ABSTRACT

The Effect of External Attentional Stimulations such as Visual Concentration Attention Techniques (VCAT) on Sustained Attention in Adults with ADHD

By

Nader Babai Siahdohoni

Dissertation [Doctoral Study] Submitted in Partial Fulfillment
Of the Requirements for the Degree of

Doctor of Philosophy

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ABSTRACT

Attention and concentration deficit is a major problem for some adults time to time. In most cases people with such problem ignore the symptoms of inattention and cope with the resultant impairment in their daily functioning. Visual Concentration Attention Techniques (VCAT) is based on attention and selective attention theory that could theoretically be used in treating individuals with Attention-deficit/Hyperactivity Disorder (ADHD). Current and previous research indicates that therapies including external attention and selective attention stimulations such as VCAT would affect the brain's functioning system by enhancing its neural activities, leading to improvement of perception, cognitive, memory, attention, focusing and concentration. However, there is a gap in the research about whether addressing attentional processes using external attentional stimulations would improve overall attention. Therefore, the purpose of the proposed research is to test the short-term and long term outcomes of VCAT exercising in individuals with ADHD. The proposed research is going to conduct a quantitative, non-clinical study using participants with and without ADHD symptoms in a two weeks intervention period to assess the effect of VCAT program in adults with ADHD. The social change implications are the value of a nonpharmaceutical intervention for ADHD, particularly in terms of no drug side effects, reduced health care costs, improved quality of life, and enhanced work performance among those suffering from this disorder. Ideally, this would lead to further applied research in the area of attention and concentration across many emotional and self-regulation problems.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1:

INTRODUCTION TO THE STUDY

According to Brown (2002), majority of adults with the lack of sustained attention do not take this matter as serious as they should. The lack of sustained attention, which could be related to the inattention symptom of Attention-Deficit/Hyperactivity Disorder (ADHD), has caused many adults difficulties in their academic progress, work place, and in their social environment (Brown). ADHD is the diagnostic label assigned to individuals with significant problems involving attention, impulsiveness, or hyperactivity (Brown, 2002). The prevalence of ADHD, once believed to be only a childhood disorder, is a condition now recognized to continue well into adulthood (Weiss & Murray, 2003) and has been estimated as high as 6% in the U.S. population. As stated by Weiss and Murray, in most cases, the men and woman managing this condition are being administered stimulant medications. Although stimulant medications may relieve the symptoms of the disorder in the short-run, prolonged use of many of these medications produce problematic side effects including liver damage (Biederman & Faraone, 2005), increased blood pressure (Searight, Burke, & Rottnek, 2000), headaches, and abdominal pain (Greenhill, 2002). In response to the need for alternative long-term interventions that do not produce the costly and dangerous consequences of pharmaceuticals, this research design will examine the efficacy of a new treatment modality for eliminating attention problems in adults diagnosed with ADHD.

A main objective of the current study is to contribute to the growing body of research demonstrating effectiveness in treating various psychiatric conditions. One example of this research is the use of attention control strategies in remediating the effects of various behavioral disorders (Robertson, 2004; Teasdale et al., 2000). Attentional stimulation is one strategy that has only recently started to be promoted within clinical psychology. Specifically, practitioners are now beginning to examine the practice of attention and selective attention therapies through visual field as effective clinical interventions. Selective attention is a process that involves focusing on a specific aspect of a scene while ignoring other aspects (Rees, Russell, Frith, & Driver, 1999). Eye movements often play an important role in visual attention, but shifting attention can also happen without moving the visual focus (Rees et al., 1999). Visual Concentration Attention Techniques (VCAT) is a form of selective attention that stimulates the brain for higher neural activities. It is based on previous theories of attention and selective attention, such as Treisman and Gelade’s Feature Integration Theory of Attention (1980) or Kyle Cave’s Feature Gate Model (1999), which stemmed from Treisman's ideas. Given the new and efficacious research in attention and selective attention, this study seeks to test the hypothesis that VCAT-program, as a self-regulation strategy, can alter the underlying cognitive processes involved in dysfunctional attentional control exhibited by individuals with ADHD.

Using visual stimulation in interventions for cognitive deficits became viable when Functional Magnetic Resonance Imaging (fMRI) studies demonstrated that focusing on images may improve cognitive abilities such as concentration, memory, multiprocessing, reasoning ability, and increase mental focus and alertness by increasing neural activities (Murray & Wojciulik, 2004). As Murray and Wojciulik emphasized, exercising the brain through sophisticated external stimuli increases the brain’s neural activities, which elevates certain brain waves (such as beta, the state of awareness), and the flow of the oxygenated blood flow throughout the brain tissues. For example, one study found that objects in the deferent locations of a visual field influence the firing rate and the activity of the neurons in the primary visual cortex (Gandhi, Heeger, & Boynton, 1998). These activities improve the plasticity of the brain and lead to restoration and regeneration of neurons (brain cells). According to Parasuraman, Greenwood, and Sunderland (2002), healthy active brain cells are the main source for improvement of attention, concentration, and cognitive abilities, as well as controlling many of the psychological and mental disorders.

There would be a major impact on thousands of adults with ADHD worldwide if the results of this study are found to be significant. Adults with ADHD would have the option of selecting a noninvasive, low-cost, and drug-free intervention that could remediate the attention difficulties influencing their everyday lives. Moreover, the improvements generated in the ability to focus and sustain attention would greatly increase the individual's productivity and reduce much of the psychosocial interference caused by ADHD. This study would also be a major contribution to the body of research on attentional selectivity stimulus. An increased knowledge base including the examination of the efficacy of a VCAT program could potentially result in greater funding pertaining to the value of attention selectivity stimulus within other areas of psychopathology.

Background of the Study

Attention problems have been studied since the early 20th century, but mostly in children. In the 1960's, scientists began to question their practice of labeling children who exhibited attention problems as brain damaged (Van der Mere, 2002). Medical and behavioral therapies were introduced in the 1970's based on further study of the behavioral difficulties. However, it was not until the following decade that diagnostic criteria were developed for this attentional disorder (Van der Mere). First described as Attention-Deficit Disorder (ADD), the American Psychiatric Association later reconceptualized the disorder according to various subtypes. In 1987, this same organization renamed the disorder as ADHD with an updated set of criteria (Barkley, 1997). Today, longitudinal studies indicate that as many as 60% of people diagnosed with ADHD as a child continue to have these same symptoms as adults (Barkley, Fischer, Smallish, & Fletcher, 2002).

These days an abundance of research and theory are available regarding the nature of ADHD. While no conclusive theory has been adopted, many highlight the prevalence of behavioral inhibition (i.e., self-regulation) problems. Several theories of self-regulation address the role of attention and awareness in the maintenance and enhancement of both psychological and behavioral functioning (Barkley, 1997; Ryan & Deci, 2000; Vohs, Baumeister & Ciarocco, 2005). Most researchers contend that different sets of behavioral processes that work along an integrated network serve to provide management and control of the executive functions that promote regulated behaviors. On the other hand, when dysfunction develops within these self-regulating processes, behavioral problems pertaining to arousal, motivation, and attention may occur.

The fields of cognitive science, psychotherapy, personality theory, among others have all pointed to the importance of attention, as well as that of observant, open awareness for the optimization of self-regulation and well-being (Schachter, Pham, King, & Moher, 2004). Founded on selective attention theory, the VCAT relates to an approach for increasing attention, concentration, and awareness (Rees, Russell, Frith, & Driver, 1999), and has recently received much attention within the field of cognitive psychology as an alternative treatment modality. This modality based on the visual system may improve self-regulation in a long-term capacity.

The current literature on attention and selective attention contains a great deal of clinical research. For example, in the cognitive neuroscience arena, several studies have examined the effects of attention selectivity on the brain using electroencephalographic (EEG) recordings (Murray & Wojciulik, 2004; Corbetta, 1998) and functional magnetic resonance imaging (fMRI) machines (Wagner, Ball, Schreiber, Feige, Lucking, & Kristeva-Feige, 1999). In addition, a plethora of studies exists that highlight the effects of attention and selective attention within an ADHD population (Wagner et al., 1999); however, all of these test populations have been children. Given the developmental differences in the cognitive functioning of children compared to adults, further study is needed to understand the effects of VCAT on the symptoms of ADHD in an adult population.

The visual system serves to construct an internal model of the physical world outside (Babai-Siahdohoni, 2007). Most of the time, there is more information in the visual field than the visual system can handle (Lamy & Tsal, 2000). The images captured by the visual system will serve as the perceptual foundation of all conscious experiences that are derived from vision, including thoughts and actions (Van Essen, Anderson, & Felleman, 1992). This suggests that attentional mechanisms are crucial to selection of relevant objects for further processing, and perhaps also to reserve those objects that are not relevant to the particular goal at hand (Soto & Blanco, 2004; Tales, Muir, Bayer, &

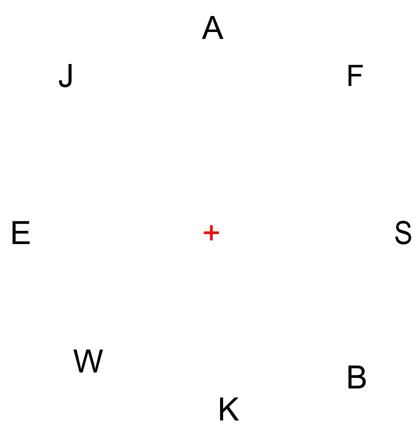
Snowden, 2002). Selective attention is one example of such conscious experience. People focus on things considered relevant and ignore those that are considered irrelevant in the process. However, much of the process during attentiveness occurs during preconscious, without effort of awareness. Selective attention that is visually motivated improves one's perception, cognition, and memory (Soto & Blanco).

The expanding study of attention has provided evidence for the link between selective attention and cognitive performance, as well as neural activity (Posner, 1982). Posner asserts that today's study of selective attention is mainly based on the findings of Donders (1868), Wundt (1912), Sokolov (1963), and Pavlov (1960). Advances in medical science validated the earlier theoretical claims by showing that functional magnetic-resonance imaging (fMRI) and electroencephalograph (EEG) together represent reliable data and imaging techniques that can be used to investigate brain processing systems (Babiloni et al., 2004). An fMRI measures the changes in oxygenation and blood flow in the more activated areas of the brain during a cognitive stimulation with a good spatial resolution (about 2–3 mm). An EEG (Beta brainwaves amplitude between 13 and 30 Hz) demonstrates the increased neural activities (Logothetis & Wandell, 2004) during a cognitive stimulation.

Similar studies such as Anne Treisman's Feature Integration Theory of Attention are widely accepted (Grivas, Down, & Carter, 2004). The feature-integration theory of attention further assumes that in order to be able to recognize and identify a combination of more than one discrete object presented in the visual search, attention needs to be directed in a serial form to target the feature (Treisman & Gelade, 1980). Kyle Cave's Feature Gate model builds on Treisman's ideas and proposes two mechanisms of visual selection, bottom-up and top-down, which roughly correlate with unconscious and conscious attentional selection, respectively (Theeuwes & Burger, 1998). The Feature Gate model suggests that visual search tasks include just a few critical characteristics with different feature maps that after the first step of processing will be incorporated into a saliency map. This saliency map once retrieved functions to further direct attention to target the most prominent event at hand. It is important to note that many other ideas related to visual selective attention were based on principles of Treisman's feature integration theory, such as Jeremy Wolfe's guided search, and others highlighted in studies conducted by Bundesen (1990) and Quinlan (2003).

As it previously is defined, selective attention is a state of consciousness, which involves focusing on a specific aspect of a scene while ignoring other aspects (Rees, Russell, Frith, & Driver, 1999). Visual Concentration Attention Techniques (VCAT) is a form of selective attention based on previous studies in this field. Eye movements often play an important role in visual attention, but it is essential to understand that shifting attention can also happen without moving the visual focus to stimulate the brain for higher neural activities (Rees et al., 1999), as VCAT does. To illustrate this, please pay close attention to the following demonstration (Figure 1) taken from Pinel (2006).

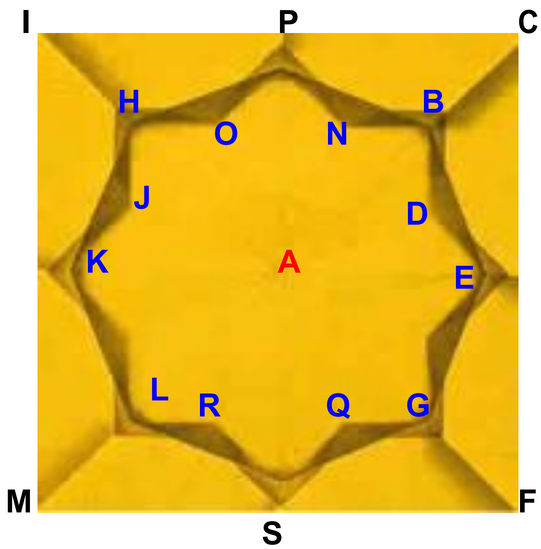
Figure 1: Illustration of Visual Selective Method



In this demonstration, the participant "fixes his gaze on the + and concentrates on it. Next, participant shift his attention to one of the letters without shifting his gaze from +. Then, participant will shift his attention to other letters, again without shifting his gaze from +" (Pinel, 2006, p. 183).

There are other models and designs, which are related to selective attention that provides similar outcomes to those of Visual Concentration Attention Techniques (VCAT). The fixed-capacity independent race model (FIRM) (Bundesen 1987), the theory of visual attention (TVA), the neural theory of visual attention (NTVA) (Bundesesn, 1990; Compton & Logan, 1993), the CODE theory of visual attention (CTVA) (Logan & Gordon, 2001), executive control of TVA (ECTVA) (Logan, 2002), and instance theory of attention and memory (ITAM) (Logan, 2002) are the main models. Each will be described in detail as part of the literature review in Chapter 2.

The whole theory of visual selective attention is unraveled by VCAT. Beginning with very basic steps through to highly sophisticated steps, VCAT uses many different objects as the visual field background with different shapes and colors including optical illusions, fractal images, and stereograms to stimulate the brain for higher activity and optimal functioning. As described in the literature review VCAT optimizes the brainwaves' patterns and neural performance leading to regeneration and restoration of brain cells that improve cognitive abilities, memory, concentration, and attention. See figure 2 for a demonstration that illustrates the basic structure of VCAT: (Figure 2). Figure 2: Demonstration of a basic structure of VCAT with Selective Attention



As the first step, the participant is instructed to fix his/her gaze on center point A and to concentrate on A for 5 seconds (equal of counting from 1 to 5). The second step is to shift his/her attention to the right, to the letter B, while ignoring all other letters without shifting his/her gaze from A, concentrating on B for 5 seconds and back to center point A. Next, the participant is instructed to shift his/her attention from center point A to C, while ignoring all other letters (including letter B) without shifting his gaze from A. The participant is instructed to concentrate on C for 5 seconds and back to center point A again. The participant goes on repeating the same steps for each and every letter (B, C, D, E, F, G) on the right side of the center point A. Then, the participant fixes his gaze on center point A, concentrates on it for 5 seconds, and shifts his/her attention to the left, to the letter H, ignoring all other letters and without shifting his/her gaze from A, concentrating on H for 5 seconds and back to center point A. Next, the participant shifts his/her attention from center point A to I, ignoring all other letters including letter H without shifting his/her gaze from A, concentrating on I for 5 seconds and back to center point A again. The same steps are repeated for each and every letter (H, I, J, K, L, M) on the left side of the center point A. Now, the participant will do the same exact steps upward for letters N, P, and O, P from center point A. Last but not least, the participant does the same exact steps downward for letters Q, S and R, S from center point A.

In this VCAT process, participant experiences two types of attention – covert and overt. The participant experiences covert attention when there is a shift of visual attention without corresponding eye movement. A change in visual attention that involves a shift in gaze is called overt attention (Rees et al., 1999).

Statement of the Problem

Adult ADHD is a behavioral disorder affecting 2% to 6% of the United States adult population (Weiss & Murray, 2003), and the number of people diagnosed is rising. Given the large number of studies examining effective means for relieving the symptoms of childhood ADHD, there is a surprising void in the progress of effectively treating the underlying mechanisms of ADHD in adults. Individuals displaying characteristics of the inattentive subtype of ADHD lack the ability to focus, or sustain attention, over a specified period of time (APA, 1994). It is the inattentive type that tends to be more prominent among adults compared to the hyperactive-impulsive type (Pierce, 2003).

Throughout the literature, a number of conflicting opinions and nonsignificant results are cited regarding which treatment is most effective in reducing the symptoms of each subtype of adult ADHD (Levin, Evan, Brooks, Kalbag, Garawi, & Nunes, 2006). Medical interventions, such as stimulant or antidepressant medication, may alleviate symptoms, but too often produce adverse side effects. Even among the studies that highlight effective treatment programs for the behavioral issues related to ADHD (i.e., hyperactivity, impulsiveness), what seems to be lacking is the specific examination of the component of inattention as it relates to the DSM-IV (APA, 1994) criteria for the disorder (see Appendix A). Taking this next step in the understanding of ADHD is critical for developing interventions and is a ripe area for further study.

Studies have shown that targeting attention and selective attention as treatments for focusing, concentrating, cognitive, emotional, and affective state disorders (e.g., depression, anxiety, obsessive-compulsiveness) can be effective (Brue & Oakland, 2002). However, treatments or therapies for ADHD have not yet examined the effectiveness of targeting selective attention (Brue & Oakland). The use of VCAT has validated much of the theory regarding the underlying mechanisms responsible for deficits in attention. Furthermore, external attention and selective attention stimuli such as VCAT's visual stimulations have recently been getting a great deal of attention in the medical field. This is evidenced by the increase in neuroimaging reports demonstrating increased blood flow and brain activation during attentional exercises in the brain regions that are implicated in the ADHD disorder, primarily those areas within the prefrontal cortex (Corbetta, & Shulman, 2002).

Budzynski et al. (1999) confirmed that cognitive performance such as memorizing, thinking, learning, and information processing occur through neural networks. Data transfer and communication between neurons takes place via an electrochemical process that carries neurotransmitters to all areas of the brain. That is, an electrical charge is carried throughout the brain by neurons for processing when the brain has been given an external stimulation through "selectivity in attention" in a visual field (Budzynski et al.). This form of data transfer within neural networks creates brainwaves that are accountable for developing and forming the state of consciousness, building memories, and controlling all the mental abilities and performance levels of the brain (Sahelian, 2000). The hypothalamus, the hippocampus, the left temporal and the frontal cortices are considered to be the main processing centers during such cognitive stimulation (Levin, Ben-Hur, Biran, & Wertman, 2005). It is also established through studies utilizing functional magnetic- resonance imaging (fMRI) that memory formation occurs in the medial temporal lobe and the hippocampus (Eichen-baum, 2000). Such neural activity also strongly depends on the transmission process of neurotransmitters between the neurons (Budzynski et al., 1999). For example, irregularities in the transfer data between neurons of the neurotransmitters dopamine, norepinephrine, and serotonin symptoms across synapses predict symptoms related to ADHD (Lacasse & Leo, 2005).

In summary, very few studies have looked at the persistence rate of ADHD, patterns of co-morbidity and long-term use of stimulants and other psychotropic medications from childhood to adulthood in a real-world setting (Wender, 2002). Further, there are very few studies examining the factors associated with sustained diagnosis of ADHD and attentional brain stimulations in treating sustained attention deficit related to the ADHD (Murphy & Barkley, 2005). There remains also an important gap in the current literature regarding the enhancement of sustained attention in treatment of ADHD in adults through attention and selective attention therapy. Therefore, the purpose of the proposed study is to demonstrate the efficiency of VCAT program in treating ADHD symptoms by enhancing sustained attention. Thus, this research will expand on the existing evidence for the important role of attention in treating psychological disorders, and will do so by focusing on selective attention in particular and with the use of the VCAT program. This study will examine the short and long term effect of exercising VCAT program in improving the attentive properties of the thousands of adult men and women who are struggling to manage the symptoms of ADHD. Reducing ADHD symptoms, potentially without the harmful side effects of medications, would provide more safe and convenient choices for adults to manage their ADHD. A substantial decrease in ADHD symptoms would reduce the extensive financial, societal, and familial burdens created by this troubling disorder. What was once a costly and frustrating disorder to deal with may be ameliorated with much more ease than was possible ever before.

Purpose of the Study

This research aims to introduce a brain exercising method that has the potential to stimulate the brain elements to a higher level of activity. The Visual Concentration Attention Techniques (VCAT) is a brain training system that utilizes a visual concentration method by using the visual field to stimulate the brain and is based on selective attention and attention theory (Babai-Siahdohoni, 2007). It is believed to improve brain function by producing higher activity and plasticity, better blood flow throughout the brain tissue, restoration, and the regeneration of neurons. It optimizes brainwave patterns that increase cognitive abilities and trains the brain to produce these activities on its own. Improved brain activities lead to memory improvement and sustained attention, which could also produce gains in focusing and concentration. These are the very mechanisms that underlie psychological disorders such as ADD and ADHD, both of which could be improved by regular use of VCAT (Babai-Siahdohoni).

Nature of the Study

This study may establish that regularly stimulating the brain and mind through Visual Concentration Attention Techniques (VCAT) could lead to treatment of neural and psychological disorders related to sustained attention such as ADHD. While other studies have already asserted the efficiency of such therapy in treatment or reducing mental disarrays, which will be further described in Chapter 3, the goal of this research remains to investigate the outcomes of frequently exercising VCAT on sustained attention in individuals diagnosed with ADHD.

Research Questions and Hypotheses

The following hypotheses will be tested in this study:

Null Hypothesis One: There will be no short-term or long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

Research Hypothesis One: There will be short-term as well as long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

Definitions of Terms

The terms utilized in this study are identified and defined below:

Attention-Deficit/Hyperactivity Disorder (ADHD): Per the diagnostic criteria of the DSM-IV (APA, 1994), an individual must experience 6 of 9 specified criteria for a diagnosis of predominantly inattentive type or must experience 6 of 9 other specified criteria for a diagnosis of predominantly hyperactive-impulsive type. If the individual has experienced six from each of the criteria sets, a diagnosis of combined type of ADHD would be established. In each case, the symptoms must have persisted for at least 6 months.

Attention deficit theory: A collective body of knowledge suggesting that symptoms of ADHD including inattention, impulsivity, and hyperactivity arise primary from deficits in specific executive functions including response inhibition, working memory, executive control, set-shifting, and interference control (Barkley, 1998; Nigg, Butler, Huang-Pollock, & Henderson, 2002; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005).

Cognitive behavioral therapy: A structured approach to therapy focusing on identifying and modifying patient's distorted cognitions (Ramsay, 2002). Patient-therapist interactions involve both cognitive and behavioral-oriented work focusing on changing thinking styles. Sessions may include time management, social skills training, attention management, and self-monitoring. Therapy is time-limited to 8-12 sessions, yet may run longer depending on the severity of the disorder (Young, 1999).

Covert attention: Attending to a given location in the absence of eye movements operates by strengthening the representation of relevant stimuli. This modulation occurs for basic dimensions of visual processing, such as contrast sensitivity (Wright, & Ward, 2008).

