The Effectiveness of the Interactive Metronome® as a Tool to Improve Selective Attention of Veterans within their Roles in Post-Secondary Education Settings in Eastern North Carolina

by

Karla Baker

November, 2014

Director of Thesis: Dr. Leonard Trujillo, PhD, OTR/L, FAOTA

Department: Occupational Therapy

The purpose of this study was to measure the effectiveness of the Interactive Metronome specific to improving attention. As veteran enrollment continues to increase in higher education, attention in the classroom and workforce due factors such as Post Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) have become an issue. Could veterans who have expressed concern of attention problems benefit from the Interactive Metronome (IM)? Three veteran students and employees from East Carolina University self-identified as having problems with attention and participated in the study. Subjects were given the IM-Home system after meeting with the PI to complete *the Canadian Occupational Performance Measure (COPM), d2 Test of Attention*, and learning to use the system. After 15 at-home sessions (4-6 weeks) with the IM, participants retook the COPM and D2. It was found that all participants rated their satisfaction with attention in school or work higher than before they started the IM. Additionally, post-test scores of the *d2 Test of Attention* showed that all participants were able to process more information. Based on these results and past studies, it is believed that the Interactive Metronome is a valuable tool in the rehabilitation process and may be especially helpful for veterans with attention problems.

The Effectiveness of the Interactive Metronome® as a Tool to Improve Selective Attention of Veterans within their Roles in Post-Secondary Education Settings in Eastern North Carolina

A Thesis

Presented To the Faculty of the Department of Occupational Therapy

East Carolina University

In Partial Fulfillment of the Requirements for the Degree

Masters of Science of Occupational Therapy

by

Karla Baker

November 2014

© Karla Baker, 2014

The Effectiveness of the Interactive Metronome ® as a Tool to Improve Selective Attention of Veterans within their Roles in Post-Secondary Education Settings in Eastern North Carolina

by

Karla Baker

APPROVED BY:

DIRECTOR OF
THESIS: _____
(Dr. Leonard Trujillo, PhD, OTR/L, FAOTA)

COMMITTEE MEMBER: _____
(Dr. Debbie Amini, EdD, OTR/L, CHT, FAOTA)

COMMITTEE MEMBER: _____
(Dr. Mary Hildebrand OTD, OTR/L)

COMMITTEE MEMBER: _____
(Dr. Jane Painter-Patton EdD, OTR/L, FAOTA)

CHAIR OF THE DEPARTMENT
OF OCCUPATIONAL THERAPY: _____
(Dr. Leonard Trujillo, PhD, OTR/L, FAOTA)

DEAN OF THE
GRADUATE SCHOOL: _____
Paul J. Gemperline, PhD

TABLE OF CONTENTS

LIST OF GRAPHS

LIST OF TABLES

CHAPTER I

Introduction

The GI Bill, first introduced to veterans in 1944 during World War II had a profound impact on American culture, serving as the basis for what we now consider the middle class. By educating millions of veterans coming back from overseas, the GI Bill enabled growth in fields of science, medicine, education, and arts after the war ended (O'Herrin, 2011).

In 2009, Congress passed the Post-9/11 Veterans Educational Assistance Act of 2008 to provide benefits for those who served after the terrorist attacks on the World Trade Towers and Pentagon in 2001. Known as the Post-9/11 GI Bill, this military benefit pays for undergraduate tuition and fees, grants a textbook fees stipend, and a monthly stipend (Steele, Salcedo, & Coley, 2010). According to the GI Bill website, it will help the veteran "from combat to career," by setting the veteran up for success in their post-military life (http://www.gibill.va.gov/). The Post-9/11 GI Bill has proved popular amongst service members as over 500,000 veterans applied for eligibility and 300,000 veterans and their family members used it within the year the program began. Furthermore, the GI Bill availability is considered a major factor for some veterans who decide to enroll in college (Steele et al., 2010).

Since the transfer to the Post-9/11 GI Bill, there has been an increase in the number of veterans enrolled in colleges and universities across the country (O' Herrin, 2011). As of 2009, student veterans comprised 3.1% of the student body in United States colleges and universities. Enrollment is expected to increase as approximately 2 million veterans return home from active duty abroad to use their Post-9/11 GI Bill benefits (Radford & Wun, 2009; Steele et. al., 2010). As in the past, veterans will choose to use the G.I. Bill to pursue post-secondary education in order to establish a post-military career, or attend college like their peers (O' Herrin, 2011).

Unfortunately, despite the financial assistance provided to veterans to assist with the establishment of a productive civilian life, several concerns have been identified that have been shown to make the veterans' academic success more difficult. According to Tanielian and Jaycox (2008), a third of the 1.64 million service members that have deployed will show signs of post-traumatic stress disorder (PTSD), traumatic brain injury (TBI), and/or depression.

Although each case of a brain injury is different, veterans or those who have experienced a mild traumatic brain injury (mTBI) have been known to experience problems with executive functions, attention, and concentration, which leave an impact on daily life (Radomski, Davidson, Voydetich, & Erickson, 2009). Those with PTSD experience similar problems with attention, memory, and other cognitive functions as well (Vasterling, Brailey, Constans, Sutker 1998; Hawn, 2011). Because the symptoms of PTSD and mTBI have similar features, it is sometimes difficult to tell the two apart and give the appropriate diagnosis (Bazarian et al., 2012). Furthermore, service members who return from war with these symptoms may go undiagnosed or the symptoms may develop later (Ginzburg & Holm, 2009). PTSD and mTBI co-occurs in this population, which may make both more prevalent than is recognized (Sayer et al., 2009).

Research has shown that attention in school is crucial for classroom success (McClelland, Acock, Piccinin, Rhea, & Stallings, 2012). In a study conducted by Plach and Sells (2013), 93% of veteran participants described troubles with the occupation of school at the college level, particularly not having the necessary skills to be successful in higher education, such as adequate concentration. Furthermore, even with later onset, concentration problems caused by PTSD may impede academic success (Hawn, 2011). Although veterans have the G.I. Bill and are highly motivated to realize their goals of becoming contributing members of the community through

higher education, attention and concentration issues due to diagnosed or undiagnosed PTSD/mTBI may interfere with their ability to succeed (Plach & Sells, 2013).

Statement of the Problem

Veterans who use the G.I. Bill to facilitate their success when leaving the military have identified cognitive concerns that may limit their potential in the occupation of higher education. Furthermore, these concerns not only affect academia but ultimately impact the veterans' lives as well. Although veterans may be able to function in the areas of basic daily life activities, these higher skills are crucial for life success and without them they cannot realize their personal potential (Plach & Sells, 2013). Inability to acquire a vocational or academic degree could limit their ability to achieve their life occupational goals.

Purpose of the Study

There exists a need to mitigate the effects of mTBI and PTSD, particularly decreased concentration and attention in veterans returning from the front lines to ensure their success in higher education. The purpose of this pilot study is to examine the effects of the Interactive Metronome™ as a means of improving the self-identified cognitive limitations of attention and concentration being experienced by previously deployed veterans.

The Interactive Metronome™ (IM) is a treatment modality that has been shown to "improve neurological functions of motor planning and sequencing" (Interactive Metronome™, 2009). According to the makers of the IM, it has been shown to improve attention, concentration, cognitive speed, memory, and a variety of other skills. Additionally, it may help clients with the diagnoses of attention deficit hyperactivity disorder, cerebral palsy, epilepsy, traumatic brain injury, and more (Interactive Metronome™, 2009). A study examined the effects of IM treatment on reading found that the IM helped with reading comprehension, which was attributed

to an increase in attention (Ritter, Colson, & Park, 2012). A large (*n*=56) experimental IM study was conducted with boys diagnosed as having ADHD and showed that the IM group had gains in attention and language processing (Schafer et al., 2001).

The IM was selected for this pilot study because of the promising neurological effects it has had in past studies regarding attention and concentration. The IM, particularly the home system, is convenient and can be done in the home on a client's own time. Furthermore, although it utilizes a bottom-up design, the IM may have carry over into other areas of occupation.

Research Questions

Could veterans that have expressed concern of attention problems benefit from the Interactive Metronome? Will the IM intervention lead to gains in attention that will lead to higher satisfaction in the attainment of higher education or job security?

Operational Definitions

For the purpose of this study, a veteran will be defined as anyone who served active duty or as a contractor for the United States Military.

Limitations

There are several limitations to this pilot study. The small sample size (*n*=3) and geographic location of the study will not allow us to generalize the results to all veterans that may or may not have been exposed to combat. The differences in age and exposure to war differed between each of the participants, so results may not be generalized to their respective populations. This study also does not have a control group, which does not allow for comparison outcomes to a similar group that did not receive the intervention. Because the veterans are all in

the intervention group, there is the possibility of a Hawthorne effect. These limitations are to be expected in a pilot study without a control group.

Delimitations

Furthermore, this study has delimitations that are necessary to address. This study is not longitudinal and will not address long-term college success measured by grade point average, classroom participation, or employment outcomes. The investigator understands there may be premorbid dispositions and other factors that may have impacted attention and concentration in the sample before joining the military or before deployment. This study will not address those concerns but acknowledges those factors are a possibility. Because the impact of war is so large, there are many factors that are considered stressful for the veteran (i.e. family issues, driving, alcohol and drug abuse, etc.). However, those life stressors are beyond the scope of the study but it is acknowledged that they impact the occupational performance of the daily life of the veteran.

Significance of the Study

With the influx of veterans into colleges and universities across the country (O'Herrin, 2001) and issues they may experience after war (Tanielian & Jaycox, 2008), it is clear the IM may have a place in helping veterans better their attention, thus making higher education within reach. This pilot study has made the first steps in looking at this relationship and may lay the groundwork for future studies.

CHAPTER II

Review of the Literature

The effects of war on service men and women, their ability to complete higher education, the neurological basis for attention deficits, and the documented effects of the IM are the foundation of this pilot study.

Veterans and the Effects of War on Ability to Complete Higher Education

There is ample literature regarding veterans' transition into higher education, especially since the enactment of the Post-9/11 GI Bill. It is expected that colleges will see a rapid entry of veterans on their campuses as the wars slowly down size overseas (O'Herrin, 2001). Veterans already account for 3.1% of undergraduates in colleges across the United States and that number is only expected to increase (Radford & Wun, 2009). In 2007-08, 85% of both veterans and active duty personnel that were enrolled in college were at least 24 years old and 62% had a child, spouse, or both. They are also more likely to be employed either part or full-time (Radford, 2009). Student veterans are motivated to succeed in their education and one study revealed 77% of participants reported achieving goals such as higher education was a driving factor for staying well in life (Plach & Sells, 2013). Although there are increasing numbers of motivated veterans using the G.I. Bill to obtain higher education for greater opportunities later in life, the long-lasting and invisible wounds of war may hinder the achievement of those goals.

Prior to seeking higher education, some veterans may have experienced combat during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) introduces a realm of problems that affect veterans' success in education. It is estimated that 20% of veterans return from war with a traumatic brain injury (TBI), with most of those cases being a mild traumatic brain injury (mTBI) (Sayer et al., 2009). As of January 2008, it was estimated that 320,000

service members that served during OEF/OIF experienced a mild TBI (mTBI) (Tanielian & Jaycox, 2008). Mild TBI is defined as "a psychological disruption of brain function as manifested by at least one of the following alteration of mental state, loss of consciousness, loss of memory or focal neurological deficit that may or may not be transient" (Sayer et al., 2009, p. 704). mTBIs may also be called concussions (Sayer et al., 2009). Another diagnosis that is seen frequently with these wars is the anxiety disorder post-traumatic stress disorder (PTSD). PTSD occurs after someone goes through an especially traumatic and/or life- threatening event and consequently experiences intense distress, traumatic memories, and psychological arousal. The PTSD prevalence rate is approximately 13-17% of veterans returning from war versus 3.5% in the general population (Seal, et al., 2007; Gradus, 2014). Effects of mTBI and PTSD resemble each other and are easily misdiagnosed or go undiagnosed (Bazarian et al., 2013). Symptoms seen in both conditions can be seen immediately or may be delayed and include headaches, dizziness, and difficulties with concentration, memory, and attention (Sayer et al, 2009; Vasterling, Brailey, Constans, & Sutker, 1998).

A study done by Vasterling, Brailey, Constans, Sutuker (1998) showed that Gulf War veterans who suffered from PTSD had more problems with attention and memory as compared to veterans without mental disorder diagnoses. Specifically, they demonstrated deficits in sustained attention and mental manipulation of attention. Furthermore, they showed more difficulty in inhibiting unrelated information during testing (Vasterling et al., 1998).

