a non-computerized therapy format for improving memory, future research may be able to improve upon the methodology of the present study as well as past studies in this area in order to find an effective computer assisted cognitive rehabilitation approach.

APPENDIX A

Informed Consent to Participate as a Research Subject

Description and Duration of Experiment:

You will be in a cognitive skills training group to improve your memory using a computer software program. You will be asked to provide information about yourself such as age, years of education, and symptoms which you might experience. You will also be asked to complete a few tests which measure your cognitive abilities before starting the cognitive skills group and then to complete the same information after the end of the group. The information will be used to help decide whether or not it would be useful to have the Cognitive Skills group in the future for other clients and to determine what kind of clients would benefit the most from the Cognitive Skills group. Any beneficial information that is gained in this study concerning future treatment for Eastway clients will be shared with the client.

No adverse effects on participants have been reported in previous research studies of this type. However, participants may experience minor visual fatigue from concentrating on the computer screen.

The group will meet for 8 weeks. Each person will have one hour of direct computer time and one hour of helping another group member with the computer program. It will take approximately 30 minutes per person to complete the research information before beginning the Cognitive Skills group and about 30 minutes after the end of the Cognitive Skills group to complete the same information. You may voluntarily terminate your participation in this experiment at any time without it having any affect on your treatment at Eastway. You will not be denied access to the Cognitive Skills group if you do not wish to participate in this study.

Confidentiality of Data:

This study will be conducted by Myra Cummings-Hill who is a graduate student at the University of Dayton; and will be supervised by John Korte, Ph.D. All records of your participation in this study will not be disclosed to others. Your name will not be associated with any of the data attained in this study nor will your name be revealed in any document resulting from this study.

Contact Person for Questions or Problems after Experiment:

If you have any questions or problems with respect to this study you may contact Laura Taylor, M.S.W., phone 222-6504, or any concerns about your rights with respect to this study you may contact Sean Hill, M.S., phone 832-4112.

Consent to Participate:

I have voluntarily decided to participate in this study. The investigator named above verbally explained the study and has adequately answered any and all questions I have about this study, the procedures involved, and my participation. I understand that the investigator named above will be available to answer any questions about procedures throughout this study. I also understand that I may voluntarily terminate my participation in this study at any time without it affecting my treatment at Eastway. I also understand that the investigator named above may terminate my participation in this study if she/he feels this to be in my best interest. In addition, I certify that I am 18 (eighteen) years of age or older.

Signature of Subject____

Signature of Witness____

APPENDIX B

Demographic Information

Demographic Information

Code:____

Sex: (Check one) ____ Male ____ Female

Age: _____

What is your cultural/racial background? (Please circle all that apply)

White/Caucasian
American Indian/Pacific Islander
Black/African American
Hispanic
Asian
Other___________________

Marital status: (Check one)
____Single
____Married
____Divorced
____Separated
____Widowed

Last grade completed? __________

Do you have any difficulty reading? ___yes ___no

Do you have any difficulty writing? ___yes ___no

Are you currently working: (Check one)
____Part-time
____Full-time
____As a Volunteer
____Not at this time

What past occupations have you held?

____

____

What is your prior computer experience?

None Quite a bit

1 2 3 4 5

APPENDIX C

Self-Report

Please check any of the following which you experience almost every day:

____**Confidence in your self**
___**Auditory hallucinations (hear "voices")**
___**Visual hallucinations (see "visions")**
___**Feelings of fear**
___**Nervousness**
___**Lack of energy**
___**Feelings of worthlessness**
___**Capable of accomplishing things**
___**Alert**
___**Don't remember what I did for periods of time during the day**
___**Enthusiasm**
___**Guilty feelings**

Please rate your ability to remember things:(circle the number that most applies)

1. On most days I am able to remember all of my scheduled appointments. (for example doctor appointments).

Always		**Sometimes**		**Never**
1	**2**	**3**	**4**	**5**

2. I often forget personal information, such as my telephone number or address.

Always		**Sometimes**		**Never**
1	**2**	**3**	**4**	**5**

3. I often have difficulty remembering events in my life that took place when I was younger.

Always		**Sometimes**		**Never**
1	**2**	**3**	**4**	**5**

4. On most days I do not have trouble recognizing people's faces.

Always		**Sometimes**		**Never**
1	**2**	**3**	**4**	**5**

5. Please rate your memory in general.

Very Poor		**Average**		**Excellent**
1	**2**	**3**	**4**	**5**

APPENDIX D

Symptom Distress Scale

During The Past 7 Days About How Much Were You Distressed Or Bothered By:	Not at All	A Little Bit	Moderately	Quite a Bit	Extremely
a. Nervousness or shakiness inside	1	2	3	4	5
b. Being suddenly scared for no reason	1	2	3	4	5
c. Feeling fearful	1	2	3	4	5
d. Feeling tense or keyed up	1	2	3	4	5
e. Spells of terror or panic	1	2	3	4	5
f. Feeling so restless you couldn't sit still	1	2	3	4	5
g. Heavy feelings in arms or legs	1	2	3	4	5
h. Feeling afraid to go out of your home alone	1	2	3	4	5
i. Feeling of worthlessness	1	2	3	4	5
j. Feeling lonely even when you are with people	1	2	3	4	5
k. Feeling weak in parts of your body	1	2	3	4	5
l. Feeling blue	1	2	3	4	5
m. Feeling lonely	1	2	3	4	5
n. Feeling no interest in things	1	2	3	4	5
o. Feeling afraid in open spaces or on the streets	1	2	3	4	5

APPENDIX E

Descriptions of the Memory I Tasks

A. Spatial Memory: This task requires the participant to go through a series of doors in different rooms which look exactly the same. If the participant goes through the wrong door, they must begin in the first room again and remember which door to go through which will allow entry into the next room. This continues until the participant gains entry into the last room. The parameters available in this task are 3, 5, 8, 10, 15, or 20 rooms to exit.

