The Neuropsychological Effects of Combined Physical and Mental Exercise in Schizophrenia

By

Maggie Manning

****

Senior Thesis

A thesis presented in partial fulfillment
of the requirements for the degree of
Bachelor of Science
Department of Psychology
Neuroscience Program

UNION COLLEGE

Schenectady, New York

June 2011

TABLE OF CONTENTS

MANNING, MAGGIE

The Neuropsychological Effects of Combined Physical and Mental Exercise in Schizophrenia

Department of Neuroscience, June 2011.

ADVISOR: Cay Anderson-Hanley

People suffering from severe mental disorders encounter many debilitating side effects. Those diagnosed with schizophrenia face a large number of challenges each day. Not only must they endure symptoms, like hallucinations and delusions, commonly associated with the illness, but their higher-level cognitive functioning is further impaired in numerous ways (Perham & Accordino, 2007). People with schizophrenia, suffering from thought disorder, battle with a pattern of disorganized thinking in which seemingly simple tasks, i.e attention and memory, are difficult. Negative symptoms include the inability to establish social relationships, and hinder their everyday experiences, including work (Wexler, 2005). Their extremely sedentary lifestyle also negatively impacts engagement in other activities (Richardson et al, 2005).

Many medications are currently available for patients seeking medical relief from schizophrenia. Yet, these are known to present various negative side effects of their own, including weight-gain and supposed “disassociation from self” (Fogarty & Happell, 2005). In response, opponents of drug therapy hope alternative measures can provide such relief, focusing mainly on physical and cognitive exercise programs independently.

Studies conducted on the benefits of physical exercise have proven conclusive. They have illustrated effects like increased motor control, improved willingness to participate, weight loss, improved mood state and enhanced self-image (Plante et al, 2006; Fogarty & Happell, B, 2005; Richardson et al, 2005; Acil et al, 2008). Research conducted by Pajonk and colleagues (2010) identified higher increases in hippocampal volume for patients with schizophrenia completing exercise. Improvements in memory were also greater for this group over the control. As a region of the brain responsible for tasks like memory, attention and navigation, plasticity of the hippocampus provides hope for improvements in such neurological functions. Additionally, review of twenty-five randomized clinical trials conducted by Mead et. al concluded that exercise can improve symptoms like depression as well (Mead et al, 2009).

Although cognitive exercise studies have been directed towards various aims, they have also been conclusive. Studies have identified significant, or nearly significant, improvements on neurological tasks such as spatial cognition and selective attention, memory tasks and wayfinding (Spence & Feng, 2010; Dickinson et al, 2010). They have also enabled patients to learn social or problem solving skills (Freitas & Levene, 2004) and elicited better treatment adherence – applying to further exercise participation, medication schedules and other settings (Ceranoglu, 2010). Some have even shown evidence that cognitive exercise can help delay episodic memory deficiencies and the onset of depression (Gates & Valenzuela, 2010)

The goal of our study was to investigate the cognitive and mood effects combined physical and cognitive exercise would have on a sample of patients with schizophrenia at Capital District Psychiatric Center. Through cybercycling, these participants experienced simultaneous physical exercise, by means of cycling, and computer-based cognitive remediation, by means of cognitively challenging Playstation 2 video game. We hypothesized that cybercycling would A) improve the higher-level cognitive functions in these adults, B) improve mood states and C) lessen psychiatric symptoms and D) would help allow us to identify barriers and motivators to participant engagement.

Before the start of, and after 5 weeks of cybercycling, participants completed a brief neuropsychological evaluation of executive functions, including the Digit Span Backwards, Stroop and Color Trails Tests. Mood state was evaluated with the Exercise- Induced Feeling Inventory and symptoms of psychosis and adjustment were measured with the Brief Psychiatric Rating Scale. After completing paired t-tests on scores from the three participants who completed the final round of testing, significant effects on the tranquility mood state and psychiatric symptoms were concluded. A nearly significant trend was also identified for improvements in executive function. Patients self-reported barriers to participation like poor motivation from staff and difficulty with the pedometer system used, whereas factors such as socialization and the gaming component were seen as motivators. Nevertheless, our small sample size, wider range of diagnoses in participants and other limitations, prevent generalization of results. The pilot study's preliminary findings demonstrate the feasibility of completing a combined exercise program in an institutionalized setting and suggest positive outcomes are possible. Future studies should use the information gathers in the secondary analysis to better develop a further investigation of combined physical and cognitive exercise in schizophrenia.

INTRODUCTION

People suffering from severe mental disorders encounter a wide range of devastating side effects. Schizophrenia is a chronic and severe mental illness diagnosed in about one percent of the current U.S. population (NIMH, 2009). Due to the extremely debilitating nature of the illness, those suffering from Schizophrenia find themselves facing an array of daily obstacles and hardships. Both physical and psychological burdens make it harder to carry out everyday tasks or remain functioning normally. Not only must they endure symptoms, such as hallucinations and delusions, commonly associated with the illness, but their higher-level cognitive functioning is further impaired in a number of ways (Perham &Accordino, 2007; McGurk, Twamley, Sitzer, McHugo & Mueser, 2007; Braus, Wolfgang, Heike, Matthias & Henn, 2002). In a society where social relationships are incorporated into much of our daily lives, their inability to establish or maintain such relationships or express emotions appropriately hinders their immersion into everyday experiences, including work environments. These taxing consequences have been the focus of much research aimed at minimizing the illness' unfavorable effects. In light of the numerous negative side effects associated with neuroleptic use, a common means of combating schizophrenia, much attention has now been directed towards exercise interventions. Here, both physical and cognitive exercise programs have been implemented in hopes of identifying their possible outcomes. Physical exercise has been shown to elicit remarkable effects related to psychiatric symptoms, treatment adherence and cognitive functioning (Pajonk et al, 2010). Additionally, cognitive exercise programs have proven similarly effective.

Schizophrenia: A Psychiatric and Cognitive Profile

People with Schizophrenia endure numerous psychological, emotional and physical changes related to their illness. These fluctuations, or changes, as highlighted in the work of Jahshan and colleagues (2010), who shed light on the importance of examining Schizophrenia over time, as periods of deterioration may be betwixt and between spans of improvement. Perhaps the most widely recognized symptoms of the illness are those that fall within the category of "psychological". Thought disorder, or disorganized thought, is just one symptom characteristic of the diagnosis (NIMH, 2009). Schizophrenia disturbs the sufferer's train of thought, producing a disorganized flow of ideas. Often preventing sufferers from being able to focus on ideas or concepts for periods at a time or remain in cohesive conversations with others, this inability corresponds to the sufferers' disturbances in attention (Perham et al., 2007). In addition, working memory and executive functioning (or higher-level cognitive processes in charge of maintaining and regulating other behaviors and abilities) are impaired, limiting the person's ability to understand information and use it soon after acquisition, respectively (Perham et. al, 2007; McGurk et. al, 2007; Braus et. al, 2002).

Troubles with basic cognitive functions, that allow one to make sense of and communicate with the world around them, become ever more unbearable when an individual must also overcome abnormal psychological symptoms. As stated earlier, people suffering from Schizophrenia experience hallucinations, or false sensory experiences that do not actually exist except in their mind. Often in relation to the senses of sight and touch, these experiences differ from the occurrence of delusions, or false beliefs that are not rooted in truth or reason (NIMH, 2009). Along with these psychological disturbances come troubles with regulation and expression of mood. The ability to convey one's emotions appropriately is important in a culture that focuses on social interactions and experiences. Yet in Schizophrenia, flat affect is a common

symptom, rendering sufferers unable to display emotions. It hinders their ability to relate well to others and thus can impact the strength of not only social relationships, but professional ones as well. As cited by Richardson and colleagues (2005), Schizophrenia is frequently coupled with the secondary symptom of social withdrawal. Sufferers do not see the need or feel the urge to be involved with others, and consequently become further isolated from reality.

In addition, Schizophrenia is occasionally accompanied by deficits in motor control and coordination. These symptoms are most commonly associated with the catatonic subtype of the illness. Individuals with a diagnosis of catatonia may exhibit repetitive movements, a period of "waxy flexibility" in which their bodies can be bent into place as positioned by others, or a state of stupor in which the sufferer remains motionless and un-reactive to the surrounding environment or stimuli of others (NIMH, 2009). It is easy to imagine how these motor impairments could negatively affect the daily processes of patients afflicted by them and how they might contribute to a lowered quality of life.

Schizophrenia: Health and Weight Issues

One of the main issues with which people suffering from schizophrenia must struggle pertains to weight. Given the extremely sedentary lifestyle of most sufferers, as well as the limitated availability of healthy foods and activities to those institutionalized patients, weight gain is significant in populations with schizophrenia.

Another topic commonly linked to weight gain and increased risk for further medical complications in Schizophrenia is Metabolic Syndrome. Characterized by "obesity (central and abdominal), dyslipidaemias, glucose intolerance, insulin resistance (or hyperinsulinaemia) and hypertension", Metabolic Syndrome is a disorder that increases one's risk for cardiovascular

disease, stroke, and type 2 diabetes (Thakore, 2005). Occurrence in populations with Schizophrenia is approximately 2-4 times higher than in healthy populations. Stores of excessive intra-abdominal fat associated with the illness and anti-psychotic use, in combination with an overwhelmingly sedentary lifestyle, significantly increase the sufferer's chance of acquiring additional medical ailments. In relation, rates of diabetes and hypertension in populations with Schizophrenia are startling.

The main source of treatment available to people suffering from Schizophrenia is psychotropic medication. Medications such as Haloperidol, Thorazine, and Olanzapine are prescribed as a chemical means of stabilizing psychotic symptoms. Many affect neurotransmitter release and binding in an attempt to relieve symptoms and improve neurological functioning. Yet, anti-psychotics are known to present various negative side effects of their own, including weight-gain and "disassociation from self". The side effects of most psychotropic medications are rather alarming. One of the most visibly obvious adverse effects is significant weight gain. As mentioned by Fogarty and Happell (2005), the weight gain from prescriptions alone lowers their confidence and motivation to partake in other medical regimes or programs. This lack of motivation tends to sustain the weight gain, as they are not taking any action to counteract the medication's effects. In addition, a number of the symptoms of Schizophrenia may not be easily relieved by medical means. For instance, the social limitations of the illness (i.e. quality of life, ability to maintain relationships and work efficacy) may not all be easily addressed and alleviated with a "quick fix" pill (Acil, Dogan & Dogan, 2008). The ever-increasing prices of these psychotropic medications have given opponents of their use just one more reason to protest their primary use.