Cover Orienting of Visual Attention Task (COVAT): Posner and his colleagues (Posner, 1980; Posner & Cohen, 1984; Posner, Snyder, & Davidson, 1980) developed a valid and reliable measure of the ability to shift one's visual-spatial attention to different areas within a 2D visual field without accompanying eye movements. This spatial cuing paradigm has been termed as the covert orienting of visual attention task (COVAT) and has been influential in the development of psychological theories of visual attention.

Neuron: The functional unit of the nervous system, consisting of the nerve cell body, the dendrites, and the axon (Steadman, 2000).

Neurotransmitter: A specific chemical agent that is released by a presynaptic cell upon excitation that crosses the synapse to stimulate or inhibit the postsynaptic cell (Steadman).

Norepinephrine: A neurotransmitter which is also catecholamine hormone that is secreted in response to hypotension and physical stress (Steadman).

Selective Attention: Selective attention is a state of consciousness which involves focusing on a specific aspect of a scene while ignoring other aspects (Rees, Russell, Frith, & Driver, 1999). It has also been described as a filter selecting relevant information from background stimuli for further processing (Treisman, 1986).

Self-regulation: A set of behaviors (i.e., processes) based on feedback loops whereby internal systems maintain stability of functioning, monitor actions, and adapt to change (Shapiro & Schwartz, 2000; Singer & Bashir, 1999).

Self-regulation theory: Although subject to numerous interpretations and derivatives, general self-regulation theory rests upon the interaction of many complex systems utilizing feedback loops that involve the basic ingredients of standards, beliefs, values, monitoring mechanisms, and inhibition controls that provide the organism the ability to regulate one's own behavior (Baumeister & Heatherton, 1996).

Serotonin: A neurotransmitter classified as a vasoconstrictor that inhibits gastric secretion and stimulates smooth muscle; present in high concentrations on certain areas of the central nervous system (Steadman, 2000).

Sustained attention: The ability to maintain a state of vigilance over prolonged periods of time (Parasuraman, Nestor, & Greenwood, 1989).

VCAT: An external stimulation (neurocognitive) therapy that affects the brain through visual field, a state of consciousness which involves focusing, concentration, and shifting attention on a specific aspect of a scene while ignoring other aspects using optical illusions, fractal images, and stereograms (Rees, Russell, Frith, & Driver, 1999; Babai-Siahdohoni , 2007).

VCAT (Nonclinical definition): Based on visual selective attention, which is defined as the configuration of mechanisms or a design enabling individuals to behave in a way that is being directed by a goal (Tales et al., 2002). An individual can behave as such by means of focusing attention so as to enable the identification of particular regions or items presented within visual arrays according to established goals, while at the same time not minding or giving attention to objects or regions that are not in accordance with the set goals (Tales et al.).

VCAT (Clinical definition): An approach to increasing awareness, concentration, and attention by improving the cognitive and mental processing system, which includes the examination of visual selective attention that includes search tasks (Pavlovskaya, Ring, Grosswasser, & Hochstein, 2002), covert orientation tasks (Parasuraman, Greenwood, Haxby, & Grady, 1992), and priming tasks (Langley, Overmier, Knopman, & Prod'Homme, 1998).

Visual Field: The visual field is the "spatial array of visual sensations available to observation in introspectionist psychological experiments", while 'field of view' "refers to the physical objects and light sources in the external world that impinge the retina ". In other words, field of view is everything that (at a given time) causes light to fall onto the retina. This input is processed by the visual system, which computes the visual field as the output (Smythies, 1996).

Wechsler Adult Intelligence scale-III (WAIS-III): WAIS-III is a norm-referenced assessment battery, which yields three composite IQ scores: Verbal IQ, Performance IQ, and Full Scale IQ as well as four Index scales Verbal Comprehension Index, Perceptual Organization Index, Working Memory Index, and Processing speed Index. The WAIS-III measures the individual’s cognitive memory Index, and is appropriate for adults between the age of 16 years old and 89 years old (Lichtenberger & Kaufman, 2002).

WAIS-III-Digit Span: subtest for measuring attention, concentration, and mental control.

WAIS-III-Digit Symbol – Coding: subtest for measuring visual-motor coordination, motor and mental speed.

WAIS-III-Symbol Search: subtest for measuring visual perception and speed.

Assumptions of the Study

Since the inability to sustain attention, or inattentiveness, is a core component of ADHD, it is assumed in this research that if inattentiveness among adults is treated, many fewer people would be diagnosed with the disorder. We also assume that the selection of participants will be based on an accurate medical history, neurological functioning and psychosocial factors that contribute to the clinical presentation. It is anticipated that more men than women will participate in this research because of the higher prevalence rate of ADHD among men (Arcia & Conners, 1998; Rasmussen & Levander, 2009). In addition, it is significant assumption to this study that adults with ADHD will have the ability to practice visual exercises successfully. That is, even though their inclusion in the study is based upon attentional dysfunction, participants will need to focus and be aware of stimuli enough to perform visual process.

The reliability of the study will be ensured by the use of standardized test procedures together with the well-establish reliability of the WAIS-III Test of Attention for adults. The likelihood of having confounding variables is minimized by having both intervention treatments in a controlled group context. Furthermore, strong external validity is expected, even though the study examines a specific group within the population, based on the mobility of the study to generalize across psychological conditions, and in light of evidence that self-regulation theory applies to many conditions involving behavioral inhibition.

Limitations of the Study

Having an inaccurate diagnosis of ADHD within the sample population would be the most significant limitation to the study. Although the DSM-IV (APA, 1994) criteria will be used in the initial diagnosis, many researchers and practitioners still question its validity in appropriately diagnosing both children and adults. For adults, DSM-IV calls for diagnosis based upon self-report and accurate recall of historical symptoms prior to age of seven. The reliability of such recall reporting would be questionable in any type of research. Other variables including age, demographics, and intelligence will be controlled in the study.

ADHD symptoms overlap with many of the same symptoms of other psychiatric conditions making comorbidity a possible issue for the study. Potentially overlapping conditions include substance abuse (27-47%), Antisocial Personality Disorder (12-27%), Major Depressive Disorder (16-31%), Dysthymia (19-37%), Generalized Anxiety Disorder (24-43%), and Obsessive-Compulsive Disorder (4.3-6.5%) (Barkley, 1998). It is in cases of comorbidity that the chances of inaccurately diagnosing a participant increase. For example, a person may be incorrectly diagnosed with ADHD, leaving another primary condition left undiagnosed, or vise versa. Because of the empirical evidence that attention and selective attention-based interventions improve the conditions of people suffering from stress, borderline personality disorder, generalized anxiety disorder, depression, and obsessive compulsive disorder (Baer, 2003), it will be important not to excluded individuals with these conditions when comorbid with ADHD from the study.

Significance of the Study

This study will consider the use of an intervention method based upon attention and selective attention theories and examine its efficacy within a clinical context. Visual Concentration Attention Techniques (VCAT) is the method that will be investigated, as a non-medication and noninvasive intervention for the problems caused by ADHD. This study is particularly important because it will be the first to use VCAT practices with an adult population diagnosed as ADHD. Given the growing evidence regarding the neurological role in all mental disorders, stimulating the brain and mind may help to alleviate many of the mental disorders that are related to poor neural functioning (Barkley, 1998). Therapies such as VCAT have the potential to improve neural function. The results of this study would certainly have great relevance for a variety of fields, such as clinical psychology, education, neurocognitive science, psychopathology, as well as alternative and complementary therapies.

Although much research exists regarding ADHD among youth, this study will investigate an adult population, for which considerably fewer studies have been published.

In summary, this research effort will examine the effect and outcomes of exercising VCAT in improving the attentive properties of the thousands of adult men and women subjected to the debilitating effects of ADHD. A non-pharmacological treatment of ADHD will move the field toward a positive societal change by reducing the extensive health, financial, societal, and familial burdens created by this troubling disorder. Studies into treatment options such as VCAT and the role of selective attention have the potential to uncover new and effective alternative treatments, which may help the individuals suffering from ADHD learn to enjoy life again.

Summary and Transition

The study of ADHD has largely been on the prevalence of and effects on children. Although the number of adults diagnosed with ADHD has been increasing over the years, the same level of support for research on adults has not been generated. Medication therapy has become the standard treatment within the adult population, yet many assert that traditional psychology and psychotherapy still have a role to play in contributing to the effective treatment of this behavioral disorder. Even with the abundance of research that exists showing effective psychological modalities for the treatment of various disorders, proven therapeutic interventions across clinical domains must continue to be reviewed for their usefulness in treating ADHD. The methods that have been widely researched include cognitive therapy, psychotherapy, personal coaching, computerized attention training, and educational programs (Weiss & Murray, 2003).

ADHD is sometimes difficult to deal with because there does not seem to be a concrete reason as to why or how the disorder may have developed. Continuing research into the etiology of ADHD will not only answer the questions of how and why, but also assist in development of new and improved treatment options in helping adults with ADHD live a better life. Hence, effective treatment options are of great social relevance. The psychological community has an obligation to examine its effective practices in light of new problems being encountered. The proposed study will focus on one of these modalities, VCAT, which has not received the same amount of attention as many of the others listed.

The next chapter contains a detailed review of the various theories contributing to ADHD, their foundations, and a review of contemporary thought contributing to its rudimentary nature. Self-regulation theory will also be discussed, especially in regard to dysfunction and the executive functions controlling attention, as well as its relationship to ADHD. VCAT will be discussed in terms of its basic tenets, thought regarding its role in cognitive process alteration, and an overview of past research examining attention and selective attention practices in the clinical context. Contributions recently provided by the neuroscience community will be reviewed in light of known changes in brain activity resulting from focusing and shifting attention practices. Chapter 3 presents the research methodology, including information on instrument reliability, validity and population sampling criteria.

CHAPTER 2:

LITERATURE REVIEW

In support of assessing the hypothetical relationship between Visual Concentration Attention Techniques (VCAT), attention and selective attention, and cognitive and psychological consequences, a detailed review of neural and attentional pathology, clinical, and psychological literature will be presented. The literature review will also discuss in detail hypotheses regarding the effect of attention and selective attention stimulations to the brain and the sustained attention. The objective of this section is to proceed toward developing a study or research design that explains any significance concerns regarding VCAT in relevance to treatment of sustained attention deficiency as part of ADHD symptoms.

Overview of Attention and Selective Attention

This chapter starts with some debates about theories and designs from neurocognitive and neuropsychological disciplines in the most significant research regarding the effects of attention and selective attention related stimulus to the brain and the mind which have been conducted over the last decade. These studies will provide a brief discussion of some of the components of the brain involving in attention and selective attention, their influence in cognitive processing, sustained attention, and concentration in adults with ADHD. A brief presentation of the family tree and other similar models to VCAT in this section will provide significant support to substantiate the efficiency and the understanding of this new therapy

The following section provides a comprehensive idea and summery review of depressive disorder, its relationship to self-efficacy, and subsequently highlights the assessment and treatment options for such disorder. Next, the topic of Visual Concentration Attention Techniques (VCAT) is introduced with its relationship to attention and selective attention theory, its significant role in improving self-efficacy, and reducing depressive symptoms. Previously conducted research on this concept is revealed, together with concise outline of measurement tools and approaches used in asset testing.

On the end of the chapter, the theoretical basis of Visual Concentration Attention Therapy, attention and selective attention theory, and VCAT's implication in clinical settings are discussed. In addition, recent studies related to this therapy are revealed, followed by a hypothetical linkage between VCAT and cognitive therapy in treating sustained attention as well as supporting the use of VCAT for other psychological disorders.

The search was conducted through Walden University Library using electronic databases PsycINFO, PsycARTICLES, Eric, Mental Measurements Year Book, the International, and Academic Search Premier. Using the key words attention and selective attention theories, cognitive therapy, attentional selectivity therapy, effects of external attentional stimulus to the brain, sustained attention, and last but not least ADHD symptoms. The chosen scientific articles were published within the last 10 years prior to year 2006. Some older articles were also considered based on their importance to the topic of the study.

Interpretation and Purpose of Attention and Selective Attention

According to Pinel (2006), individuals consciously use only a small part of their eyes' visual fields and the brain unconsciously records the rest of stimuli that stimulate their sensory organs and save it to unconscious memory. Most of the time, there is more information in the visual field than the visual system can handle (Lamy & Tsal, 2000). This suggests that attentional mechanisms are crucial to selection of relevant objects for further processing and, perhaps also, to reserve those objects that are irrelevant to present goals (Soto & Blanco, 2004).

According to Fernandez-Duque and Posner (1997), the word attention pertains to various mental abilities such as orienteering to sensory stimuli, maintaining the alert state and orchestrating the computation needed to carry out the complex task of day-to-day life. One of attention's characteristics involves the ability to switch from one task to another for restraining unusual responses to improve decision-making function (Fernandez-Duque, Baird, & Posner, 2000; Fernandez-Duque, 2006). In doing a task, there is an improved response on some visual neurons as compared to a non-focus attention (Parasuraman, Greenwood, & Sunderland, 2002). It has been hypothesized that when the brain responses to different stimulus from the basal forebrain, it modulates the processing of stimuli and associations that may eventually become an effective cognitive performance, which also is the most essential part of perception (Parasuraman et al., 2002).

People only understand a little subset of numerous stimuli that stir up human sensory organs at any time and generally ignore the rest (Voytko, 1996). When this process takes place it is referred to as selective attention (Voytko). As Rensink (2002) stated, there are two ways to focus attention: one is the internal cognitive process (also know as endogenous attention) and the other is the external cognitive process (also known as exogenous attention). Endogenous attention task place through top-down neural mechanisms, whereas exogenous attention takes place through bottom-up (from lower to higher levels) neural mechanisms (Rensink).

One element that plays an important role in visual attention is eye movement; however, it is important to realize that visual attention can be changed without shifting the direction of visual focus (Ress, Russell, Frith, & Driver, 1999). According to Rensink, O'Regan and Clark (1997), some people think if they would look directly at a certain scene, they would have a better awareness of the details of that scene, which could not always be true. The individual would not become conscious about the details of the events, when the "attention is not activated by physical cue" (Rensink et al., 1997, p. 362). There are physical and environmental cues on awareness that would help people pay attention to important events (Grivas, Down, & Carter, 2004).

Visual Selective Attention

Visual selective attention refers to one's ability to recognize multiple objects in cluttered scenes (Tales et al., 2002). An individual can behave as such by means of focusing attention so as to enable the identification of particular regions or items presented within visual arrays according to established goals, while at the same time not minding or giving attention to objects or regions that are not in accordance with the set goals (Tales et al.). Admittedly, however, experts in the field such as Dagenbach & Carr (1984) recognized that both activation and suppression of visual information are governed by rules that are highly complex. Also, as it is suggested by Posner (1980), "It seems reasonable to suppose that orienting in semantic memory will take advantage of these same principles [component processes]" (Posner, p. 22) of attention. This very complexity does not confine the mechanisms in selective attention for the sole purpose of directing cognitive resources for sensory processing (Posner). These mechanisms also serve in orienting the activation and suppression of particular internal representation including words, images, and memories such as those in semantic representation (Posner, Werner-Inhoff, Friedrich, & Cohen, 1987).

Common frameworks for the examination of visual selective attention include search tasks (Pavlovskaya, Ring, Grosswasser, & Hochstein, 2002), covert orientation tasks (Parasuraman, Greenwood, Haxby, & Grady, 1992), and priming tasks (Langley, Overmier, Knopman, & Prod'Homme, 1998). Priming tasks in turn refer to the kind of task that pave the way for examining opposing facilitative and inhibitory mechanisms that are intended to operate in the course of normal selective attention (Dagenbach & Carr, 1994). In this connection, the enhancement of the relevant target is tantamount to facilitation, and with suppression of distractors is tantamount to inhibition. These two opposing functions are both active in efficient selection of the target (Dagenbach & Carr).

Instruments Used in Measuring Brain Activities

Electroencephalograph (EEG) is an instrument that measures the brainwaves, which determine the performance levels of the brain and its overall mental abilities that are largely governed by an individual's state of mind (Wagner, Ball, Schreiber, Feige, Lucking, & Kristeva-Feige, 1999).

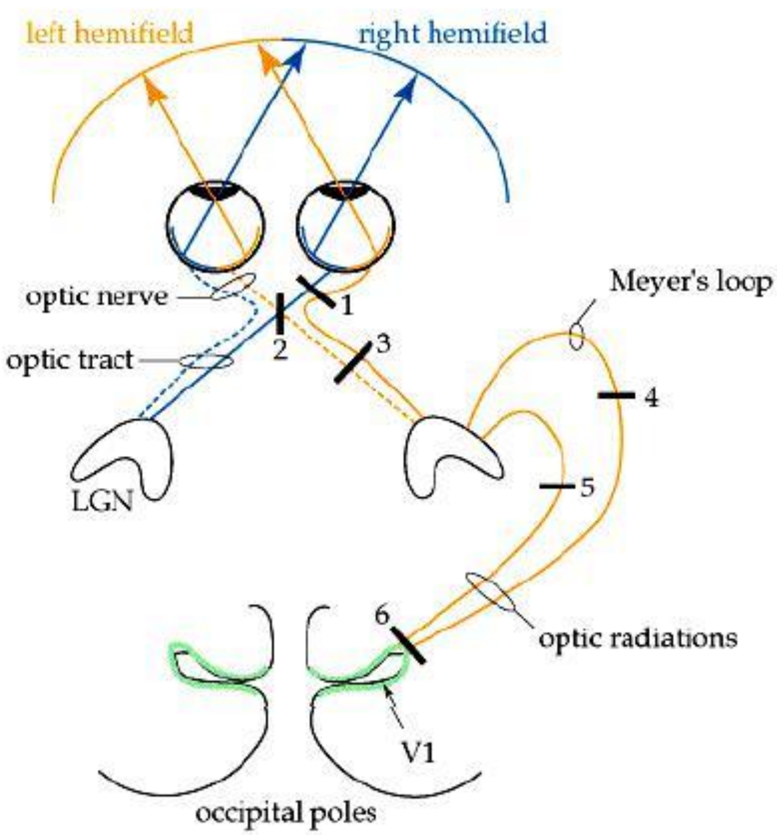
Functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) are the main instruments used for monitoring brain activity (Cabeza & Nyberg, 2000). The predecessor of fMRI is the MRI, which is formerly used to acquire structural images of the brain; however, fMRI is much more reliable than the previous one because this instrument can generate images of brain activities and not just images of brain anatomy (Squire, 1992). The major characteristic of fMRI is its ability to measure and capture images of the oxygen rich blood and deoxygenated blood flow in the brain (Cabeza & Nyberg, 2000). The human body contains a large volume of water formed by oxygen and hydrogen molecules. Hydrogen particles are presented as positively charged protons, which spin and produce magnetic fields with specific waves (Aine, 1995). The MRI uses these powerful magnetic fields, radio frequencies, and computers to generate images of brain elements or other internal body structures (Aine).

Primary Visual Cortex and Its Connections

According to the study conducted by Gandhi, Heeger and Boynton (1998), external attentional stimulus coming from the right or the left half of an exhibit would affect the brain activity in visual cortex in the way that the stimulus coming from the left side would be processed by the neurons in the right hemisphere and those from the right side would be process by the neurons in the left hemisphere.

In order to make sure that signals from both eyes go to both sides of the brain, axons travel away from optic nerves to optic chiasm inside half of each hemisphere, cross over to the other half, and project to the opposite half of the brain. The first part of signals that are on the main visual pathway going to thalamus will process as visual signals for the occipital lobe that make up the primary visual cortex and send these signals to the temporal lobes for continued processing. The other part of signal taking the second visual pathway leaving the optical chiasm are divided in midbrain and the area of the superior colliculus, whose function is the coordination of visual input with other sensory input before sending the signals to thalamus and occipital lobe.

Figure 3: Presentation of Primary Visual Cortex and its Connections



The lateral geniculate nucleus (LGN) of the thalamus and the thalamic reticular nucleus (TRN) are the main pathways in which visual data travels to get to cerebral cortex (McAlonan, Cavanaugh, & Wurtz, 2006). Visual information is sent from both the thalamus and cortex in the form of topographically systematizes signals to TRN, where these signals are processed as organized projections and sent back to the thalamus (McAlonan et al., 2006).

Striate cortex (V1) is the main provider of visual input to posterior visual cortical areas, which includes the V2, V3, V4, superior colliculus, lateral geniculate nucleus, and pulvinar nuclei of the thalamus (Robinson & Petersen, 1992).

According to Robinson and Petersen these pathways in the posterior visual cortical areas are in charged for controlling and instigating eye movements that would generate conscious visual awareness.

Figure 4: Presentation of Primary Visual Cortex and its Connections in the Brain

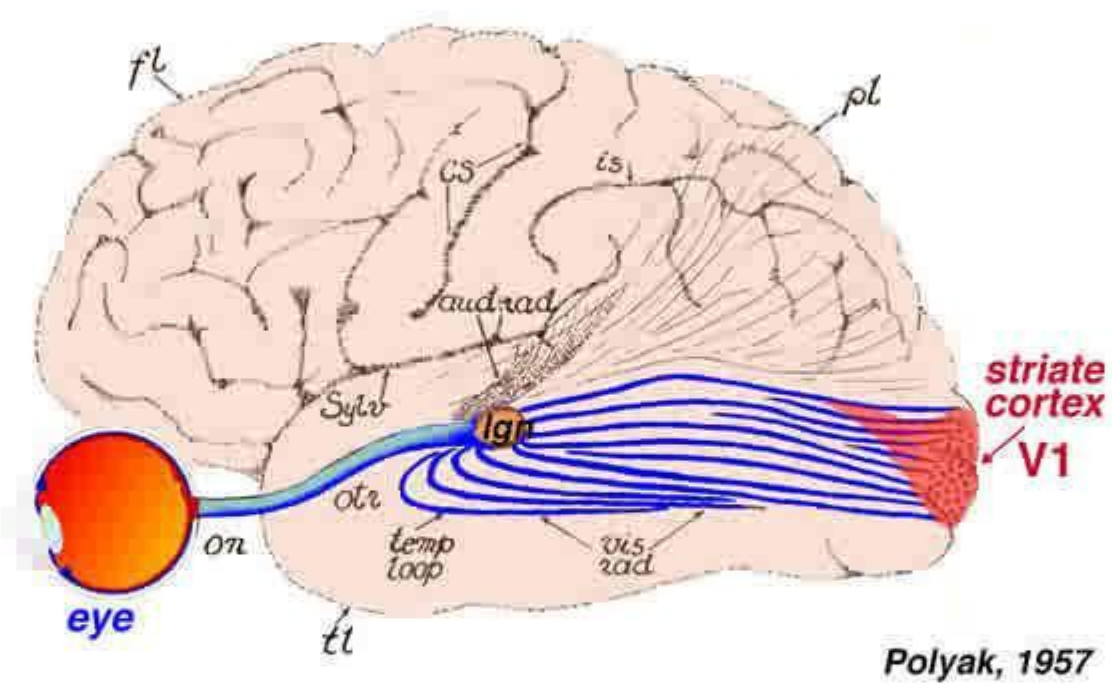


Figure 8. Visual input to the brain goes from eye to LGN and then to primary visual cortex, or area V1, which is located in the posterior of the occipital lobe. Adapted from Polyak (1957).