Another study with college students showed mTBIs were related to decreased response accuracy and more frequent omission errors on a cognitive control task. This indicates difficulty in sustained attention (Pontifex et al., 2012).

Many veterans who have endured war and have returned home with mTBI or PTSD choose to go back to post-secondary education but express difficulties with cognitive skills such as attention and concentration due to their deployment (Plach & Sells, 2013). Learning at the post-secondary level is more taxing than at lower levels as more attention, memory, and executive function is required (Maclennan & MacLennan, 2008). Attention and concentration are important skills in succeeding in academia and without the ability to attend in the classroom, veterans may not obtain a degree to help further the likelihood for success in a desired career.

In an interview about his experience after leaving the Army Reserves, one student reported "I think I was a better student when I came back…but what made it hard was my attention span and my patience were very short, so sitting in class… became very hard to do." Another student reported, "Once I got back to school, it was like I know what I need to do and it is right in front of me, but I'm just not doing it. I don't know if it is because I am not as focused as I was before I left, or…I don't know" (Ackerman, DiRamio & Garza Mitchell, 2009, p.10). These statements reflect the students' desire to participate in higher education, but also the struggle with attention problems that make success in this occupation difficult as well. A focus group interviewed student veterans enrolled in college and found that 10% were coping with physical or psychological challenges that came after serving in the military. Among these involved anxiety, hyperaltertness, and difficulty concentrating. A larger survey revealed that in veterans across public and private two-four year programs, 67.8% were coping with a service-related injury or disability, and 54.5% of them rated this category as a "moderate" or "major" challenge (Steele et al., 2010).

In a study done by Plach & Sells (2013), 93% of the respondents described challenges with school when interviewed using the Canadian Occupational Performance Measure.

Challenges in school were rooted in not being able to relate to other students and not having the academic skills to succeed such as difficulty concentrating. In screening the participants, they found that 40% tested positive for possible mTBI which may explain their difficulties in school (Plach & Sells, 2013). Symptoms caused by PTSD and mTBI are related to stressors such as the inability to concentrate or maintain attention which in turn affect performance in the classroom (Hawn, 2011). Additionally, deficits of attention and concentration may interfere with daily routines and occupations such as work and family roles because they are no longer as automatic (Radomski, Davidson, Voydetich & Erickson, 2009).

Neurological Basis for Attention Deficits of Veterans

PTSD leads to many occupational deficits that service members suffer through on a regular basis. Research has shown cognitive deficits due to PTSD are related to interference during the encoding process in the brain. Veterans with PTSD may have attentional bias to other stimuli around them which takes away cognitive resources that should be directed at their present task (Hayes, LaBar, Petty, McArthy, & Morey, 2008). This follows Broadbent's (1958) theory that we can only attend to one stimulus at a time. In the classroom, veterans may have difficulty directing their attention to a classroom lecture when there are other distracting stimuli present. The IM may help solve this attention deficit since it "trains the brain" to process information through repetition in which one must practice holding their attention (Interactive Metronome, 2009).

Bazarian et al. (2012) found that the severity of PTSD is correlated with the severity of traumatic combat exposure events in the 52 veterans studied. Furthermore, results showed that with higher levels and exposure to PTSD, there was higher mean diffusivity on diffusion tensor imaging (DTI) and white matter lesions on magnetic resonance imaging. Although not

statistically significant, researchers found 10 brain regions that were associated with PTSD and TBI (Bazarian et al., 2012). This demonstrates that there are structural brain changes due to neurochemical alterations that occur as a result of chronic stress, such as PTSD.

Like PTSD, the effects of mTBIs can be seen on the brain's structure. The symptoms of mTBI are due to decreased gray matter in the dorsolateral prefrontal cortex and anterior cingulate cortex, which are both crucial for both cognitive control and attention (Pontifex et al., 2012). Those with mTBI may also see "deficits in the allocation of attentional resources, delays in stimulus classification and processing speed, and deficits in evaluating and signaling for modulations in top-down control during action monitoring process" (Pontifex et al., 2012, p. 558). These deficits may lead to the inability for an individual to engage in sustained attention (Pontifex et al., 2012).

Although veterans are motivated to obtain higher education in order to become a productive member of society, they tend to have lower levels of achievement in college (Durdella & Kim, 2012). Whether this is due to factors before or after deployments is not clear. However, veterans are given an opportunity through the generous benefits of the GI Bill to obtain and excel in higher education and should not be restricted due to post-war effects on cognition, more specifically attention and concentration. New technologies are being utilized with the purpose of helping the veteran's cognitive functioning, one of which may be the Interactive Metronome™.

The Interactive Metronome®

The IM is a technology that surfaced in 1992 to help musicians improve their rhythm. It was then discovered that it could be used as a neurological treatment that helps with motor planning and sequencing. The theory behind the IM is that timing and rhythmicity is crucial for

motor planning and sequencing and cognitive functions such as attention. Furthermore, it is believed that timing is the foundation for these higher processes that allow us to flourish on a daily basis. The feedback mechanism that is specific to this software makes it unique to other software. The makers suggest that the IM can help with diagnoses of ADD/ADHD, autism, cerebral palsy, epilepsy, and traumatic brain injuries and with cognitive impairments such as impaired cognitive speed, memory, executive functions, and attention and concentration (Interactive Metronome, 2009).

The participant is outfitted with a headset and palm (or foot) trigger, stands in front of a computer, and is asked to follow a tone he hears in the headset and clap to that beat. If the foot trigger is used, he is asked to tap on it with their toes or heel. If the audio feedback is turned on and the participant "hits" within 15 milliseconds of the beat, he will hear a "reward" tone. However, if he hits more than 15 milliseconds behind or ahead of the beat, he will hear an adverse tone. If the visual feedback is turned on, participants can see how many milliseconds ahead of or behind the beat they are. A typical program can be completed in 3-5 weeks and is composed of 12-15 one-hour sessions. Sessions can be modified to fit the participant's capabilities.

A randomized control study was done with 49 school-age children with language and reading impairments. Both groups received a traditional language and reading intervention while the experimental group received IM treatment in addition. The results of the study showed both groups made significant gains in reading fluency and comprehension, but the effects were larger in the IM group. The students in the IM group were able to read more efficiently and faster than the control group, which may be attributed to the treatment increasing focus and attention (Ritter, Colson, & Park, 2012).

An experimental pretest-posttest study was done with 6-12 year old boys (*n*=56) with ADHD diagnoses showed similar results. The participants were split into a video game (placebo), IM group, or control group. Those in the video game or IM group engaged in their technology for 15 hours with 1-hour sessions over 3-5 weeks. The results revealed that the boys in the IM group showed significant improvements in attention, motor control, language processing, reading, and ability to regulate aggression as compared to the other two groups. However, a limitation in this study is that for the four tests the authors used to measure attention and concentration in the participants, significant *p*-values were not given (Shaffer et al., 2001).

A pilot study involving ten children with a range of developmental delays studied the effects of a Sensory Integration (SI) program along with applied interactive metronome training. This is not the exact technology this pilot study will be investigating but operates on the same concept as the IM. Rather than standing in front of the computer, the children watched a movement the therapist did, had their eyes covered by the therapist, and then were instructed to do the movement they just saw after contemplating it for 2 minutes. Movements included raising a hand or leg, clapping, or stomping to several beat sounds such as a drum, triangle, tambourine, or piano. If they did the movement appropriately, they were positively reinforced and the speed of the exercise was increased. Additionally, the participants were given SI intervention for 45 minutes/day, 5 days/week for approximately a month. The children used the applied interactive metronome for 10 minutes per SI session. Investigators used the Corner's Teacher Rating Scale to assess sensory processing and found significant differences in attention and hyperactivity following the intervention ($p < .05$). Overall, results showed that the children made gains in attention, sensory processing, praxis, and posture control. The authors attribute this to the

combination of SI and metronome treatment through addressing both executive functions and sensory processing (Kim, Bo & Yoo, 2012).

Research with animals has shown that after brain injuries occur, structural changes take place (Nudo, 1999). This research suggests strategies that enhance plasticity in the motor cortex can lead to gains in functional abilities. The IM operates on the concept of neural plasticity and may be a strategy that allows the brain to build and strengthen connections through the repetitive exercises.

A randomized control trial was completed at the Defense and Veterans Brain Injury at Fort Carson, Colorado and was conducted with 46 soldiers that with blast-related brain injuries (BRBIs) and consequently neurocognitive complaints. Participants were divided into a Treatment as Usual (control) group where they received regular rehabilitation or the experimental group where they received regular rehabilitation and IM treatments. Participants underwent neuropsychological testing involving EEG functional connectivity and Event Related Potentials (ERPs) in BRBI. ERP investigations examine the micro-dynamics of cognitive processes when they happen and "characterize the functioning of cortical operators during predesigned cognitive tasks" (pp. 648-649). Those in the IM group showed changes in ERP patterns, particularly the contingent negative variation (CNV) response, and improvements in neuropsychological tests of memory and attention. Furthermore, there was an increase in CNVs, which is related to attention, and the increase shows that a bigger neural population was ready for activation. This is significant because BRBIs tend to decrease this activation and the IM reversed this problem. Additionally, several neuropsychological tests were used to assess the soldiers, including the Wechsler Test of Adult Reading (WTAR), Integrated Visual and Auditory Continuous Performance Test (RBANS), Delis-Kaplan Executive Functioning System (D-KEFS)

Trail Making and Color-Word Inference subtests, Test of Memory Malingering, and selected subtests from the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV). There were a total of 26 subtests used. Researchers found there were significant group differences for the RBANS Attention (p= .004), Immediate Memory (p= .019), and Delayed Memory (p= .031). Although there were no other positive statistically significant differences, 21 of the 26 cognitive measure subtests showed more changes in the IM group over the Treatment as Usual group. (Nelson, MacDonald, Glover & Brewer, 2012; Nelson, MacDonald, Stall, & Pazdan, 2013).

The authors concluded that the IM may induce neuroplasticity that traditional therapy does not. The repetitive exercises the IM has the participant undergo may launch neurophysiologic networks that target higher executive functions such as attention. Adding the IM treatment to standard rehabilitation care may bring about better neuropsychological changes for soldiers who have received mild to moderate TBIs (Nelson, MacDonald, Glover & Brewer, 2012; Nelson, MacDonald, Stall, & Pazdan, 2013).

CHAPTER III

Methodology

Population

The population was comprised of veterans. For the purposes of this study, a veteran is defined as someone who was active duty in the military or was a government contractor. This population was chosen because of the influx of veterans returning from the Wars on Terrorism with mTBI and PTSD. As a result, veterans may face problems with executive functions such as attention and concentration, which are essential skills for success in education (Ackerman, DiRamio & Garza Mitchell, 2009). In general, when veterans return many choose to further their education by using the G.I. Bill but may not succeed due to cognitive problems resulting from exposure to the combat environment (Steele et al., 2010). The population sample consisted of two full-time ECU students and one full time ECU employee.

The inclusion criteria for this study were as follows:

- A male or female veteran
- Enrolled in post-secondary education or employed at East Carolina University
- Self-identified as having problems with attention that may interfere with school or work occupations

The exclusion criteria for this study are as follows:

- History of prolonged alcohol or drug abuse
- Use of medications that fall under the category of narcotics
- Unstable medical conditions (as identified by Interactive Metronome®)
    - Seizure disorders

  - Vestibular hypersensitivity—experiences vertigo, has sensitivity to tones, sounds, music, etc.
- Have experienced moderate to severe traumatic brain injury

The exclusion criteria for this study were decided after considering the recommendations of the IM makers and considering the safety of the participants and investigator. The IM makers recommend that those with unstable medical conditions such as seizure disorders or those that have vestibular hypersensitivity do not undergo IM treatment. Vestibular input may be uncomfortable in those that have vestibular hypersensitivity and these participants may find the IM's tasks disorienting and overwhelming (Interactive Metronome™, 2009). Participants should not have experienced a moderate-to-severe traumatic brain injury because only the effects of a possible mild traumatic brain injury will be examined. Alcohol or drug abuse and the use of narcotics are exclusionary due to investigator safety concerns, as some interviews and testing were done one-on-one. These factors may also impact data and may not show the true effects of the IM intervention.

Interested participants were assessed using the Canadian Occupational Performance Measure (COPM) and d2 Test of Attention (*d2* Test); which are reviewed in the next section.

Instrumentation

The Interactive Metronome® (IM), Canadian Occupational Performance Measure (COPM) and the d2 Test of Attention (*d2* Test) were used as instruments for the study.