These drugs also intensify appetite and produce fatigue, lessening the likelihood of weight loss or prevention of further weight gain (Poulin et al, 2007). Therefore, the prescriptions have a secondary and indirect impact on weight-gain further limiting the ambition of sufferers to make self-improvements. As addressed by Silverstein (2010), people suffering from Schizophrenia have been shown to have significantly lower levels of intrinsic motivation than normal controls. Applying not only to daily living styles, these findings shed light on studies conducted in experimental settings where motivation and encouragement are key factors (Velligan, Kern & Gold, 2006). Researchers report that, regardless of treatment or intervention type, positive reinforcements or encouragers may be necessary to address these intrinsic motivation deficits and foster physical and psychological benefits (Miller and Mason, 2004).

Oftentimes patients suffering from Schizophrenia live in monitored facilities or group homes. In these institutions, access to nutritious and healthy foods, financial resources and independent travel may be restricted. These obstacles do not have a positive influence on sufferers' motivation levels nor their overall health, and impede them from making positive changes towards weight loss. Leas and Mccabe (2007), determined that obesity, cigarette smoking and an overall sedentary lifestyle are all more prevalent in populations of mental illness in comparison to normal controls. These characteristics of living increase the risk of acquiring other medical complications, such as Cardiovascular Disease (Richardson et al, 2005).

Treatment: Physical Exercise

Due to the evidence of weight gain associated with neuroleptic use, and the consequential risk factors of such weight gain, opponents of anti-psychotics have argued for a better means of relief for people suffering from Schizophrenia. Exercise has been explored as an alternative

intervention that may not replace conventional treatments, but perhaps could supplement or complement them, thereby minimizing reliance on medications and perhaps providing an improved path to better physical and mental health. Since additional intra-abdominal weight gain from medications may further one's chances of acquiring conditions like diabetes and hypertension, these advocates endorse alternative measures of treatment such as physical exercise.

The physical exercise regimens advocated have taken numerous forms, most notably structured exercise programs and lifestyle interventions. The design of structured exercise programs is regimented and focuses on scheduled sessions, varied but consistent routines, progress tracking and personal goals. Although they are oftentimes challenging, structured exercise programs have been employed with relation to Schizophrenia because of their requirement for safe and appropriate levels of physical exertion (Richardson et. al, 2005; Gorczynski & Faulkner, 2010). Furthermore, they are commonly incorporated into research pursuits as they call for strict supervision and result in accurate and easily comparable findings.

Acil, Dogan and Dogan conducted a structured exercise program in 2008 with patients suffering from Schizophrenia in the attempt to better understand the possible effects of such exercise. Requiring participants to attend a forty-minute long exercise session three days a week for ten weeks, these researchers found significant results. Compared to controls, patients who had engaged in exercise had lower scores on assessments of both positive and negative symptoms, as well as the Brief Symptom Inventory Scale. In addition, these exercisers had increased scores on the World Health Organization Quality of Life Scale. Therefore, not only were these investigators able to illustrate the effects of physical exercise on physical health, but on overall well-being and psychiatric symptoms as well. A strong correlation between positive

results from the WHO's QOL scale and low scores on negative symptoms indicates the detrimental role of negative symptoms (i.e. flat affect, etc.) on a sufferer's quality of life and stresses the need to relieve these symptoms(Norman et. al, 2000). These results fit hand in hand with those from Acil and colleagues (2008), signifying the ripple effect of positive outcomes related to physical exercise.

In 2004, Fogarty, Happell and Pinikahana carried out a similar three-month structured exercise program focused on Schizophrenia. Designed by exercise physiologists, in which six male patients with Schizophrenia participated. Upon completion, they discovered an array of positive outcomes including improved heart rate, body weight, and positive attitude. The investigators also stated that the perceived benefits by the participants seemed to add to their motivation and willingness to continue with treatment involving physical activity (Fogarty et al, 2004). In other words, since the individuals felt as though they could identify improvements in themselves produced by the exercise, they seemed to be far more willing to cooperate with the program further.

Another similar study aimed at determining the effect of physical exercise on Clinical Depression introduced participants to an 8 week long structured aerobic exercise program. Upon completion, interviews revealed that subjects identified antidepressant effects, increased energy, and improved adherence to other components of rehabilitation, that they felt were directly related to their participation in the program. The second piece of the study included a time-series analysis carried out to gather more quantitative data. Here the investigators used the Beck Depression Inventory to link reduced depression and increased fitness with aerobic exercise (Pelham, Campagna, Ritvo & Birnie, 1993). Although these results were collected from a population without schizophrenia, the findings still suggest similar results may be possible for

this population.

Although structured exercise programs have elicited convincing advances in the health of people suffering from Schizophrenia, they can also prove to be quite costly and demand numbers of staff that many psychiatric facilities or group homes are unable to allocate for this purpose. Thus other studies have been carried out to investigate the effects of lifestyle intervention programs on Schizophrenia. These efforts are aimed at making permanent changes to various aspects of an individual's routine. By emphasizing the importance of physical activity throughout one's day, they focus on changing sedentary behaviors and encourage walking groups and home-based exercise. This design offers much more flexibility in the case of time and does not necessitate travel to a facility (Richardson et al, 2005). These benefits make lifestyle intervention programs very enticing to those designing such regimes for people suffering from Schizophrenia.

As cited by Richardson and colleagues (2005), people suffering from serious mental illness are less active than the general population. In light of this fact, those promoting the use of physical exercise, especially lifestyle interventions, highlight the role weight gain from medications and general obesity play in motivation, commitment to treatment, metabolic syndrome and the development of additional medical problems. They assert that fewer risk factors are associated with therapy centered on physical exercise, and that such programs may in turn improve a wider range of symptoms than drug based therapy. Stressing supportive mental health staff, well organized and highly structured sessions, promoters of physical exercise interventions focus on its effects upon well being, physical health, psychological symptoms and social skills collectively (Hodgson, McCulloch &Fox (2011)).

A wide-range of positive outcomes related to psychological health in Schizophrenia produced by physical exercise programs have been identified in previous literature (Faulkner & Biddle, 1999; Mead et al, 2009). Those studies that made use of the Brief Psychiatric Rating Scale identified improvements on psychometric outcome variables such as anti-depressant effects, anxiety reduction, mood-elevation, improved self-esteem, fewer auditory hallucinations, improved behavior and better sleep patterns. They found numerous instances over which such findings had been reported. Improvements in depression and physical health were also highlighted in the running study conducted by Hannaford and Harrell on 25 outpatients with psychiatric diagnoses (Hannaford, Harrell & Cox, 1988; Meyer, 2000). Results from the 1989 work of Clarkson-Smith and Hartley were equally definitive. After conducting exercise interviews, vocabulary tests, measures of working memory and measures of reaction time for their participants, these investigators were able to correlate better measures of reasoning, working memory and reaction time with performance of exercise. Although the scores from the Digit Span Test conducted had failed to reach statistical significance, the study did overall support the idea that physical exercise can have influential effects of the higher-level functions that are so commonly impaired in Schizophrenia.

Schizophrenia is also associated with issues in early stages of information processing (Braus, Wolfgang, Heike, Matthias & Henn, 2002). A 2008 Ploughman article identifies studies in which exercise was found to improve information processing (by means of increased levels of serotonin and norepinephrine), as well as produce faster reaction times and improvements in overall executive functioning (by means of elevated rates of oxygen consumption). In total, the array of exercise programs that have been completed in connection to research on Schizophrenia have suggested positive outcomes of exercise on physical, cognitive and psychiatric aspects of

functioning. The 1990 literature review by Leith and Taylor suggests significant results were found in more than half the studies of their concentration.

Many efforts have been made to identify the ways in which physical exercise programs can be modified so as to amplify the positive outcomes. The 1986 study from Lukoff, Wallace, Liberman and Burke involved a 10-week in hospital program comparing holistic health with social skills training. Participants in the holistic condition partook in 30 minutes of exercise everyday, as well as education in stress management. These individuals displayed greater advances in positive outcomes during their inpatient phase. Their results support the recommendations developed by the Schizophrenia Patient Research Outcomes Team (PORT). This group designs recommendations to improve the quality and cost-effectiveness of Schizophrenia treatment based on the most recent scientific evidence. Lehmanand colleagues note in their 1998 report that 'Recommendation 23' from the Schizophrenia PORT indicates therapies should be used over time, combining support, education, and behavioral and cognitive skills training targeting deficits in Schizophrenia to improve functioning and other problems. Therefore, dual enrollment in educational programs concerned with health improvement and physical exercise regimes may produce the most beneficial results for patients with Schizophrenia.

Treatment adherence, one factor essential to successful exercise regimens, is also easily influenced by self-perception. The social experience of group exercise has also been linked to participation loyalty in studies (Unger, Skrinar, Hutchinson & Yelmokas, 1992). Participants associated an inclined motivation to go to class with this idea of socialization. Comparable results were collected by Poulin and colleagues in 2007. Alhough these particular investigators were unable to pinpoint specific psychological effects generated by physical activity, they could

distinguish significant improvements in physical health and metabolic risk.

Overall, studies conducted thus far on physical exercise in Schizophrenia have provided a wide range of evidence to suggest physical activity can result in long-lasting physical and psychological improvements (Martinsen & Stephens,1994; Gorczynski & Faulkner, 2010). Many have identified increased fitness levels, as well as reduced blood pressure, improved heart rate, heightened flexibility and enhanced exercise tolerance (Fogarty et. al, 2004). In addition, exercise is seemingly able to help individuals function more efficiently in the environment they wish to live by affecting "self-esteem, stress levels, social interaction, anxiety, depression, motivation, sleep, activities of daily living (ADLs) and self-image" (Perham and Accordino, 2007). These indicate advances not only in physical health but in cognitive realms as well. Results from Fogarty and Happell (2005) also address this eclectic progress. They found that in Schizophrenia, increased physical activity leads to lowered depression, fewer hallucinations, healthier self-image and a better attitude towards physical exercise (Fogarty et. al, 2005). Thus the effects of physical exercise on Schizophrenia seem undisputable and appear to affect various aspects of cognitive, psychological and physical functioning.