Brain Areas Involved in Attention and Selective Attention Activities

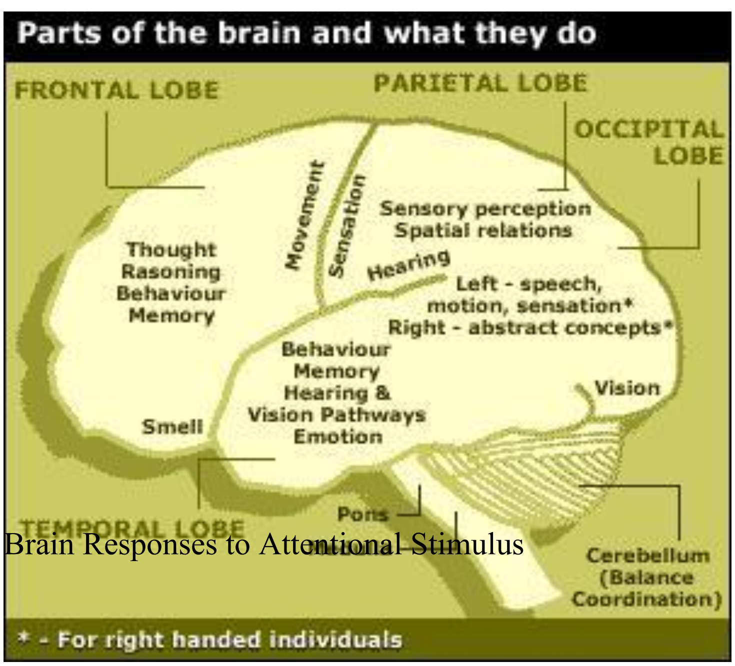
According to Blakeslee (1999), the brain is a very complex organ that contains many areas. Some of the areas involved in attention and attentional selectivity are brain stem, cerebral cortex, and cerebellum. Memory and emotion as well as all of the individual's conscious and unconscious experiences take place within the brain, where some experiences are stored and some are forgotten (Blakeslee). The part of the brain that is responsible for oculocomotor activities and movement is the cerebellum (Paulus, Magnano & Conti, 2004).

Paulus et al. (2004) stated that complex motor activities such as writing or swimming will not be possible if the cerebellum is not functioning. However, the cerebellum is not only limited to controlling motor movement, its function can be extended to the thought processes and emotions of the individual. Findings of empirical research suggest that cerebellum damage could cause emotional and mental difficulties (Paulus et al.). Another important part of the brain is the thalamus. According to Levin et al. (2005), the thalamus is a large and deep structure that located in the middle of the brain. This part regulates many components of arousal and mutual relay between other brain functioning. It is located in the central part of the brain and is also responsible for a wide range of functions such as language, happiness, and the experience of despair (Levin et al.).

The basal ganglia, which includes the neostriatum, the globus pallidus, and the substantia nigra, is responsible for some emotions such as impulsiveness and some motor activities (Petty, Bonner, Mouratoglou, & Silverman, 1996). If the basal ganglia are impaired, the individual will manifest loss of control of some important motor functioning (Pickett, Kuniholm, Protopapas, Friedman, & Lieberman, 1998). This part of the brain works in coordination with the frontal lobe to better process perceptual experiences (Baxter, 2003). The temporal lobe is another part of the brain that is responsible for the proper functioning of language, rhythm, and expression (Soussignan, Ehrle, Henry, Schaal, & Bakchine, 2005). The temporal lobe is also important for the visual recognition of memory and it enables the organism to respond to the perception of what is seen and smelled. The uppermost responsibility of the temporal lobe is to sense danger and assess opportunities in the environment (Amaral, 2003). Electroencephalograph (EEG) studies show that the temporal lobe is activated when the organism is viewing scary situations or images but it is not activated when the organism is only exposed to simple images (Amaral).

The anterior cingulate gyrus is another part of the brain that participates in many features of high profile brain functioning and working memory (Richer, Boulet, Maheu, Achim, & Chouinard, 2002). Thus, this part of the brain is responsible for the retrieving of short-term memory and also plays an important role in sustaining against changing expectations, shifting set, and also for evaluating instructions to make the individual know what to do next (Richer et al., 2002). The prefrontal cortex integrates and manages the purposeful functioning of most the other brain structures, including receiving data and providing mutual regulatory control of many of the brain areas (Baxter, 2003). While some of the brain areas perform primary processing of data, the frontal lobes interpret and provide meaning to these experiences (Pickett et al., 1998). According to Pickett et al. (1998), the pre-frontal cortex is the center of all brain functioning, which also is responsible for decision-making. In the frontal lobes relevant integration is required to be able to put a bridge between long term goals and specific sections required at the moment and to issue these objectives into purposeful behavior. Though these cognitive processes are described seemingly in sequence pattern, in reality they occur virtually simultaneously (Pickett et al).

In summary, the frontal lobes are assumed to be one of the most important parts of brain involving cognitive function such as impulse control, judgment, language, memory, motor function, problem solving, ability to plan and execute complex tasks, and sexual behavior and socialization (Squire & Knowlton, 2000). The cerebral cortex is associated with perceptual functioning, and the superior temporal sulcus (STS) is concerned with interpretation of biological motion, which is elicited by movements of the eyes, mouth, hands, and body (Allison, Puce & McCarthy, 2000). Figure 5: Illustration of Brain parts involving Attentional Responses.



Brain Responses to Attentional Stimulus

According to Hillyard and Anllo-Vento (1998), there is recorded increased in electrical brain responses over left and right visual cortex when the participant is given instruction to direct attention towards appropriate contralateral side of space. With the use of neuroimaging techniques, studies show that stimulus-evoked potentials from cortical sensory areas are strongly affected by attention with enhanced electrical brain responses when participant focused attention to stimuli indicative of gained control in sensory neocortex. One good example of a typical study is the one conducted by Liu, Slotnik, Serences, and Yantis (2003) where participants were presented with a series of red or green dots moving either to the left or to the right serving as stimuli. A cue in instruction before each stimulus served to indicate the basis of the participant's response: Was the response based on the color or was it based on the direction of the dots? In a cue instruction in which participants were directed to give attention to the color amidst the presence of both color and motion in all arrays of stimulus, the fMRI activity in terms of color-sensitive regions (V4) showed enhanced brainwaves. The same thing happened when participants were instructed to attend to the direction of the motion while both motion and color were presented in the stimulus arrays.

The fMRI technique revealed increased activity in the motion-sensitive regions (Liu et al., 2003). There are also other studies conducted by Kastner, Pinsk, Weerd, Desimone, and Ungerleider (1999) with findings showing evidence for the biasing signal before the presentation of stimulus as well as observations revealing that regions of the frontal cortex becoming active before the presentation of expected stimulus.

The Effect of Attention and Selective Attention to the Brain

The Effect of Attention and Selective Attention Stimulus to Neurons

The construction of neural network plays a crucial role in the facilitation of learning and critical thinking processes based on the study conducted by Budzynski, Jordy and Budzynski (1999). According to this study, neural network refers to the function of brain system involving brain cells called neurons that are communicating with each other through an electrochemical process in which neurotransmitters carry message/s from one neuron to another across a synapse. This communication starts from external stimuli or information coming in through the senses such as hearing, seeing, smelling, feeling (touch), tasting, and others that affect appropriate neural connection, thus initiating activity. The brain in turn responds to given stimulus by discharging electrical energy or charge. Cortical evoked response is produced in the process (Budzynski et al., 1999).

The evoked responses use the neurons as vehicle to travel throughout the brain in order to form the object of respective stimulus. For example, sense of the sight, or what we see; the sense of touch or what we feel, and so on. Aside from the evoked response, there are brainwaves being created within the process of transmitting electrical communications in between neurons, which also raise the blood flow through out the brain (Budzynski et al., 1999).

Attention affects neuron's firing rate by increasing the coherence between neuron's responses to the same stimuli (McAdams & Maunsell, 1999b). Attention, therefore, serves as a multiplying factor of cortical neurons thus speeding up its functions (Corbetta, 1998). The application of this concept enables the measurement of an individual's attention to stimuli through the use of functional magnetic resonance imaging (fMRI) (McAdams & Maunsell, 1999b). For example, according to Motter (1993), a participant instructed to give attention to one or another location in a visual scene, fMRI showed an enormous increase of neural activities in human primary visual cortex (V1). Thus, neural mechanisms involved in attention biasing in the studies involving human participants have been described using electrophysiology and functional neuroimaging (Motter). The seat of activation of attention biasing that could be in the visual or auditory cortices has been the focus of most studies in this regard; in fact there were some earlier investigations conducted employing event-related potentials in order to show the enhancement or increase in electrical brain responses by having participant focusing attention towards appropriate (contra lateral) side of space (Boynton, Demb, Glover, & Heeger, 1999). The study on this particular participant matter has evolved with the introduction of blood flow-based neuroimaging techniques like the functional magnetic resonance imaging (fMRI) and the positron emission tomography (PET) (Shulman, Corbetta, Buckner, Fiez, Miezin, Raichle, & Petersen, 1997). These techniques have enabled a more efficient demonstration of the process involved in neural activity enhancement by attention (Boynton et al, 1999). In particular study, wherein participants are instructed to direct attention to particular dimension of a stimulus that could be from a number of sensory regions including color, motion, and face responsive regions of visual cortex, has shown that neural activity demonstrated through such techniques is enhanced (Hillyard & Anllo-Vento, 1998). This study therefore, suggests that there is a gain of control in sensory neocortex given the condition.

The Effect of Attention and Selective Attention Stimulus to Brain Waves

Attention and attentional selectivity stimulus affect neuron's firing rate and raised the brain waves (Hillyard & Anllo-Vento, 1998). Brain waves are electrical discharges originating from the brain in response to external stimulus such as attentional discriminations (Becker & Holtmann, 2006). According to Becker and Holtmann, brain waves are categorized in four waves ranging from high amplitude to low frequency. Frequencies are measures of the firing speed (pulse speed) of neurons/networks. They are measured in pulses per second. One pulse per second is one Hertz (Hz).

Becker and Holtmann describe these four brain waves as follow:

Slow Frequencies

Delta (0.5-3.0 or 0-4Hz). Primarily found during deep sleep; high waking levels can indicate a lesion.

Theta (3-7 or 4-8Hz). Normally seen during hypnagogic states (waking up/falling asleep); also important to memory consolidation. Thinking is image-based and creative-intuitive.

Middle Frequencies

Alpha (8-11 or 8-12Hz). Mental stillness, pure awareness without processing; should center on 10Hz for adults.

SMR/LoBeta (12-15 or 12-16Hz). Physical stillness. body presence. Body often feels heavy and warm, low muscle tone.

Fast Frequencies

Beta (15-18 or 16-20Hz). Detail-oriented processing. Language, logical-rational thought.

Beta2 (19-22 or 20-24Hz). Extreme engagement, highly focused, curious; may be experienced as anxious.

Hibeta (23-38 Hz). Hyper-vigilance; extreme anxiety; generally relates to PTSD or abuse history.

The study conducted by Lubar and Deering (1981) has established that the lack of adequate Beta1 (SMR - short for sensory motor rhythms) brain waves is the cause for deficiency in concentration and maintaining attention. Lubar and Deering's study also demonstrated that people with attentional deficits show strong signs of slow brain waves. Enhancing the Beta1/Theta ratio by increasing Beta1 (focused concentration) and decreasing Theta will improve concentration in children diagnosed with attentional and learning deficiency. This improvement in concentration can lead to enhancement of school performance and behavior control. Lubar (1985) also proved through neurofeedback sessions that people could improve concentration by using the feedback coming through an Electroencephalograph (EEG) to elevate Beta1 waves.

Another study conducted by Linden, Habib and Radojevic (1996) showed that such feedback treatments in improving Beta1 waves increases IQ scores, which is a proof of the significant effect of improved Beta1waves in enhancement of cognitive functioning and intelligence. EEG biofeedback exercises in improving and learning to normalize Beta1 brain waves has been suggested to decrease seizure symptoms in people with epilepsy disorders (Lubar & Deering, 1981).

The Effect of Attention and Selective Attention Stimulus to Brain's Blood Flow

When an individual is paying close attention to an object, the neural activity (neural responses and signals) in the brain is heightened (Murray & Wojciulik, 2004). According to Murray and Wojciulik, blood flow increases in the area around the occipital lobe (the part of the brain responsible for vision) will cause the individual to experience clearer vision or sharper visual responses. Likewise, the ability to perceive what is seen is also enhanced (Murray & Wojciulik). Functional Magnetic Resonance Imaging (fMRI) is used to study the areas where attention and visual processes are found. Scientists have shown that these areas of the brain increase in blood flow when the individual focuses on a certain task. These findings prove that attention and visual stimuli are directly related to each other (Wagner et al.). For example, in the study conducted by Corbetta et al. (1998), fMRI and surface-based representations of brain activity were used to evaluate working structure of two activities, which were involved in "covert shifts of attention to peripheral visual stimuli, attentional, and saccadic shifts to the same stimuli" (Corbetta, 1998, p. 762). In this study, fMRI showed that in each task all the areas of networking in parietal, frontal, and temporal lobes were extremely active. The result suggested that "attentional and oculomotor processes are tightly integrated at the neural level" (p. 762), which improves perceptual and cognitive activities. This study also demonstrates that paying close attention to an entity might indeed improve "perception by increasing the selectivity of neuronal subpopulations in higher visual areas" (Corbetta, 1998, p. 763).

The Effect of Attention and Selective Attention on Memory

According to Palmeri & Gauthier (2004), memory performs supporting functions in recognizing objects and categorizing perceptions. In view of Dougherty, Gronlound and Gettys (2003), memory supports decision-making. Also, memory is a process that influences attention. Memory is modified by expertise (Chase & Simon, 1973), and effects how a person reads (Zwaan, 1994), speaks (Goldinger & Azuma, 2004), and plans (Gronlund, 2005). As Gronlund emphasized memory is vital for most individual's functioning in almost every facet of day to day living. However, despite the vastness of human memory's scope brought about by the supply of vast amount of memories and a magnitude of sensory input being processed by the brain, a person can only have access to limited or small amount of information at a time (Pashler, 1998).

According to Pashler, many theories on memory and attention focus on this very selectivity of the brain process building upon the idea or notion of limited capacity. In this notion of limited capacity as applied to theory of attention, it is commonly assumed that there are particular processes that can only be applied to one or few, or even limited features of perceptions, one or few objects, or events simultaneously (Pashler).

In terms of working theories on memory, there is an assumption that only a small number of chunks or representational elements that can be maintained in a highly accessible state at the same time (Miyake & Shah, 1999). With this assumption, a framework integrating attention and memory has been developed (Cowan, 1988, 1995) with a core concept focused on attention having limited capacity of about four elements (Cowan, 2001). The four elements comprised representations in long term - memory (LTM) made active through perception or through memory processes.

As previous studies failed to address the type of memory as whether short or long term mediating in the process of producing mental images, current study conducted by Ishai, Haxby and Ungerleider (2002), purposely investigated the neural correlates in relation with imagery generated from short and long term memory (STM and LTM). This study employed known faces to localize the visual response perception, and at the same time to make comparisons on the responses, while visual imagery was being generated from STM and imagery from LTM. For the STM study participants were directed to memorize presented pictures of specific celebrities before the task, while for the LTM participants were instructed to just imagine known faces or faces of celebrities without being presented with specific pictures during the experimental session. Data findings revealed that famous faces when visually perceived caused to activate and affect the inferior occipital gyri, lateral fusiform gyru, the superior temporal sulcus, and the amygdala . Face - selective regions as well as their small subsets and the hippocampus were also activated by the visual imagery test (Ishai et al., 2002). The STM experimentation has established that visual imagery produced by STM brought about greater activation in all of the regions mentioned compared to the imagery from LTM (Ishai et al.).

A framework of working memory (WM) typically focuses on two salient aspects of the process. One aspect points to the sharply limited storage capacity of working memory system. This notion has expounded by Miller (1956) in his article on the magic number seven (plus or minus two). Other estimates of working memory's capacity somewhat differ in terms of modalities and types of stimulus. However, there is an agreement that working memory's capacity is limited with considerably lower number of items falling to three or four than the one proposed by Miller (Cowan, 2001). Another aspect of the process points to the crucial role of WM's activation and maintenance for multiple complex cognitive operations covering vastly varied functions such as language comprehension, problem solving, and cognitive control particularly suggested by nearly every large-scale model of cognition (Miyake & Shah, 1999). Therefore, it is necessary to maximize the efficiently use of the limited capacity of WM resource in terms of information processing required in ensuring the success of multiple cognitive performance. Failure to do so may cause a widespread deficit in cognitive functioning (Miyake & Shah). Thus, impairment in the efficient use of WM resources resulting in widespread performance deficit has been an idea used by researchers in hypothetically explaining certain disorders such as schizophrenia (SC) (Barch, 2005).

According to Barch, schizophrenia is about deficit performance in a wide variety of cognitive domains, which is caused by the impairment in the efficient use of WM limited resource or capacity. It is not only impairment in the efficient use of WM resources being hypothetically used to explain SC, but also impairments in attention as a core cognitive deficit in SC (Zubin, 1975). It is also believed that impairment in attentions may be somewhat related with impairments in WM. This is so because of the vital role that attention plays in the selection and transfer of task relevant perceptual representations going into WM, and also because the effective use of attention is the basis of the efficient use of WM.

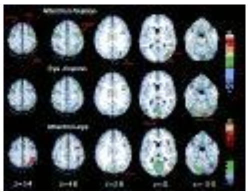
Another study conducted by Sperling (1960) on memory showed that selective attention could guide WM encoding. Likewise, Averbach and Coriel (1961) experiments demonstrated the influence of attention-directing cues to the pieces of information retained from brief visual displays. Thus early evidence was provided through experiments that showed cues presented shortly after the offset of target arrays guiding selection. This selection was a manifestation of attention operating at a late, post perceptual stage of processing in this particular type of task (Averbach & Coriel). Meanwhile, contemporary research of Woodman, Vecera and Luck (2003) has revealed that the selective transfer of representations into WM can be influenced by top-down as well as bottom-up cues. This means that encoding in WM could be under the control of volition with the participant's goal serving as a guide or could be under the influence of very important features of perception that in turn capture attention in a somewhat automatic manner (Woodman, Vecera, & Luck).

Neuroimaging Evidence of the Effects of Attention and Selective Attention to the Brain and its Components

Neuroimaging illustrations and fMRI studies have shown that when individuals pay close attention to a variety of external visual stimulations and try to detect or shift attention during oculomotor localization tasks, the frontal lobe, and the parietal and frontal cortex of the brain are highlighted and exhibit a significant increase in neural activity (Corbetta, 1998).

The neuroimaging studies conducted by Martínez et al. (1999) demonstrate that attentional stimulus and shifting attention to any direction from a specific focus point in the visual field will increase neural network activities in various parts of brain and effect changes in brain waves. According to fMRI study in attentional takes conducted by Martinez et al. as shown in figure 1, increased neural activities in regions of parietal and frontal lobes, regions near intraparietal sulcus (IPS), precentral sulcus (PrCeS), posterior end of superior frontal sulcus (SFS), medial frontal gyrus (MeFG), middle frontal gyrus, and frontal operculum were localized bilaterally. In addition, some more neural activity has been detected in the area of the right hemisphere in lateral occipital cortex (LO), human middle temporal (MT) complex, near the superior temporal sulcus (STS), and more dorsally at the junction between intraparietal and transverse occipital sulcus (IPS/TOS).

Figure 6: Demonstration of increased neural network activities



When individuals shift their attention to the left in the visual field, the neural activities increase in the right hemisphere and likewise, shifting attention to the right side in the visual field will affect the neural activities in the left hemisphere (Martinez et al., 1999).

Figure 7a and b: Increased activities in the right (RH) and left (LH) hemisphere

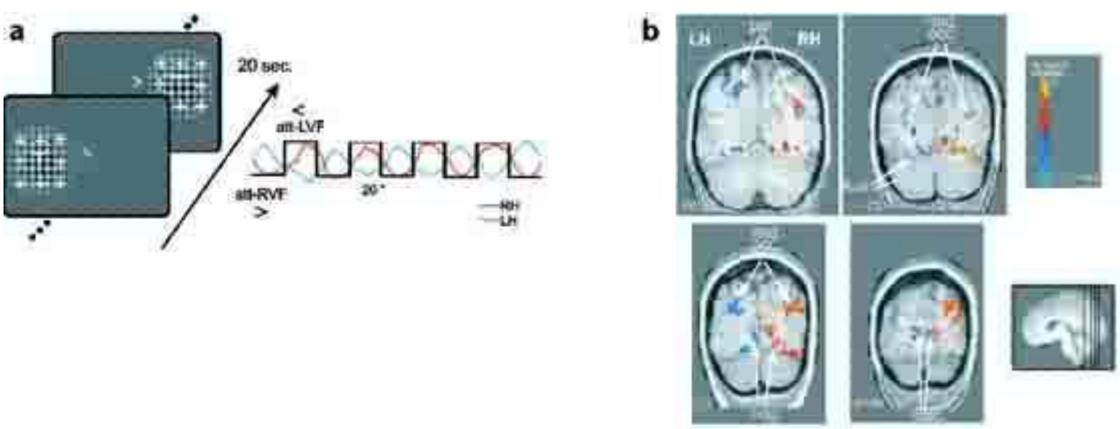
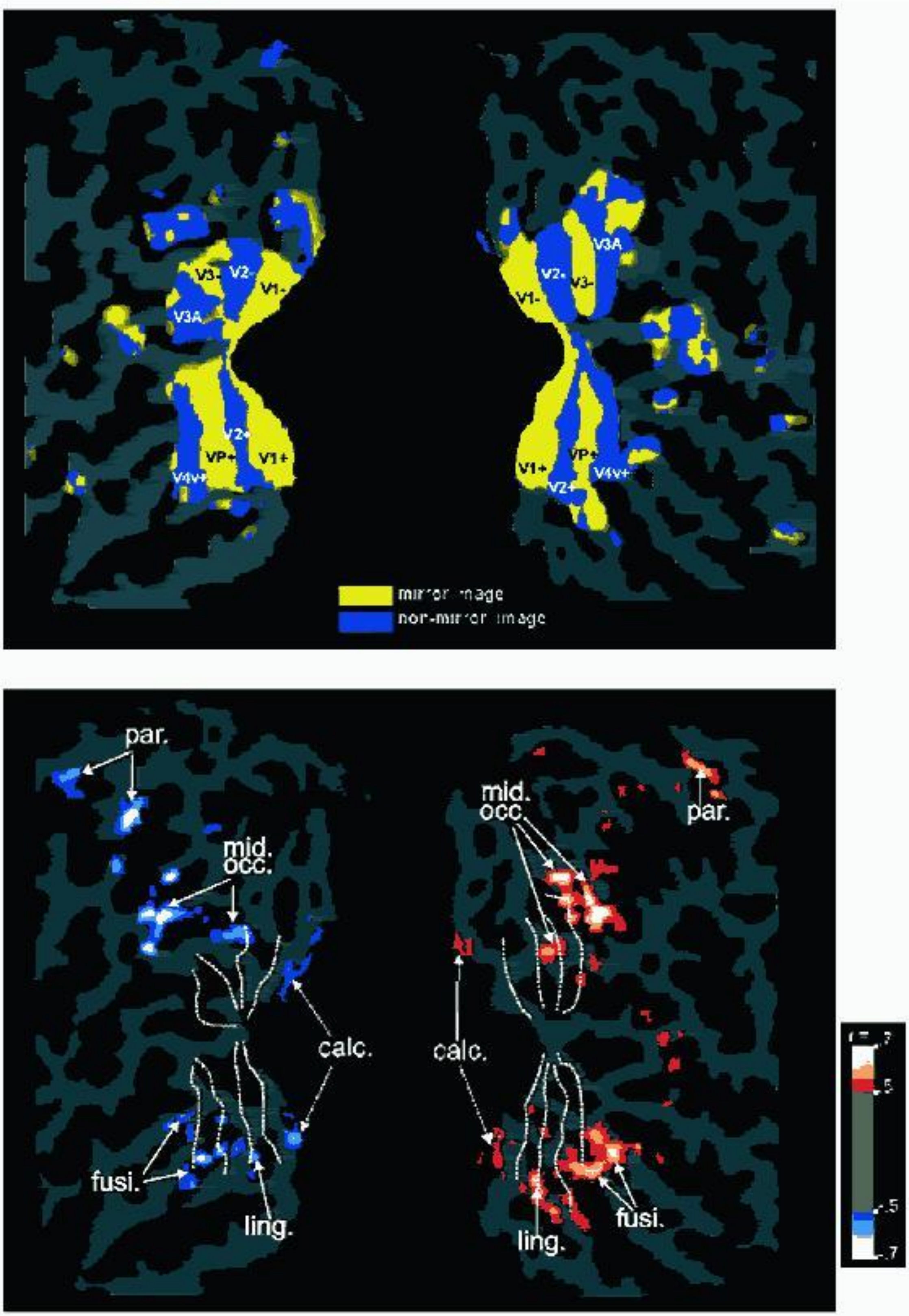


Figure 7a shows the changes in striate cortex of the right (RH) and left (LH) hemisphere, while subject is presented to attentional stimulus. There are five notably stimulate pixels to see.