The IM is a computerized program that operates on the theory of "training the brain to plan, sequence, and process information more effectively through repetition of interactive exercises" (Interactive Metronome™, A Total Approach). The participant, equipped with headphones and a trigger strapped on the hand, stands in front of the system and attempts to clap

their hands on the tone that is paced at 54 beats per minute. Other components include tapping the toes or heel, slapping the thigh, or alternating between two movements for a total of thirteen exercises. The goal is to match the beat within 15 milliseconds of the tone and the score is calculated from this. The participant will receive audio or visual feedback depending on the preferred settings. A typical program lasts 3-5 weeks with 12-15 one-hour sessions but may be individualized (Interactive Metronome™, A Total Approach). The protocol the participants of this study will underwent is described in the procedures. The IM acts as both a tool for evaluation as well as treatment intervention, which are separate performance entities provided by the instrument. For this study, the In-Home IM (IM-Home) system was used for participant convenience.

The IM is complex in that it provides a series of different evaluation tools that are identified as the Long Form Assessment (LFA) and Short Form Assessment (SFA). These provide all of change from the base line as well as indications of progress during the treatment process. However, the primary role of the IM is not that of assessment, but rather a treatment intervention tool. Research critics may argue that one cannot have an instrument that is both treatment and assessment. The IM makers acknowledge this and recommend that providers incorporate additional standardized evaluations as part of the treatment regimen (Interactive Metronome™, 2009).

Research with the IM is ongoing, and pilot results are promising. A randomized control trial done with service members that suffered from blast-related brain injuries and treated with the IM showed changes in brain patterns that were related to attention (Nelson et al., 2012).

In this study, participants used the IM-Home system. It is nearly identical to the IM Pro System but can be installed on the client's computer, is wireless, and the data was sent directly to

the PI for collection. The IM-Home system components allowed the PI to track the progress of the participants so software or scheduling issues could be resolved immediately.

The COPM is a client-centered assessment tool that measures the client's perception of occupational performance and satisfaction with areas identified (Law et al., 2005). The tool is a semi-structured interview in which the client identifies activities and occupations that are important to him or her. The client and therapist look at these activities in terms of what the client wants, what they need to be able to do, and where they are encountering problems—either in how they perform or in fulfillment of participating in the activity. The COPM takes into account the interaction between the person, environment, and occupation (Warren, 2002). The flexibility of the COPM allows the client to orient towards different areas of occupation or use as a larger, more general client centered evaluation. In this study, a modified COPM focusing on education or as an area of occupation will be used to gain baseline scores that indicate the client's perceived performance and satisfaction with their performance.

Dedding, Cardol, Isaline, Dekker and Beelen (2004) conducted a study to measure the convergent and divergent validity of the COPM with a cross-sectional design using 99 clients. They did this by comparing the COPM to the Disability and Impact Profile (DIP) and Sickness Impact Profile (SIP68). The investigators concluded that the COPM has both convergent and divergent validity and the tool gave practitioners information a standard instrument could not give. Also, the investigators emphasized that the COPM is a good outcome measure for client-centered practice and it is helpful for those with more than one problem with occupations. The COPM is unique in that it reflects changes from the client's perception (Dedding et al., 2004).

The *d2* Test of Attention was developed in 1962 in Germany and Switzerland is the most popular test to assess attention within many European countries (Zillmer & Kennedy, 1999).

The tool measures processing speed, rule compliance, and quality of performance, which allows individual estimation of attention and concentration performance. Those that fail the *d2* Test usually have problems with concentration and with ignoring distractions (Zillmer & Kennedy, 1999).

The *d2* Test is a short paper-and-pencil cancellation test with 14 rows (trials) with 47 spread out "p" and "d" characters that have dashes surrounding them. The goal symbol is a "d" with two dashes while the rest of the symbols are considered distracters. The participant is directed to go from left to right and cancel out as many of the goal symbols as they can in each row with 20 seconds given per trial and without breaks between each trial.

Although it was originally normed on German populations, Zillmer and Kennedy (1999) concluded the test is a reliable measure of selective attention for the American population after assessing 506 American college students aged 18-32. Additionally, they looked at the test's construct validity against the Trail Making Test A and B, the Symbol Digit Modalities Test (SDMT), and the Stroop Color Word Test (SCWT). They found that the *d2* Test was strongly correlated with the measures of complex attention, concentration and distractibility. Therefore, the *d2* Test has good sensitivity and validity and may be appropriately used as a test of concentration and attention on the U.S. population (Zillmer & Kennedy, 1999).

Another study by Bates & Lemay (2004) demonstrated that the *d2* Test has internal consistency, construct validity, and is valid to be used in the U.S. population. They concluded the *d2* Test requires substantial attentional processing and that it may serve as a useful tool for identifying populations with attention problems.

Procedure

IRB approval was obtained prior to beginning the research process (Appendix A). The Primary Investigator (PI) contacted the East Carolina University Student Veterans Association and set up two dates to give a presentation on the IM and discussed the purpose of the study with potential applicants. With it being a small group, the PI asked the participants to refer other veterans they may know who may meet the criteria for the study. This snowballing method was used to expand the potentially small sample size. Following the presentation, attendees were offered the opportunity to participate if they meet inclusion and exclusion criteria and instructed to contact the investigators to set up times for COPM and *d2* testing, if interested. There were four men and women that contacted the PI and set up times for COPM and *d2* testing.

Each participant arranged a time to meet individually with the PI to begin testing and learn how to use the IM system. All meetings were conducted in the ECU Occupational Therapy Department and lasted approximately 30-45 minutes. After participant consent was obtained (Appendix B), the investigator administered the general survey (Appendix C) and modified COPM to each participant to establish areas of education or work-related occupations that he or she finds challenging. The addendum questionnaire (Appendix D) was used to aid in focusing the COPM towards those occupational needs that are more relevant to a veteran who is a full-time student or employee. In order to have participated in the study, the individual must not have only demonstrated the motivation to succeed in school or work, but also expressed having difficulty with attention and concentration through the interview with the COPM. The investigator was knowledgeable in asking appropriate questions to address this issue. Each participant then took the *d2* Test to ascertain a quantitative score of their attention and concentration abilities.

After testing was completed, each participant was given the IM-Home system and login information. The PI taught each participant how to set-up, break-down, login, and access all of the exercises. Each participant was given the investigator's contact information should problems occurred. For the purpose of fidelity, the participants demonstrated his or her abilities to correctly operate the units.

Participants underwent 15, 9-30 minute IM sessions over a 4-8 week period. Each session had 1-14 tasks and the session lengths will gradually increase from 468 beats to 1,500 beats. This protocol was derived from the Interactive Metronome maker's premade "Template L- Sustained Attention and Impulse Control- 15-30 Minutes/Sessions." This template consists of 90 sessions. Due to the study's length and participant's motivation, the PI pulled the proportionate number of sessions/tasks and modified the plan to 15 sessions (Appendix E). The Nelson (2013) study also used a 15-session protocol. Participants were encouraged to do 2-3 sessions per week and each participant's total length of time was different due to their own time constraints. In order to be included in data analysis, participants must have completed all sessions.

Data was continuously collected and electronically sent to the PI after each session. Participants were monitored electronically based on completion of established times. When they showed inconsistency, they were contacted for assistance. The participants e-mailed the PI when problems arose with the system.

After participants completed approximately 12 of their sessions, they were contacted to set up a time to complete the COPM and take the *d2* Test for post-scores. Each participant came back to the ECU Occupational Therapy Department at an agreed upon time by both the PI and participant. Each participant completed the COPM and *d2* test and was thanked for their time in

the study. All participants were offered the option of keeping the IM Home system to continue further sessions at home; two participants opted for this. Three of the four participants completed the study. Participant 4 elected to not complete the study after 1 week due to time constraints.

Description of Participants

Participant 1 (P1). Participant 1 is a 55 year old Caucasian female. Her highest level of education completed is a Master's degree. She is a full-time employee of East Carolina University. Although she did not serve active duty, she worked in government service as a contractor for 14 years. She spent a majority of her time in Middle East Saudi Arabia until January 2003.

P1 was the least consistent with her IM schedule and took 14 weeks to complete the IM protocol. She started on October 3 and ended December 31, 2013 (See Appendix F for all participant calendars).

Participant 2 (P2). Participant 2 is a 29 year old Caucasian male. His highest level of education completed is an Associate's degree. He is currently a full time senior Biology major and is using his GI Bill benefits to attend East Carolina University. He also has a part-time job. Participant 2 served in the U.S. Army for five years, in both Operation Enduring Freedom and Operation Iraqi Freedom where he witnessed combat. He left the Army in January 2008.

P2 completed the IM protocol in seven weeks, beginning on October 3 and ending on November 16, 2013.

Participant 3 (P3). Participant 3 is a 38 year old African American male. His highest level of education completed is an Associate's Degree. He is currently a full-time senior Industrial Technology major and is using his GI Bill Benefits to attend East Carolina University. He served in the United States Marine Corps for three years and left in October of 1986.

P3 completed the IM in five weeks, beginning on October 14 and ending on November 7, 2013.

Data Analysis

At the completion of the study, the participants had pre/post scores and measures from the IM (Short form assessments & long form assessments), COPM, and *d2* Test.

With the COPM, a 2-point or 20% change was expected from baseline. The answers related to education or work was more closely scrutinized compared to the other areas of occupation. The hypothesized outcome in this area would potentially mean that the IM impacted attention, which may lead to higher levels of education or work satisfaction.

The *d2* Test assesses attention and concentration through a variety of measures. However, due to the low number of participants, t-tests did not yield anything significant so raw scores were depended on for most analyses. Percentile rank and standard scores are included in the data analysis section, however, due to the differing age groups between participants and large ranges in the *d*2 scoring criteria, these numbers are not as reliable for comparison. Additionally, there are US norms that were only based on college students, while the other norms are from a large European sample. Lastly, some numbers for the percentile ranks and standard scores had to be approximated or averaged when they fell between a large range.

Categories analyzed in the *d2* Test included: total number (TN), errors of omissions (E1), errors of commissions (E2), errors (E), total-errors (TN-E), concentration performance (CP), and fluctuation rate (FR). The descriptions that follow are those that the test maker defined. Total number represents the total number of items processed, including the correct and incorrect symbols the test-taker crossed out. According to the test makers, it is highly reliable measure of attentional allocation, processing speed, amount of work completed, and motivation

(Brickenkamp & Zillmer, 2010). Errors of omission occurr when items that are supposed to be crossed out were not, while errors of commission occur when items that were not supposed to be crossed out, were. Errors of omission are related to attentional control, rule compliance, accuracy of visual scanning, and quality of performance. Errors of commission do not occur as often as errors of omission and measures inhibitory control, rule compliance, accuracy of visual scanning, carefulness, and cognitive flexibility. Errors is the sum of errors of omission and commission. E% is the percentage of errors and is calculated by looking at the total errors over the total number of items processed. Total number-error is the total number of items processed minus the total number of errors, thus it measures the relationship of speed and accuracy in the test-takers performance. Concentration performance is the number of correctly crossed out items minus errors of commission. This is a more accurate measure of the test-takers ability because unlike total number-errors, concentration performance cannot be skewed due to superficial scanning, skipping over sections, or random test-taking. It is highly reliable and considered a great way to measure both the coordination of speed and accuracy of the test takers performance. Fluctuation rate (FR) is the difference between the line with the most numbers processed and the line with the least numbers tested. This is not a reliable measure in looking at attention (Brickenkamp & Zillmer, 2010).

After each session of the IM the participant completed, the scores were sent electronically to the investigators. The IM progressively analyzed each session against the individual's past scores and had several long and short form tests the participant completed to measure progress. The investigator gathered the data and compared the pre- and post-test scores of participant improvements. This long form assessment (LFA) was completed during the first and fifteenth session for each participant. This test provided us the ability to compare the user's ability from

baseline to completion of the study. According to the IM makers, the LFA measures both motor skills and cognitive skills, including attention, selective attention, task persistence, auditory processing, and self-monitoring (Interactive Metronome, 2009). In the LFA, there were 14 tasks that were analyzed to compute a % performance change score. The 14 tasks were as follows: 1) both hands, 2) right hand 3) left hand, 4) both toes, 5) right toe, 6) left toe, 7) both heels, 8) right heel, 9) left heel, 10) right hand/ left toe, 11) left hand/ right toe, 12) balance right foot/ tap right toe, 13) balance left foot/ tap right toe, 14) Repeat task #1 with guide sounds. If the participant did not reach the IM's set threshold of 20 repetitions, a percentage was not computed for that task. This resulted in participants having missing data from their compiled LFA scores. In analyzing the LFA, three measures were examined: task average, variability average, and super-right-on (SRO) percentage. The task average is how close the switch is hit to the reference tone during the IM task. It is measured in milliseconds and a lower number indicates better performance. Variability average is a measure of how close the switch hits were to each other rather than the reference tone. The SRO% refers to the percentage of hits that were within 15 ms of the reference tone (Interactive Metronome, 2009). The percentage of change was anticipated to be between 14-24 percent since baseline.