The research conducted in 2010 by Pajonk and colleagues focused on the effects of physical exercise on hippocampal plasticity in Schizophrenia – thus seemingly bridging between physical and cognitive investigation. Many patients suffering from Schizophrenia have been found to have a lower hippocampal volume than other "normal" subjects. However, previous findings have suggested physical exercise is capable of increasing hippocampal blood volume and neurogenesis as well as increasing levels of activation of cortical networks. These researchers hypothesized an increase in hippocampal volume with exercise, as well as clinical/cognitive improvements. Over a 3-month study, 24 participants were assessed on

affective symptoms, heart rate, gas exchange, blood lactate concentrations, premorbid intelligence and cognitive performance/verbal memory. Magnetic Resonance Imaging (MRI) was also utilized. Contrary to expectations based on prior research, the starting hippocampal volumes of the subjects with Schizophrenia were not significantly smaller than those of controls. Nonetheless, increases in hippocampal volume for all patients assigned to the exercise group were greater than those of the non-exercise group.

Improvements in memory for subjects with Schizophrenia were also greater in the exercise group than in the non-exercise group, by nearly 34%. No difference in verbal measures of premorbid intelligence were determined and changes in the Positive and Negative Syndrome Scale could not be linked to hippocampal volume. These are reassuring points suggesting exercise was the causative agent. Thus, the results of the investigation illustrate that plasticity of the brain is feasible in Schizophrenia. As a region of the brain responsible for tasks like memory, attention and navigation, plasticity of the hippocampal region provides hope for improvements in such neurological functions stemming from physical exercise.

Treatment: Cognitive exercise

Results of past studies are similarly convincing with regard to positive effects of mental exercise, “cognitive rehabilitation”, virtual reality gaming and cognitive rehabilitation in people suffering from Schizophrenia. These concepts and programs are all extremely similar in that they consist of completing mentally stimulating tasks in the hopes of restoring normal cognitive functioning or improving areas of deficit. Several investigations have been able to record promising data, while others have come close to showing a significant relationship between cognitive therapy and improvements. The 2010 work of Dickinson and colleagues, for example,

identified improvements in the hypothesized direction for various neuropsychological processes. Others have collected more results in support of these findings.

As suggested by Freitas and Levene (2004), researchers believe that by using cognitive stimulators, such as video games, participants are able to simulate real-life experiences while learning social or problem solving skills, and reaping benefits in cognitive functioning. Although the methods of cognitive exercise programs have taken many directions, with our nation's ever developing cyber-culture and increasing reliance on technology, it appears as though virtual gaming may be a reasonable realm to look towards for cognitive benefits. Tichon's 2007 article highlights the ways in which the country's workforce has already begun to implement mandatory virtual reality training procedures, outside of experimental settings, targeted at acclimating employees to certain conditions they may experience on site. By participating in such educational and simulatory programs, employees are expected to harness necessary skills and formulate appropriate adaptation techniques.

Studies involving cognitive exercise through virtual reality gaming have resulted in some of the same conclusions as those drawn from physical exercise studies. As described by Ceranoglu (2010), these programs have similarly established increases in treatment adherence and better attitudes towards treatment overall. Likewise, a 2008 study by Van Schaik and colleagues, found participants of all fitness levels and exercise histories to be receptive to the Virtual Augmented Exercise (VAE) routine. These researchers determined that the combination of cognitive and physical exercise successfully distracted participants to such a degree that they were no longer concerned with how long they had been working, and thus exercised for longer and were more willing to repeat exercise bouts.

Furthermore, cognitive exercise treatments have resulted in specific advances in neurological functioning. In particular, the use of video games in therapy has been linked to improvements in spatial selective attention, spatial perceptual resolution, and contrast sensitivity (Spence & Feng, 2010). While some studies have pinpointed specific cognitive improvements, findings from Grynszpan and colleagues, (2011) suggest that computer-assisted cognitive remediation (CACR) enhances overall general cognition, with a particularly significant effect size for social cognition. Here reviews of 16 randomized controlled trials identified improvements in verbal memory, working memory, attention/vigilance and speed of processing. Through research on cognitive enhancement therapies, Wexler and Bell (2005) found that cognitive deficits in Schizophrenia are often tied to abnormalities in brain activation. Although commonly addressed by pharmacological means, they argued these deficits could be equally improved through behavioral interventions, similar to their 10-15 week program and that implemented by Grynszpan et al (2011).

Similar results were also collected from a cognitive remediation program conducted by Lindenmayer and colleagues in 2008. Their experimental group, consisting of persons with Schizophrenia, participated in a cognitive remediation program for twelve weeks. During this time, participants in the experimental group used a specially chosen series of computer programs –focused on mentally stimulating activities - for 2 hours per week and partook in group discussions relating material to daily activities. Individuals in the control condition participated in computer use – but were not asked to engage in the cognitive training exercises or discussions. Researchers found greater improvements in academic achievement, verbal working memory, psychomotor speed, information processing speed, verbal learning and executive functioning for those in the experimental group than for controls. These improvements carried over to vocational

endeavors as well. Participants in the experimental group worked significantly more weeks over follow-up, worked for longer hours and earned more collectively. These improvements in vocational pursuits were replicated in the work of Bell, Bryson and Wexler (2003). With such significant improvements in real-life work situations, the results of such cognitive remediation programs suggest overall improvements in general quality of life and social skills developed throughout treatment and sustained throughout follow-up. These results support the use of cognitive remediation in real world settings and emphasizes the real-world applicability of benefits from such cognitive remediation programs (Tichon, 2007).

Although statistical evidence illustrating improvements resulting strictly from cognitive exercise is somewhat limited, studies have been able to demonstrate the ability of cognitive exercise to slow or delay cognitive decline. In 2010, Gates and Valenzuela collected data substantiating the idea that cognitive exercise can help delay episodic memory deficiencies and the onset of depression. Their comments help identify the ways in which cognitive exercise therapy can be used to reduce disability and help alleviate the symptoms and negative consequences of Schizophrenia. Similar effects were discovered by Krabbendam and Aleman in 2003. The efforts of these investigators were directed towards compiling a met-analysis of various studies in which cognitive exercise techniques were used. They determined that throughout numerous investigations involving patients with Schizophrenia, several findings had been similar: severity of symptoms was reduced, social skill and ability had increased and self-esteem of the subjects had improved.

Although the use of game-sims, in which real-world experiences are simulated, has not resulted in direct improvements towards those areas of higher-level functioning impaired in Schizophrenia, they have still proven to be quite useful. The 2007 study by McGurk and

colleagues identified numerous positive life changes in patients with Schizophrenia resulting from cognitive remediation. Participants identified improved ability to secure and keep professional positions and enhanced quality of interpersonal relationships. Additionally, Freitas and Levene (2004) assert that these modes of therapy may be particularly helpful in engaging specific participant groups. Video games are a popular means of entertainment for many people and may prove especially valuable in treatment of younger sufferers of Schizophrenia.

Summary:

The benefits recorded from cognitive exercise regimes, in combination with the effectiveness of physical exercise therapy, have encouraged some interest in treatment centered around simultaneous physical and cognitive exercise. Both forms of exercise have been linked to increased treatment adherence and positive attitudes towards continuation (Unger et al, 1992; Ceranoglu, 2010). The effects of physical exercise on higher-level functioning and psychiatric symptoms were far more well-recorded than those from cognitive therapy. Nevertheless, treatment involving virtual reality gaming and video games, did elicit advances in spatial selective attention, spatial perceptual resolution, and contrast sensitivity while suggesting promising possibilities for additional future findings.

Perhaps the combination of physical and cognitive treatments may result in additive benefits strong enough to turn the “nearly significant” results of cognitive treatments into statistically significant findings. The work of Plante, Cage, Clements and Stover in 2006 investigated the psychological benefits of physical exercise in combination with Virtual Reality modules. These researchers designed three conditions: 1) outdoor exercise, (2) lab exercise with VR of walking experience and (3) VR viewing of walk. One hundred and twelve participants were instructed to complete the self-report checklist for momentary mood states, a survey

evaluating social desirability or defensiveness, and the Paces Activity Enjoyment Scale. Results indicated that outdoor exercise was more enjoyable and energizing but less relaxing than exercising paired with VR components. Thus the effects of combined physical and cognitive exercise appear different than those from strictly physical exercise alone, as we would expect.

In a recent pilot study conducted by Hopkins (2010), participants suffering from Schizophrenia were recruited to test the effects of brief bouts of combined physical and cognitive exercise. The study focused on cybercycling, a task in which subjects played a virtual reality videogame in which the bike they were riding was the control. Two participants completed the protocol and case studies revealed more prominent results for the experimental condition. In the investigation, one subject had been assigned to the physical exercise condition, while the other engaged in combined physical and cognitive exercise. Thus comparison of results was still possible. While both subjects reported increased revitalization and decreased exhaustion upon condition completion, the participant in the combined condition showed a greater improvement on the Stroop Task (8 second improvement versus 5 seconds). In addition, this participant alone demonstrated improvement upon post-testing of the Trails Making task. These results demonstrate that cybercycling studies, one form of combined physical and cognitive exercise, are feasible in an institutionalized setting and may produce positive results in the hypothesized direction. Nevertheless, more research and investigations should be completed before significant conclusions can be drawn. Cybercycling, in which a participant is visually stimulated by a course, rider and corresponding objective, may be an appropriate, resource-efficient and cost effective way of combining such treatments in a manner clients can easily understand and employ.

Current Study:

Results from previous studies have indicated physical exercise is an efficient means by which such improvements can be produced. Those concerning cognitive exercise involving gaming and virtual reality games, have elicited some promising advancements and offer room for further development. The available literature previously cited discusses the resulting effects of both forms of treatment on Schizophrenia and has led our investigators to believe combination of physical and cognitive treatment may enhance the overall impact on sufferers. Drawing from the experience of others, our study will take on a similar form while accounting for individual and institutional limitations on site (Plante, Cage, Clements & Stover, 2006; Hopkins, 2010).