Figure 7b presents colored anatomical pictures from coronal slices related to attentional stimulation. Left side represents the LH and right side the RH. Red to yellow scale shows the attentional stimulus from the left visual field, and dark-to-light blue scale presents the attentional stimulus from the right visual field. Spatial attention has activated the calcarine fissure (calc.), lingual gyrus (ling.), posterior fusiform gyrus (fusi.), middle occipital gyrus (mid. occ.) and posterior parietal lobe (par.).

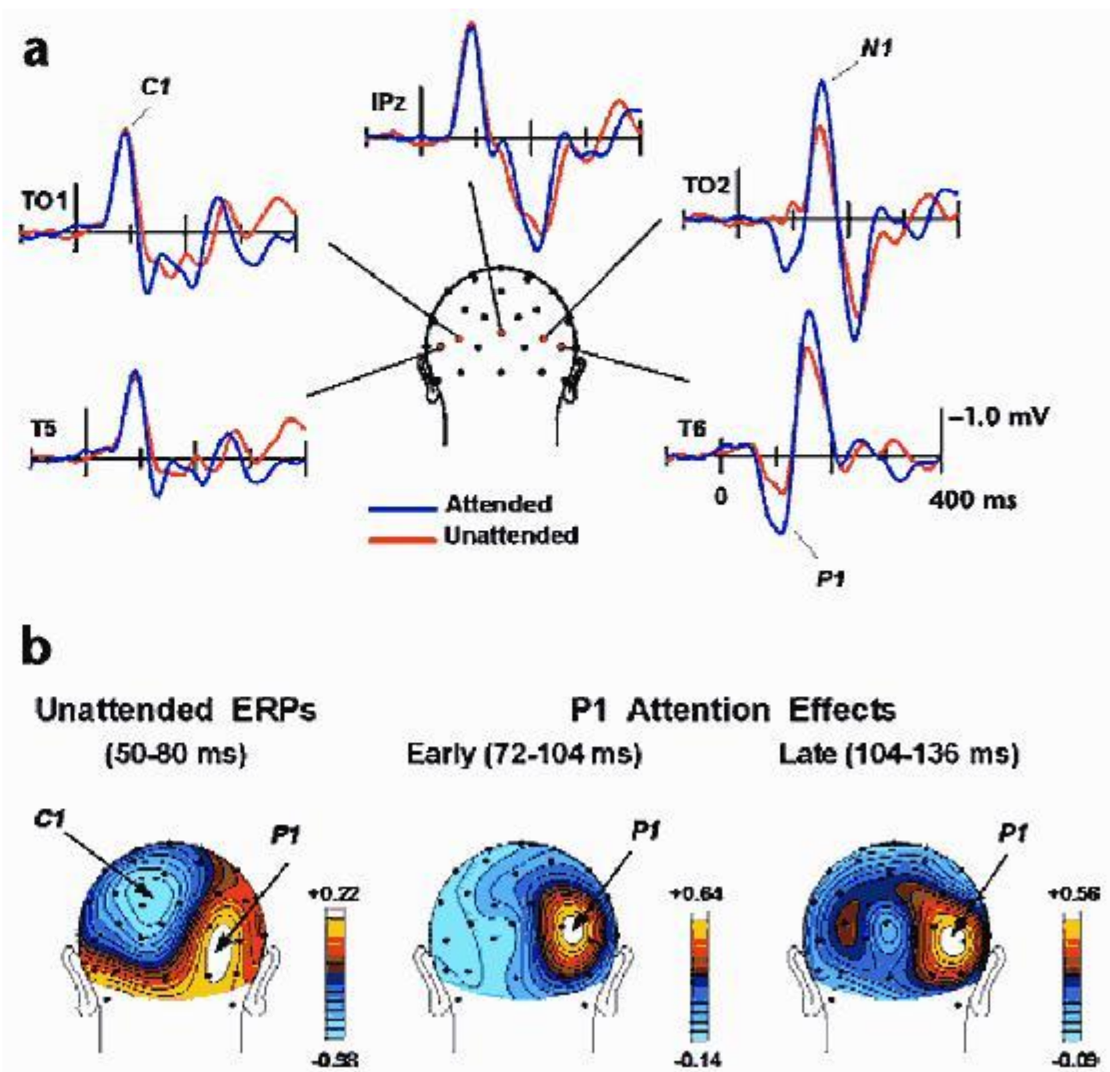
According to Martinez et al. (1999), during an attentional shifting to the left of visual field the red areas are the sign of increased neural activates and blue areas for the increased neural activities related to the light shifting of attention in the visual field. These following regions are activated by inattention interation: The middle occipital (mid. occ.) region included the superior and inferior divisions of the middle occipital gyrus and associated sulci (lateral occipital and lunate). V1 is the striate cortex and V2, V3, and V4 are the extrastriate cortical regions.

Figure 8a and b: Grand-averaged Event Related Potential (ERP) waveforms and scalp topographies


V3-
V2-
V1-
V3A
V2+
VP+
V1+
V4v+
V3A
V2+
V3-
V1-
VP+
V1+
V2+
V4v+
mirror image
non-mirror image
par.
mid.
occ.
calc.
fusi.
ling.
mid.
occ.
par.
calc.
ling.
fusi.
.5
-.5
-.7

The participant has been presented to a standard stimulus to the left visual field and an elicited stimulus to the right visual field for the measurement of the brain waves. The results are readable from the electrodes at occipitotemporal (TO1/TO2), temporal (T5/T6) and occipitoparietal (IPz) sites.

Figure 9a and b: Development and Regeneration of Brain Cells and Neurons



Latest neuroscience discoveries and studies have revealed that areas of the human brain are capable of developing and regenerating new cells and neurons. According to Gould, Beylin, Tanapat, Reeves, and Shors (1999) and Gross (2000), the regeneration of neurons in the human brain occur in the area of cerebral cortex and the outer portion of the brain that are responsible for learning, thoughts, decision-making, and daily intellectual functioning.

Edelman (1987) in his "neural Darwinism" or Levi-Montalcini and Calissano (1979) used Nerve Growth Factor (NGF) to explain the regeneration of neurons. According to Edelman (1987), in order for neurons to function accurately, a better blood flow though out the brain is needed to supply oxygen and necessary nutrients to neurons for maximum plasticity and neural functioning. One neuron can connect to almost thirty-five thousand other cells within the brain. As neurons' activities become more intense they build more connections and sprout dendrites that connect between the neighboring brain cells, where they develop a circuit of highly activated network (Edelman). For example, attentional and cognitive stimulations cause the hippocampus (an area closely related to memory consolidation) to become a center of highly developed network of activity. This then leads to regeneration and new added neurons (Eriksson et al., 1998).

As Edelman (1987) argued, idle and inactive neuron connections lead to death of the cells by affecting the functioning of other individual healthy neurons. Studies conducted by Levi-Montalcini and Calissano (1979) showed that Nerve Growth Factor (NGF) is positively correlated with regeneration and maintenance of healthy neurons. Aging and inactivity of neurons contribute to their death and therefore maintaining them is the most important part of their functioning (Counts & Mufson, 2005). High level cognitive activities and stimulation to the neurons lead to the secretion of NGF. For example, stimulation to the neurons could restore lost function and activate the damaged area of the brain, after a brain injury, stroke, or other neural diseases such as Alzheimer over time (Counts & Mufson).

Clinical use of Attention and Selective Attention Therapy As

Heilman and Valenstein (1993) stated, one phenomenon revealing characteristics of impairments in the domain of selective attention, in particular visual selective attention points to Alzheimer's disease (AD). This disease is described as a breakdown in the functioning of memory, loss of spatial orientation, and significant language impairment among others (Heilman & Valenstein). The findings showing impairments in the domain of selective attention particularly in terms of vision have consistently emerged in a great deal of studies or investigations in this regard (Tales, Muir, Bayer, & Snowden, 2002).

Traumatic brain injury (TBI) is another concrete situation that makes clear the scenario on attention and selective attention therapy for treatment of memory loss (Olver, Ponsford & Curran, 1996). According to Van Zomeren and Brouwer (1994), attention is a multidimensional construct that involves several overlapping processes or components such as that common distinction between the aspects of attention concerning intensity and selectivity. The intensity aspect of attention refers to the regulation of attentional activation levels that cover the reception state towards stimulation and response preparedness such as alertness (Van Zomeren & Brouwer).

Parkinson's disease (PD) is another kind of disorder that relates to destruction of neurons and brain cells in the area of Substantia Nigra (SN), which is part of the Basal Ganglia (Miller & DeLong, 1987). SN is responsible for releasing dopamine, a neurotransmitter that has been shown to be involved in the control of movements and the signaling of error in prediction of reward, motivation, and cognition. Cerebral dopamine depletion is the hallmark of Parkinson's disease (Arias-Carrión & Pöppel, 2007). As reported by Arias-Carrión and Pöppel, other pathological states have also been associated with dopamine dysfunction, such as schizophrenia, autism, and attention deficit hyperactivity disorder, as well as drug abuse. In addition, increased neural functioning in the SN arising from attentional execution may play a significant role in improved cognitive performance (Sarter & Bruno, 1999; Counts & Mufson, 2005).

Clinical use of Brain Stimulation in Treatment of psychological disorders

Brain stimulation techniques have been the center of attention in treating psychiatric disorders such as depression for quite a while. For example, Electroshock or Electroconvulsive Therapy (ECT), which in combination with anti-depressant medications affect the regularity of the neurotransmitters' discharge in the brain in treating depression (Sampson, Solvason, & Husain, 2007). According to Sampson et al., brain stimulation therapies similar to ECT are invasive including the use of anesthesia, which may cause side effects such as cognitive impairment and memory loss . Thus using Transcranial Magnetic Stimulation (TMS), which is a noninvasive technique in stimulating cerebral cortex through magnetic impulses hooked up to the skull is another way to relieve depressive symptoms.

Clinical use of Attention and Selective Attention Stimulation in Treating Depression

Empirical investigations have established that deficit in emotional and mood control is a risk factor for depression (Brody, Hahn , Spitzer, Kroenke, Linzer, deGruy, Williams, 1998). Visual Attentional stimulus effect the neural activities in the visual and prefrontal cortex and the basal ganglia area. These areas are responsible for mental and psychological functioning including impulse regulation, problem-solving, self-consciousness, and self control (Barkley, 1995; 1997). These areas also regulate the release of neurotransmitters involving depression such as dopamine, norepinephrine, and serotonin (Arnstein, 1999).

Another important instrument using attentional stimulus in detecting malfunction areas in the brain caused by psychological disorders is Neurofeedback (Wolf, LeCraw, & Barton, 1989). Neurofeedback uses an Electroencephalography (EEG) to screen the control learning progress of certain psychological disturbances such as anxiety, stress, and depression by learning to control the related brain waves (Baehr & Baehr, 1997). For example, enhancing Beta brain waves are supposed to improve self-control, attention, depression, and generalized seizures (Baehr & Baehr). As previously established attention and attentional selectivity enhance and regulate Beta brain waves.

Visual Concentration Attention Techniques (VCAT)

Background

Visual Concentration Attention Techniques (VCAT) is a visual concentration training method based on attention and selective attention theory that uses the visual field to stimulate the brain for greater plasticity, a better blood flow through out the brain tissue, restoration, and regeneration of neurons for an utmost functioning of the neurological system (Gross, 2000; Babai-Siahdohoni, 2007). VCAT could be an approach for treatment of many neural network related disorders in the human brain. The system is exercised through visual attentional stimulations by focusing, concentrating, and shifting attention to all and every object in the visual field. These stimulations could also be combined with sounds for a maximum effect. These objects have to present different fixtures, shapes, colors, and sizes (Optical Illusions, Fractal Images, and Stereograms) for a better stimulation of the brain. VCAT optimizes neural activities and brainwave patterns, increases cognitive abilities such as memory, and trains the brain to execute these activities on its own (Babai-Siahdohoni). Improving neural performance will not just enhance cognition and memory (Woodman, Vecera, & Luck, 2003) but also it helps to control psychological problem such as stress and depression, controlling emotional distress, temperament, and mood (Carlson, Ursuliak, Goodey, Angen & Speca, 2001). Other improvements relate to concentration, sustained attention, multiprocessing, listening skills, and increasing mental focus (Shalev & Tsal, 2003). Attentional shifting in the visual field through VCAT's system may also be effective in building new brain cells, improving eyesight, improving visual neglect and visual field impairment/hemianopsia (Vivas, Humphreys & Fuentes, 2003), and helping to improve common brain and psychological disorders involving brain cells damage and memory loss, such as Alzheimer's, Parkinson's, and schizophrenia (Tales, Haworth, Nelson, Snowden, & Wilcock, 2005).

VCAT is an improved amalgamation of all its earlier versions (Babai-Siahdohoni). It uses the significant principles and approach of attention and selective attention theories, and methods based on categorization and memory. It interprets attention as to concentrate, to concentrate as to select by shifting the attention, and to select is categorizing. To categorize means to exercise the memory system, exercising the memory system to construct and trigger the neural circuit to transfer information. This concept is revealed in formal theories and structures by previous studies of VCAT's ancestors, which are presented here as the basis for VCAT.

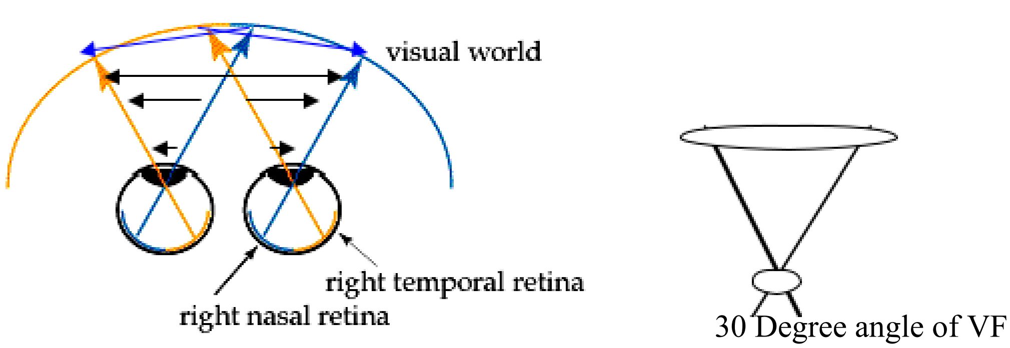
The goal of VCAT is to present an optimal system in attention and attentional selectivity that embrace all of its former models in a simple entity. Different steps represent different way of shifting attention for identification, classification, and assessment of the targeted objects. Shifting attention enhances neural functioning in the parietal lobe, sensory cortex, and other parts of extrastriate visual areas in the brain (Maunsell, 1995; Corbetta, Miezin, Shulman, Petersen, 1993). In addition, computing such attentional shifting in every possible direction in visual field will improve blood flow and brain's Beta1 wave activity in both hemispheres (Corbetta et al., 1993; Harter, Aine, & Schroeder, 1982). VCAT's predication is not only improvement of psychological, neuropsychological disorders, but also improvement in alertness, sustained attention, and concentration (Babai-Siahdohoni).

Visual attention and visual search has been the center of psychological research for many years. The most recent research is based on the work of Treisman & Gelade (1980). Visual attention is concerned with using visual information for conscious access based on selectivity, which relates to the Boolean map (i.e., the shape of the selected region; Huang & Pashler, 2002) and the action of selection that optimizes performance (Posner, 1980). According to Posner, attentional cueing is a major factor in visual selection and detection of target in the Boolean map and selective functioning controls the processing of the targeted objects in the visual field by visual processing system.

VCAT's Theory of Visual Field (VF)

We consciously use only a small part of our eyes' visual field (as shown in figure 7) and our brain unconsciously records all and every event happening around us. This unconscious recording is partially saved in the working memory (WM) and some others are lost (Pinel, 2006). For instance, you are driving your car on the street and your eyes are concentrated most of the time on the car driving in front of you, even if you turn your head to the side, you are still looking at one particular point. You are not conscious of what is happening out side of your viewpoint, even though your brain is recording the whole visual field unconsciously. Now, if you were trained to use constantly and consciously all of the area of your visual field and you would learn to be aware of almost all events around you, you would keep enhancing your brain functioning system by enforcing it to keep interpreting, processing, and decoding all events around you at all time and save it in your WM.

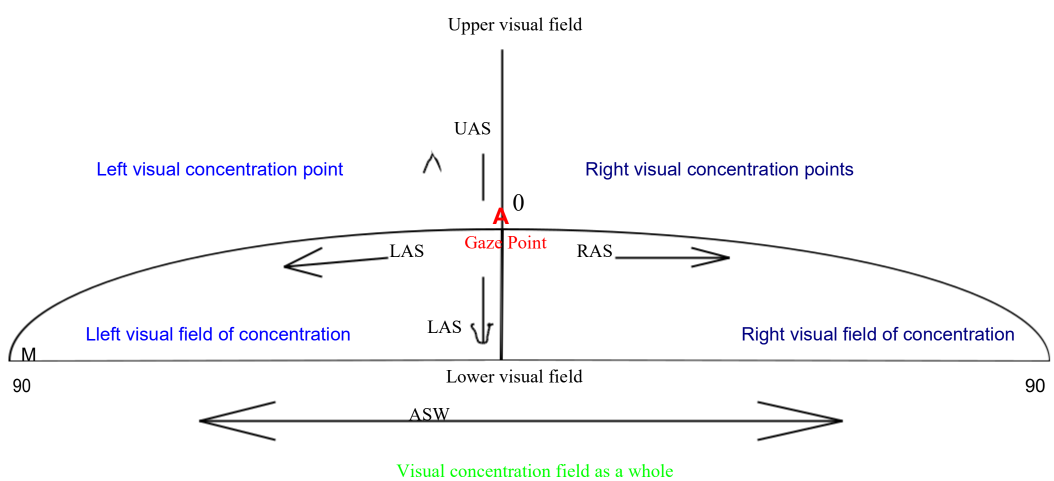
Figure 10: Outlook presentation of the Visual Field.



VCAT's Model of Visual Field (VF)

VCAT assumes that visual field is shaped like a half of a circle, a 180-degree total; 90 degree to the right, and 90 degree to the left (from the center point A=0; the nose line); 45 degree up and 45 degree down from the center point (A=0; the nose line). Figure 8- Presents VCAT's exhibit of visual field. This display divides visual field in five different sections (Gazing point, Left VF, Right VF, upper VF, and Lower section of visual field). The attentional shifting occurs after each gazing, first to the right, then to the left, and up and down. Each attentional shifting includes focusing (gaze point) ignoring (distractor/s), selecting and accessing (targeting) object/s.

Figure 11: VCAT's Model of Visual Field



Gaze Point = GP; Left Attentional Shift = LAS; Upper Attentional Shift = UAS;

Ignore Point = IP; Right Attentional Shift = RAS; Lower Attentional Shift = LAS;

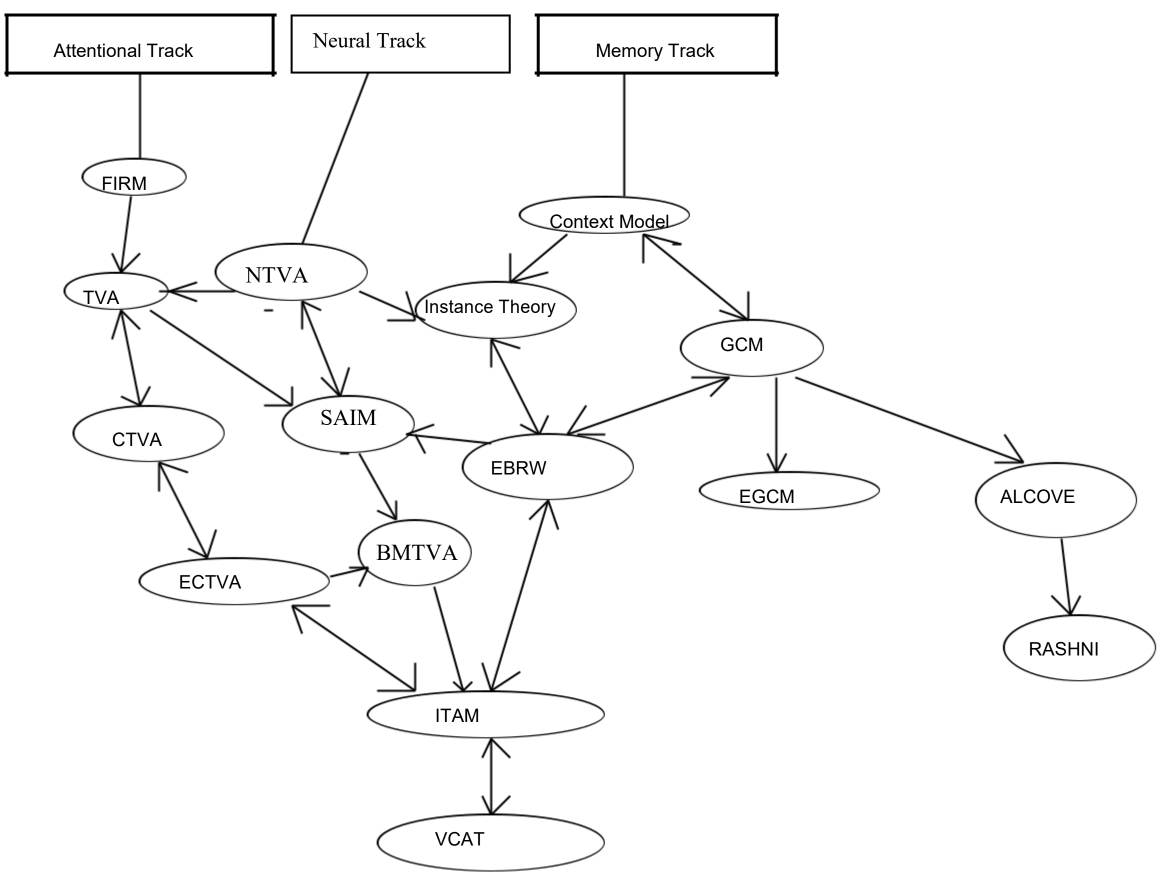
Concentration point = CP; Attentional Shift as Whole = ASW; Visual Field = VF

Right Visual Field of Concentration = RVFC; Left Visual Field of Concentration = LVFC;

VCAT and the related Theories

The theories of attention, selective attention, and memory go all the way back to the basic ideas of Shepard (1957) and Luce (1959). Every other related theory is based on these ideas by improving or expanding them to increase the assumption's strength and validity (Logan & Gordon, 2001). VCAT is constructed of the combination of existing attentional and memory theories and models. Figure 9 presents a pattern of such theories and models that VCAT is developed from.