B. Visual/Spatial Memory (Shapes and Places): In this task the screen is divided into 30 small blue windows, and 2 rows across the bottom contain 10 shapes. The program randomly selects shapes from this group and places them in the windows at the top. The participant must memorize the shapes and their locations so that when the top group clears the shapes can be selected and placed back into the same windows which the computer chose. The parameters available in this task are 3, 4, 5, 6, or 7 shapes at the start of the task.

C. Sequenced Recall (Words--Visual): The participant is presented with a list of four letter words (animals) to memorize in the order presented. The task allows for 2 seconds per word for study time. After the study time, a list of 16 words is presented. Using the mouse, the participant clicks on the words memorized in the same order in which they were shown. The parameters are 3, 4, 5, 6, 7, 8, 9, 10, or 11 words at the start.

D. Sequenced Recall (Digits--Visual): The participant is presented with a series of numbers one at a time which must be memorized in the order that they are presented. After the last number clears, the participant must click on the numbered command buttons in order to duplicate the sequence that the numbers were memorized. The number of digits to start with may be modified to either 3, 4, 5, 6, 7, 8, 9, or 10 digits.

E. Sequenced Recall (Graphics--Visual): A series of graphic figures are presented one at a time. The task requires that the participant memorize the graphics in the order that they are presented. After the last graphic clears, the participant must click on the graphics pictures buttons in order to duplicate the memorized sequence. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 graphics to start.

F. Sequenced Recall Reversed (Digits--Visual): A series of numbers are presented one at a time. The task requires memorizing the numbers in the order that they are presented. After the last number clears the participant must click on the numbered command buttons in reverse order so that the sequence is duplicated in reverse of that memorized. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 digits to start.

G. Sequenced Recall Reversed (Graphics--Visual): A series of graphic figures are presented one at a time. The task requires that the participant memorize the graphics in the order that they are presented. After the last graphic clears, the participant must click on the graphics pictures buttons in reverse order to duplicate the memorized sequence in reverse. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 graphics to start.

H. Sequenced Recall (Digits--Auditory): The participant is presented with a series of numbers one at a time orally. The numbers must be memorized in the order that they are presented. After the last number is spoken, the participant must click on the numbered command buttons so that the memorized sequence is duplicated. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 digits to start.

I. Sequenced Recall Reversed (Digits--Auditory): The participant is presented with a series of numbers one at a time orally. The numbers must be memorized in the order that they are presented. After the last number is spoken, the participant must click on the numbered command buttons in reverse order so that the memorized sequence is duplicated in reverse. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 digits to start.

J. Nonsequenced Recall (Digits--Visual): The participant is presented with a group of numbers all at one time. The task requires the memorization of all the numbers in any order. After the numbers clear, the individual must click on the numbered command buttons so that the entire group that was memorized is entered. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 numbers at start.

K. Nonsequenced Recall (Graphics--Visual): The participant is presented with a group of graphics all at one time. The task requires the memorization of all of the graphics in any order. After the graphics clear, the individual must click on the numbered command buttons so that the entire group that was memorized is entered. The available parameters are 3, 4, 5, 6, 7, 8, 9, or 10 graphics at start.

APPENDIX F

Attendance Log

TASKS WORKED ON	TIME SPENT ON EACH TASK	*ATTENTION SCORE	*HELPING SCORE

*Attention Score(1-5), 1=Paid very little attention, had to be redirected often; to 5=Very attentive, did not need to be redirected;
*Helping Score(1-5), 1=Did not give any suggestions to partner or was inappropriate with suggestion; to 5=Constantly gave appropriate suggestions;

APPENDIX G

Debriefing Statement

The purpose of this study was to determine if a computer-assisted therapy program improves memory compared with a therapy group that did not use the computer-assisted program. Memory may be impaired for several different reasons, including medications, inability to sleep, symptoms of depression or anxiety. By repeatedly working on tasks that require using memory, parts of the brain are repeatedly activated or exercised to build up one's memory. This might be thought of as exercising one's muscles to build up muscle mass.

The hypothesis was that the group which received the computer-assisted therapy would show improvements on tests of memory compared with the therapy group that did not use the computer program to improve memory. The dependent measures include a score of perceived memory abilities from the Self-Report questionnaire, the total score from the Symptom Distress Scale, time in seconds on each of the parts of the Trail Making Test (Parts A and B), the scaled scores for the Arithmetic subtest, the Digit Span Subtest, and the Letter-Number Sequencing subtest, and the Working Memory Index score. All results of this study will be shared with the clients.

APPENDIX H

Evaluation Form

1. What did you like about the group?

2. What did you not like about the group?

3. How would you change the group?

4. Overall, how would you rate the group?

Excellent				Terrible
1	2	3	4	5

5. Any other comments you have about the group in general:

6. What did you like about the leaders of the group?

7. What did you dislike about the leaders of the group?

8. What suggestions for the leaders do you have in terms of how to be more helpful?

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