The aim of the current study was to investigate the effects of combined physical and cognitive exercise, by means of cyber-cycling, on neuropsychological functioning in patientsdiagnosed with Schizophrenia or Schizo-Affective Disorder. Participants used the cyber-cycle use for a 5-week span during which exercise patterns were monitored. Neuropsychological assessment of executive function will be administered, before and after exercise, to test the hypotheses that combined treatment will improve mood state, psychiatric symptoms and executive function.

Hypotheses:

We expect to find that five weeks of cyber-cycling will:

1. Benefit cognitive functioning
2. Minimize psychiatric symptoms
3. Improve mood states

As a secondary analysis, we will examine patient exit interview responses to identify trends or indicators of retention/attrition effects – focusing on barriers and motivators.

METHODS

Participants

Participants were recruited from the Capital District Psychiatric Center (CDPC) in Albany, New York. The CDPC IRB determined that the investigation should be conducted in the context of a program evaluation. Staff insured that each participant was given health clearance to partake in the study and individual informed oral consent was obtained. Written consent was not necessary, as the IRB committee had requested the study be viewed as program evaluation, for which oral consent suffices. Out of the approximately 30 clients on the designated unit of the facility, personnel and staff identified 15 to be medically eligible for participation. Ten showed initial interest and six completed pre-program assessments. All individuals were between the ages of 18 and 60, but given the diversity of psychiatric diagnoses on the unit and in order to be inclusive and maximize enrollment, inclusion criteria were relaxed. Diagnoses included: schizo-affective disorder, post traumatic stress disorder (PTSD), bipolar disorder, borderline personality disorder, depressive disorder and pervasive developmental disorder not otherwise specified. Participants, were trained in the use of the cybercycle.

Procedure

Before the start of, and after 5 weeks of, cyber-cycling, participants underwent a brief neuropsychological evaluation of Executive Function. This included the complete Digit Span Forwards and Backwards, Stroop and Color Trails Tests. To evaluate the mood state of participants, the investigators administered the Exercise-Induced Feeling Inventory (EFI). Additionally, symptoms of psychosis were measured with the Brief Psychiatric Rating Scale. The batteries were administered to identify each individual's base levels of functioning before

and after the period of cyber-cycle rehabilitation and took roughly 40 minutes to complete. During both rounds of testing, the primary investigator relayed the same set of directions so as to insure consistency across delivery (Appendix A). Participants were trained in the use the cyber-cycle in this study (Appendix B). They were introduced to the Playstation game, *Nascar 2009*, that they would be using, were able to practice briefly on the bike and demonstrated to the experimenter that they understood what to do during their individual exercise. They were also given instructions regarding pedometer use and how it would relate to tracking personal progress. Once each of the subjects had been briefly trained and given a personal pedometer, the bike was set up on Unit (X) at the facility. Staff members on the unit were given basic instructions as to how to turn on the monitor and gaming console, and were given answers to basic questions the patients might ask (ex. How do I navigate through the gaming menus?). All of the staff members were briefed together so as to insure a common set of instructions would be given to each participant.

Given that the bike was in a central location within one of the units, it was readily accessible to all participants. Patients were directed to check out their personal pedometer from the staff at the front desk each time they engaged in cyber-cycle use. The staff members recorded how long they exercised. The records from the pedometers were collected weekly. The participants were encouraged to use the bike at least every other day for periods of at least 30 minutes.

Participants were given weekly motivational calls to improve study adherence, and were visited by the primary investigator weekly to address any questions or concerns. In addition, they were given small incentives, such as water bottles or magnets, each week to reinforce their continued participation.

After five weeks of exercise had been completed, each of the participants met with the primary investigator for a final session. During this time, they completed the same neuropsychological battery of assessments (The Digit Span Backwards, the Exercise-Induced Feeling Inventory (EFI), the Color Trail Making Tests, the Stroop Task, and the Brief Psychiatric Rating Scale (BPRS)). However, participants were given alternative versions of each test so as to ensure any improvements were not based upon practice effects. After completion of the assessments, the participants were debriefed and the purpose of the study was explained again. In addition, they were thanked for their time and an end-of-the-study celebration was planned.

Measures:

Executive Function:

The Color Trails 2

The Children's Color Trails Test (PAR, Inc, 2011) is divided into Parts 1 and 2. The first trial requires participants to connect numbered dots in order, from 1-15, without lifting their pencil from the paper. These numbers are not arranged in sequential order but rather randomly about the page. They are also coded alternately in pink or yellow, with evens as one color and odds the other. Still subjects need only follow the numbers to determine where to move the pencil next. Participants were instructed to return to the last correct dot if they made a mistake and were told to try to complete the task in as short a time as possible. Color Trails 2 requires subjects to focus on two sets of numbers from 1-15. One set is color-coded yellow and the other pink. Participants must connect the digits in an ascending pattern while simultaneously alternating between colors. Thus they must draw from the pink 1 to the yellow 2, involving discrimination based on both number and color (ex. choosing between two different 2's on the page). Once again, if they made a mistake, they returned to the last correct dot and tried to

complete the task in as short a time as possible. Color Trails versions X, and Y were used in the study as they are recommended for research purposes. They were alternated at times of testing to insure outcomes were not a result of practice effects.

Digit Span Backwards

The Digit Span Backwards (WSM-III) was administered in accord with the standardized procedure. First, participants listened to patterns of numbers (increasing in length by trial). They then recited the list they had heard. Thus to a stimulus of "1-2-3", they should have responded "1-2-3". Next, they were instructed to reverse the order of the digits. So a stimulus of "1-2-3" required a response of "3-2-1". The trial was terminated once an individual had incorrectly recalled two responses for any given sequence length. The participant received one point for each sequence they correctly recalled. A score of 0 indicated the participant did not correctly recall any of the strings of digits and a final score of 16 was the highest possible. The total number of points they earned was used for the analysis.

Stroop C

The Stroop Task (PAR, Inc, 2011) was also administered to measure executive functioning. Stroop A required participants to name the colors of colored blocks as quickly as they could upon presentation. Stroop B asked these same participants to read the written name of color words printed in black as quickly as possible. Stroop C called for participants to state the color in which the written words had been printed, while ignoring the word itself that named a different color. Their scores reflected the time it took for the participants to complete a trial successfully. (Appendix D)

Mood *State:*

Exercise-Induced Feeling Inventory (EFI)

In the Exercise-Induced Feeling Inventory (Gauvin & Rejeski, 1993) participants rated how well twelve adjectives related to their state of being immediately after regular exercise engaged in prior to the study (pre-test) and also recalling how they felt immediately after completing the final session of cyber-cycle exercise (post-test). The Inventory was developed using a likert scale upon which 0 indicated they did not feel that way and 4 indicated they felt very strongly that way. Each of the adjectives corresponded to one of four concrete 'feeling state subscales': positive engagement, revitalization, tranquility, and physical exhaustion. Total scores for these feeling states were determined by totaling the scores from the three adjectives related to each. (Appendix C)

Psychiatric Symptoms:

The Brief Psychiatric Rating Scale (BPRS)

The Brief Psychiatric Rating Scale (Psychiatric Times, 2009) was used to measure the extent to which certain psychiatric symptoms were present in the participants. The dimensions reviewed were: somatic concern, anxiety, emotional withdrawal, conceptual disorganization, guilt feelings, tension, mannerisms and posturing, grandiosity, depressive mood, hostility, suspiciousness, hallucinatory behavior, motor retardation, uncooperativeness, unusual thought content, blunted affect, excitement and disorientation. The evaluation assessed these eighteen symptoms; each on a scale from 1-7, with 0 indicating the symptom was not present and 7 indicating it was extremely severe. (Appendix E)

History of Medical Conditions and Prior Health:

The participants were also asked to fill out a Health and Fitness History (Appendix F) in which they outlined prior experience with surgeries, loss of conciousness and other medical events that may be of valid concern. The survey took approximately ten minutes to complete.

RESULTS

Participants:

Three of the six enrolled participants completed the exercise and post-testing. Two dropped from the study because they were being discharged from the Capital District Psychiatric Center, while the third dropped as he was too uncomfortable using the cyber-cycle given his prior back
conditions and issues.

1) 57 y.o, single, right-handed male with 16 yrs education, institutionalized for approximately 30 years. He had a medical history of significant loc, seizures, high blood pressure, beginning stages of diabetes and spine/back issues. His primary diagnosis was Schizo-Affective disorder.

2) 21 y.o single, right-handed female with 10 yrs education. She had a medical history of high blood pressure, risk for diabetes and hypothyroidism. Her primary diagnoses were Post Traumatic Stress Disorder (PTSD), Bipolar Disorder and Borderline Personality Disorder.

3) 26 y.o single, right-handed male with 11 yrs of education who has been institutionalized for 1 year. He had a medical history of asthma and impulse control, with primary diagnoses of depressive disorder and pervasive developmental disorder not otherwise specified.

Cognitive Functioning

Despite the small sample, exploratory analyses were undertaken to guide future research. Paired t-tests were conducted on pre and post-test scores of the three executive function tasks; no significant effects were found, but a weak "trend" was noted on Stroop C ($p = .12$; Table 1 & Figures 1,2,3).

Psychiatric Symptoms

Results collected from pre- and post- assessments of psychiatric symptoms were quite promising (Table 2). A paired t-test, revealed a significant decrease in psychiatric symptoms ($p = .05$; Table 2; Figure 4) correlating well with our hypothesis.

Mood State

Paired t-tests for the four subscales of the Exercise Induced Feeling Inventory (Positive Engagement, Revitalization, Tranquility and Physical Exhaustion) revealed, a significant change in participants' state of Tranquility ($p = .05$; Table 3; Figure 5). The other mood states were not significantly affected.

Exercise behavior:

Below indicates the number of minutes spent riding by each of the participants. Here it can easily be seen that some participants engaged in much more use than others.

Participant	Minutes spent riding
101	185
102	48
103	471

Post hoc secondary analyses:

Self-Reported Reactions to Cybercycling

Informal interviews were conducted with each participant regarding their reactions to the cybercycle usage. Through their responses, we were able to identify several barriers and motivators that influenced participation and study adherence. Factors such as poor motivation from facility personnel, difficulty in initial exercise, and challenges understanding the pedometer system hindered participation and lowered their willingness to engage in cybercycle use. Other aspects, however, seemed to increase motivation and propelled participants to engage in cybercycle exercise more often. These factors included support from particular individuals as well as constant contact from the primary investigator, the virtual reality component of exercise and the socialization aspect of the group study.