Figure 12: VCAT's Family Tree



Theories linked together by bidirectional arrows are identical to each other and to VCAT.

The attentional track is started with fixed-capacity independent race model (FIRM) (Bundesen, 1987; Bundesen, Pedersen & Larsen, 1984; Shibuya & Bundesen, 1988). FIRM relates to functioning and presentation of partial and whole report tasks, which is changed by Bundesen (1990, 1998a, 1998b; Bundesen & Harms, 1999) in order to develop the theory of visual attention (TVA). TVA consists of wide varieties of attentional tasks such as feature search, cueing, single-item identification, and priority learning. Distance and grouping effects in flanker tasks and feature-and conjunction-search tasks are related to each other and they should be connected; therefore, TVA and the theory of perceptual grouping by proximity [COntour DEtector (CODE) (Van Oeffelen & Vos, 1982; 1983)] are combined to the CODE theory of visual attention (CTVA) (Logan, 1996; Logan & Bundesen, 1996). The theory of executive control of TVA (ECTVA) (Logan & Gordon 2001) relates to crosstalk and set-switching effects in dual-task situations. The instance theory of attention and memory (ITAM) (Logan & Gordon, 2002) is the integration of the previously explored theories of attention and memory. VCAT is related to different outlooks in attentional concepts and appearance in the visual field.

The memory track is started with the context model of classification. There is the recognized pattern of arrangements (Medin & Schaffer, 1978), which was improved by Nosofsky (1984) in regard to similarity in objects to establish generalized context model (GCM). GCM provides precise collections of categorized data such as identification categorization and recognition categorization. Exemplar-based random-walk model

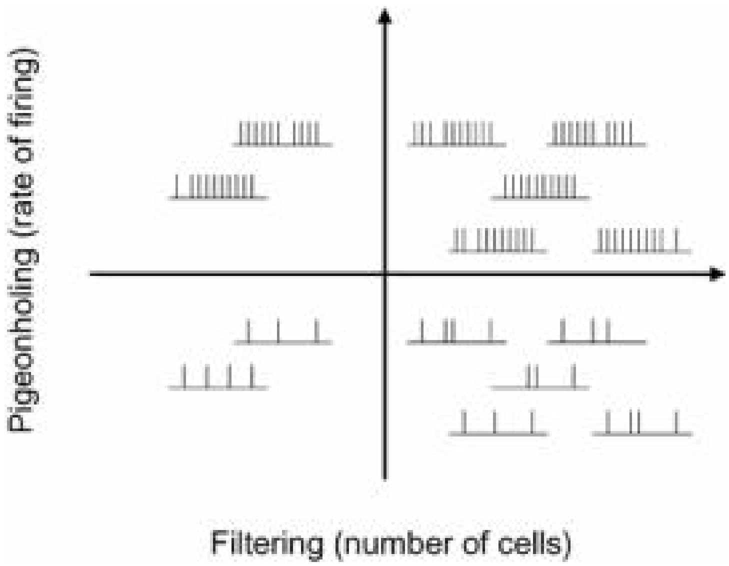
(EBRW) (Nosofsky & Palmeri, 1997) is the combination of GCM and ITAM, which includes categorization, precision, and perception and learning configurations such as automatization.

VCAT is similar to ITAM in that both are models of attention and attentional selectivity functioning theory based on visual cognition. VCAT also resembles ITAM in utilizing the constancies of previous theories in performance, selection, categorization, and memory concepts. VCAT unlike ITAM covers attention in dimensions based of attentional weights (Logan & Gordon, 2002). Similarity between targeted objects and their distractors are sustained as the most important basis for the formal attentional theories, but not in VCAT's concept. VCAT supports all kind of different objects and images with various shapes, size, color, and space position.

Memory track does not reveal attention to objects, but it concerns the theory of classification and dimension, theories of learning , theory of similarity, and similarities influence on categorization performance (Logan & Gordon, 2002). The most priority in VCAT is the attention and the shift of attention to and from the objects in a display by gazing, concentrating, and shifting on one or multiple objects in visual field as partial or whole.

The Neural track relates to both memory and the attentional track, since it stimulates the neural network through attentional stimulus to generate memory (Bundesen, 1990). VCAT shares many similarities to the Neural Theory of Visual Attention (NTVA) (Bundesen, 1990), which is an extended theory of TVA. It relates to attentional selectivity stimulus and its influence to neural activity, the mind, and the behavior (Bundesen). According to Bundesen NTVA affects both psychological and neural interactions. NTVA includes two selections: filtering (selection of objects) and pigeonholing (selection of features). Filtering affects the individual's cortical neurons, (where objects are analyzed) and pigeonholing happens in encoding and interpreting of selected features in a high level of neural activities (Bundesen).

Figure 13: Illustration of the NTVA's filtering and pigeonholing selection process



During an attentional functioning, high neuronal activity has been observed in the visual areas of V1, V2, V4, and the inferotemporal (IT) cortex, as well as the middle temporal visual area (MT), medial superior temporal area (MST), and prefrontal (PF) cortex (Bundesen, 1990). Bundenses has also explained the way visual information process happens across the brain. Attentional-related visual data enters the Lateral Geniculate Nucleus (LGN) of the thalamus through the eye visual field, where it then travels to the striate and extrastriate cortical areas. Here, all the objects and features are interpreted, analyzed, and processed. The processed data then is sent to a saliency map in the pulvinar (Pul) nucleus of the thalamus to be collected and processed as attentional weights of the stimulated images. After cortical processing system is done with analyzing the priority of the data, high attentional weights are transferred to the visual short-term memory (VSTM).

VCAT's basics and foundations relate strongly to NTVA and ITAM as far as stimulation of the brain through attentional functioning and selective attention theory. VCAT is the new expanded development of SAIM, ITAM, and NTVA that is formulated with a powerful system in enhancing neural and psychological related problems through visual attentional functioning and memory performance.

VCAT's relation to NTVA and ITAM is mainly in object selection and stimulus set, filtering task, attention, and categorization as a voluntary process in choosing between presented objects in the display and choosing between available groups of objects in the memory (Logan & Gordon, 2002).

Object selection and stimulus set allows choosing a target in the display and shifting the attention to it (Logan & Gordon). This model works on the bases of parallel processing of objects across visual field to produce a spatial map of where specific features are located. Shifting attention to the selected object in the visual field is an important aspect of cognitive control (Knudsen, 2007).

Filtering task is the input and the selection process of targeted object by getting access to it. The filtering task measures an individual's ability to focus on important information and ignore irrelevant distractions, which provides an indication of the ability to sustain attention, concentration, and ignore distraction (Slotnick, Schwarzbach, Yantis, 2003).

Simulating emergent attention and spatial memory in the selective attention for identification model (SAIM) (Humphreys & Heinke, 1997; 1998) is another attentional and attentional selectivity to which VCAT bears a resemblance. SAIM is similar to VCAT depending on selective attention in objects recognition and classification. Humphreys & Heinke (1999) predicted that SAIM is also able to identify different neuropsychological disorders of visual selection such as visual neglect impairment.

According to Humphreys and Heinke, in the past, there have been many studies conducted in relation to computational models of visual attention that ramble SAIM's method in normal visual selection and neuropsychological data including the feature gate model (Cave, 1999), guided search (Cave & Wolfe, 1990), Search via Recursive Rejection (SERR) (Humphreys & Müller, 1993), Selective Attention Model (SLAM) (Pfaf, Vander-Heijden, & Hudsen, 1990), and the spatial transformation model (Pouget & Sejnoski, 1997). Further development in such models happened in neurobiological constraints on selection (Deco & Zihl, 2001) and to resolve the functional error of vision such as view-invariant object recognition (Hinton, 1981a; 1981b).

SAIM is also similar to VCAT in supporting the integrated competition model (Duncan, 1998), objects or object to implement forms of winner-take-all (WTA), which is affected by both bottom-up and top-down factors, (object and object, VCAT only), objects grouping and multiple stimulus, self-inhibition of targets to initiate the selection of other objects consequently (Humphreys & Mueller, 1993).

SAIM uses both WTA competition and self-inhibition as its features after each object selection to commence the attentional shifting. Top-down factors relate to accumulation and saving of objects' illustration in the working memory (Usher & Neibur, 1996).

The Boolean Map Theory of Visual Attention (BMVTA) (Huang & Pashler, 2002), resembles VCAT in defining and creating the selection and access map or the attentional sifting's display in the visual field for visually and consciously recognition of objects and access to them. BMVTA's unlike VCAT divides the visual field in two displays with selected and not selected objects, whereas VCAT divides the visual field in five displays with mixtures of selected and unselected objects (as shown in the figure-d). BMVTA and VCAT use the same principles in computing the combination of one Boolean map with output of other ones (intersection and union, as shown in figure-d). Other similarities between VCAT and BMVTA are included in location and object encoding, single-feature access (VCAT single and multiple access of object/s), multiple-location access, feature-by-feature selection (VCAT object by object selection; object and object; object and object as a whole; as shown in figure-d), and the location-feature routine (LF) (Huang & Pashler), which is used to reach conscious access to the display. In BMVTA, LF is used according to top-down control value for similar looking targets in one specific location of the display (e.g., concentrate or shifting attention to everything green, objects on the top right corner) (Huang & Pashler). VCAT uses the same principles with combinations of bottom-up for a mixture of targets in every corner of the display (as show in figure 11). BMVTA former models are included feature-based attention or the guidance process in Wolfe's guided search model (Kim & Cave, 1995), and Hoffman's two-stage model (Hoffman, 1979).

Key Factors of the Effects of VCAT's Model

Gaze Cueing of Attention

The eyes are the key to visual attention in cognitive search (Perrett, Hietanen, Oram, & Bensen, 1992). According to Perrett et al. (1992), gazing based on attentional cueing is important for interpretation and recognition of objects in the visual field. Such gazing influences the neural transaction including neural responses in the areas of the cortical region and superior temporal sulcus (STS; Perrett et al., 1992; Emery, 2000). For example, looking forward with eyes fixed on an object. (As shown in figure 11)

Attentional Gaze Cueing and Body Parts Movement

Gaze cueing combination of eyes and body parts such as head, and body position cues, or eyes and hands movement activate STS neural responses. These are assumed to be the central part of neural system in regard to collective perception (Pelphrey, Morris, Michelich, Allison, & McCarthy, 2005). For example, STS neural network will correspond to syndicate direction of head and gaze such as looking with the head forward to own moving hands and arms with eyes fixed on the fingers only. STS is also connected to the amygdala, a structure of the limbic system that is activated in emotional depressive circumstances (Thomas, Drevets, Whalen, Eccard, Dahl, Ryan et al., 2001). Damage to the amygdala lead to deficiency in judgment of gazing direction and the identification of facial manifestations of others (Young, Aggleton, Hellawell, Johnson, Broks, & Hanley, 1995).

Shifting Attention

Shifting attention from one object to another (object by object or object and object) relates strongly to parietal cortex, which is connected to STS and the reciprocal connections between STS and the intraparietal sulcus (IPS) (Rafal, 1996; Nobre, Sebestyen, Gitelman, Mesulam, Frackowiak, & Frith, 1997). According to Corbetta et al. (1991) and Nobre et al. (1997), through such connections data regarding the attentional covert/ overt shifting and the eye-gaze direction are being analyzed and processed for the proper response. (As shown in figure 11)

Directions of Attentional Shifting (Bottom-up and top-down)

Fixing the eyes on a target (Gaze Point) and voluntarily shifting the attention to any direction to a particular object within the visual field leads to controlled attention and cueing by top-down (endogenous) (Posner, 1980). Bottom-up (exogenous) happens, when attentional sifting from the gaze point is reflexive or stimulus driven.

Attentional controls such as bottom-up (exogenous) activated the neural network in posterior attention system involving subcortical structures such as the pulvinar and the superior colliculus (SC) (Rafal, Calabresi, Brennan, & Sciolto, 1989). Top-down (endogenous) is predicted to influence neural functioning in the cortical areas in anterior including cingulate gyrus and the supplementary motor area which are related to positive emotional feeling such as hope and expectancies (Carr, 1992; Corbetta et al., 1993), and posterior areas of the brain including intraparietal sulcus (IS) (Corbetta et al., 2000). *Brain Conditioning to Self-Training and Automatically Functioning*

VCAT assumes that brain has the capability to self-train itself automatically after it is conditioned to the VCAT's steps. Thus, the brain will automatically compute VCAT principles in real daily life practice. According to the studies conducted in sustained automatic attention the basal forebrain cholinergic function, amygdala central nucleus (CEA), the magnocellular cholinergic neurons of the sublenticular substantia innominata/nucleus basalis (SI/nBM), and the posterior parietal cortex (PPC) were recognized as important factors for sustained automatic attention in the presentation of a precise selective attention method (Pearce & Hall, 1980; Holland, Han, & Gallagher, 2000).

Clinical Evidence for VCAT

Thomas et al. (2001) stated that attentional shifting and eye-gaze cueing affect the neural network associated with the limbic system and damages in this area especially to amygdala will cause deficiency in neural transaction. Damage in this region has been determined to be the cause of emotional related psychological disorders (Mulrow, Williams, & Trivedi et al., 1998).

According to Vuilleumier (2002), proper functioning of neural system plays a significant role in eye-gaze cueing. Vuilleumier presented evidence of patients with damages to temporoparietal area of the right hemisphere suffering from attentional discrepancy for computing stimulations reflected to the left (contralesional) side of the visual field (unilateral visual neglect). Vuilleumier also provided evidence that ignorance to such effect will lead to a total blindness in the left side of visual field. Eye-gaze cueing and attentional shifting exercises have shown tremendous improvements in patients with visual neglect disorders.

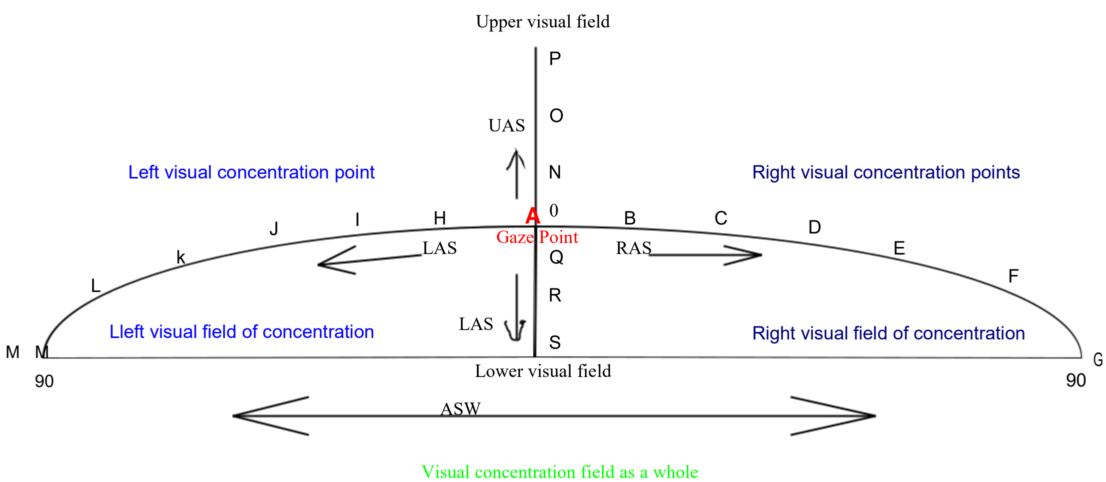
Cognitive functioning such as thinking, computing, learning, ability in memorizing, and multi tasking are components that strongly depend on an efficient working memory (WM) (Keefe, 2000). According to Keefe, destruction to temporal and frontal lobes is the cause of cognitive decline by not being able to use the resources of the WM, which may lead to psychological disorders such as schizophrenia (SC). Patients with SC have shown deficiency in cognitive processing that has been related to impairment of WM and attentional functioning (Barch, 2005; Zubin, 1975). Attention is suggested to be vital in selection and data transfer of cognitive related tasks in to WM and the effective use of WM is positively correlated with efficient use of attention (Zubin). Selective attention is predicted to be guidance in WM encoding, which is investigated by Sperling (1960) and Averbach and Coriel (1961) in their experiments with iconic memory. These researchers established that attentional shifting cues affect the retained data from short visual exhibits. Also recent studies on top-down and bottom-up cues predicted that attentional selectivity affects the data representation and encoding in WM (Schmidt, Vogel, Woodman, & Luck, 2002; Woodman, Vecera & Luck, 2003). Further, the study conducted by Gold, Wilk, McMahon, Buchanan, and Luck (2003), showed congregate proof that attentional selectivity's stimulus can be used by patients with SC to guide WM encoding.

VCAT's Main Display

Master Key Division in Visual Field

Imagine the visual field as a half of a circle (180-degree); 90 degree to the right and 90 degree to the left (from the center point A-the nose line); 45 degree up and 45 degree down from the center point A=0 (the nose line). Starting from center point A=0 go to the left and right to a 90 degree of each side, which would make a half of a circle of 180 degree. Now, assume that we have divided our half circle in to 6 (15 degree) sections in each side; a total of 12 section in the right and left of the visual field. And 3 (15 degree) sections on each side up and down from the center point A=0(the nose line). Now we assign these sections with alphabetic figures; starting on the center point from A=0 to the right 15 degree = B, 30degree = C; 45 degree =D; 60degree = E; 75degree = F; and 90degree = G;(for the beginners we should just use 3 points, A, D, and G); from the center point 0 = A again to the left same process 15 degrees H, I, J, K, L, M, (for the beginners use just the A, J, and M). From center point A= 0 to point N=15 degree up, then to points O and P each 15 degree up wards; same process down from A= 0 to Q =15 degree, R and S each 15 degree down wards. Now we covered all the effects' points in the visual field (as shown in Figure 14).

Figure 14: Presentation of VCAT's Display



The Effect of VCAT's Processing System to Brain

Master Key effect to Brain

Phase I and Phase II- the Object-to-Object Effect and Object-and-Object Effect (Selective Attention)

According to functional brain imaging studies shifting the gaze of attention in the visual field is associated with the activation of superior temporal sulcus (STS), intraparietal sulcus, and fusiform gyrus (Pelphrey, Singerman, Allison, & McCarthy, 2003) as well as the activation in regions of extrastriate, cortex of temporal-parietal junction, ventro-lateral refrontal cortex, frontal eye fields, and intraparietal sulcus (Corbetta & Shulman, 2002). For example, shifting attention to images with shapes and/or colors increases the response in the fusiform gyrus (Corbetta et al., 1990; Clark et al., 1997), while selective attention to speed and motion enhances the activity in visual area MT (V5- the middle temporal) and a region of extrastriate visual cortex (Beauchamp, Cox, & DeYoe, 1997; Born & Bradley, 2005).

Shifting attention to the right and or left in the visual field was examined using Positron emission tomography (PET) in which the ventral and lateral occipital region were highlighted as a sign for significantly higher blood flow levels contralateral to the direction of attention (Corbetta & Shulman, 2002). Shifting attention to the left affected the left lateral prefrontal cortex as well as the left middle and inferior frontal gyrus. The right and left parietal cortex were also activated during both left- and right-field attentional shifting (Herrod, Minhas, Pickard, & Orban, 2000).

Phase III- Object-and-object as a Whole Process (Divided Attention) to the Brain According to the Positron emission tomography (PET) study conducted by Corbetta, Miezin, Dobmeyer, Shulman, & Petersen (1991), selective attention activated the globus pallidus, caudate nucleus, lateral orbitofrontal cortex, posterior thalamus/colliculus, and insular-premotor regions, while the divided condition activated the anterior cingulate and dorsolateral prefrontal cortex. Shifting attention to the right and or left in the visual field was examined using Positron emission tomography (PET) in which the Ventral and lateral occipital region highlighted as a sign for significantly higher blood flow levels contralateral to the direction of attention (Corbetta et al., 1991). Shifting attention to the left affected the left lateral prefrontal cortex as well as the left middle and inferior frontal gyrus (Pelphrey, Singerman, Allison, & McCarthy, 2003).Right and left parietal cortex were activated during both left- and right-field attentional shifting (Herrod, Pawanjit, Minhas, & Orban, 2000).

VCAT's System Process- (Sustained, Overt and Covert Attention, Endogenous and Exogenous, and Up Down and Bottom Up)

According to the fMRI studies conducted by Corbetta et al. (1998) showed that overt and covert attention shift tasks affect the frontal, parietal and temporal lobes. However, covert attention was more influential to the right dorsolateral cortex, which is an area of brain that relates to voluntary attentional shifting and working memory (Peterson, Kramer, & Irwin, 2004).

Spatial attention is a combination of exogenous (externally-driven, bottom-up, involuntary, automatic) and endogenous (internally-driven, top-down, voluntary, non automatic) mechanisms the parietal cortex, superior colliculus, and anterior attentional system is involved in detecting salient stimuli and preparing motor responses (Rosen, Rao, Caffarra, Scaglioni, Bobholz, Woodley, Hammeke, Cunningham, Prieto, & Binder, 1999).

Sustained attention underlies enhancement of attention and cognitive capacity (Sarter, Givens, & Bruno, 2001). According to fMRI studies and research conducted on neural activities sustained attention is associated with activation of dorsal anterior cingulate cortex, dorsolateral prefrontal cortex (Weissman et al., 2006), visual cortex and attentional orienting (e.g. the superior frontal sulcus and intraparietalsulcus) as well as the right frontal, parietal areas, and the thalamus (Posner & Rothbart, 2007). Anterior attention system, posterior attention system, and sensory areas interacting with the basal forebrain are linked to sustained attention as well (Sarter et al, 2001). The anterior attention system involves right mediofrontal and dorsolateral prefrontal cortical regions and modulates (top down), the function of the posterior cortical (parietal) regions (Posner & Petersen, 1990). Activation of the basal forebrain cholinergic projections (bottom up) is necessary for sustained attention performance and cortical cholinergic inputs may contribute to activation of frontoparietal regions (Sarter et al.).