CHAPTER IV

Analysis of Data

Canadian Occupational Performance Measure

Participant 1

Pre-test interview. This study did not address the self-care component of the COPM. In the productivity section, we discussed her work. P1 notes that she first started noticing her attention change in the last three years (2010). She reported not necessarily have lapses of attention, but has to work harder at keeping her attention. She reported becoming more forgetful and having difficulty remembering names and last-minute appointments. Regarding leisure, P1 reports playing softball twice a week and running for exercise.

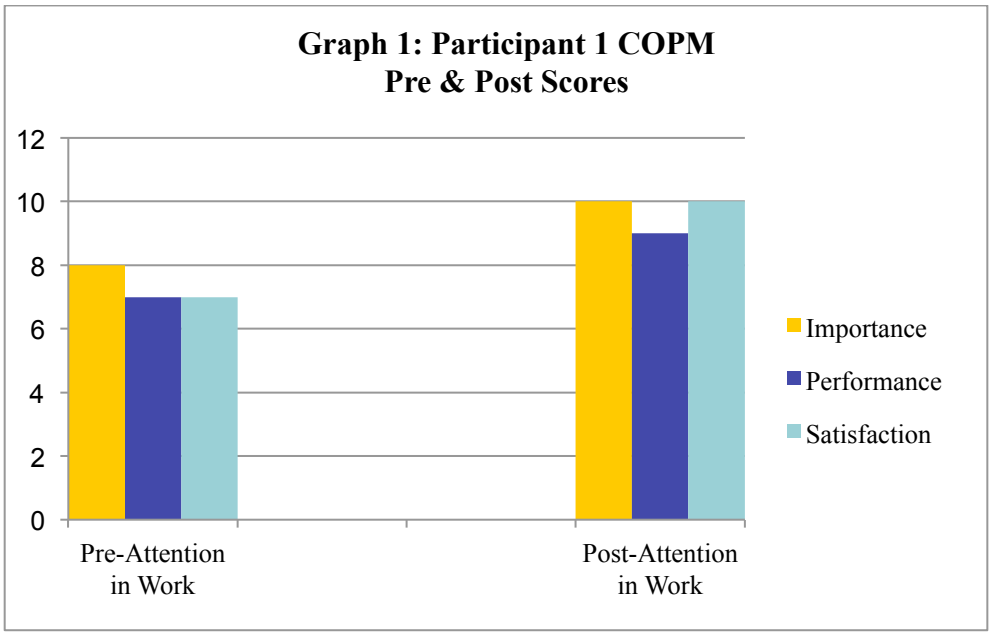
Post-test interview. In the follow-up interview, P1 reported being able to work more consistently. She noted that she is able to stay more on one task more efficiently and being much more focused. During the IM process, P1 moved to another home and reported that "everything was going well." Regarding the IM itself, she reported knowing that she would have had more improvement if she had been more consistent with her IM schedule. She would suggest the IM system to others who had attention problems. She chose to keep the system for future use.

Occupational performance ratings. P1 identified three occupational performance areas that were important in her life: relationships, finances, and attention in work.

Regarding her relationships, her pre-ratings were as follows: Importance-10; Performance-10; Satisfaction- 9. Her post-ratings were as follows: Importance: 10; Performance-7; Satisfaction-8. There was no gain in importance and a three and two point loss in performance and satisfaction, respectively.

Regarding finances, her pre-ratings were as follows: Importance- 8; Performance-9; Satisfaction- 5. Her post-ratings were 10 for all three categories. These are two, one, and five point gains, respectively.

Regarding attention in work, her pre-ratings were as follows: Importance- 8; Performance- 7; Satisfaction-7. Her post-ratings were as follows: Importance: 10; Performance-9; Satisfaction-10. This a two point gain in importance, two point gain in performance, and a three point gain in satisfaction. See Graph 1 below for a visual description of the gains in attention in work.



Participant 2

Pre-test interview. This study did not address the self-care component of the COPM. In the productivity section, we addressed the occupation of school. P2 noticed a change in his attention as time passed. He reported being more forgetful, but it had not affected anything beyond school. He reported lapse of concentration in studying and sometimes in the classroom.

He also commented that his grades are lower than he would like because of his busy lifestyle. For leisure activities, P2 reported that he watched TV and movies and played video games. He said that his marriage is now better that he is out of the military.

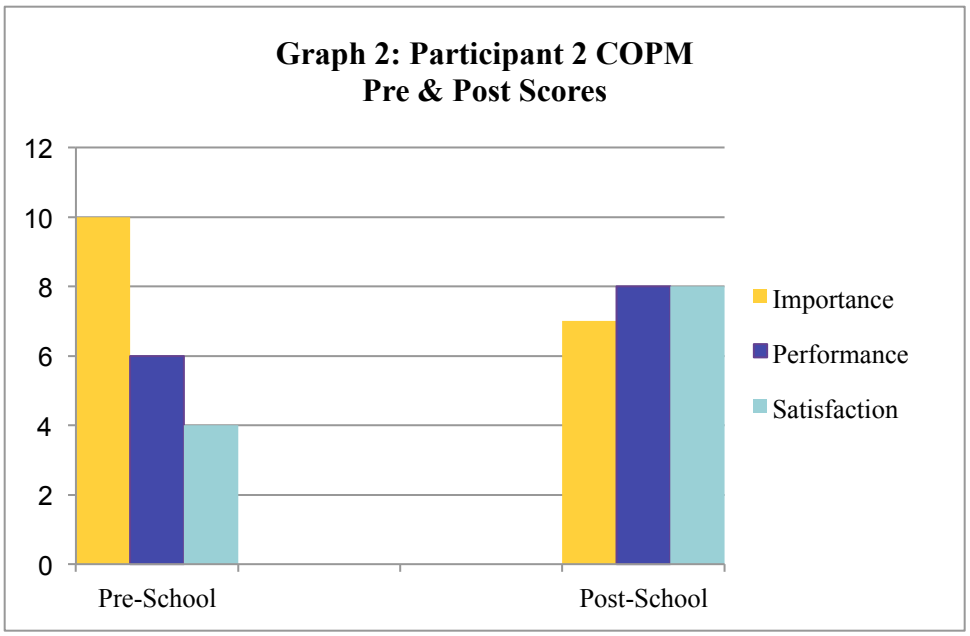
Post-test interview. P2 reported that school is going "good" and is doing reasonably well. He noted that he is not studying as much as he should as graduation was quickly approaching. Even after using the IM, P2 did not notice a change in his attention or quality of school work. Additionally, he did not notice differences in lapses of concentration. Marriage and leisure qualities were reported the same since pre-test. Regarding the IM itself, P2 reported that he enjoyed doing it and noticed an improvement in the ability to keep with the beat. He reported that he would recommend it to someone, but opted not to keep the system because of limited time.

Occupational performance ratings. P2 identified three occupational performance areas that were important in his life: leisure activities, relationships, and school.

Regarding leisure activities, his pre-ratings were as follows: Importance-3; Performance-6; Satisfaction-7. His post-ratings were as follows: Importance-7; Performance-9; Satisfaction-9. These are four, three, and two point increases, respectively.

Regarding relationships, his pre-ratings were as follows: Importance-7; Performance-6; Satisfaction-7. His post-ratings were 9 for all categories. This is a two, three, and two point increase, respectively.

Regarding school, his pre-ratings were as follows: Importance-10; Performance-6; Satisfaction-4. His post-ratings were as follows: Importance-7; Performance-8; Satisfaction-8. This is a three point loss in importance, a two point gain in performance, and a four point gain in satisfaction. See Graph 2 below for a visual description of the gains in performance of school.



Participant 3

Pre-test interview. This study did not address the self-care component of the COPM. P3 discussed that he was interested in the IM because of the potential benefits of improved concentration and attention. He said as time has gone on, he has not been able to multitask and feels more scattered. His goal was to narrow his focus. Because of his attention and busy lifestyle, his grades were not as high as he would like them to be. He also reported taking on a lot of commitments at one time. P3 reported playing video games and watching movies as his preferred leisure activities.

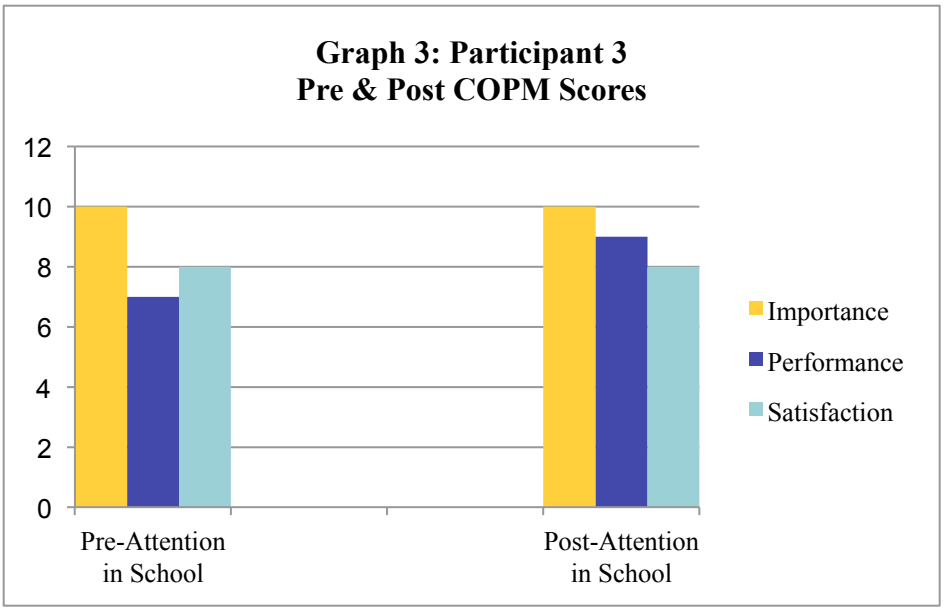
Post-test Interview. P3 stated that school was going well and he was "buckling down" because the semester was coming to an end. He said he understood the material that was presented to him in the classroom. He reported that he was a little better with multitasking and incorporated an organization strategy to better schedule his day. He also noticed slight changes like increased focus while doing homework. While on the IM, he reported difficulty getting his mind to focus on the task, but found the rhythm helped him hone in on the program. He found

toward the end of the study, he was more consistent and being on the IM became more automatic. P3 reported that he would recommend the IM to others and decided to keep the system for further practice even after the study ended.

Occupational performance ratings. P3 chose two occupational performance areas that were important in his life: leisure activities and attention in school.

Regarding leisure pursuits, his pre-ratings were as follows: Importance-10; Performance-9; Satisfaction-10. His post-ratings were 10 for all categories. Importance and satisfaction remained consistent at 10 while his performance increased by one point.

Regarding attention in school, his pre-ratings were as follows: Importance-10; Performance-7; Satisfaction-8. His post-ratings were as follows: Importance-10; Performance-9; Satisfaction-8. There was no gain in importance or satisfaction; however there was a two point gain in performance. See Graph 3 below for a visual description of the gains in attention.



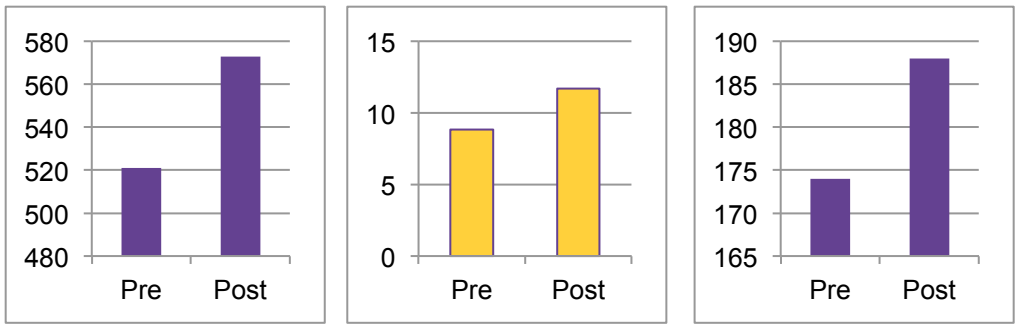
Summary. For the purpose of this study, attention and quality of work or school were focused on during the COPM. All participants expressed a desire to improve their attention and

concentration. While there were variations of scorings in other occupational performance areas, all participants reported at least a 20% gain (2 point) in their performance of school or work, as hypothesized. See Appendix G for all scores in chart form.

d2 Test of Attention

Participant 1. The raw baseline scores for P1 were as follows: Total Number- 521; Errors of Omission-42; Errors of Commission-4; Errors-46; Total Number-Errors-475; Concentration Performance-174; Fluctuation Rate-6. The post-test scores were: Total Number-573; Errors of Omission-67; Errors of Commission-0; Errors-67; Total Number-Errors-506; Concentration Performance-188; Fluctuation Rate-13. There was a 52 point increase in Total Number, which meant that P1 was able to process more information in the same set amount of time from baseline. However, with a faster processing time P1 showed an increase in Errors of Omission, but eliminated all Errors of Commission. There was a 25 point increase in Errors of Omission, 4 point decrease in E2, and 21 point increase in overall Errors. There was a 2.86% increase in Errors. For Total Number-Errors there was a 31 point increase and for Concentation Performance there was a 14 point increase; this suggests that P1's overall attention increased after using the IM. Reference Graph 4 below for visuals for total numbers processed, percentage errors, and concentration performance.