DISCUSSION

Schizophrenia is an incapacitating illness that affects sufferers' abilities in numerous areas including cognitive, mood and behavioral functioning. Not only responsible for deficits in executive functioning (mental processes like focus, attention, multi-tasking and planning (Gorczynski & Faulkner, 2010)), Schizophrenia also involves other psychological complications such as delusions, hallucinations, disorganized thought and anxiety (Perham & Accordino, 2007; McGurk et al, 2007; Braus, et al, 2002). Increased medical concerns, in the form of Metabolic Syndrome, also place people suffering from Schizophrenia at greater risk of acquiring further medical conditions such as Type 2 diabetes and high blood pressure (Thakore, 2005). These complications alone, or when paired with significant weight gain associated to Psychotropic medications and extremely sedentary lifestyles, can have an extremely negative effect on the individual's Quality of Life (QOL), relationships, social experiences and professional future (Norman et al, 2000).

Already facing these multiple and strenuous obstacles, some treatment programs may seem like a daunting endeavor in comparison to the "quick fix" of pills. However, medicating people will Schizophrenia does not effectively address all symptoms or prevent people from acquiring others, nor are they always worth all of the complications that can result (Acil, Dogan and Dogan, 2008). In addition, several studies have concluded that medications alone reduce overall confidence and motivation for exercise which could counter physical and mental health problems, both inside and outside of the treatment setting (Fogarty and Happell, 2005).

In reaction, numerous investigations have been conducted to discover the effects of cognitive and physical exercise independently on Schizophrenia. Cognitive Rehabilitation therapy programs have taken on a number of approaches, identifying related improvements in social/emotional recognition, executive function, work interventions, motivation (specifically in adolescents), treatment adherence, and memory deficits (Dickinson et al, 2010; Ceranoglu, 2010; Spence et al, 2010; Lindenmayer et. al, 2008). The results of physical exercise programs have been even more impressive. Citing effects like increased participation, improved motor control, heightened executive function, significant weight loss, lowered psychiatric symptoms and increased Hippocampal plasticity, they have proven to be quite successful (Fogarty et al, 2005; Pajonk et al, 2010; Perham et al, 2007). The different effects identified in response to physical versus cognitive exercise have been quite pronounced. Although some studies have begun to investigate the effects of combined physical and cognitive exercise, these attempts are few in number and call for additional follow-up (Hopkins, 2010).

Our current investigation was aimed at evaluating the effect of combined physical and cognitive exercise in the task of cybercycling. This form of exercise simultaneously stimulates riders physically, by way of a stationary bike, and cognitively, through visual representations of

a course, rider and objective – providing an interactive experience for the participant. In combining the two forms of exercise, we believed the positive effects found in Schizophrenia from each independently might cumulate. We hypothesized to see enhanced cognitive functioning, fewer psychiatric symptoms and improved mood states after a 5-week period of cybercycling. After collecting and analyzing data from several neuropsychological evaluations, administered both pre and post-test, we were able to identify significant effects of cybercycling upon psychiatric symptoms and the Tranquility subscale of mood state. These results regarding mood state seem to replicate the 2006 work of Plante, Cage, Clements and Stover. A mild trend was also noted in the hypothesized direction for improvements in executive function from the Stroop Task part C. Yielding from such a small sample, this value does suggest that positive and significant findings might be possible in a larger sample size. The results of this pilot investigation suggest that implementing an exergaming intervention on an inpatient psychiatric unit is feasible, and that some patients really enjoy the exercise. The data suggests psychiatric symptoms and mood state can be improved. The cognitive implications are less clear, but it is likely that with a larger sample, the trend noted might turn significant as has been noted in prior research (Pajonk et al, 2010).

Exit interviews revealed specific barriers and motivators in an institutionalized setting was enlightening. Poor motivation from the staff, difficulty in the beginning stages of exercise, and challenges understanding or adhering to the pedometer system were all factors identified by the patients as hindrances to their participation. They also agreed that support from particular individuals, as well as constant contact from these supporters, promoted and facilitated participation, in addition to the virtual reality component of the exercise and the engagement it

allowed them to have with fellow unit members. Future research should try to incorporate the motivators identified while designing a structured program that limits the obstacles mentioned.

Overall, the study's findings partially supported with the projected hypotheses. Psychiatric Symptoms and Mood states were indeed improved by the cybercycling while cognitive functioning showed improvements in the hypothesized direction – that with a larger sample size may prove to be significant. Although the study was conducted upon a small sample, and not all participants had been diagnosed primarily with Schizophrenia, we were able to highlight significant effects upon psychiatric symptoms and mood state, as well as a nearly significant trend regarding executive function. Our results suggest further investigation involving combined physical and cognitive exercise could produce significant and meaningful results. The findings from our secondary analysis may also be applied in future studies conducted in institutionalized settings to better plan against barriers and reinforce motivators.

Strengths

Throughout the neuropsychological evaluations in our investigation, participants were assessed using different versions of the respective tests. At no point during the study were participants given an exam exactly like one they had already completed. This cautious measure was taken to insure that any improvements from pre to post-test were not due to practice effects. In addition, our investigation was nicely designed to accommodate participants in an institutionalized setting. There was no set time during which participants were required to ride, but were rather told to work around their own personal schedules. Furthermore, the bike was quickly accessible at a central location on the unit, so as to easily engage participants throughout the day. Last, the cost of the study overall was quite minimal as available resources were used, transportation was not necessary and the physical incentives were small.

Limitations

Due to a low rate of enrollment and low retension rate, our small sample size was a significant limitation to our study. Several unit members were not cleared for participation based on medical and behavioral records. Others had proven to be unmotivated, both in regards to treatment adherence and at the time they were approached for participation. Some were unfamiliar with video game use and thus intimidated by the modern concept of cybercycling. The low retension rate however, as mentioned above, was due to external factors. Of the three participants that had dropped from the study, two had terminated their participation after release from the Capital District Psychiatric Center to other residencies. Only one participant left of his own free will – because of physical back pain and discomfort on the bike.

However, the limiting effects of the small sample size were two-fold. One, due to the small number of participants, we were unable to separate participants into control and exercise conditions as we would have hoped to do. Consequently, our results are not definitive, as we cannot see if they would be replicated in an institutionalized population who was not cybercycling. In addition, because of the low rate of enrollment, we were forced to open our sample to individuals without a diagnosis of Schizophrenia. This further limited our findings, as we can no longer state the effects are directly related to Schizophrenia alone.

In addition, due to the small sample size, we were not able to control for the different amounts of exercise the various patients underwent. Several of them engaged in routine cybercycle use, while one was less active on the machine. This could have skewed are results and limited our ability to accurately understand the direct influence of the cycbercycle exercise.

Results from the Brief Psychiatric Rating Scale were collected by the primary investigator, who was not blinded to the goal of the study, nor trained in psychiatric diagnostics. Therefore, biases may have influenced the results, adding another limitation to the study.

Use of the pedometer system also served as a limitation in our study. Many of the participants were unfamiliar with pedometers and had trouble fixing the devices to their clothing during exercise. Additionally, the staff were responsible for passing out the pedometers to the patients, but would not always remember to do so or would let participants engage in cybercycle use without using a pedometer- thus understimating usage. Interestingly enough, both the pedometer use and staff assistance were factors the patients identified as barriers to their participation.

Future Research

The results collected from our cybercycle study convey the advantageous effects in Schizophrenia possible through combined physical and cognitive exercise. Schizophrenia is an incurable, life altering illness characterized by psychiatric symptoms, impaired cognitive functioning, weight gain and increased risk of further medical complications. Compromising an individual's social experiences, emotional recognition, professional possibilities and motivation, Schizophrenia seriously deteriorates a sufferer's ability to interact with others effectively and engage in the same satisfying relationships or experiences of which others may boast.

Drawing upon the significant effects found in our investigation, it seems as though combined physical and cognitive exercise holds a promising future in treatment of Schizophrenia. Aiding sufferers in areas of cognitive and physical impairment, as well as mood state and psychiatric symptoms, could help them in numerous life experiences. The lower cost of

exercise treatments, in comparison to most psychotropic medications, may also help those sufferers who are further incapacitated by poverty or financial turmoil.

The results of our secondary analysis should also be used when designed future studies combining physical and cognitive exercise in an institutionalized setting. The barriers identified should be planned for and measures taken to insure their influence is minimal. Furthermore, those factors patients' reported to be motivational should be incorporated extensively into future research pursuits.

The aim of further investigations on the topic should be to engage more participants in exercise endeavors involving combined physical and cognitive exercise. By eliciting more participation from individuals suffering from Schizophrenia or Schizo-Affective Disorder, these studies may be able to identify results that better generalize to the intended population.

Conclusion

Previous research studies identified the positive effects of cognitive and physical exercise independently in Schizophrenia. Our investigation focused on combining these two forms of exercise in hopes of producing a cumulative effect. Several neuropsychological evaluations were used to assess participants before and after they engaged in five weeks of cybercycling. Due to a low enrollment rate and low retention rate, three participants remained involved in the study long enough to complete the final evaluations. Due to this small sample size, and the various diagnoses of the participants, the final results from this pilot study do remain preliminary findings. Nevertheless, the scores and self-reported responses did elicit findings in line with our initial hypotheses. Significant effects were identified on psychiatric symptoms and the Tranquility mood state. In addition, a mild trend was identified for executive function using paired t-tests.

The results from our secondary analysis highlighted barriers such as poor motivation from staff, difficulty in initial exercise and challenges with the pedometer system, as well as motivators like constant contact from individual supporters, the virtual reality component of exergaming and group socialization. These factors can all be used to better design future studies. Ultimately more investigation should be aimed at further exploring and pinpointing the exact effects of cybercycling in Schizophrenia. Improvements in various areas of impairment, including cognitive functioning, psychiatric symptoms and mood state, are probable effects of cybercycling and ones whose influence could drastically improve a sufferer's quality of Life and overall self-satisfaction. For a population fighting so many obstacles, cybercycling may hold the promise of relief.