Sustained attention enhances perception in eccentric positions in the visual field, which helps patients with foveal vision loss to develop a peripheral ‘preferred retinal locus’ (PRL). Besides central scotoma topography, local variations of attentional performance could influence the choice of PRL location (Altpeter, Mackeben, & Trauzettel-Klosinski, 1999).

As stated by Berridge & Waterhouse (2003), sustained attention stimulations activate neural network belonging to locus coeruleus (LC), which instigates memory storage as well as object recognition. Reformation of neural network in this area is associated with release of noradrenaline by the LC, which is also assumed to play an important role on Schaffer collateral (SC)-CA1 synaptic plasticity and assisting in the encoding of highly relevant novel spatial features and memory formation (Lemon & Manahan-Vaughan, 2006).

The Locus Ceruleus, a nucleus in the brain stem, has projections that expand into the spinal cord, the brain stem, cerebellum, hypothalamus, the thalamic relay nuclei, the amygdala, the basal telencephalon, and the cortex (Bracha, Garcia-Rill, Mrak, & Skinner, 2005). LC research associated with clinical depression, stress, panic disorder, and anxiety showed the involvement of the norepinephrine (INN) or noradrenaline (BAN) from the LC (Bracha et al., 2005).

Norepinephrine is a hormone and neurotransmitter (Rang, 2003). As a stress hormone it influences parts of brain where attention and responding actions are controlled. For example, together with epinephrine, norepinephrine triggers fight-or-flight responses, increasing the heart rate, eliciting the discharge of glucose from energy stores, and enhancing the blood flow to the skeletal muscle (Brunton, Lazo, Parker. 2006). According to Brunton et al. norepinephrine, along with dopamine is recognized to have an enormous effect on depression as well as in enhancing attention and focus. For example, psychostimulant medications such as methylphenidate (Ritalin/Concerta), dextroamphetamine (Dexedrine), and Adderall are prescribed to help increase levels of norepinephrine and dopamine to help individuals with ADD/ADHD.

Other functional magnetic resonance imaging (fMRI) studies showed involvement of serotonin in sustained attention by activation of other brain area such as thalamus and caudate nucleus, which presumably are connected to subcortical network for sustained attention (Wingen, Kuypers , Van de Ven, Formisano , & Ramaekers, 2007). Serotonin is another neurotransmitter that plays a vital role in the modulation of depression, aggression, anger, body temperature, mood, sleep, appetite and metabolism (Wingen et al., 2007).

According to the fMRI studies conducted by Corbetta et al. (1998) showed that overt and covert attention shift tasks affect the frontal, parietal and temporal lobes. However, covert attention was more influential to the right dorsolateral cortex, which is an area of brain that relates to voluntary attentional shifting and working memory (Peterson, Kramer, & Irwin, 2004).

Spatial attention is a combination of exogenous (externally-driven, bottom-up, involuntary, automatic) and endogenous (internally-driven, top-down, voluntary, non automatic) mechanisms in which according to Rosen, Rao, Caffarra, Scaglioni, Bobholz, Woodley, Hammeke, Cunningham, Prieto, & Binder (1999) the parietal cortex, superior colliculus, and anterior attentional system are involved in detecting salient stimuli and preparing motor responses.

Center point finger-arm effect-Attentional Gaze Cueing and Body Parts Movement

Gaze cueing combined with eyes and body parts, for example, the head, body position cues, or eyes and hand movement, activate STS neural responses. These responses are assumed to be the central part of neural system in regard to collective perception (Pelphrey, Morris, Michelich, Allison, & McCarthy, 2005). For instance, STS neural networks will correspond to syndicate the direction of the head and the gaze so that one is looking with the head forward to his own moving hands and arms with his eyes fixed on the fingers only. STS is also connected to the amygdala, a structure of the limbic system that is activated in emotional depressive circumstances (Thomas, Drevets, Whalen, Eccard, Dahl, Ryan et al., 2001). Damages to the amygdala lead to deficiency in judgment of gazing direction and the identification of facial manifestations of others (Young, Aggleton, Hellawell, Johnson, Broks, & Hanley, 1995).

Summary

It is now broadly recognized that neurons are the main channel between vision, attention, and behavior (i.e., Budzynski, Jordy & Budzynski, 1999). Indeed, all of the readily understood brain functions such as thinking, learning, and data processing have all been studied with regard to their respective neuronal activity. Through neural networking, perception becomes data in the brain that undergoes processing and manifests into an individual's behavior. The transfer of data within the network of neurons is made possible by an electrical process that is present in all parts of the brain (Budzynski et al., 1999).

Starting with sensory stimulation, a person sees or touches an object. The sensors of the eyes or skin receive the stimulus and it goes to the brain in the form of electrical impulses. The electrical impulses travel in the network of neurons and reach a specific part or parts of the brain. The brain processes these electrical impulses into information. Next, the brain interprets the information and the mind of the individual is established into a particular state (Budzynski et al.). At this point the individual can behave accordingly to the stimulus that was received. The study of all the data transfer and network activity has been made possible by the use of a technology called Electroencephalograph imaging.

When brain waves are produced by the data transfer between neurons, some information is stored in the brain in the form of memories (Squire, 1992). Memories are formed inside the area of the brain called the medial temporal lobe and hippocampus, where the encoding of words also takes place (Eichenbaum, 2000). These facts were observed through functional magnetic resonance imaging (fMRI). The fMRI technology shows that the blood flow in the medial temporal lobe increases as the participant forms his/her memory (Wagner, Ball, Schreiber, Feige, Lucking, & Kristeva-Feige, 1999). Likewise, scientists have also observed an increase in blood flow in these areas during word encoding process (Wagner et al., 1999).

Although extensive research and studies have been conducted in the recent decade regarding attentional and attentional selectivity methods based on psychological and neuropsychological disorders, there is still much uncertainty regarding the true effect of such models for enhancing cognitive function and performance. Many of the models provide substantial evidence that address strategies in attentional functioning and their effects on psychological and emotional related disorders such as stress, anxiety, and depression. Therapy models such as psychotherapy, CBT, attention and concentration trainings as well as self-esteem training and management have been successful in improving psychological and emotional symptoms and helping individuals live a better life (Ramsey & Rostain, 2007). VCAT is a combination of previous attentional functioning models with regard to strategies and techniques, and provides a simple display with sophisticated steps to empower its validity. VCAT predicts that such steps will have an enormous impact in relieving neuropsychological as well as psychological related disorders. Further, VCAT predicts that eye-gazing and attentional shifting cues will improve sustained attention, memory, self-esteem, and can decrease the emotional symptoms of sustained attention related to ADHD. Psychological and neuroscience research in attentional shifting and eye-gaze cueing are promising a bright future for this kind of study, making it possible to find solutions to neuropsychological disorders such as ADHD, Alzheimer, and Parkinson disease.

Chapter 3 will describe a proposed study that utilizes a structured, quantitative, and non-clinical study design, which will test the short-term and long term outcomes of VCAT exercising in individuals with ADHD. Discussion regarding the diagnostic criteria and assessment tools are briefly stated, along with reliability and validity data concerning the psychometric instruments intended for use in the design. Identification of statistical analysis methods is provided. A description of the sampling methodology is included with justification regarding selection methods and criteria. The treatment modalities are also discussed, providing information concerning procedure, ethics, length of treatment, and measurement tools.

CHAPTER 3:

RESEARCH METHOD

Introduction

Drawing upon literature demonstrating effectiveness of self-regulation strategies in remediating cognitive deficits, this chapter will describe the procedures in a non-treatment pour science research design intended for documenting the cognitive occurrence while exercising selective attention techniques such as VCAT and the enhancement of sustained attention in adult population with ADHD. The chapter begins with an overview of the design methodology including discussion of experimental conditions to be introduced and the test instruments used in the assessment process. Here, in this study materials used are included a structured clinical interview and feedback questionnaire designed by the primary researcher, a questionnaire assessing knowledge of ADHD, a structured interview for ADHD symptoms, World Health Organization Adult ADHD Self-Report Scale (ASRS), objective measures of attention, self-report measures of ADHD symptoms, and effort tests. The objective measures include three subtests from the Wechsler Adult Intelligence Scale: Digit Symbol Coding, Digit Span, and Symbol Search.

The following section provides a comprehensive overview of participant selection for the study, including details of the inclusion and exclusionary criteria to be employed. Substantive rationale for these criteria is also notated.

The following section outlines methods for participant involvement in the study. Explicit procedures provide the steps participants will take during pre-intervention screening and during each of the two group conditions. Next, a review is provided to disclose the methods to be taken to ensure the reliability and validity of the study. The chapter concludes with an explanation of the descriptive and inferential statistical analysis proposed for the study.

Design

The proposed study is a quantitative, non-treatment within-subject pretest-posttest study design. This design will allow for gathering information of fundamental processes that are basis of clinical treatments as well as determination of the relationship between two factors, like the short and long term effect of exercising VCAT on cognitive processes such as sustained attention in adults with ADHD. This type of design will allow collecting and analyzing of numerical data in exploring relationship and/or interaction between variables for a comparison between and within different treatment groups as well as assessing changes in symptoms over time. Thus, the use of such a design will address the question of whether or not exercising VCAT program will have any short or long term effect on sustained attention in adults with ADHD.

Sampling Determination

General public of large Phoenix ~~metropolian~~metropolitan will be used for the ~~porpose~~propose of ~~sampeling~~sampling determination. Participants will be recruit by public advertising such as

Arizona Public Media, Criagslist, Arizona State University Campos (Public bulletin borders), and Arizona Community Colleges (Public bulletin borders).The intent of drawing a sample from a large metropolitan community is to increase the probability of an ethnically diverse group across socioeconomic and educational strata; thereby enhancing external validity.

Inclusion Criteria (Norms for Selected Participants)

The proposed study will include both male and female with and without ADHD symptoms and/or diagnosis. Paticipants will be adults with ages ranging from 21- 55 years of age to reduce the effects of age-related illness and to provide sufficient population sample size.

Exclusion Criteria

Exclusions will include those with any of the following conditions: (a) current substance abuse, (b) brain injury, (c) schizophrenia, or (d) other psychoses. Precautions will also be taken to ensure participants do not have a history or currently experiencing: sleep disorders, headaches, visual and auditory disorders, seizure disorders, endocrine disorders, or use herbal remedies. Each of these situations may result in symptoms that overlap the ADHD diagnosis (Spencer & Adler, 2004).

Additional exclusionary criteria will involve: (a) those undergoing psychotherapy or counseling, (b) individuals with more than four lifetime sessions of CBT, (c) current practice of meditation more than once per week, (d) inability to read and speak English at the 4th grade level, (e) IQ less than 75, and (f) currently taking certain types of medication (i.e., antipsychotic, antidepressant, anticonvulsant).

Attempts to exclude those currently taking ADHD-prescribed medication (e.g., Atomoxetine, Methylphenidate) is ideal for the study; yet would likely result in a very small sample size, thereby reducing statistical power. Therefore, this study proposes to include either: (a) individuals not on ADHD-medication for at least the previous four weeks or (b) individuals on a stabilized dosage for at least two months (Safren & Otto et al., 2004). Medication use will be noted during the assessment for use as a covariate if needed.

Interview & Screening Instruments

Participants eligible for the study based upon inclusion criteria will be contacted to determine their willingness to participate. Those volunteering for the study will be scheduled for a screening interview to last no more than an hour. Those passing these initial screening procedures will be deemed eligible for the baseline assessment.

The screening process will include administration of the World Health Organization Adult ADHD Self-Report Scale (ASRS) to determine selection of patients with the Inattentive subtype of ADHD. The ASRS (Belendiuk, Clarke, Chronis, & Raggi, 2007) is a validated and normed scale with good internal consistency (Cronbach's alpha = .90). The ASRS v1.1 can be used as a tool to help screen for ADHD in adult patients (Belendiuk, Clarke, Chronis, & Raggi, 2007). According to Belendiuk et al. (2007), insights gained through this screening may suggest the need for a more in-depth clinician interview. The questions in the ASRS are consistent with DSM-IV criteria and address the manifestations of ADHD symptoms in adults. Content of the questionnaire also reflects the importance that DSM-IV places on symptoms, impairments, and history for a correct diagnosis, which takes about five minutes to complete and can provide information that is critical to supplement the diagnostic process (Belendiuk et al.). The validity of the 18-question World Health Organization Adult ADHD Self-Report Scale (ASRS) Screener was assessed in a sample of subscribers to a large health plan in the US (Kessler & Ustun, 2004). A convenience sub-sample of 668 subscribers was administered the ASRS Screener twice to assess test-retest reliability and then a third time in conjunction with a clinical interviewer for DSM-IV adult ADHD. The data were weighted to adjust for discrepancies between the sample and the population on socio-demographics and past medical claims (DeQuiros & Kinsbourne, 2001). As reported by Kooij, Buitelaar, van den Oord, Furer, Rijnders, & Hodiamont (2005), internal consistency reliability of the continuous ASRS Screener was in the range .63–.72 and test-retest reliability (Pearson correlations) in the range .58–.77. A four-category version of the ASRS Screener had strong concordance with clinician diagnoses, with an area under the receiver operating characteristic curve (AUC) of .90. The brevity and ability to discriminate DSM-IV cases from non-cases make the six-question ASRS Screener attractive for use both in community epidemiological surveys and in clinical outreach and case-finding initiatives (Kooij et al., 2005).

Participant interviews will account for the existence of conditions including brain lesions and traumatic brain injury. Conditions such as these have been known to have detrimental effects on sustained attention (McMillan et al., 2002). Interviews will also be used to determine other exclusions to the study including current substance abuse, schizophrenia, and other types of psychoses.

Any individual meeting the criteria for any of these disorders or other exclusionary criteria, based upon the initial screening or the ASRS v1.1, will be excluded from the study.

Sampling method

The study seeks to obtain a sample that accounts for the potentially high rate of exclusions and drop-outs in this type of study and also achieves sufficient statistical power. One of the key exclusionary criteria will be adults with a diagnosis other than the inattentive subtype of ADHD. A thorough literature search was unable to identify percentage differences between subtypes, therefore this study will use ordinal data provided by Pierce (2003), and assume that 75% of the participants in the initial population are diagnosed with the inattentive type.

In terms of accounting for potential participant drop-outs, Kabat-Zinn and Chapman-Waldrop (1988) found that of 784 patients enrolled in attentional or CBT programs administered over a two year period, 24% dropped out of the program, while another attentional or CBT study accounted for an 11% drop-out rate (Reibel, Greeson, Brainard, & Rosenzweig, 2001). Drop-out rates of 17% (Stevenson, Stevenson & Whitmont, 2003) and preadmission screening disqualification of 22% (Safren, Otto, et al., 2004) have been reported regarding cognitive therapy programs for adults with ADHD. Thus, for this study, a drop out rate of 20% will be assumed.

The G-Power program (Buchner, Erdfelder, & Faul, 1997) was used to estimate the sample size necessary for a sample paired and a *t* test with one independent and three dependent variables measured three times. In order to achieve sufficient statistical power (.80), a 5% Type I error rate ($\alpha = .05$), and assuming a medium effect, a total sample size of 40 participants are needed. Based on past studies and meta-analysis, the following exclusions will be assumed from: screening interviews (22%) and drop-outs (20%). Therefore, initial recruitment will involve a population of 36 adults with ADHD expected to be eligible for the study post-screening. Yet, given the expected drop-out rate (20%), it is assumed the total number completing the study intervention and subsequent posttest will be 30.

Protection of Participant's Rights

Only the researcher will recruit potential participants for taking part in the research. The recruitment process will primarily consist of sending out emails and letters to potential participants. In addition, researcher will sign a confidentiality agreement and will keep all of the participants' personal data locked and secured in a location where only the researcher has access. Any information provide by the participants will be kept confidential and the researcher will not use any of this information for any purposes outside of this research project.

Measures

The instruments to be used for the study include the Wechsler Adult Intelligence Scale III (WAIS-III), widely used as a measure for assessing sustained attention in adults with ADHD. The three dependent variables Digit Symbol Coding (DSC), Digit Span (DS), and Symbol Search (SS) scores will serve as measures of sustained attention for this test.

The current version of the WAIS is the WAIS-IV, which was released in 2008. The WAIS-IV is composed of 10 core subtests and five supplemental subtests, with the 10 core subtests comprising the Full Scale IQ. With the new WAIS-IV, the verbal/performance subscales from previous versions were removed and replaced by the index scores (Wechsler, 2008). The General Ability Index (GAI) was included, which consists of the Similarities, Vocabulary and Information subtests from the Verbal Comprehension Index and the Block Design, Matrix Reasoning and Visual Puzzles subtests from the Perceptual Reasoning Index. The GAI is clinically useful because it can be used as a measure of cognitive abilities that are less vulnerable to impairment (Wechsler). However, no one has yet even claimed, much less published research demonstrating that WAIS-IV is somehow a "better" or more true/accurate tool in measuring sustained attention in adult with ADHD. In addition, due to the fact to that there are vast amount of literature and research supporting WAIS-III's factor structure in measuring sustained attention in adult with ADHD, the purposed study is intending to use the WAIS-III as the assessment tool for sustained attention.

Objective Measures of Attention

Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) Digit Symbol-Coding (DSC), Digit Span (DS), and Symbol Search (SS) subtests

The WAIS-III is the revised form of the WAIS-R test and the age range of the test is 16-89. The ADHD sample in the normative studies for the WAIS-III was found to perform relatively more poorly on the DSC, DS, and SS subtests (Technical Manual for WAIS-III). The test is made up of 11 subtests that are part of the IQ measure. One half of these tests require verbal logic and reasoning (Tulsky, Saklofske, Chelune, & Heaton, 2003). As described by Tulsky et al. (2003), the remaining subtests looks at nonverbal reasoning. The relative strengths and weaknesses of a person's performance on these subtests enable the psychologist to understand how a person processes information. The nonverbal scale also enables the psychologist to measure cognitive potential with relatively limited intrusion from verbal abilities. In addition to the IQ scores, the WAIS-III provides index scores for Verbal Comprehension, Perceptual Organization, Working Memory and Processing speed. The Processing Speed Index (PSI) with the subtests SS and DSC requires visual perception and organization, visual scanning, and the efficient production of multiple motor responses. These tasks require executive control of attention and sustained effort for a 2-minute period of time while working with simple visual material as quickly as possible. Like the IQ scores these are standard scores with a mean of 100, which here in this study all the scores of the dependent variables are the score averaged from DSC, DS, and SS subtest scaled scores that are converted to T-scores.

As noted by Lichtenbergerer, Kaufman and Lai (2001), the DSC subtest for visual-motor coordination and motor and mental speed is a timed paper and pencil symbol substitution or coding task. Participants use a key of paired numbers and nonsense symbols to complete the task, which requires participants to draw the corresponding symbols below rows of numbers. The DS subtest is an attention/concentration test, which consists of two parts. The first part requires participants to repeat increasingly long strings of numbers orally presented by the examiner and the second part requires participants to recall the string of presented numbers in reverse order. The SS subtest is a visual perception and speed test, Which is a timed orthographic measure of visual attention, scanning, and motor speed. Participants must determine if a target nonsense figure is present in a string of figures and mark a corresponding —yes" or —no" box presented at the end of each item (Lichtenbergerer et al.).

Technical Evaluation of Psychometric Properties

Norms

Shum, O'Gorman, and Myors (2006, p. 130) state that one of the strengths of the WAIS-III is the size and representativeness of the standardization sample used in test development. According to the Technical Manual, the WAIS-III (1955) and WMS-III (Wechsler, 1997) normative information was based on United States standardization samples of 2,450 individuals representative of the population of adults aged 16-89 years. A stratified, census-based sampling plan ensured that the standardization samples included representative proportions of adults according to each selected demographic variable. The variables used for stratification were age, sex, race/ethnicity, education level, and geographic region.

According to the Wechsler (1955), one set of norms was produced that was representative of US Census proportions as regards all variables except age. It was based on the performance of a reference group that consisted of the participants in the standardization sample who were between the ages of 20 and 34. The Manual recommends that this set of norms be used when clinical questions dictate comparisons of an individual's performance to that of a reference group. Another set of norms was produced that was based on age-corrected subtest scores. The Manual recommends that this set of norms be used when clinical questions dictate comparisons of an individual's performance to that of his or her age group.

Reliability

The WAIS-III only exists in one version, so there is no issue with alternate forms. According to the Wechsler (1940), interscorer agreement is very high, averaging in the high .90s, and the stability of WAIS-III scores was assessed and found to be adequate across time for all age-groups.

As reported by Wechsler (1940), the reliability of each WAIS-III subtest (except Digit Symbol-Coding and Symbol Search) was estimated using a split-half procedure from the item scores from a single administration, with the correlation corrected using the Spearman-Brown formula. Since Digit Symbol-Coding and Symbol Search subtests are speeded subtests, the split-half coefficient was not considered to be a good estimate of their reliability. For that reason, test-retest stability coefficients were used as the reliability estimates for these two subtests, with the correlation being corrected for the variability of the standardization sample.

The sample included 394 participants, with roughly 30 participants from each of the 13 age-groups. The reliability coefficients of the WAIS-III IQ scales and indexes were calculated with the formula recommended by Guilford (1954) and Nunnally (1978). The average reliability coefficients across age-groups of the subtests (except Picture Arrangement, Symbol Search and Object Assembly), which were calculated with Fisher's z transformation, range from .82 to .93. The Symbol Search subtest had a coefficient of .77, Picture Arrangement had .74, and Object Assembly had .70. The Object Assembly subtest is not included in the computation of IQ and Index scores, in part because of its low reliability for older adults.

Validity

The Technical Manual (p. 75) asserts that, in order to ensure content validity, comprehensive literature reviews were undertaken, consultants were consulted, surveys were carried out, and focus groups and an advisory panel were set up. The Manual also provides considerable detail about the testing that was done of the WAIS-III's concurrent criterion-related validity. The WAIS-III convergent validity for subtests ranged from .50-.89.

WAIS-III Administration

WAIS-III will be administrated by means of standard procedures. A computer program will be used to compute the data. All participants will be tested for pretest at the first session and will be retested again for the posttest at the end of the study. All tests will be administered to the participants at the hospital's testing center.

Procedures

A description of the study will be presented to an ethics review board, as necessary, prior to conducting the study. Upon IRB approval, the researcher will begin the process of contacting those participants meeting the initial inclusion criteria. Contact will be made using phone, email, and mail-in request forms. The description, objectives, and timing of the study will be provided to each participant, along with a schedule listing prescreening interview dates and times. Participants will select from any of the available interview times when making their appointment. The option to participate is entirely at the patient's discretion. No coercion or retribution will be assessed to patients electing not to participate. The participants will be provided with informed consents approved by the IRB. This document is indented to provide participants with relevant information regarding participants' rights as well as information necessarily to decide whether they want to participate or not. This form should be included in with a discussion of the research and reporting concerns information (where to report questions and concerns). In addition, participants are advised that their participation is voluntary and that he or she can quit the study at any time without any consequences.

Participant eligibility will be based upon a two steps screening process: (a) initial interview questionnaires (b) questionnaire assessing knowledge of sustained attention deficit World Health Organization Adult ADHD Self-Report Scale (ASRS). The interview will be hand-written using a standard form to obtain information concerning age, gender, ethnicity, behavioral therapy history, meditation experience, and any other conditions that may invalidate their participation in the study (e.g., sleep disorders, visual and auditory disorders, psychoses, current medication use, brain injury).