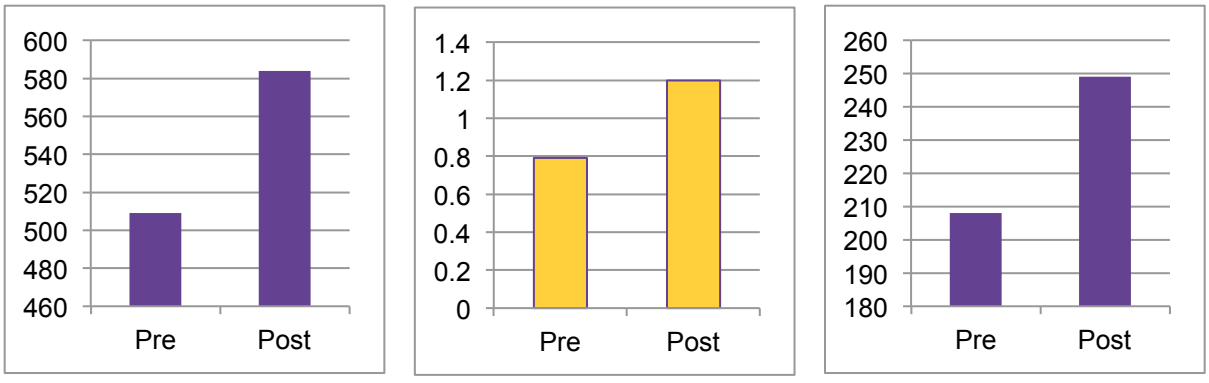
Graph 4: Participant 1 *d2* Pre & Post Scores



L to R: Total Numbers Processed, Percentage of Errors, & Concentration Performance.

Participant 2. The raw baseline scores for P2 were as follows: Total Number- 509; Errors of Omission-4; Errors of Commission- 0; Errors- 4; Total Number-Errors- 505; Concentration Performance- 208; Fluctuation Rate- 12. The post-test scores were: Total Number- 584; Errors of Omission- 6; Errors of Commission- 1; Errors- 7; Total Number-Errors- 577; Concentration Performance- 249; Fluctuation Rate- 10. P2 had a 75 point increase in Total Number of items processed, which meant that P2 was able to process more information in the same set amount of time from baseline. There was a slight increase in Errors of Omission (2 points) and Errors of Commission (1 point), which caused a slight three point increase in total Errors. There was a 72 point increase in Total Number-Errors and 41 point increase in Concentration Performance, which may suggest that P2's overall attention increased after completing the IM protocol. Reference Graph 5 below for visuals for total numbers processed, percentage errors, and concentration performance.

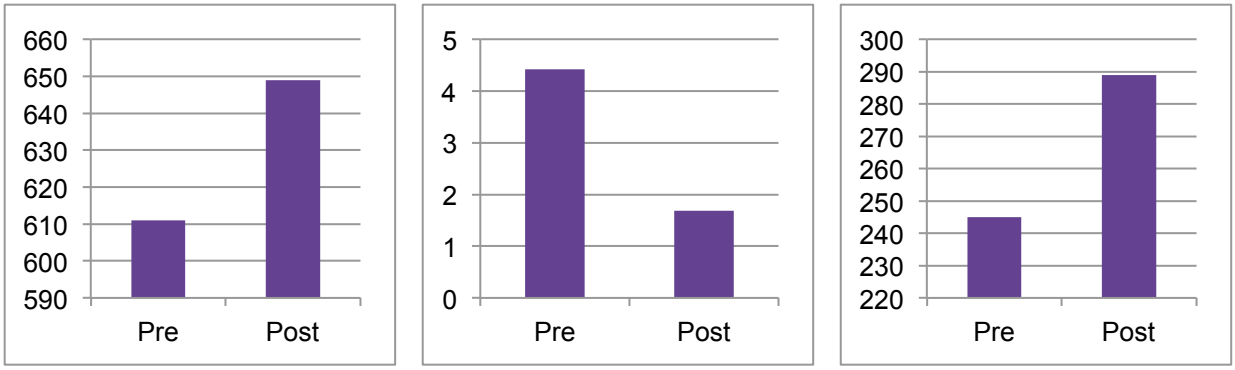
Graph 5: Participant 2 *d2* Pre & Post Scores



L to R: Total Numbers Processed, Percentage of Errors, & Concentration Performance.

Participant 3. The raw baseline scores for P3 were as follows: Total Number- 611; Errors of Omission- 21; Errors of Commission- 6; Errors- 27; Total Number-Errors -584; Concentration Performance- 245; Fluctuation Rate- 9. The post-test scores were: Total Number- 649; Errors of Omission- 11; Errors of Commission- 0; Errors- 11; Total Number-Errors- 638; Concentration Performance- 289; Fluctuation Rate- 4. There was a 38 point increase in Total Number, which mean that P3 processed more information in the same set amount of time from baseline. There was a 10 point decrease in Errors of Omission and Errors of Commission were eliminated with a 6 point decrease. This decreased the total Errors by 16 points. There was a 54 point increase in Total Number-Errors and a 44 point increase in Concentration Performance, which may suggest that P3's overall attention increased after completing the IM protocol. Reference Graph 5 below for visuals for total numbers processed, percentage errors, and concentration performance.

Graph 6: Participant 3 *d2* Pre & Post Scores



L to R: Total Numbers Processed, Percentage of Errors, & Concentration Performance.

Summary. All participants experienced an increase in total number of items processed in the *d2* test. Although P1 & P2 had an increase in their errors, all participants had increases in their Total Number-Errors and CP scores, which are a more accurate measure of their actual attention. Furthermore, although these are raw scores, the large increases may be reflective of an actual increase in attention contributed to the use of the IM. See Appendix H for all scores in chart form.

Long Form Assessment

Participant 1. Due to not reaching the threshold of 20 repetitions in several tasks in either the pre- or post-LFA, several tasks could not be analyzed for P1. The tasks that were analyzed included 1, 2, 3, 4, 7, 8, 10, and 14. Several parameters were measured for each participant including: task average, variabuilty average, and Super-Right-On Percentage (SRO). The task average is how close the switch is hit to the reference tone during the IM task. It is measured in milliseconds and a lower number indicates better performance. Variability average is a measure of how close the switch hits were to each other rather than the reference tone. The SRO% refers to the percentage of hits that were within 15 ms of the reference tone (Interactive Metronome, 2009). For Task 1, P1 had a 74.88% increase in her task average, 58.02% increase in her variability average, and 651% increase in her Super Right Ons (SROs). For Task 2, she had an 83.47% increase in her task average, 83.44% increase in her variability average, and 116.65% increase in her SROs. For Task 3, she had a 64.47% increase in her task average, 31.71% increase in her variability average, and 399.70% in her SROs. For Task 4, she had a 70.57% increase in her task average, 59.55% increase in her variability average, and her SRO could not be calculated because of an improper baseline value. For Task 7, there was an 82.56% increase in her task average, 82.08% increase her in variability average, and 800.90% increase in

her SROs. For Task 8, there was a 6.5% decrease in her task average, 10.64% decrease in her variability average, and 79.19% decrease in her SROs. For Task 10, there was 66.38% increase in her task average, 73.29% increase in her variability average, and 99.85% increase in her SROs. For Task 14, there was a 62.66% increase in her task average, 60.36% increase in her variability average, and 214.21% increase in her SROs. See Table 1 for comparisons between pre and post scores for the task averages, variability averages, and SRO %, along with the % performance change between the pre and post LFAs.

Table 1

Comparison with Previous LFA #1

	A Previous LFA Test Date #1: 10/03/2013				B Latest LFA Test Date: 12/31/2013				% Performance Change From A to B*		
Task	Rep.	Task Avg	Var Avg	SRO%	Rep.	Task Avg	Var Avg	SRO%	Task Avg	Var Avg	SRO%
1	50	100.76	81.00	6.00	51	25.31	34.00	45.10	74.88	58.02	651.67
2	30	133.50	157.00	20.00	30	22.07	26.00	43.33	83.47	83.44	116.65
3	30	97.03	41.00	6.67	30	34.47	28.00	33.33	64.47	31.71	399.70
4	30	108.30	89.00	0.00	30	31.87	36.00	23.33	70.57	59.55	
5					30	28.27	36.00	46.67			
6					29	31.69	40.00	37.93			
7	30	172.63	173.00	3.33	30	30.10	31.00	30.00	82.56	82.08	800.90
8	25	62.04	47.00	16.00	30	66.07	52.00	3.33	-6.50	-10.64	-79.19
9					30	80.87	103.00	6.67			
10	30	140.70	146.00	6.67	30	47.30	39.00	13.33	66.38	73.29	99.85
11					30	29.57	30.00	33.33			
12					30	54.30	94.00	26.67			
13					30	91.77	153.00	10.00			
14	53	88.92	111.00	9.43	54	33.20	44.00	29.63	62.66	60.36	214.21

NOTES: If less than 20 repetitions of a task were completed no data will be reported for that task.
* Positive values = Performance improvement
Negative (-) values = Performance decrease
Zero (0) values = No significant change in performance
** Based on best Task Average score for each Short Form Test task in the current file

Participant 2. Due to not reaching the threshold of 20 repetitions in several tasks in either the pre- or post-LFA, several tasks could not be analyzed for P2. The tasks that were analyzed included 1, 2, 3, 5, 7, 8, 10, 11, 13, and 14. For Task 1, P2 had a 72.47% increase in his task average, 62.30% increase in his variability average, and 256.62% increase in his SROs. For Task 2, he had a 68.33% increase in his task average, 60.34% increase in his variability average, and 727.14% increase in his SROs. For Task 3, he had a 66.34% increase in his task average, 47.14% increase in his variability average, and 700.90% in his SROs. For Task 5, he had a

53.85% increase in his task average, 55.41% increase in his variability average, and 620.72% increase in his SROs. For Task 7, there was a 52.76% increase in his task average, 32.65% increase his in variability average, and 503.91% increase in his SROs. For Task 8, there was a 25.67% increase in his task average, 6.06% increase in his variability average, and 37.76% increase in his SROs. For Task 10, there was a 58.67% increase in his task average, 52.54% increase in his variability average, and 233.3% increase in his SROs. For Task 11, there was a 43.53% increase in his task average, 35.09% increase in his variability average, and 117.02% increase in his SROs. For Task 13, there was a 51.16% increase in his task average, 41.86% increase in his variability average, and 236.31% increase in his SROs. For Task 14 there was a 52.19% increase in his task average, 50% increase in his variability average, and 122.29% increase in his SROs. See Table 2 for comparisons between pre and post scores for the task averages, variability averages, and SRO %, along with the % performance change between the pre and post LFAs.