ACKNOWLEDGEMENTS

1. A special thanks to the participants from the Capital District Psychiatric Center
2. Thank you to Michael Prezioso, PhD and Richard Kornak, Treatment Team Leader (TTL) at the Capital District Psychiatric Center for their time and dedication
3. Great thanks to Professor Cay Anderson-Hanley, PhD for advising me through the thesis project
4. Thank you to Union College's Internal Education Fund (IEF) for granting me funds to complete my study
5. Final thanks to Professor Cay Anderson-Hanley's lab team for assisting me in set-up and practice with the cybercycle

References

"BPRS: Brief Psychiatric Rating Scale" (2009) http://www.psychiatrictimes.com/clinical-scales/schizophrenia/

Acil , A., Dogan, S. & Dogan, O. (2008). The effects of physical exercises to mental state and quality of life in patients with Schizophrenia. *Journal of Psychiatric and Mental Health Nursing, 15*, 808–815

Bell, M., Bryson, G. G., & Wexler, B. E. (2003). Cognitive remediation of working memory deficits: Durability of training effects in severely impaired and less severely impaired Schizophrenia. *Acta Psychiatrica Scandinavica, 108(2)*, 101-109. doi:10.1034/j.1600-0447.2003.00090.x

Braus, D.F., Wolfgang, W.F., Heike, T., Matthias, R., Henn, F.A. (2002). Sensory Information Processing in Neuroleptic-Naive First-Episode Schizophrenic Patients: A Functional Magnetic Resonance Imaging Study. *Archives of General Psychiatry, 59*, 696-701

Ceranoglu, T., (2010). Video Games in Psychotherapy. *Review of General Psychology, 14(2)*, 141–146

Clarkson-Smith, L., and Hartley, A. (1989). Relationships Between Physical Exercise and Cognitive Abilities in Older Adults. *Psychology and Aging, 4(2)*, 183-189

Dickinson, D., Tenhula, W., Morris, S., Brown, C., Peer, J., Spencer, K., Li, L., Gold, J., and Bellack, A. (2010). A Randomized, Controlled Trial of Computer-Assisted Cognitive Remediation for Schizophrenia. *American Journal of Psychiatry, 167(2)*, 170-180

Duckworth, Ken. M.D., "Schizophrenia" National Alliance on Mental Illness. February 2007. http://www.nami.org/Template.cfm?Section=By_Illness&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=54&ContentID=23036

Faulkner, G., & Biddle, S. (1999). Exercise as an adjunct treatment for Schizophrenia: A review of the literature. *Journal of Mental Health, 8(5)*, 441-457

Fogarty, M., & Happell, B. (2005). Exploring The Benefits Of An Exercise Program For People With Schizophrenia: A Qualitative Study. *Issues in Mental Health Nursing, 26(3)*, 341-351

Fogarty, M., Happell, B., & Pinikahana, J. (2004). The Benefits of an Exercise Program for People with Schizophrenia: A Pilot Study. *Psychiatric Rehabilitation Journal, 28(2)*, 173-176

Freitas, S., and Levene, M. (2004). An Investigation of the use of simulations and video gaming for supporting exploratory learning and developing higher-order cognitive skills". *IADIS International Conference Cognition and Exploratory Learning in Digital Age (CELDA)*, 35-42

Gates, N. and Valenzuela, M. (2010) Cognitive Exercise and Its Role in Cognitive Function in Older Adults. *Current Psychiatry Reports, 12*, 20-27

Gauvin & Rejeski (1993) The Exercise-Induced Feeling Inventory: development and initial validation. *Journal of Sport & Exercise Psychology (JSEP)*, 15(4), 403 - 423.

Gorczynski, P., & Faulkner, G. (2010). Exercise therapy for Schizophrenia. *Schizophrenia Bulletin, 36(4)*, 665-666. doi:10.1093/schbul/sbq049

Grynszpan, O. O., Perbal, S. S., Pelissolo, A. A., Fossati, P. P., Jouvent, R. R., Dubal, S. S., & Perez-Diaz, F. F. (2011). Efficacy and specificity of computer-assisted cognitive remediation in Schizophrenia: A meta-analytical study. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences, 41(1)*, 163-173. doi:10.1017/S0033291710000607

Hannaford, C., Harrell, E., & Cox. (1988) Psychophysiological effects of a running program on

depression and anxiety in a psychiatric population. *The Psychological Record,* Vol 38(1), 37-48.

Hodgson, M., McCulloch, H., and Fox, K. (2011) The Experiences of People with Severe and Enduring Mental Illness Engaged in a Physical Activity Programme Integrated into the Mental Health Service. *Mental Health and Physical Activity*. doi:10.1016/j.mhpa.2011.01.002

Hopkins, Veronica (2010) *Exergaming and Schizophrenia: The Neuropsychological Effects of Exercise*. Unpublished thesis: Union College.

Jahshan, C., Heaton, R. K., Golshan, S., & Cadenhead, K. S. (2010). Course of neurocognitive deficits in the prodrome and first episode of Schizophrenia. *Neuropsychology, 24(1),* 109-120. doi:10.1037/a0016791

Krabbendam, L., & Aleman, A. (2003). Cognitive rehabilitation in Schizophrenia: A quantitative analysis of controlled studies. *Psychopharmacology, 169(3-4),* 376-382

Leas, L. and Mccabe, M. (2007). Health Behaviors among Individuals with Schizophrenia and Depression. *Journal of Health Psychology, 12(4)* 563-579. DOI: 10.1177/1359105307078162

Lehman, A.F., Steinwachs, D.M., Dixon, L.B., Goldman, H.H., Osher, F., Postrado, L., Scott, J.E., Thompson, J.W., Fahey, M., Fischer, P., Kasper, J.A., Lyles, A., Skinner, E.A., Buchanan, R., Carpenter, W.T., Levine, J., McGlynn, E.A., Rosenheck, R., & Zito, J. (1998). Translating research into practice: The Schizophrenia Patient Outcomes Research Team (PORT) Treatment Recommendations. *Schizophrenia Bulletin, 24(1*), 1-10.

Leith, L.M. & Taylor, A.H. (1990). Psychological aspects of exercise: A decade literature review. *Journal of Sport Behavior, 13*, 219-239.

Lindenmayer, J., McGurk, S., Mueser, K. T., Khan, A., Wance, D., Hoffman, L., & ... Xie, H. (2008). A randomized controlled trial of cognitive remediation among inpatients with persistent mental illness. *Psychiatric Services, 59(3),* 241-247. doi:10.1176/appi.ps.59.3.241

Lukoff, D., Wallace, C.J., Liberman, R.P., Burke, K. (1986). A holistic program for chronic schizophrenic patients. *Schizophrenia Bulletin, 12(2),* 274-282.

Martinsen, E. & Stephens, T. (1994). Exercise and mental health in clinical and free-living populations. In R.K. Dishman (Ed.), Advances in Exercise Adherence, 55-72

McGurk, S. R., Twamley, E. W., Sitzer, D. I., McHugo, G. J., & Mueser, K. T. (2007). A meta-analysis of cognitive remediation in Schizophrenia. *The American Journal of Psychiatry, 164(12),* 1791-1802

Mead, G. E., Morley, W., Campbell, P., Greig, C. A., McMurdo, M. T., & Lawlor, D. A. (2009). Exercise for depression. *The Cochrane Library, Issue 4*, 1-61

Meyer, T and Broocks, A. (2000). Therapeutic Impact of Exercise on Psychiatric Diseases: Guidelines for Exercise Testing and Prescription. *Sports Medicine, 30(4),* 269-279

Miller, R., & Mason, S. E. (2004). Cognitive enhancement therapy: A therapeutic treatment strategy for first-episode Schizophrenia patients. *Bulletin of the Menninger Clinic, 68(3),* 213-230. doi:10.1521/bumc.68.3.213.40406

National Institute of Mental Health (2009). "Schizophrenia" http://www.nimh.nih.gov/health/publications/Schizophrenia/complete-index.shtml#pub7

Norman, R.M.G, Malla, M.K., McLean, T., Voruganti, L., Cortese, L., McIntosh, E., Cheng, S., & Rickwood, A. (2000). The relationship of symptoms and level of functioning in Schizophrenia to general wellbeing and the Quality of Life Scale. *Actica Psychiatrica Scandinavia, 102(4),* 303-309.

Pajonk, F.G., Wobrock, T., Gruber, O., Scherk, H., Berner, D., Kaizl, I., Kierer, A., Müller, S., Oest, M., Meyer, T., Backens, M., Schneider-Axmann, T., Thornton, A.E., Honer, W.G., & Falkai, P. (2010). Hippocampal plasticity in response to exercise in Schizophrenia. *Archives of General Psychiatry, 67(2),* 133-143.

PAR Inc, (2011) "Stroop Color and Word Test" http://www4.parinc.com/Products/Product.aspx?ProductID=STROOP

PAR, Inc, (2011) "Children's Color Trails Test (CCTT)" http://www4.parinc.com/Products/Product.aspx?ProductID=CCTT

Pelham, T.W., Campagna, P.D., Ritvo, P.G., & Birnie, W.A. (1993). The effects of exercise therapy on clients in a psychiatric rehabilitation program. *Psychosocial Rehabilitation Journal, 16(4),* 75-84.

Perham, A., & Accordino, M. (2007). Exercise and functioning level of individuals with severe mental illness: A comparison of two groups. *Journal of Mental Health Counseling, 29(4),* 350-362.