Participants who passed the initiation screening and willing to continue toward the non-clinical study will be scheduled for their first and second sessions (Appendix B). Participants will have the choose of selecting from any of the available interview times and dates (weekend/week day) when making their appointments. The option to participate in this non-clinical study is entirely at the participant's discretion. No coercion or retribution will be assessed to patients electing not to participate in he study.

Prior to the study, all selected participants will meet with the researcher to gain information concerning the process and purpose of the study, participant expectations, and level of commitment required for successful completion. The participants will be provided with informed consents approved by the IRB. This document is indented to provide participants with relevant information regarding participants' rights as well as information necessarily to decide whether they want to participate or not. This form should be included in with a discussion of the research and reporting concerns information (where to report questions and concerns).

The sessions are processed as follows:

a) First session-Baseline

1. First-pretest of cognitive assessment (three subtests of WAIS III Digit Symbol Coding (DSC), Digit Span (DS), and Symbol Search (SS)).

2. VCAT Exercises (Appendix C)

3. First-posttest, immediate repeat of WAIS assessments (DSC, DS, SS).

b) Second session- New Baseline (a week later)

1. Second-pretest of cognitive assessment (three subtests of WAIS III Digit Symbol Coding (DSC), Digit Span (DS), and Symbol Search (SS)).

2. VCAT Exercises

3. Second-posttest, immediate repeat of WAIS assessments (DSC, DS, SS).

Analyzing score differences between steps a.1 and a. 3 will inform the researcher about short-term outcomes of VCAT exercises. Analyzing score differences between steps a. 3 and b. 1 will inform the researcher about longer-term outcomes of VCAT exercises. Analyzing score differences between steps a. 3 and b. 3 will inform the researcher about overall outcomes of VCAT exercises. Details of the VCAT program are listed in Appendix C.

Data Collection and Analysis

Hypothesis

H_0: There will be no short-term or long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

H_1: There will be short-term as well as long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

Data will be analyzed using SPSS version 13.0. Tables will be provided to indicate descriptive statistics (i.e., mean, standard deviation) between the two groups for age, gender, and race. A sample *t* test will be performed to determine if the groups differ at baseline on any of the above, potentially confounding variables. In the case of statistically significant differences, the confounding variable will be controlled for in the primary analyses described below.

An additional table will provide average group means and standard deviation for the following variables as a result of pretest evaluation: Participants (ADHD and non-ADHD) scores based on the three subtests from the Wechsler Adult Intelligence Scale (DSC, DS, and SS). Scores on the WAIS-III subtests are converted to standardize T-scores to allow for easier comparison and interpretation across measures in this category.

Chapter 4 will describe the study's result including a comprehensive description of the important facts and data analysis of the paired and sample *t* testing for all the participants in this non-treatment study.

CHAPTER 4:

RESULTS

In the previous chapters, a basis for this combined confirmatory factor analysis was established by reviewing existing research and identifying areas lacking consistent empirical support. Subsequently, the methodology used in this study was detailed in Chapter III. Results of the statistical analyses performed in this study are presented in this chapter within the context of the initial research questions presented.

Here in this chapter tables will be provided indicating descriptive statistics (i.e., mean, standard deviation) for the participants age, gender, and race. An Independent Samples *t*-test will be performed to determine if the measures differ at baseline on any of the above, potentially confounding variables. In the case of statistically significant differences, the confounding variable will be controlled for in the primary analyses described below.

Furthermore, the current study finds strong evidence that there is a significant improvement in assessing attention and concentration abilities in the participants with ADHD. An additional table will provide average means and standard deviations for the following variables as a result of pretest and posttest evaluation of the three subtests from the Wechsler Adult Intelligence Scale (DSC, DS, and SS). Scores on the WAIS-III subtests were converted to standardize T-scores to allow for easier comparison and interpretation across measures in this category.

Data Analysis

Participants with ADHD and without ADHD (NADHD) diagnosis were administered three subtests from the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) which includes the Digit Span (DS), Digit-Symbol Coding (DSC), and the Symbol Search (SS) (Wechsler, 1997). Digit Span (DS) is part of the WAIS-III Working Memory Index and is made up of two parts: digit span forward and digit span backward. DS forward requires the participant to repeat a series of numbers of increasing length immediately after being spoken by an examiner (Groth-Marnat, 2000). This task measures attention and immediate auditory recall and sequencing. DS backward requires similar cognitive demands as DS forward but includes an additional working memory component requiring the participant to recall the digits in reversed sequence. In this study DS forward and backward scores are combined to provide a total combined score on attention (Lezak, 1995). Digit-Symbol Coding (DSC) is one of the two tasks that comprise the Processing Speed Index of the WAIS-III. This is a timed paper and pencil test requiring rapidly transcribing symbols that have been paired with digits. It is one of the most sensitive measures of brain dysfunction due to the number of complex cognitive abilities required (Groth-Marnat). Sustained and focused attention, response speed, and visuomotor coordination play important roles in performing well on this task (Lezak).

Symbol Search (SS) is the other task that makes up the Processing Speed Index of the WAIS-III. This measure is a pencil and paper measure requiring the participant to scan multiple lines of symbols for the presence or absence of designated targets and to mark “yes” or “no.” This task taps abilities such as visuomotor coordination and speed, rapid decision-making and sustained/selective attention (Groth-Marnat).

Hypothesis

H_0: There will be no short-term or long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

H_1: There will be short-term and long-term positive changes in sustained attention among adults diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type participating in a VCAT exercising program as measured by the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997).

A 2 (time: pre, post) X 3 (measures: DSC, DS, and SS) Independent Samples *t* test will be performed. The analysis will include scores of DSC, DS, and SS as the dependent variables. A significant interaction is expected between the participants in increasing sustained attention over time, as measured by WAIS-III components DSC, DS, and SS. Further, the Independent Samples *t* test is expected to show overall improvements in sustained attention (as measured by WAIS-III subtests DSC, DS, and SS) at a significantly greater rate at the posttest by the second session.

A Paired Samples Test measures will be used to analyze pair wise comparisons of the means to determine the nature of the relationship between variables and to find out the short term and long term effect of exercising VCAT accordingly. This data will support hypothesis testing by evaluating mean scores between the variables to determine significance. Next, if significance testing yields a significant result, the eta-squared (*eta*^{2}) value will be computed to establish the strength of the relationship. This statistic will indicate how much of the variability in sustained attention can be attributed to treatment modality.

H_0: $\mu_{mm} = \mu_{ct} = \mu_{wl}$

H_1: Not all means are equal

The Paired Samples Test will determine the relationship of scores between the pretest session one (pretestS1) and posttest session one (postestS1), posttest session one and pretest session two (pretestS2), and posttest session one and posttest session two (postestS2). Here, we look to assess whether there are any short-term or long term outcomes by exercising VCAT in participants with ADHD.

All the posttests' scores are (statistically) significantly higher than those scores from the pre-tests. In addition, all the posttests' scores of participants with ADHD are almost equal to those posttest's scores of participants without ADHD (NADHD); the Paired Samples Test measures (mean) comparisons ($p < .05$) at a 95% confidence interval will be provided in a table.

Table 1

Demographic Characteristics

		Sex		
		Male	Female	Total
Ethnicity	Caucasian	5	3	8
	African American	3	4	7
	Hispanic	6	3	9
	Other	2	0	2
	Total	16	10	26
		Male	Female	Total
SymptomADHD		10	7	17
	NADHD	6	3	9
	Total	16	10	26

Thirty-four participants signed up to participate in the study. Of these, five did not meet the inclusion criteria due to having current neurological disease, or moderate to severe brain trauma within the past five years and three more opted to withdraw from the study stating they were not comfortable simulating ADHD. Of the remaining twenty six participants ($N = 26$), there were female ($n = 10$) and male ($n = 16$). Participants ranged in age from 21 to 55 years, the mean age of participants was $M = 35.24$ with a $SD = 10.19$.

In this type of study, the raw scores for DS forward and backward were analyzed separately, but both scores were also combined according to standard scoring procedures. Digit-Symbol Coding (DSC) is one of the two tasks that comprise the Processing Speed Index of the WAIS-III. This is a timed paper and pencil test requiring rapidly transcribing symbols that have been paired with digits. It is one of the most sensitive measures of brain dysfunction due to the number of complex cognitive abilities required (Groth-Marnat). Sustained and focused attention, response speed, and visuomotor coordination play important roles in performing well on this task (Lezak).

Symbol Search (SS) is the other task that makes up the Processing Speed Index of the WAIS-III. This measure is a pencil and paper measure requiring the participant to scan multiple lines of symbols for the presence or absence of designated targets and to mark “yes” or “no.” This task taps abilities such as visuomotor coordination and speed, rapid decision-making and sustained/selective attention (Groth-Marnat).

In summary, the current study finds strong evidence that there is a significant improvement in assessing sustained attention in participants with ADHD after exercising VCAT.

Primary Analysis

The study used Wechsler Adult Intelligence Scale (WAIS-III) as a measure for assessing sustained attention in adults with ADHD. The three dependent variables Digit Symbol Coding (DSC), Digit Span (DS), and Symbol Search (SS) scores were served as measures of sustained attention for this test, while VCAT (attention and selectivity attention techniques) is used as the independent variables. Scores on the WAIS-III subtests were converted to standardize T-scores to allow for easier comparison and interpretation across measures in this category

Table 2 provides the mean and standard deviation scores of participants difference scores (between pre- and posttest) for all the subtests DSC, DS, and SS. Table 2

Independent Samples t test's scores *on Objective Measures of Attention in participants with/out ADHD*

Objective	Session1		Session2	
Participants	ADHD	NADHD	ADHD	NADHD

Measures	*Mean/SD*	*Mean/SD*	*Mean/SD*	*Mean SD*
Pretest DS	46.60/4.99	49.16/5.18	54.94/1.2	55.17/.77
Posttest DS	54.78/1.38	54.89/.66	56.35/.96	56.62/.73
Pretest DSC	45.99/5.07	48.52/4.99	54.36/.88	53.94/1.10
Posttest DSC	54.96/1.26	54.22/1.29	55.98/.63	55.79/.79
Pretest SS	46.60/4.88	49.06/5.54	54.37/.81	54.71/1.17
Posttest SS	54.60/1.07	54.87/1.68	55.93/.85	56.13/.68
Pretest total	46.40/4.79	48.91/5.21	54.55/.62	54.61/.84
Posttest total	54.61/.76	54.66/.93	56.09/.49	56.18/.51

The review of the participants' means (Table 2) indicates that both type of participants ADHD (*M* = 46.40, *SD* = 4.79) and NADHD (*M* = 48.91, *SD* = .62) gained improvement in sustained attention as expected after exercising VCAT (ADHD, *M* = 54.61, *SD* = .76 and NADHD, *M* = 54.66, *SD* = .93). In fact, the participants, who were diagnosed with ADHD performed significantly better after exercising VCAT at the posttests on all the dependent variables DS, DSC, and SS by the second session (*M* = 56.09 and *SD* = .49).

Paired Samples Test measures is used to analyze pair wise comparisons of the means for Pair1 (PretestS1 & PostestS1-shorterm effect), Pair2 (PostestS1 & PretestS2-long term effect), and Pair3 (PostestS1 & PostestS2-total effect). The analysis indicated the differences between means were significant for all three dependent variables derived from WAIS-III subtests (Table 3). Furthermore, all the posttest scores were positively correlated with participants' level of perceived performance on the tests after exercising VCAT (Pair 1, *r* = .604, *p* = .001; Pair 2, *r* = .919, *p* = .001; Pair 3, *r* = .633, *p* = .001). Table 3

Paired Samples Test measures for comparisons of the means for short term and long term effect

Paired Differences

Measures	*Mean*	*SD*	*t*	*df*	*Sig. (2-tailed)*	*95% Confidence Interval*
Pair 1	-7.36	4.54	-8.26	25	.000	-9.2 to -5.53
Pair 2	.06	.32	.89	25	.382	.19 to .890
Pair 3	-1.45	.63	-12.05	25	.000	-1.23 to -12.05

The Paired Samples Test (Table 3) compares three paired groups. It calculates the difference between each set of pairs, and analyzes that list of differences based on the assumption that the differences in the entire population follow a Gaussian distribution. If the significance value is less than .05 (alpha), there is a significant difference; and if the significance value is greater than. 05, there is no significant difference between the pairs. In addition, the measure of effect (*Eta2* = *t2*/(*t2* + *DF*)) will show what percentage of the variability in the DV (test scores) is actually due to the IV (VCAT).

Pair 1 is statistically significant, $t(25) = -8.26$, $p < .05$, with $M = -7.36$ and $SD =$ 4.54, meaning that there is a significant difference between the pretest and posttest scores in session one and all the participants gained improvement in sustained attention (short term effect) as expected after exercising VCAT. According to the *Eta2* result (0.73), 73% of the variability in the test score in session one is due to the exercising VCAT, which is a large effect.

Pair 2 does not show a statistically significant value, $t(25) = .89$, $p > .05$, with $M =$ .06, $SD = .32$, meaning that there isn't a significant difference between the posttest's scores in session one and the pretest's scores in session two, and that the improved sustained attention due to exercising VCAT may have a long term effect as well.

Pair 3 is statistically significant, $t(25) = -12.05$, $p < .05$, with $M= -1.45$ and $SD =$ .63, meaning that there is a significant difference between the posttest scores in session one and the posttest scores in session two, and that, all the participants continue improving sustained attention by exercising VCAT on a regular bases (total effect).

According to the *Eta2* result (0.85), 85% of the variability in the test score in Pair 3 (total effect) is due to the exercising VCAT, which is also a large effect.

This concludes the chapter in which the results of the confirmatory factor analyses were presented along with subsequent computations of research sample performance on the combined factor structure. The implications of the study's findings and those from all other analyses performed will be addressed in the next chapter. Additionally, the limitations of this study and suggestions for future research will be discussed.

CHAPTER 5:

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This chapter puts together a collective presentation concerning the body of literature reviewed in proposing the intended study. The core questions and hypotheses of the study are re-examined including the instruments and methods used in assessing the study's claims. Then, the materials discussed in chapter Two will be revealed along with the most significant themes of the study. Next, the practical and social implications are discussed including the study's conclusion and the recommendation.

Research Questions and Hypothesis

The underlying research question and concern was the exploration and examination of outcomes after exercising VCAT in participants with and without ADHD. Particularly, sustained attention was the main concern of ADHD's symptoms in adults diagnosed with ADHD according to the DSM-IV. The research question addressed was whether adults with and without ADHD disorder could develop short or long term improvement in sustained attention as a result of participation in a VCAT program. Thus, it was hypothesized that VCAT exercising would have positive short and long term outcomes on both participants with ADHD and without ADHD. The study used a systematic methodology in enlightening research's theories and testing the hypotheses. In this regard several studies have already established that deficiency in sustained attention (Murphy & Barkley, 2005) is an effective inducement in developing ADHD in adults and children.

According to the large number of data demonstrating correlations between inattentive disorder and ADHD symptoms, this study would consider VCAT as an effective strategy in improving sustained attention related to ADHD. Within its non-clinical context, the proposed study has compared measures of sustained attention between pretest and posttest assessments of participants with and without ADHD before and after exercising VCAT. Thus, according to the result of the study it is assumed that exercising VCAT has an positive short term and long term affect on sustained attention in adult with and without ADHD.

Literature Review of Chapter Two

A few significant facts regarding this research have been disclosed through a precise literature review of the study. Overviews of the prevailing theories of attention and selective attention have provided significant information allowing for a comparison and critique of the behavior analytical, cognitive, and neuropsychological views in this study. Furthermore, the techniques, cognitive, and neural effects of VCAT's attention and selective attention based methodology was explained and distinguished from other similar models and theories such as the Instance Theory of Attention and Memory (ITAM) (Logan, 2002) and the Natural Theory of Visual Attention (NTVA) (Bundesen, 1990). The development of ITAM from theories of attention, selection, and memory created a significant result toward the progress of visual cognition.

This study specially concentrates on the importance of the effect of attentional and attentional selectivity stimulated based therapies such as VCAT to sustained attention and the working memory (WM) in which their successful use relate strongly to the effective use of attention, focus, and concentration (Sperling, 1960). Recent studies also have demonstrated that attention and attentional shifting based on top-down and bottom-up cues has an enormous impact on sustained attention, selective data transfer, and illustration into WM; especially in the circumstances, in which there are more information presented that can be stored (Schmidt, Vogel, Woodman, & Luck, 2002).

The NTVA is another important model of attention and selective attention theory that unveils a series of attentional influences in mind and behavior represented in the psychological literature (Bundenson). According to this model attentional and attentional selectivity stimulus will be distributed through visual processing across the human brain. External visual stimulus picked up by eye passes through the nucleus (LGN) of the thalamus to the striate and extrastriate cortical areas to a saliency map in the pulvinar (Pul) nucleus of the thalamus and all the collected stimuli will be processed by the means of attentional weights by the neurons. The processed information then will be send to visual short-term memory (VSTM), where the data started to be encoded (Corbetta & Shulman, 2002).

Cognitive exercises such as Visual Concentration Attention Technique (VCAT) based on attention and selective attention have been utilized in the recent time to attend many clinical conditions such as ADHD, ADD, major depressive disorder, stress disorders, anxiety disorders, and obsessive-compulsive disorder. Some other related researches have also been conducted in treatment of Alzheimer, Parkinson, and Huntington's disease (Cossa, Della Sala & Spinnler, 1989).

Importance of the Study

The advantage of presenting a neural and cognitive study such as VCAT is to increase the potential numbers of empirical literature assessing the effect of attention and selective attention based therapies to construct new ones in treating related psychological issues.

According to Robertson (2004) attentional stimulations play a crucial role in neurological rehabilitation. There are also some fundamental literatures based on attentional biases in all different kind of psychiatric clinical settings such as sustained attention deficiency related to ADHD in adults, depression, anxiety, and schizophrenia (e.g. Wells & Matthews, 1994). Initially, William James (1890/1950) recognized that individuals understand their environments pretty much through attentional factors including related health, neurological and psychiatric illness.

Current literatures indicate few research studies, which examined the effect of deficiency in sustained attention on patients with ADHD, and none used a method involving attention and selective attention therapy as VCAT dose. Therefore, this research provides one of the most effective and precise method of cognitive training in improving sustained attention and concentration in individuals diagnosed with ADHD.

Earlier studies involving attention and selective attention-based intervention are included with many kinds and different limitations including small sample sizes, inadequate power, and deficiency in effect size reporting, lack of standardized procedures, and no treatment comparison groups. The proposed study would endeavor of resolving such restrictions. While previously researches have contributed description of the process and procedures engaged in the intervention, VCAT provides precise details and concrete steps for such intervention. VCAT is also the first study that links the level of sustained attention and memory performance with the ADHD.

Clinical Implications

The proposed research is component enough to direct possible inquiries and concerns within the scientific community and present reasonable facts in validating the effectiveness of VCAT's attention and attentional selectivity-based interventions. Some studies suggest that many adults with ADHD disorder don't show any effective symptoms by using medications or they are vulnerable to unpleasant side effects (Simpson & Plosker, 2004). VCAT offers an inexpensive, non-addictive treatment with no effect side what so ever that otherwise would come with medications. Utilizing VCAT will be also considerably effective in many other conditions in which attention and selective attention are considered as key effect for the intervention (e.g., stress, personality disorders, and as mentioned before anxiety, schizophrenia, dementia, Alzheimer, and Parkinson disease).

VCAT-based attention and selective attention cognitive exercising have been suggested to have extensive impacts in today's medical research communities; effectiveness of such interventions would support and encourage the future development of nonpharmacetical interventions in many different neuropsychological treatments (Husain & Kennard, 1996). For example the effect of space-based and object- based stimulus on visual selection in treatment of visual neglect and extinction (Humphery & Heinke, 1998). According to another study conducted by Kasten, Poggel, Muller-Oehring, Gothe, Schulte and Sabel (1999), attentional cueing improves vision and amplifies long-term neuronal plasticity. The authors proposed that top-down signals preactivate partially damaged areas of VI, thus linking visual and attentional neuronal networks, with the effect of permanently increasing conscious visual perception.

VCAT's usefulness and efficiency would promote earlier development in neurocognitive reviews illustrating brain functioning during attentional stimulus in the areas of the brain that are proven to be accountable for visual stimulus processing. For example common problem with attention and concentration, short-term memory, organizing/prioritizing, impulsiveness, multi-tasking and occasionally poor social skills and mood swings. Such cognitive related issues are backed by data developed in brain imaging researches with individuals diagnosed with ADHD (Monastra, Monastra, & George, 2002). Single photon emission computed tomography (SPECT) and positron emission tomography (PET) scan studies have demonstrated that deficiency in metabolism of many region of the brain involving in cognitive processing such as attentional, inhibitory, and decision making behaviors, which is predicted to be the cause of ADHD (Monastra et al., 2002). The standard EEG neurofeedback treatment, traditional neurotherapy (brainwave training), and Autonomic Nervous System (ANS) biofeedback for learning are suggested to be effective in treatment of ADHD (Monastra et al.).

This research is about the effectiveness of VCAT in treating sustained attention deficiency related issue in adults with ADHD. In addition, even, in a case of no direct effect, there may be an indirect effect of VCAT in combination with some other cognitive- based therapies such as cognitive behavior therapy, interpersonal therapy, brief psychotherapy, interpersonal psychotherapy, and imipramine plus clinical management (Elkin, 1994). Such therapies have shown to be effective intervention in treating many different kind of psychological and neuropsychological disorders (Kuyken, Peters, Power, & Lavander, 2003).

Social Implications

Attention Deficit Hyperactivity Disorder (ADHD) is a mental condition characterized by a person's inattention, hyperactivity and impulsiveness (Murphy &

Barkley, 2005). According to Murphy and Barkley, is a disorder that involves complex biological, psychological, and social disturbances. It affects people's Health and their productive lives, impairing their personal satisfaction, and the ability to fulfill their social lives.

VCAT based attention and selective attention therapies could have significant and positive implications in the society by attempting to treat such social issues and problems. Such therapies based on attentional process have been suggested to have positive effect on concentration, attention, memory, emotional and behavioral issues (Fiske & Taylor, 1991), self-regulation and positive mood (MacLeod et al., 2002), and achievement in individuals' goals.

The proposed study predicts significant efficiency in VCAT program, thus extending such program will be accounted for enhancement in quality of life, individuals' well-being, and improvement in many different kind of psychological issues. Due to sustained attention deficiency disorders many people are suffering from poor cognitive performance affecting their interpersonal skills, their socioeconomic status, and their educational goals, which lead to greater societal burdens (Ramsay, 2002). Improvement of ADHD symptoms such as the sustained attention as a result of VCAT program could be an opening door to treatment of similar issues in the society and the creation of great social relevance.

Limitations and Suggestions for Future Research

When considering the generalizability of the results of this study to other samples, it is important to note the limitations that may affect how well these data will apply. Several characteristics of the research sample were less than optimal. For one, the overall research sample was relatively small and results pertaining to ADHD diagnosis were based on even smaller numbers; however, this is not uncommon for studies within this area of research. There also was limited ethnic and socioeconomic diversity among research study participants that may impact generalizability of these results. Due to the number of examiners used in data collection for both the standardization sample and the research sample, likelihood for examiner error also may be a limitation in the study.