Table 2

Comparison with Previous LFA #1

	A Previous LFA Test Date #1: 10/03/2013				B Latest LFA Test Date: 11/16/2013				% Performance Change From A to B*		
Task	Rep.	Task Avg	Var Avg	SRO%	Rep.	Task Avg	Var Avg	SRO%	Task Avg	Var Avg	SRO%
1	54	70.59	61.00	11.11	53	19.43	23.00	39.62	72.47	62.30	256.62
2	30	55.77	58.00	6.67	29	17.66	23.00	55.17	68.33	60.34	727.14
3	30	91.90	70.00	3.33	30	30.93	37.00	26.67	66.34	47.14	700.90
4	25	74.88	82.00	8.00							
5	30	74.20	74.00	3.33	25	34.24	33.00	24.00	53.85	55.41	620.72
6											
7	29	55.93	49.00	6.90	24	26.42	33.00	41.67	52.76	32.65	503.91
8	30	35.37	33.00	23.33	28	26.29	31.00	32.14	25.67	6.06	37.76
9	30	39.63	33.00	26.67							
10	30	63.47	59.00	10.00	30	26.23	28.00	33.33	58.67	52.54	233.3
11	27	55.22	57.00	14.81	28	31.18	37.00	32.14	43.53	35.09	117.02
12	30	57.47	40.00	10.00							
13	30	50.90	43.00	13.33	29	24.86	25.00	44.83	51.16	41.86	236.31
14	54	39.22	46.00	20.37	53	18.75	23.00	45.28	52.19	50	122.29

NOTES: If less than 20 repetitions of a task were completed no data will be reported for that task.
* Positive values = Performance improvement
Negative (-) values = Performance decrease
Zero (0) values = No significant change in performance
** Based on best Task Average score for each Short Form Test task in the current file

Participant 3. Due to not reaching the threshold of 20 repetitions in several tasks in either the pre- or post-LFA, several tasks could not be analyzed for P3. The tasks that were analyzed included 1-9 and 11-12. For Task 1, P3 had an 82.03% increase in his task average, 51.22% increase in his variability average, and 1252.73% increase in his SROs. For Task 2, he had a 70.06% increase in his task average, 57.14% in his variability average, and 325.13% increase in his SROs. For Task 3, he had a 49.27% increase in his task average, 28.57% increase in his variability average, and 47.66% in his SROs. For Task 4, he had a 65.82% increase in his task average, 10.81% increase in his variability average, and 399.70% increase in his SROs. For Task 5, there was a 82.63% increase in his task average, 37.14% increase his in variability average, and his SROs could not be calculated because of an improper baseline value. For Task 6, there was a 68.62% increase in his task average, 29.73% increase in his variability average, and 433.3% increase in his SROs. For Task 7, there was a 77.97% increase in his task average, 74.71% increase in his variability average, and 833.61% increase in his SROs. For Task 8, there was a 69.16% increase in his task average, 14.29% increase in his variability average, and his SROs could not be calculated because of an improper baseline value. For Task 9, there was a 77.04% increase in his task average, 55.17% decrease in his variability average, and his SROs could not be calculated because of an improper baseline value. For Task 11, there was a 71.57% increase in his task average, 35.94% increase in his variability average, and 356.22% increase in his SROs. For Task 12, there was a 47.75% increase in his task average, 24.39% increase in his variability average, and his SROs could not be calculated because of an improper baseline value. See Table 3 for comparisons between pre and post scores for the task averages, variability averages, and SRO %, along with the % performance change between the pre and post LFAs.

Table 3

Comparison with Previous LFA #1

	A Previous LFA Test Date #1: 10/14/2013				B Latest LFA Test Date: 11/07/2013				% Performance Change From A to B*		
Task	Rep.	Task Avg	Var Avg	SRO%	Rep.	Task Avg	Var Avg	SRO%	Task Avg	Var Avg	SRO%
1	52	89.27	41.00	3.85	48	16.04	20.00	52.08	82.03	51.22	1252.73
2	30	49.77	42.00	13.33	30	14.90	18.00	56.67	70.06	57.14	325.13
3	29	35.86	28.00	27.59	27	18.19	20.00	40.74	49.27	28.57	47.66
4	30	78.20	37.00	6.67	30	26.73	33.00	33.33	65.82	10.81	399.70
5	30	157.47	70.00	0.00	31	27.35	44.00	58.06	82.63	37.14	
6	30	63.63	37.00	10.00	30	19.97	26.00	53.33	68.62	29.73	433.3
7	28	159.21	174.00	3.57	30	35.07	44.00	33.33	77.97	74.71	833.61
8	30	140.00	42.00	0.00	30	43.17	36.00	23.33	69.16	14.29	
9	30	200.00	29.00	0.00	29	45.93	45.00	13.79	77.04	-55.17	
10	25	100.96	64.00	4.00							
11	30	122.80	64.00	6.67	23	34.91	41.00	30.43	71.57	35.94	356.22
12	26	71.92	41.00	0.00	26	37.58	31.00	23.08	47.75	24.39	
13					30	30.87	31.00	23.33			
14					48	25.71	30.00	31.25			

NOTES: If less than 20 repetitions of a task were completed no data will be reported for that task.
* Positive values = Performance improvement
Negative (-) values = Performance decrease
Zero (0) values = No significant change in performance
** Based on best Task Average score for each Short Form Test task in the current file

Summary. In the tasks that could be fully analyzed, all participants showed an increase in performance change of a large majority of tasks. The lack of data or decrease in performance change in several of the tasks could be attributed to difficulty of the task or fatigue. From these results, it is suggested that after fifteen sessions on the IM, one will see improvements in most of these tasks that involve coordination and attention. The anticipated increases from baseline (14-24%) were trumped significantly, as some increases were in the hundreds of percent.

CHAPTER V

Conclusions & Recommendations

Summary

This was a pilot study to examine the intervention of the IM on veterans who had identified attention problems that may have interfered with work or school endeavors. Three participants successfully completed 15 IM sessions that were designed for improving attention. They underwent three pre- and post-measures that collectively looked at their lifestyles, work or school endeavors, their attention, and progress on the IM.

Results

The veterans in this study all expressed concerns of attention in their work and school lives through the COPM. After following a 15-session protocol on the IM system, all participants improved on their attention as suggested by their raw scores on the *d2* Test of Attention. Additionally, all participants improved on the actual usage of the IM through consistent practice over five to fourteen weeks.

Through the COPM, we found all of the veterans in this study improved 20% in their perception of performance in work or school. Two participants' satisfaction with school or work improved between 30 and 50% while one participant's satisfaction remained the same. Regarding importance, one participant's levels remained the same while another's improved by 20%. The other participant's decreased by 30%, but this could be attributed to him being close to graduation; thus, not feeling the pressure he may have felt at the beginning of the study.

Two of the participants felt as if the IM made a difference in their attention, while the third did not perceive any changes at all. Although the participants showed increases in the use of the IM, increased attention via the raw scores of the *d2*, and higher perceived performance in

school and work, statistical analyses could not be run because the sample size was too small. Thus, the final results remain inconclusive because there was not a quantitative measurement to validate changes that may be statistically significant with a larger sample.

Conclusions

Research Question 1. As a feasible study, it was successful in showing that there may be some benefits to using the IM for veterans who have expressed concerns of attention problems.

Research Question 2. This study was successful in showing that the IM may be related to gains in attention as evidenced by the *d2* Test of Attention. There was also a perceived increase in the performance of the occupations of school and work as shown by the COPM.

Recommendations

Methods to Improve the Study. Because of the nature of pilot studies, there were many factors that could not be modified even if this study had desired to do so. This study utilized a very small sample size, so a larger sample size would be recommended for related future studies. This would allow for tests to be run to yield a statistical significance. Furthermore, a more homogenous sample and a control group would maximize the potential for a study of this nature. In this study, the participants were not asked to identify as having an mTBI or PTSD for personal issues; however, it would be ideal if the sample size were diagnosed with an mTBI or PTSD so that results would be more easily generalized to this population. A brain scan may further validate the IM system as well. All participants had been out of military or government service for at least five years. Having another sample that were in the military or was closer to getting out of the military would help in controlling for extraneous factors between the exit date and entrance into education or work.

Final Implications. Through this research and past research, the IM has shown to be a useful tool for many populations that many identify attention problems. As a feasible study, investigators were successful in showing that through IM use, veterans that identified problems in attention during school or work may have had changes in attention and perceived performance in the occupations of work and school. Further research is needed to validate the IM on this population.

References

Ackerman, R., DiRamio, D., & Mitchell, R. (2009). Transitions: Combat veterans as college students. *New Directions For Student Services*, (126), 5-14. doi:10.1002/ss.311

Bates, M. E. & Lemay, E. P. (2004). The d2 test of attention: construct validity and extensions in scoring techniques. *Journal of the International Neuropsychological Society, 10*(3), 392-400. I: http://dx.doi.org/10.1017/S135561770410307X

Brickenkamp, R. & Zillmer, E. (2010). *The d2 test of attention: first U.S. edition.* Cambrdige, MA: Hogrefe Publishing.

Bazarian, J.J., Donnelly, K. Peterson, D.R., Warner, G.C., Zhu, T., & Zhong, J. (2012). The relation between posttaumatic stress disorder and mild traumatic brain injury acquired during operations enduring freedom and Iraqi freedom: a diffusion tensor imaging study. *The Journal of Head Trauma Rehabilitation, 28*(1), 1-12. doi: 10.1097/HTR.0b013e318256d3d3

Bolt, E. M., Dekker, J., Eyssen, I. C. J. M., Maasdam, A., Oud, T. A. M., & Steultjens, M. P. M. (2011). Responsiveness of the Canadian Occupational Performance Measure. *Journal of Rehabilitation Research & Development*, *48*(5), 517+. Retrieved from http://go.galegroup.com.jproxy.lib.ecu.edu/ps/i.do?id=GALE%7CA260582659&v=2.1&u=gree96177&it=r&p=HRCA&sw=w.

Broadbent, D. (1958). *Perception and Communication*. London: Permagon Press.

Davidson, L., Erickson, M. W., Radomski, M. V., & Voydetich, D. (2009). Occupational therapy for service members with mild traumatic brain injury. *AJOT: American Journal of Occupational Therapy*, *63*(5), 646+. Retrieved from

http://go.galegroup.com/ps/i.do?id=GALE%7CA212106699&v=2.1&u=gree96177&it=r&p=HRCA&sw=w

Dedding, C., Cardol, M., Isaline, C. E., Dekker, J., & Beelen, A. (2004). Validity of the canadian occupational performance measure: A client-centred outcome measurement. *Clinical Rehabilitation, 18*(6), 660-7. doi: http://dx.doi.org/10.1191/0269215504cr746oa

Durdella, N. (2012). Understanding patterns of college outcomes among student veterans. *Journal of Studies in Education. 2(2),* 109-129. Retrieved from http://www.macrothink.org/journal/index.php/jse/article/view/1469.

Ginzburg, H & Holm, K. (2009). The struggle for DOD/VA benefits. *Psychiatric Annals, 39*(2), 71-77. Retrieved from http://search.proquest.com.jproxy.lib.ecu.edu/docview/217032989?accountid=10639

Gradus, J. (2014). Epidemiology of PTSD. Retrieved from http://www.ptsd.va.gov/professional/PTSD-overview/epidemiological-facts-ptsd.asp

Hawn, H.(2011). Veterans and Veteran Families in General Education. *The Journal of General Education* 60(4), 248-264. Penn State University Press. Retrieved March 1, 2013, from Project MUSE database.

Hayes, J., Petty, K., McCarthy, G., A., Rajendra. (2009). Alterations in the neural circuitry for emotion and attention associated with posttraumatic stress symptomatology. *Psychiatry Research: Neuroimaging, 172*(1), 7-15.

IM Certification Provider Training Manual (2009).

Interactive Metronome™. General Format. Retrieved from www.atotalapproach.com/docs/IM.pdf.

Koomar, J., Burpee, J.D., DeJean, V., Frick, S., Kawar, M.J., & Fischer, D.M. (2000). Theoretical and clinical perspectives on the Interactive Metronome™: a view from

occupational therapy practice. *The American Journal of Occupational Therap, 55(2),* 163-166. Retrieved from http://ajot.aotapress.net/content/55/2/163

Kim, H.H., Bo, G.H., Yoo, B.K. (2012). The effects of a sensory integration programme with applied interactive metronome training for children with developmental disabilities: a pilot study. *Hong Kong Journal of Occupational Therapy, 22*(1), 25. doi:10.1016/j.hkjot.2012.05.001

Law, M., Baptiste, S., Carswell, A., McColl, MA., Polatajko, H., & Pollock, N. (2005). *Canadian Occupational Performance Measure*. 4th ed. Toronto (Canada): Canadian Association of Occupational Therapists

McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., Stallings, M.C. (2012). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly, 28(2).* 314-324. Retrieved from http://www.sciencedirect.com/science/article/pii/S0885200612000762#.

Nelson, D.L. (2006). Group comparative studies: quantitative research designs. In G. Kielhofner (Ed.) *Research in Occupational Therapy* (pp. 66-89). Philadephia, PA: F.A. Davis Company.

Nelson, L, MacDonald, M, Glover, C,Brewer, K. (2012). Effects of interactive metronome therapy on neuropsychological test performance and electrocortical functional connectivity following blast related brain injury.*BRAIN INJURY, 26*(4-5), 648-649.

Nelson, L., MacDonald, M., Stall, C. Pazdan, R. (2013). Effects of interactive metronome therapy on cognitive functioning after blast-related brain injury: a randomized controlled pilot trial. *Neuropsychology,* advanced online publication. Doi: 10.1037/a0034117.