Plante, T. G., Cage, C., Clements, S., & Stover, A. (2006). Psychological benefits of exercise paired with virtual reality: Outdoor exercise energizes whereas indoor virtual exercise relaxes. *International Journal of Stress Management, 13(1),* 108-117

Ploughman, M. (2008) Exercise is brain food: The effects of physical activity on cognitive function. *Developmental Neurorehabilitation, 11(3),* 236-240

Poulin, M., Chaput, J., Simard, V., Vincent, P., Bernier, J., Gauthier, Y., & ... Tremblay, A. (2007). Management of antipsychotic-induced weight gain: Prospective naturalistic study of the effectiveness of a supervised exercise programme. *Australian and New Zealand Journal of Psychiatry, 41(12),* 980-989

Richardson, C., Faulkner, G., McDevitt, J., Skrinar, G., Hutchinson, D., & Piette, J. (2005). Integrating Physical Activity Into Mental Health Services for Persons with Serious Mental Illness. *Psychiatric Services, 56(3),* 324-31

Silverstein, S. (2010). Bridging the gap between extrinsic and intrinsic motivation in the cognitive remediation of Schizophrenia. *Schizophrenia Bulletin, 36(5),* 949-956

Spence, I., and Feng, J. (2010). Video Games and Spatial Cognition. *Review of General Psychology, 14(2),* 92–104

Thakore, J. (2005). Metabolic Syndrome and Schizophrenia. *British Journal of Psychiatry, 186,* 455-456

Tichon, J. (2007). Training cognitive skills in virtual reality: Measuring performance. *CyberPsychology & Behavior, 10(2),* 286-289

Unger, K.V., Skrinar, G.S., Hutchinson, D.S., & Yelmokas, A. M. (1992). Fitness: A viable adjunct to treatment for young adults with psychiatric disabilities. *Psychosocial Rehabilitation Journal, 5(3),* 21-28

Van Schaik, P., Blake, J., Pernet, F., Spears, I. and Fencott, C. (2008). Virtual Augmented Exercise Gaming for Older Adults. *CyberPsychology & Behavior, 11(1),* 103-106

Velligan, D. I., Kern, R. S., & Gold, J. M. (2006). Cognitive Rehabilitation for Schizophrenia and the Putative Role of Motivation and Expectancies. *Schizophrenia Bulletin, 32(3),* 474-485. doi:10.1093/schbul/sbj071

Wexler, B., & Bell, M. (2005). Cognitive remediation and vocational rehabilitation for Schizophrenia. *Schizophrenia Bulletin, 31(4),* 931-941.

Table 1. Stroop Task- Part C – Scores (Pre- and Post Tests)

		Stroop A	Stroop B	Stroop C
	Pt. 101	33.94	21.18	59.05
	Pt. 102	22.98	18.13	44.76
	Pt. 103	36.94	33.08	51.98

		Stroop A	Stroop B	Stroop C
	Pt. 101	28.44	18.17	44.86
	Pt. 102	22.63	16.21	43.31
	Pt. 103	40.9	36.17	42.82
pre	ave	31.29	24.13	51.93
	SD	7.35	7.90	7.15
post	ave	30.66	23.52	43.66
	SD	9.33	11.00	1.06
ttest		0.93	0.94	0.12

Table 2. Brief Psychiatric Rating Scale Scores (Pre- and Post-tests)

BPRS PRE-TEST	
Patient	Score
101	25
102	31
103	26
BPRS POST-TEST	
Patient	Score
101	23
102	21
103	21
Paired t-test	0.05

Table 3. Exercised Induced Feeling Inventory Scores

Average Sum			
Positive Engagement (Qs: 4,7,12)	**Revitalization (Qs: 1,6,9)**	**Tranquility (Qs: 2,5,10)**	**Physical Exhaustion (Qs: 3,8,11)**
2.67	2.00	2.00	2.00
2.33	0.67	1.67	4.00
2.00	2.67	2.67	0.00
2.00	1.67	3.00	1.67
2.67	3.33	3.00	3.00
3.33	3.33	4.00	0.00
Paired t-test			
0.48	0.28	**0.05**	0.77

Chart 1. Change in Executive Function Pre- to Post 1-month Exercise

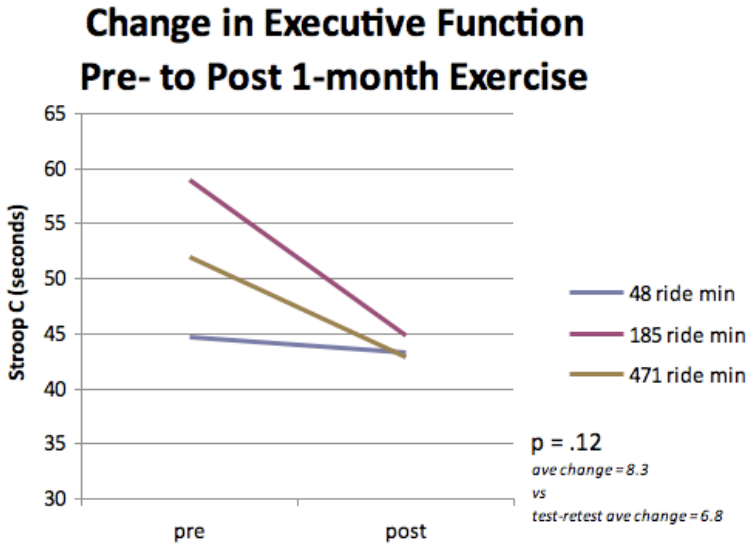


Chart 2. Change in Psychiatric Symptoms Pre- to Post 1-month Exercise

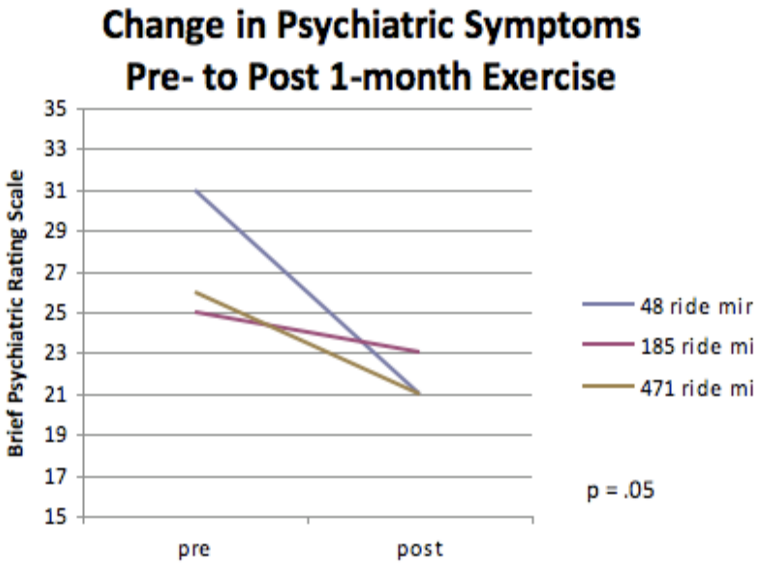
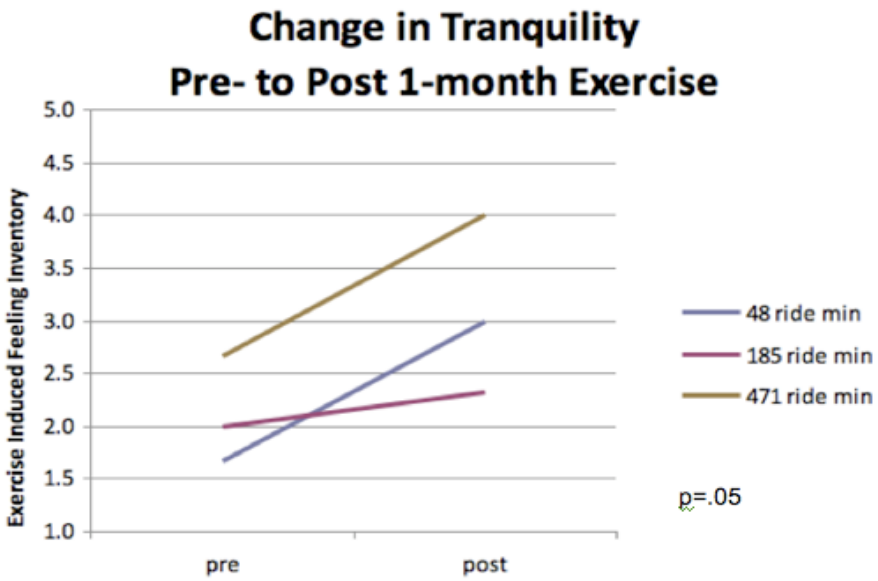


Chart 3. Change in Tranquility Pre- to Post 1-month Exercise



Appendix A. Neuropsychological Evaluation Instructions

Brief Neuropsychological Assessment Battery
"Exercise Study at CDPC"

Mark all answers, responses and ratings on the appropriate record sheets.

_____ Prepare resident for administration of the assessment as follows:

Thank you so much for agreeing to assist us in our study about the benefits of exercise. For the duration of our time together, I will be reading directly from this sheet. By doing so, we will be able to maintain consistency between evaluations. We would also like to insure each participant is provided with clear concise directions. At any time during the testing, please feel welcome to ask me any questions or present any concerns you might have. Before we begin, would you like to use the bathroom? Or would you like a glass of water? If you wear glasses, we ask you put them on or adjust them now, as testing is about to begin!

Next, you will start work on a series of puzzle-like tasks. A majority of them will be quite interesting, though some may pose some difficulty for you. Do not be worried if you have trouble with any of the tasks. We only ask that you try your best on each of them.

_____ Exercise Induced Feeling Inventory (EFI)

Please use the following scale to indicate the extent to which each word below described <u>how you feel at this moment in time.</u> Record your responses by circling one number next to each word.

_____ Brief Psychiatric Rating Scale

Now I am going to ask you a few questions related to several feeling states. Please answer the questions honestly.

_____ Administer Color Trails (time to complete if less than 60 sec or stop at 60 sec and record # correct)

Be sure to be ready with the stopwatch, even a one second difference in recording time can be significant.

<u>PRACTICE</u>:
In this box are different colored circles with numbers in them. When I say "begin," I want you to take this pencil and connect the circles by going from 1 (point to the 1)**, 2** (point to the 2)**, 3** (point to the 3), **and so on, until you reach the end. I want you to**

connect the circles in the correct order as quickly as you can, without lifting the pencil from the paper. If you make a mistake, I will point it out. When I do, I want you to move the pencil back to the last correct circle and continue from there. The line that you draw must go through the circles and must do so in the correct order. Do you have any questions?
Okay, let's practice. Put your pencil here where this hand tells you to start. When I say "begin," connect the circles in order as quickly as you can until you reach the circle next to the hand telling you to stop. Ready? Begin. (Begin timing as soon as you detect movement toward the first circle.)

TEST:
Now I have a sheet with several more numbers and circles. Connect the circles in order like you did just a moment ago. Again, work as quickly as you can, and do not lift the pencil from the paper as you go. Make sure that your lines touch the circles.

Point to the first circle and say the following:

You will start here, where the hand tells you to start, and end where the hand tells you to stop. Ready? Begin.