In the future, studies should be conducted to ascertain whether the factor structure proposed here is supported in various clinical populations and across demographic groups. Furthermore, alternative assessment tools such as the Test of Variables of Attention (TOVA) and Connors'Continuous Performance Test (CCPT) should be used in combination with the WAIS-III to determine the effectiveness of VCAT in improvement of sustained attention in adult with ADHD.

Conclusion

Empirical support of VCAT- based intervention through attention and selective attention theories hold promising future for related researches in treating attentional deficiency in adults with ADHD.

According to the previously discussed literatures, fMRIs, and clinical studies of attention and selective attention, this study concludes that shifting attention and attentional stimulus provided by VCAT would improve brain functioning system. It affects the oculomotor localization tasks, the frontal lobe, and the parietal and frontal cortex of the brain and by exhibiting a significant increase in neural activity (Corbetta, 1998). In addition, the neuroimaging studies conducted by Martínez et al. (1999) demonstrate that attentional stimulus and shifting attention to the right and left in the visual field will increase neural network activities in various parts of brain and effect changes in the brain waves and the oxygenated blood flow. According to Edelman (1987), in order for neurons to function accurately, a better blood flow though out the brain is needed to supply oxygen and necessary nutrients to neurons for a maximum plasticity and functioning. Thus, attentional and cognitive stimulations cause that hippocampus (an area closely related to memory consolidation) become a center of such highly developed network of activity, which lead to regeneration and new added neurons (Eriksson et al., 1998). This will cause enhancement in sustained attention, concentration, and cognitive abilities such as memory, as revealed by Woodman et al. (2003).

Baumeister and Heatherton assume that regular attentional and attentional selectivity training (e.g., VCAT-program) would improve cognitive functioning by enhancing one's focus, attention, and concentration. Thus, the proposed study will lastly conclude that VCAT program would provide an effective treatment in relieving ADHD symptoms in adults by enhancing one's sustained attention leading to enhancement of concentration and memory performance.

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APPENDIX A

DSM-IV Diagnostic criteria for Attention-Deficit/Hyperactivity Disorder

(Inattention)

A.

(1) six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

(a) often has difficulty sustaining attention in tasks or play activities

(b) often does not seem to listen when spoken to directly

(c) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

(d) often has difficulty organizing tasks and activities

(e) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)

(f) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)

(g) is often easily distracted by extraneous stimuli

(h) is often forgetful in daily activities

Note. From American Psychiatric Association (1994). Copyright 1994 by the American Psychiatric Association. Reprinted by permission. B.

STRUCTURED CLINICAL INTERVIEW

Date:__________ Age: _________ Gender: male female

Race: Caucasian, African American, Hispanic, Asian, Other___________________

Years of education and college status:_____________________________________

College major and minor:____

Current grade point average:____

Rule outs

Have you ever had a head injury? Yes No

(Have you ever been hit on the head hard enough to make you see stars [dizziness, trouble concentrating after, confused] lose consciousness, or seek medical treatment?) Yes No

If yes, describe head injury(ies): type of injury, length of unconsciousness, medical treatment, diagnosis, hospitalization, and post-traumatic amnesia.

____

Do you have any neurological conditions? Yes No

If yes, please describe____

Do you have a seizure disorder? Yes No

Have you ever been diagnosed with Attention-Deficit/Hyperactivity Disorder? Yes No Do you currently have significant problems with inattention, impulsivity, or hyperactivity that interfere with your academic functioning, social life, or work performance? Yes No

APPENDIX B

Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist

Today's Date:

Please answer the questions below and as you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months.

1. How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

2. How often do you have difficulty getting things in order when you have to do a task that requires organization?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

3. How often do you have problems remembering appointments or obligations?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

4. When you have a task that requires a lot of thought, how often do you avoid or delay getting started?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

5. How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

6. How often do you feel overly active and compelled to do things, like you were driven by a motor?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

7. How often do you make careless mistakes when you have to work on a boring or difficult project?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

8. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

9. How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

10. How often do you misplace or have difficulty finding things at home or at work?

144

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

11. How often are you distracted by activity or noise around you?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

12. How often do you leave your seat in meetings or other situations in which you are expected to remain seated?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

13. How often do you feel restless or fidgety?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

14. How often do you have difficulty unwinding and relaxing when you have time to yourself?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

15. How often do you find yourself talking too much when you are in social situations?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

145

16. When you’re in a conversation, how often do you find yourself finishing the sentences of the people you are talking to, before they can finish them themselves?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

17. How often do you have difficulty waiting your turn in situations when turn taking is required?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

18. How often do you interrupt others when they are busy?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

APPENDIX C

VCAT-PROGRAM

- Orientation
  - Set ground rules regarding confidentiality and privacy
  - Review guidelines for participation
  - Education on VCAT's means and techniques
- Distributing methods and related materials for the daily VCAT's process and agenda

Each participant goes through all the steps according to the instructions provided in the table A.

APPENDIX D

IRB APPROVAL

Dear Mr. Babai Siahdohoni,

This email is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "The Effect of External Attentional Stimulations such as Visual Concentration Attention Techniques (VCAT) on Sustained Attention in Adults with ADHD."

Your approval # is 03-31-11-0108891. You will need to reference this number in your dissertation and in any future funding or publication submissions. Also attached to this e-mail is the IRB approved consent form. Please note, if this is already in an on-line format, you will need to update that consent document to include the IRB approval number and expiration date.

Your IRB approval expires on March 30, 2012. One month before this expiration date, you will be sent a Continuing Review Form, which must be submitted if you wish to collect data beyond the approval expiration date.

Your IRB approval is contingent upon your adherence to the exact procedures described in the final version of the IRB application document that has been submitted as of this date. If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB application, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher. Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden web site or by emailing irb@waldenu.edu: http://inside.waldenu.edu/c/Student_Faculty/StudentFaculty_4274.htm

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Please note that this letter indicates that the IRB has approved your research. You may not begin the research phase of your dissertation, however, until you have received the Notification of Approval to Conduct Research (which indicates that your committee and Program Chair have also approved your research proposal). Once you have received this notification by email, you may begin your data collection. Sincerely,

Jenny Sherer, M.Ed., CIP
Operations Manger
Office of Research Integrity and Compliance
Email: irb@waldenu.edu
Fax: 626-605-0472
Tollfree : 800-925-3368 ext. 1341
Office address for Walden University:
155 5th Avenue South, Suite 100
Minneapolis, MN 55401

APPENDIX E:

CONSENT TO PARTICIPATE IN RESEARCH

The Effect of External Attentional Stimulations such as Visual Concentration Attention Techniques (VCAT) on Sustained Attention in Adults with ADHD

You are invited to be in this study because you are an adult with ADHD who has expressed interest in the research. This study is conducted by Nader Siahdohoni, who is a doctoral student in Clinical Psychology at Walden University. Mr. Siahdohoni is conducting this study for his doctoral dissertation. Dr. Coles is his faculty sponsor for this project.

Your participation in this non-clinical study is entirely voluntary. You should read the information below and ask questions about anything you do not understand, before deciding whether or not to participate. This form is part of a process called “informed consent” to allow you to understand this study before deciding whether to take part.

Purpose of the Study

The title of the study is “The Effect of External Attentional Stimulations such as Visual Concentration Attention_Techniques (VCAT) on Sustained Attention in Adults with ADHD”. VCAT is a method of exercising attention and concentration by focusing and shifting attention around from one object to another. It is not yet known whether this exercise can help people with ADHD, but this study will help determine whether we can provide a treatment based on these exercises in the future.

The purpose of this study is to test if exercising attention and concentration methods such VCAT would have any effect on sustained attention associated with ADHD. This study does not involve a treatment program of any type; however it will inform future treatment for attention problems. We hope to use what we learn from this study for future treatments of attention problems, improved quality of life, to enhance work performance among those suffering from this disorder, and ideally, this would lead to further applied research in the area of attention and concentration across many emotional and self-regulation problems.

Study Procedures:

a) The study is planned for a 2 week period, I will ask you to come in twice, for an hour each time.

b) If you agree to be in the study, you will be asked to look at a booklet of symbols and finding certain symbols in that booklet, then you will be doing a concentration activity by repeating certain numbers forward and backward. In addition, you will be asked to look at different characters and writing down the corresponding number to that character.

c) You will then exercise VCAT and repeat step b) once more.

Voluntary Nature of the Study

Your participation in this non-clinical study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study

There are no risks to this study and no direct benefits for individual participants.

If discomforts become a problem, you may discontinue your participation.

Confidentiality

Any information that is obtained in connection with this non-clinical study that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a code number to let Mr. Siahdohoni and Dr. Coles know who you are. We will not use your name in any of the information we get from this study or in any of the research reports. When the study is finished, we will destroy the list that shows which code number goes with your name. Information that can identify you individually will not be released to anyone outside the study. Mr. Siahdohoni will, however, use the information collected in his dissertation and other publications. We also may use any information that we get from this study in any way we think is best for publication or education. Any information we use for publication will not identify you individually.

Contacts and Questions

The researcher's name is Nader Babai-Siahdohoni. The researcher's faculty advisor (Chair) is Dr. Coles. You may ask any questions you have now. Or if you have questions later, you may contact the researcher at (480) 688-8732 or n.siahdohoni@yahoo.com or the advisor at (800) 925-3368 or charlton.coles@waldenu.edu if you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the

Director of Research Center at Walden University. Her phone number is 1-800-925-3368, extension 1210. The IRB approval number is 03-31-11-0108891.

The researcher has included two copies of this form. Complete one form and return. Retain the other copy for your files.

Statement of Consent:

Please check the box below and return if you agree to the terms in this cover sheet.

Please indicate your consent to participate by completing and returning this packet to:

Nader Babai-siahdohoni

125 N. 22nd Place #109

Mesa. Arizona 85213

A self-addressed, stamped envelope has been included.

I have read the above information. I have received answers to any questions I have at this time. I am 21 years of age or older, and I consent to participate in this non-clinical study. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Printed Name of Participant ______________________

Date of consent ______________________

Participant's Written or Electronic* Signature ______________________

Researcher's Written or Electronic* Signature ______________________

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Table 4:

VCAT's Process

For each day of intervention, variety of images will be used in combination with the master key display explained in table B1. Starting with psychic images in day two and continuing with numeric and alphabetic images in day three, then multi colored natural environment such as mountains and ocean waves images in day four, motion images for day five, illusion images in day six, fantasy images in day seven, close range captured images in day eight, far and distance captured images for ninth day, and mirror reflected images will be scheduled for the tenth day. Relaxation images will be used between each phase.

VCAT's Methodology

VCAT's processing system

Depending on disorder and the stage of the disorder, VCAT's general processing system is as follow:

VCAT's Master Key Effect- used with an illustration that contains a mixture of different colors, shapes, and presents different sceneries and background in combination with VCAT display.

VCAT's Master Key Effect, a three simple steps methodology that you will use for all the effects.

Phase I-Object-to-Object Effect

Step1-Object to Object attentional shifting to right

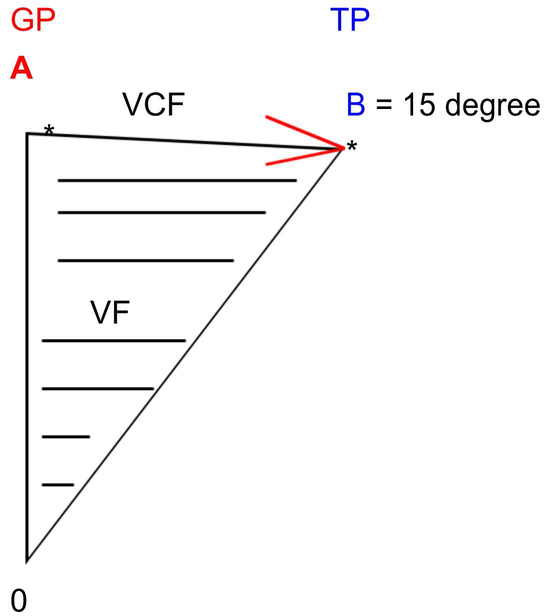
Step2-Object to Object attentional shifting to left

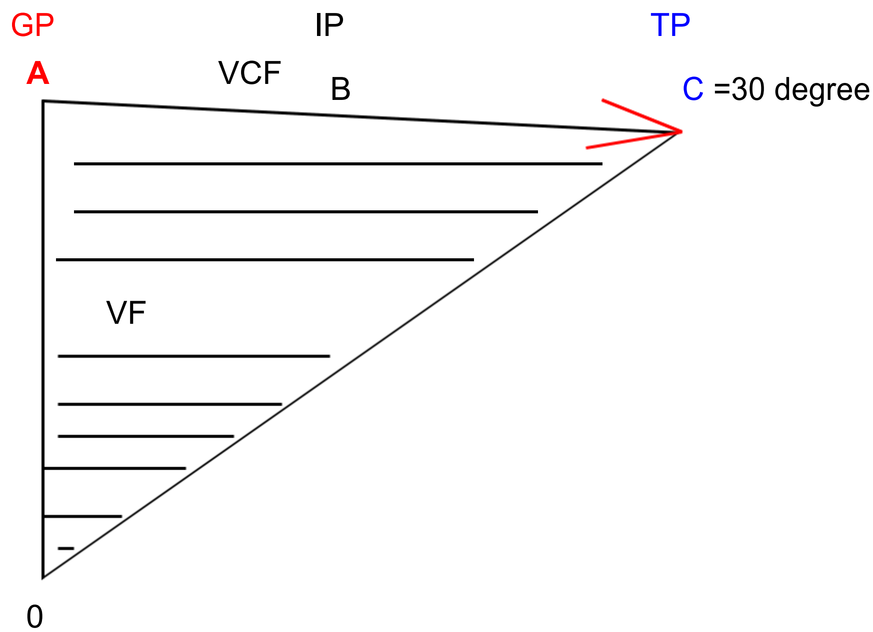
Steps3-Object to Object attentional shifting up ward

Step4-Object to Object attentional shifting downward

To start, you need to fix your gaze on center point A, concentrate on it for 10 seconds. Next, you will shift your attention to the right, to the letter B, ignoring all other letters without shifting your gaze from A, concentrating on B for 10 seconds and back to center point A. Then, you will shift your attention from center point A to C, ignoring all other letters including Target Point B without shifting your gaze from A, concentrating on TP C for 10 seconds and back to center point A again. Repeat the same steps for each letters (B, C, D, E, F, G) on the right side of the center point A. Next, you will fix your gaze on center point A, concentrate on it for 10 seconds, and shift your attention to the left, to the letter H, ignoring all other letters and without shifting your gaze from A, concentrating on H for 10 seconds and back to center point A. Then, you will shift your attention from center point A to I, ignoring all other letters including letter H without shifting your gaze from A, concentrating on I for 10 seconds and back to center point A again. Repeating same steps for each, and every letter (H, I, J, K, L, M) on the left side of the center point A. Then, you will do the same exact steps upward for letters N, P, and O, P from center point A. Finally yet importantly, you will do the same exact steps downward for letters Q, S and R, S from center point A.

Presentation of Object-to-Object Effect





Phase II- Object-and-Object Effect

Step1-Object and Object attentional shifting to right

Step2-Object and Object attentional shifting to left

Step3-Object and Object attentional shifting up ward

Step4-Object and Object attentional shifting downward

In this step you are going to stare (gaze) on GP A for about 10 seconds; then, while you are still staring on A you will concentrate and shift your attention to TP B(going to the right of the visual field display without moving head or eyes) for about 10 seconds. Next, while you are still staring on GP A and concentrating on TP B you will add the TP C in to your visual field of concentration. (At this point, you should stare at GP A and have TP B and TP C in your concentration field, where A is the GP and B and C are the attentional Target points-TPs). After 10 second, you will add TP D to the concentration field without moving head or eyes. (Now you should still staring at GP A and have 3 other TPs B,C,D in your concentration field). Next, you continue to add the other points (E, F) in the right visual field into the concentration field while still staring on GP A. In every step you will be counting from 1 to 10, which should equal 10 seconds, and after a while you will be getting the hang of it and without counting any more you will automatic do the 10 seconds. Next, you will do the same process from GP A to the left, up and down in the visual field display until you have covered all the TPs in the visual concentration field.

TP=Target Point

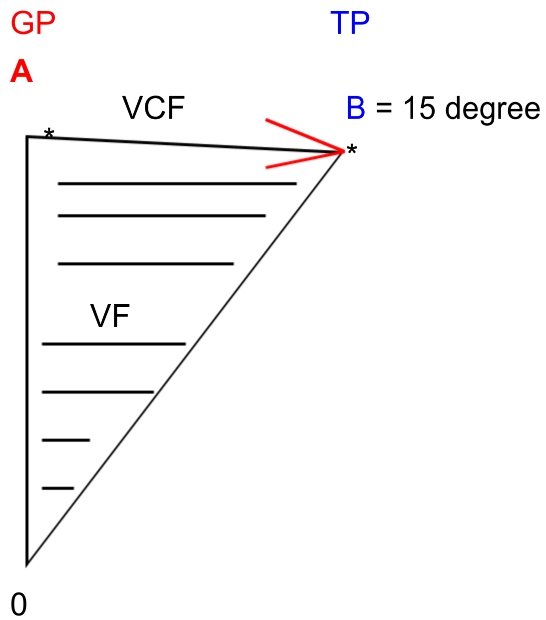
IP=Ignore point

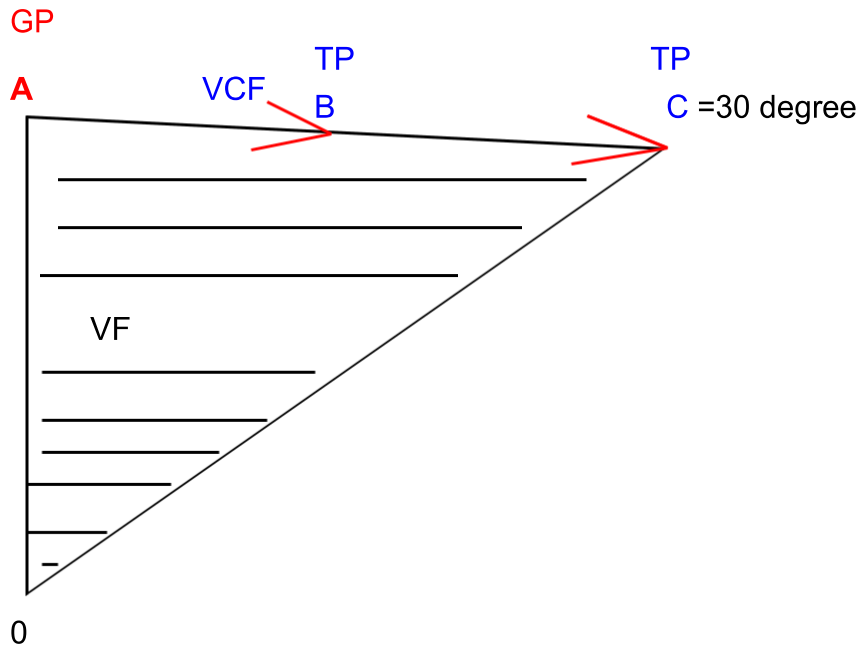
VF=Visual Field

VCP=Visual Concentration Point

GP=Gaze Point

Presentation of Object-and-Object Effect





Phase III- Object display as a Whole Process

Upon completion of phase I and 2; you are then ready to shift the attention to all the TPs (the right, left, up and down side) in your visual field in one concentration and attentional point while keep staring at GP A.

Table B- Setting up the VCAT Display with different Images for each Session

VCAT's general processing system for ADHD: This part includes a complete description of every steps of VCAT's processing system.

Phase A- Center point Effect (Sustained Attention-applies to each phase)-Focus and concentration point (Stare point) on the center point A without moving eyes.

VCAT System process

System Process I (SPI) - meditation and relaxation

Step 1- Center point finger effect (eyes are moving with the index finger- Head is in forward still position- VCAT display principles will be applied).

Here you will stretch your right arm straight to the front of your nose with the index finger pointing upwards. Next, you will stare at the top of your index finger for 10 seconds and move it to the right very slowly. You will follow the top of the index finger only with your eyes and without any head movement all the way to the brake point of your shoulder blade. Stop right there for 10 second and very slowly move the arm back to the center point (front of your nose) while still staring on the top of the index finger without any head movement. Further, you will repeat the same process going to the left and back to the center point (using the left arm). You will also use the same process, form center point up and down with each arm, where the finger is pointed to the left with the right arm and right with left arm.

Step 2- Finger-arm-visual field effect (eyes are in still position-VCAT display principles is being utilized). Same as step 2 with just a GPA in the back ground as a focus point.

Here you should choose an object far in front of you; it could be anything from a picture, statue, a blank point, a dot on a wall or simply use one of the VCAT's images as center point A. Next, you will stretch your right arm straight to the front of the nose parallel to the chosen center point A with the index finger pointing upwards. You will focus and stare at center point A for 10 seconds and then shift your attention from center point A to the top of your index finger and fully concentrate on it. Then, you move very slowly the index finger to the right in your visual field without moving the head or the eyes (You are still focusing on the center point A), while you keep shifting the attention with the moving index finger to the brake point of your shoulder blade. Here, you are staring at center point A; while your full attention is on your index finger, which is now all the way to end of the right eye's visual field. After 10 seconds, you will move the index finger back to the center point A, while you are still staring at center point A and keep concentrating on the index finger. Next, you will continue the same process with the same arm all the way to the left and back to the center point A. Further, you are going to do the exact same process from center point A with the same arm up and down, while keep staring on point A with the shifted attention on the top of the index finger, which is now pointing to the left. Finally, you will be use the same exact process with the left arm.

Step 3- Head movement to all direction- eyes still and focused on stare point A

Focus and stare on the GPA for 10 seconds; slowly move your head all the way to the right to your shoulder blade without moving your eyes or losing the GPA from your focus point and your attention and slowly back to the start point (GPA). Now, go to the left, up and down the same exact way.

Step 4- Head movement to all direction with eyes following- Stare point A is kept in attention at all times.

Focus and stare on the GPA for 10 seconds; slowly move your head all the way to the right to your shoulder blade with your eyes following the move with out losing the attentional focus from your focus point GPA and slowly back to the start point (GPA). Now, go to the left, up and down the same exact way.

Phase B- Master Key Effect will be used in all the steps.

System Process III (SP III)-Closed within object effect (GPA is centered and all the TPs are scattered to the left, right up, and down in a closed frame display)

System Process IV (SP IV) - Far within object effect (GPA is located on the far end and all other TPs are scattered on the front of the GPA in a closed frame display)

System Process V (SP V) - Near within object effect (GPA is located on the front part and all other TPs are scattered on the back of the GPA in a closed frame display)

System Process VI (SP VI) - Open out object effect- (GPA is centered and all the TPs are scattered far from each other to the left, right, up, and down in a open display

System Process VII (SP VII) - Closed opened out object effect (combination of a Closed within object effect with Open out effect- here the GPA is the closed within object effect in the center and all other objects used as the open out effect.

System Process VIII (SP VIII) - Cool down effects- these steps (1 to 4 point-display) could be used to relax the eyes and the brain after a heavy work out for a better out come.