O'Herrin, E. (2011). Enhancing Veteran Success in Higher Education. *Peer Review*, *13*(1), 15-18.

Plach, H. L., & Sells, C. H. (2013). Occupational performance needs of young veterans. *AJOT: American Journal of Occupational Therapy*, *67*(1), 73+. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CA314443348&v=2.1&u=gree96177&it=r&p=HRCA&sw=w

Pontifex, M. B., Broglio, S. P., Drollette, E. S., Scudder, M. R., Johnson, C. R., O'Connor, P.,M., & Hillman, C. H. (2012). The relation of mild traumatic brain injury to chronic lapses of attention. *Research Quarterly for Exercise and Sport, 83*(4), 553-9. Retrieved from http://search.proquest.com.jproxy.lib.ecu.edu/docview/1269154434?accountid=10639

Radford, A.W. (2009). *Military service members and veterans in higher education: what the new GI Bill may mean for postsecondary institutions.* Washington, DC: American Council on Education.

Radford, A.W., & Wun, J. (2009). *Issue tables: A profile of military service members and veterans in higher education.* Washington, DC: U.S. Department of Education, National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2009182.

Ritter, M., Colson, K., Park, J. (2012). Reading intervention using interactive metronome in children with language and reading impairment: A preliminary invesigation. *Communication Diosorders Quarterly.* Retrieved from: http://cdq.sagepub.com/content/early/2012/09/24/1525740112456422.

Sayer, N.A., Rettman, N.A., Carlson, K.F., Bernardy, N., Sigford, B.J., Hamblen, J.L., & Friedman, M.J. (2009). Veterans with history of mild traumatic brain injury and

posttraumatic stress disorder: challenges from provider perspective. *Journal of Rehabilitation Research & Development*, *46*(6), 703+. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CA218658467&v=2.1&u=gree96177&it=r&p=HRCA&sw=w

Seal, K.H., Bertenthanl, D., Miner, C.R., Sen, S., Marmarc, C. (2007). Bringing the war back home: mental health disorders among 103,788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. *Arch Intern Med, 167*(5), 476-482.

Shaffer, R.J., Jacokes, L.E., Cassily, J.F., Greenspan, S.I., Tuchman, R.F., Stemmer, P.J. (2001). Effect of interactive metronome training on children with ADHD. *The American Journal of Occupational Therapy. 55(2).* 155-162. Retrieved from http://ajot.aotapress.net/content/55/2/155.full.pdf+html.

Steele, J., Salcedo, N., & Coley, J. (2010). Service members in school: military veterans' experiences using the Post-0/11 GI Bill and Pursing Postsecondary Education. Washington, DC: The American Council on Education.

Tanielian, T. & Jaycox, L.H. (Eds.). (2008). *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery.* Santa Monica, CA: RAND.

Thompson, C.B. & Panacek, E.A. (2006). Research study designs: Experimental and quasi-experimental. *Air Medical Journal, 25*(6), 242-246. Doi: 10.1016/j.amj.2006.09.001.

Vasterling, J. J., Brailey, K., Constans, J. I., & Sutker, P. B. (1998). Attention and memory dysfunction in posttraumatic stress disorder. *Neuropsychology*, *12*(1), 125-133. doi:10.1037/0894-4105.12.1.125.

Warren, A. (2002). An Evaluation of the Canadian model of Occupational Performance and the Canadian Occupational Performance Measure in Mental Health Practice. *The British Journal of Occupational Therapy, 65(11).* 515.

Zillmer, E.A. & Kennedy, C.H. (1999). Construct validity for the d2 test of attention. *Archives of Clinical Neuropsychology, 14*(8), 728. *doi: 10.1093/arclin/14.8.728*

Zillmer, E.A. & Kennedy, C.H. (1999). Preliminary United States Norms for the d2 test of attention. *Archives of Clinical Neuropsychology, 14*(8), 727-728. *doi: 10.1093/arclin/14.8.727*

Appendix A

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · www.ecu.edu/irb

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: Leonard Trujillo
CC:
Date: 7/15/2013
Re: UMCIRB 13-001427
The Effectiveness of the IM with Veterans in Higher Education Settings

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 7/14/2013 to 7/13/2014. The research study is eligible for review under expedited categories #4 and #7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name	Description
1Flyer IM Karla.docx	Recruitment Documents/Scripts
Anticipated general survey for participants who meet inclusion and exclusion criteria and are interested in setting up a time for COPM interview and d2 Testing.docx	Data Collection Sheet
COPM Addendum Topics of Discussion that will be tied into interview.docx	Interview/Focus Group Scripts/Questions
IM Concnet Karla B - 2013.doc	Consent Forms

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

Appendix B

Study ID:UMCIRB 13-001427 Date Approved: 7/14/2013 Expiration Date: 7/13/2014

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: The Effectiveness of the Interactive Metronome™ as a Tool to Improve Selective Attention of Veterans within their Role as Student in Secondary Education Settings within Eastern North Carolina

Principal Investigator: Leonard Trujillo, PhD, OTR/L, FAOTA and Karla Baker, OTS
Institution/Department or Division: Occupational Therapy
Address: Health Sciences Building, Greenville, NC 27834
Telephone #: 252-744-6195

Study Sponsor/Funding Source: NA

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?

The purpose of this research is to examine the effects of the Interactive Metronome™ as a means of improving the issues with attention and concentration being experienced by previously deployed veterans. The decision to take part in this research is yours to make. By doing this research, we hope to learn more about how the Interactive Metronome effects attention.

Why am I being invited to take part in this research?

You are being invited to take part in this research because you are a veteran that has witnessed combat in Operation Enduring Freedom or Operation Iraqi Freedom. If you volunteer to take part in this research, you will be one of about 5 at East Carolina University and 5 at Pitt Community College.

Are there reasons I should not take part in this research?

I understand I should not volunteer for this study if I have a history of prolonged alcohol or drug abuse, use medications that fall under the category of narcotics, have an unstable medical condition such as seizures or becoming dizzy easily or sensitivity to sounds, or have experienced a moderate to severe brain injury.

What other choices do I have if I do not take part in this research?

You can choose not to participate.

Where is the research going to take place and how long will it last?

The research procedures will be conducted at the East Carolina University Health Sciences Building rm. 3325 and in your home. You will need to come to East Carolina University Health Sciences Building rm. 3325 2-3 times during the study. The total amount of time you will be asked to volunteer for this study is approximately 18 hours over the next 6-8 weeks.

What will I be asked to do?

Study ID:UMCIRB 13-001427 Date Approved: 7/14/2013 Expiration Date: 7/13/2014

Title of Study:

You are being asked to do the following: If you decide you are interested in the study, you will set up a time with us to take the d2 Test of Attention and Canadian Occupational Performance Measure (COPM) to further see if you qualify for the study. The d2 Test of Attention is a letter-cancellation test and the COPM is an interview. Both tests will determine whether you have problems with attention. Once this is completed you will be informed if you qualify or do not qualify for the study. If it is determined that you qualify, we will contact you to set up a time to come to the ECU Health Sciences Building so we can show you how to set up and use the Interactive Metronome in your home. From the time you express interest to the time you are equipped with your own set-up is about 2 weeks. Once you know how to use the In Home Interactive Metronome, you will take it home and have 15 at-home sessions completing the protocols established with the In Home Interactive Metronome. You will have and use the system for 4-6 weeks, depending on how you space out the sessions. When you complete the sessions, you will be asked to return the ECU Health Sciences Building to turn in the equipment and taken the d2 Test of Attention and COPM again.

What possible harms or discomforts might I experience if I take part in the research?
It has been determined that the risks associated with this research are no more than what you would experience in everyday life. You may feel at the beginning that you should be scoring better than the feedback received, but this is normal and you should see improved scores as time and completion of the protocols progress.

What are the possible benefits I may experience from taking part in this research?
Other people who have participated in this type of research have experienced gains in attention, organizational skills and concentration. By participating in this research study, you may also experience these benefits.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study

What will it cost me to take part in this research?
It will not cost you any money to be part of the research. The sponsor of this research will pay the costs of the Interactive Metronome software. *Should you need a PC /Laptop one may be provided to you.*

Who will know that I took part in this research and learn personal information about me?
To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- The sponsors of this study. The IM™ Corporation is providing the equipment, but will not have access to your data or private information. They are supplying the equipment used, but do not have access to the data collected.
- Any agency of the federal, state, or local government that regulates human research. This includes the Department of Health and Human Services (DHHS), the North Carolina Department of Health, and the Office for Human Research Protections
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.

How will you keep the information you collect about me secure? How long will you keep it?
Participants will be assigned an identification number so that identifying names and information are kept confidential. The information obtained in this research may be stripped of identifiers and used in future research without anyone knowing it is information from the participant. Data obtained will be shared only with the thesis committee chairperson and will be kept in a secure location until 2018 (5 years) at which time it will be destroyed. It is hoped that this study not only be part of a thesis process, but lead to publications that may assist in the treatment of veterans who have similar complaints as you have experienced.

*Consent Version # or Date:*_____

_____
Participant's Initials

Study ID:UMCIRB 13-001427 Date Approved: 7/14/2013 Expiration Date: 7/13/2014

Title of Study:

What if I decide I do not want to continue in this research?
If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. You will not lose any benefits that you should normally receive. You will be asked to return any equipment provided you to use in your home setting.

Who should I contact if I have questions?
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator Leonard Trujillo at 252-744-6195 or Karla Baker at 757-618-2215 (Monday-Friday, between 8 am-5 pm).

If you have questions about your rights as someone taking part in research, you may call the Office for Human Research Integrity (OHRI) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the OHRI, at 252-744-1971.

Due to the limited amount of qualified participants and our involvement in the community, you may already be acquainted with us. It is not anticipated that this will have a bearing or an impact on your participation on the study and your information will be kept confidential with no reference to participation in the study.

Is there anything else I should know?
Currently there are little known treatment or interventions other than medications that are being implemented to assist veterans as they return to higher education. Your possible participation may benefit not only your personal opportunities, but those of other veterans in similar status or situation.

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name (PRINT)_____ Signature Date

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____

Person Obtaining Consent (PRINT) Signature Date

_____

Principal Investigator (PRINT) Signature Date

*Consent Version # or Date:*_____

_____
Participant's Initials

Appendix C

Participant ID:

Gender:

Race:

Age:

Highest level of education you have completed:

Where are you currently enrolled (have intensions of enrolling) in secondary education?

What is your current standing (i.e. first year, second year)?

What is your current area of study (if applicable)?

Are you using the GI Bill benefits to attend school?

Do you have a part-time or full-time job?

In which branch did you serve? For how long?

Did you serve in either Operation Enduring Freedom or Operation Iraqi Freedom?

When did you leave the service? (Month & Year)

Did you witness combat?

How often per week to you consume alcohol?

Do you take prescribed or non-prescribed narcotics?

Do you have a diagnosed or non-diagnosed moderate or severe traumatic brain injury?

Do you have a seizure disorder, vertigo, or are sensitive to tones and sounds?

Appendix D

COPM Addendum Topics of Discussion that were tied into interview (as needed)

- Has there been a noticeable change in attention and concentration since coming back from deployment and/or leaving the military?
- Has that change in attention and concentration led to less satisfaction in areas of occupation? If so, which ones?
- What are some instances (examples) in which you have noticed decreased attention and concentration?
- Do you feel lapses of concentration and attention in the classroom?
- How has that impacted classroom participation? Grades? Are there consequences (dropping classes, not gaining degree on intended timeline)?
- Have you tried strategies to help with attention and concentration in the past?