(Begin timing as soon as you detect movement toward the first circle. Be sure to record # of dot just completed at 60 seconds, as well as time to complete all).

Record circle color and number at 60 seconds: _____

Record time to complete (in seconds): _____

PRACTICE:
In this box are different colored circles with numbers in them. This time I want you to take the pencil and connect the circles in order by going from this color 1 (point to the pink 1), **to this color 2** (point to the yellow 2), **to this color 3** (point to the pink 3**), and so on, until you reach the last number next to the hand telling you to stop.**

Take the pencil and point to the example below the box as you say the following:

Notice that the color changes each time you go to the next number. I want you to work as quickly as you can. Do not lift the pencil from the paper once you have started. I f you make a mistake, I will point it out. When I do, I want you to move the pencil to the last correct circle and continue from there. As before, the line you draw must go through the circles in the correct order. Do you have any questions?

Okay, let's practice. Put your pencil here next to the hand telling you to start. When I say "begin," connect the circles in order as quickly as you can, changing from one color to the next, until you reach the hand telling you to stop, Ready? Begin.

(Begin timing as soon as you detect movement toward the first circle.)

TEST:
Now I have a sheet with several more numbers and colored circles. Connect the circles like you did just a moment ago. Again, work as quickly as you can.

Point to the first circle and say the following:

You will start here, where the hand tells you to start, and end where the hand tells you to stop. Ready? Begin.

(Begin timing as soon as you detect movement toward the first circle. Be sure to record # of dot just completed at 60 seconds, as well as time to complete all).

Record circle color and number at 60 seconds: _____

Record time to complete (in seconds): _____

_____ Administer the Stroop Task

Prior to administration:
The next task sometimes causes frustration to participants. However, it is quite interesting. Once again we would like to ask you to try your best on each part of the task.

COLOR BLOCKS:
First, I will present you with a series of colored blocks. Here we ask you to name the colors you see on this top, sample row (point to the row)**.**

Once the subject is able to complete the sample line correctly:

Great, now that you know the general idea, I would like you to tell me the names of each color block starting at the beginning of the first row and moving towards the right. If you make a mistake, restate the color of the block you are having trouble with, and continue. Move across the row and down to the next line and across, etc., until finished. Ready? Begin. (Examinee can self-correct, but do not prompt for corrections)**.**

BLACK WORDS:
For the next portion the task is similar. On this page you will read the words as quickly as you can. Please try the sample line (point)**.**

Great! Now, just as before, start at the beginning of the first row (point) **and read across as quickly as you can without making mistakes. Once you have completed a row, move on to the next one until you are finished. Ready? Begin.**

COLORED WORDS:

On this last part of the task, you are asked to tell me the color of the ink and ignore the written word. This part is more challenging, but try your best, starting with the sample line.

Great! For the last time, start at the beginning of the top row, reading across and then moving to the next row. Proceed as quickly as you can without making mistakes until the end. Ready? Begin.

_____ Administer Digit Span (forward)

Read numbers at rate of one second per number. Be sure to record <u>all</u> responses whether right or wrong. Discontinue after 2 failures of the same length of digits.

I am going to read off some numbers. Listen carefully to the series. When I am finished, I would like you to say them back to me. Just repeat what I have said.

_____ Administer Digit Span (backward)

Read numbers at rate of one second per number. Be sure to record <u>all</u> responses whether right or wrong. Discontinue after 2 failures of the same length of digits.

Now I am going to say some more numbers. But this time, I would like you to repeat them backwards. For example, if I say 7-1-9, what would you say? *(If they get it correct, continue with the task!)*

_____ Conclude by thanking the participant for their time and energy.

Thank you so much for participating in today's testing. We hope that your results, as well as your participation with our cyber-cycle program, will help us learn more about the benefits of exercise on Schizophrenia. At this time, do you have any questions or concerns you would like to share with me?

If they ask questions you are not prepared to answer, tell them you will consult with Dr. Prezioso or your professor and get back to them. Make it clear that you cannot answer any specific questions regarding results or performance, as the information is intended for research purposes only.

Appendix B. Cybercycle Set-up

Appendix C.

Exercise Induced Feeling Inventory

Instructions: Please use the following scale to indicate the extent to which each word below describes **how you have been feelingly recently**. Record your responses by **circling one number next to each word**.

	Do Not Feel	**Feel Slightly**	**Feel Moderately**	**Feel Strongly**	**Feel Very Strongly**
Refreshed	0	1	2	3	4
Calm	0	1	2	3	4
Fatigued	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Relaxed	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Tired	0	1	2	3	4
Revived	0	1	2	3	4
Peaceful	0	1	2	3	4
Worn-out	0	1	2	3	4
Upbeat	0	1	2	3	4

Appendix D.

Participant ID#: _____ Date _____

The Stroop

(adapted from Van der Elst, 2006 – 40 item – Version 1)

Directions: underline word if correct, put ltr of incorrect answer next to answer, use "C" if self-corrects

Colored Blocks Trial:

Sample Line: Time (min' sec")

red green blue green red blue blue green red green _____

Timed:

red blue green red blue red green green blue blue _____

red blue green blue red green red blue green red _____

red green blue red green red blue green red green _____

green red blue green blue green red blue blue red _____

Plain Words Trial:

Sample Line: Time (min' sec")

green red green blue blue red green red blue red _____

Timed:

red blue red green blue red green blue red blue _____

red green blue red green red blue green blue green _____

red blue red green blue red green blue red blue _____

blue green red red blue green red blue red green _____

Colored Words (Interference Trial):

Sample Line: Time (min' sec")

blue red green red blue green red blue green red _____

Timed:

blue green blue blue red green red blue green red _____

green red blue green blue red green red blue green _____

blue red green blue red green red blue green red _____

blue green red blue red blue green red green blue _____

Appendix E.

BRIEF PSYCHIATRIC RATING SCALE

Therapist:	Date:

Write in the appropriate number for each item, using the following key:

NOT PRESENT	VERY MILD	MILD	MODERATE	MODERATELY SEVERE	SEVERE	EXTREMELY SEVERE
1	2	3	4	5	6	7

1.	**SOMATIC CONCERN** Degree of concern over present bodily health. Rate the degree to which physical health is perceived as a problem by the patient, whether complaints have a realistic basis or not.	10.	**HOSTILITY** Animosity, contempt, belligerence, disdain for other people outside the interview situation. Rate solely on the basis of the verbal report of feelings and actions of the patient toward others; do not infer hostility from neurotic defenses, anxiety nor somatic complaints. (Rate attitude toward interviewer under "uncooperativeness.")
2.	**ANXIETY** Worry, fear, or over-concern for present or future. Rate solely on the basis of verbal report of patient's own subjective experiences. Do not infer anxiety from physical signs or from neurotic defense mechanisms.	11.	**SUSPICIOUSNESS** Belief (delusional or otherwise) that others have now, or have had in the past, malicious or discriminatory intent toward the patient. On the basis of verbal report, rate only those suspicions which are currently held whether they concern past or present circumstances.
3.	**EMOTIONAL WITHDRAWAL** Deficiency in relating to the interviewer and to the interviewer situation. Rate only the degree to which the patient gives the impression of failing to be in emotional contact with other people in the interview situation.	12.	**HALLUCINATORY BEHAVIOR** Perceptions without normal external stimulus correspondence. Rate only those experiences which are reported to have occured within the last week and which are described as distinctly different from the thought and imagery processes of normal people.
4.	**CONCEPTUAL DISORGANIZATION** Degree to which the thought processes are confused, disconnected or disorganized. Rate on the basis of intergration of the verbal products of the patient; do not rate on the basis of patient's subjective impression of his own level of functioning.	13.	**MOTOR RETARDATION** Reduction in energy level evidenced in slowed movements. Rate on the basis of observed behavior of the patient only; do not rate on basis of patient's subjective impression of own energy level.
5.	**GUILT FEELINGS** Over-concern or remorse for past behavior. Rate on the basis of the patient's subjective experiences of guilt as evidenced by verbal report with appropriate affect; do not infer guilt feelings from depression, anxiety or neurotic defenses.	14.	**UNCOOPERATIVENESS** Evidence of resistance, unfriendliness, resentment, and lack of readiness to cooperate with the interviewer. Rate only on the basis of the patient's attitude and responses to the interviewer and the interview situation; do not rate on basis of reported resentment or uncooperativeness outside the interview situation.
6.	**TENSION** Physical and motor manifestations of tension "nervousness" and heightened activation level. Tension should be rated solely on the basis of physical signs and motor behavior and not on the basis of subjective experiences of tension reported by the patient.		
7.	**MANNERISMS AND POSTURING** Unusual and unnatural motor behavior, the type of motor behavior which causes certain mental patients to stand out in a crowd of normal people. Rate only abnormality of movements; do not rate simple heightened motor activity here.	15.	**UNUSUAL THOUGHT CONTENT** Unusual, odd, strange, or bizarre thought content. Rate here the degree of unusualness, not the degree of disorganization of thought processes.
		16.	**BLUNTED AFFECT** Reduced emotional tone, apparent lack of normal feeling or involvement.
8.	**GRANDIOSITY** Exaggerated self-opinion, conviction of unusual ability of powers. Rate only on the basis of patient's statements about himself or self-in-relation-to-others, not on the basis of his demeanor in the interview situation.	17.	**EXCITEMENT** Heightened emotional tone, agitation, increased reactivity.
9.	**DEPRESSIVE MOOD** Despondency in mood, sadness. Rate only degree of despondency; do not rate on the basis of inferences concerning depression based upon general retardation and somatic complaints.	18.	**DISORIENTATION** Confusion or lack of proper association for person, place or time.
		19.	**ELEVATED MOOD** Happy, laughing, joking, optimistic, with exaggerated sense of well being.

ADM 528

Appendix F.

Exercise Study at CDPC

ID: _____ Date: _____

Health & Fitness History Form

Yrs of Education (HS = 12)	_____
Gender	_____
Marital Status	_____
Handedness	_____
Yrs in institution(s)	_____
Prior Occupation(s)	_____

History of:

Significant LOC	YES / NO
Seizures	YES / NO
Stroke	YES / NO
High Blood Pressure:	YES / NO
Diabetes	YES / NO
Heart attack	YES / NO

Other: _____

Current medications:

Current treatments:

How many times did you exercise last week?
What exercise activities do you usually do?