Appendix E

IM Protocol used by all participants

ECU Veterans — **Session 1 / 15**

Task 1: LF Both Hands 54 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Both Hands		
	Repetition / Duration	54 / 1 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 2: LF Right Hand 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Right Hand		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 3: LF Left Hand 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Left Hand		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 4: LF Both Toes 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Both Toes		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 5: LF Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Right Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 6: LF Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Left Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 7: LF Both Heels 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Both Heels		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 8: LF Right Heel 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Right Heel		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 9: LF Left Heel 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Left Heel		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 10: LF Right Hand / Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Right Hand / Left Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 11: LF Left Hand / Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Left Hand / Right Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 12: LF Balance Right Foot / Tap Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Balance Right Foot / Tap Left Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 13: LF Balance Left Foot / Tap Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	LF Balance Left Foot / Tap Right Toe		
	Repetition / Duration	30 / 0.6 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4
Task 14: LF Both Hands 54 Reps with Guide Sounds; Scene: Default; Visual: Auditory				
	Exercise Name	LF Both Hands		
	Repetition / Duration	54 / 1 Min.	Tempo	54
	Guide Sound	ON	Difficulty	100
	SRO	15	Burst Threshold	4

Total Tasks: 14, Reps: 468, Minutes: 9.2 — Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 2 / 15**

Task 1: Claping Both Hands Together 500 Reps No Guide Sound; Scene: Default; Visual: Auditory				
	Exercise Name	Claping Both Hands Together		
	Repetition / Duration	500 / 9.3 Min.	Tempo	54
	Guide Sound	OFF	Difficulty	100
	SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 500, Minutes: 9.3 — Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 3 / 15**

Task 1: Both Hands 1000 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash				
	Exercise Name	Both Hands		
	Repetition / Duration	1000 / 18.5 Min.	Tempo	54
	Guide Sound	ON	Difficulty	1
	SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1000, Minutes: 18.5 — Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 4 / 15**

Task 1: Both Hands 1000 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	1000 / 18.5 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1000, Minutes: 18.5

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 5 / 15**

Task 1: Both Hands 1000 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	1000 / 18.5 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1000, Minutes: 18.5

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 6 / 15**

Task 1: Both Hands 1500 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	1500 / 27.8 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1500, Minutes: 27.8

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 7 / 15**

Task 1: Both Hands 1500 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	1500 / 27.8 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1500, Minutes: 27.8

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 8 / 15**

Task 1: Right Hand / Left Toe 1500 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Right Hand / Left Toe		
Repetition / Duration	1500 / 27.8 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1500, Minutes: 27.8

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 9 / 15**

Task 1: Left Hand / Right Toe 1500 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Left Hand / Right Toe		
Repetition / Duration	1500 / 27.8 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1500, Minutes: 27.8

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 10 / 15**

Task 1: Right Hand / Left Toe 1500 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Right Hand / Left Toe		
Repetition / Duration	1500 / 27.8 Min.	Tempo	54
Guide Sound	ON	Difficulty	1
SRO	15	Burst Threshold	4

Total Tasks: 1, Reps: 1500, Minutes: 27.8

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 11 / 15**

Task 1: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.9 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 2: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.2 Min.	Tempo	80
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 3: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.5 Min.	Tempo	65
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 4: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 2.2 Min.	Tempo	45
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 5: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 3.3 Min.	Tempo	30
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 6: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.1 Min.	Tempo	90
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 7: Both Hands 200 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	200 / 3.7 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Total Tasks: 7, Reps: 800, Minutes: 14.9

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans **Session 12 / 15**

Task 1:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 1.9 Min.**	Tempo	**54**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 2:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 1.2 Min.**	Tempo	**80**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 3:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 1.5 Min.**	Tempo	**65**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 4:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 2.2 Min.**	Tempo	**45**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 5:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 3.3 Min.**	Tempo	**30**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 6:	**Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**100 / 1.1 Min.**	Tempo	**90**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**
Task 7:	**Both Hands 200 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash**			
	Exercise Name	**Both Hands**		
	Repetition / Duration	**200 / 3.7 Min.**	Tempo	**54**
	Guide Sound	**ON**	Difficulty	**100**
	SRO	**15**	Burst Threshold	**4**

Total Tasks: 7, Reps: 800, Minutes: 14.9

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 13 / 15**

Task 1: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.9 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 2: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.2 Min.	Tempo	80
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 3: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.5 Min.	Tempo	65
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 4: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 2.2 Min.	Tempo	45
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 5: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 3.3 Min.	Tempo	30
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 6: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.1 Min.	Tempo	90
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 7: Both Hands 200 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	200 / 3.7 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Total Tasks: 7, Reps: 800, Minutes: 14.9

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 14 / 15**

Task 1: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.9 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 2: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.2 Min.	Tempo	80
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 3: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.5 Min.	Tempo	65
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 4: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 2.2 Min.	Tempo	45
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 5: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 3.3 Min.	Tempo	30
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 6: Both Hands 100 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	100 / 1.1 Min.	Tempo	90
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Task 7: Both Hands 200 Reps with Guide Sounds; Scene: Default; Visual: Enriched without Flash

Exercise Name	Both Hands		
Repetition / Duration	200 / 3.7 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Total Tasks: 7, Reps: 800, Minutes: 14.9

Last Updated On: 9/27/2013 1:48:59 PM

ECU Veterans — **Session 15 / 15**

Task 1: LF Both Hands 54 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Both Hands		
Repetition / Duration	54 / 1 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 2: LF Right Hand 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Right Hand		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 3: LF Left Hand 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Left Hand		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 4: LF Both Toes 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Both Toes		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 5: LF Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Right Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 6: LF Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Left Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 7: LF Both Heels 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Both Heels		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 8: LF Right Heel 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Right Heel		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 9: LF Left Heel 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Left Heel		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 10: LF Right Hand / Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Right Hand / Left Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 11: LF Left Hand / Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Left Hand / Right Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 12: LF Balance Right Foot / Tap Left Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Balance Right Foot / Tap Left Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 13: LF Balance Left Foot / Tap Right Toe 30 Reps No Guide Sound; Scene: Default; Visual: Auditory

Exercise Name	LF Balance Left Foot / Tap Right Toe		
Repetition / Duration	30 / 0.6 Min.	Tempo	54
Guide Sound	OFF	Difficulty	100
SRO	15	Burst Threshold	4

Task 14: LF Both Hands 54 Reps with Guide Sounds; Scene: Default; Visual: Auditory

Exercise Name	LF Both Hands		
Repetition / Duration	54 / 1 Min.	Tempo	54
Guide Sound	ON	Difficulty	100
SRO	15	Burst Threshold	4

Total Tasks: 14, Reps: 468, Minutes: 9.2

Last Updated On: 9/27/2013 1:48:59 PM

Appendix F

Participant Calendars

Participant 1

October, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
		1	2	Show Details 3 Long Form, 28.53 Total Rep: 402	4	5
6	Show Details 7 Attend Overtime, 26.1 Total Rep: 500	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	Show Details 23 Reg Form, 50.67 Total Rep: 1000	24	25	Show Details 26 Reg Form, 35.98 Total Rep: 1000
Show Details 27 Reg Form, 31.81 Total Rep: 1000	28	29	30	31		

November, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
					1	2
Show Details 3 Reg Form, 40.75 Total Rep: 1500	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	Show Details 19 Reg Form, 22.88 Total Rep: 3000	20	21	22	23
Show Details 24 Reg Form, 61.33 Total Rep: 7500	25	26	27	28	29	30

December, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
Show Details 1 Reg Form, 112.92 **Total Rep: 1500**	2	3	4	5	Show Details 6 Reg Form, 112.65 **Total Rep: 1500**	7
8	9	Show Details 10 Reg Form, 21.71 **Total Rep: 700**	11	12	13	14
15	16	17	18	19	20	21
Show Details 22 Reg Form, 26.09 **Total Rep: 700**	23	24	Show Details 25 Reg Form, 24.02 **Total Rep: 900**	26	27	28
Show Details 29 Reg Form, 22.41 **Total Rep: 800**	30	Show Details 31 Long Form, 22.07 **Total Rep: 522**				

Participant 2

October, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
		1	2	Show Details 3 Long Form, 35.37 Total Rep: 468	4	5
Show Details 6 Attend Overtime, 36.91 Total Rep: 500	7	8	Show Details 9 Reg Form, 27.65 Total Rep: 1000	10	11	Show Details 12 Reg Form, 24.77 Total Rep: 1000
13	14	Show Details 15 Reg Form, 21.81 Total Rep: 1000	16	Show Details 17 Reg Form, 18.91 Total Rep: 1500	18	19
20	Show Details 21 Reg Form, 16.38 Total Rep: 1500	22	Show Details 23 Reg Form, 40.32 Total Rep: 1500	24	25	26
Show Details 27 Reg Form, 28.04 Total Rep: 1500	28	Show Details 29 Reg Form, 27.68 Total Rep: 3000	Show Details 30 Reg Form, 14.5 Total Rep: 800	31		

November, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
					1	2
Show Details 3 Reg Form, 17.67 Total Rep: 800	4	5	Show Details 6 Reg Form, 13.48 Total Rep: 800	7	8	9
10	11	12	Show Details 13 Reg Form, 13.56 Total Rep: 800	14	15	Show Details 16 Long Form, 17.66 Total Rep: 468
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Participant 3

October, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	Show Details 14 Long Form, 35.86 Total Rep: 468	Show Details 15 Reg Form, 46.29 Attend Overtime, 82.49 Total Rep: 1500	16	Show Details 17 Reg Form, 31.21 Total Rep: 2000	Show Details 18 Reg Form, 25.59 Total Rep: 1000	19
20	21	22	23	Show Details 24 Reg Form, 26.65 Total Rep: 1500	25	Show Details 26 Reg Form, 21.38 Total Rep: 1500
27	Show Details 28 Reg Form, 49.43 Total Rep: 1500	Show Details 29 Reg Form, 40.17 Total Rep: 1500	30	Show Details 31 Reg Form, 34.5 Total Rep: 1500		

November, 2013

Sunday	Monday	Tuesday	Wendesday	Thursday	Friday	Saturday
					Show Details 1 Reg Form, 14.44 Total Rep: 800	Show Details 2 Reg Form, 13.87 Total Rep: 800
Show Details 3 Reg Form, 17.52 Total Rep: 800	4	Show Details 5 Reg Form, 13.11 Total Rep: 800	6	Show Details 7 Long Form, 6 Total Rep: 846	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Appendix G

COPM Scores

PARTICIPANT 1			
	PRE	PRE	PRE
	Importance	Performance	Satisfaction
Attn in Work	8	7	7
Relationships	10	10	9
Finances	8	9	5
	POST	POST	POST
	Importance	Performance	Satisfaction
Attn in Work	10	9	10
Relationships	10	7	8
Finances	10	10	10
PARTICIPANT 2			
	PRE	PRE	PRE
	Importance	Performance	Satisfaction
School	10	6	4
Leisure	3	5	7
Relationships	7	6	7
	POST	POST	POST
	Importance	Performance	Satisfaction
School	7	8	8
Leisure	6	9	9
Relationships	9	9	9
PARTICIPANT 3			
	PRE	PRE	PRE
	Importance	Performance	Satisfaction
Attn in school	10	7	8
Leisure	10	9	10
	POST	POST	POST
	Importance	Performance	Satisfaction
Attn in school	10	9	8
Leisure	10	10	10

Appendix H
D2 Test of Attention Scores

P1-Pre	Raw Score	Percentage	PR (US College)	SS (US College)	PR (Age 50-59, M/F)	SS (Age 50-59, M/F)
TN	521		50	100	97.1	119
E1	42		10	85		
E2	4		50	100		
E	46	8.83	17.5	90	42.1	111
TN-E	475		25	92	96.4	118
CP	174		25	95		
FR	6		90	115	90	113
P1-Post	Raw Score	Percentage	PR (US College)	SS (US College)	PR (Age 50-59, M/F)	SS (Age 50-59, M/F)
TN	573		75	105	99.4	125
E1	67		10	75		
E2	0		75	105		
E	67	11.69	10	80	27.4	94
TN-E	506		50	100	98.6	122
CP	188		37.5	98		
FR	13		50	100	50	100
P2-Pre	Raw Score	Percentage	PR (US College)	SS (US College)	PR (Age 19-39, M/F)	SS (Age 19-39, M/F)
TN	509		37.5	97.5	95.5	117
E1	4		75	105		
E2	0		75	105		
E	4	0.79	75	105	98	121
TN-E	505		50	100	98.2	121
CP	208		60	102.5		
FR	12		62.5	102.5	46	99
P2-Post	Raw Score	Percentage	PR (US College)	SS (US College)	PR (Age 19-39, M/F)	SS (Age 19-39, M/F)
TN	584		80	107.5	99.7	128
E1	6		75	106		
E2	1		75	105		
E	7	1.2	50	105	91.9	114
TN-E	577		80	110	99.9	130
CP	249		82	110		
FR	10		75	105	75	106.5
P3-Pre	Raw	Percentage	PR (US	SS (US	PR (Age 19-39,	SS (Age 19-39,

	Score		College)	College)	M/F)	M/F)
TN	611		90	115	99.9	130
E1	21		37.5	97.5		
E2	6		37.5	99		
E	27	4.42	50	100	50	100
TN-E	584		82.5	110	99.9	130
CP	245		82.5	110		
FR	9		75	105	78.8	108
P3-Post	Raw Score	Percentage	PR (US College)	SS (US College)	PR (Age 19-39, M/F)	SS (Age 19-39, M/F)
TN	649		95	118	99.9	130
E1	11		62.5	102.5		
E2	0		75	105		
E	11	1.69	75	110	90	112.5
TN-E	638		95	118	99.9	130
CP	289		95	120		
FR	4		95	120	97.1	119