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An Action Research Inquiry into the Relationship Among Aerobic Activities, Memory, and Stress with Students Identified as Gifted

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Abstract

Students identified as gifted come from varying socio-economic strata and nationalities with a range of talents and temperaments comprising a diverse community. They may experience stress for a variety of reasons. Although a certain amount of stress can enhance the learning process, too much stress can impede learning, especially memory. Strategies have been offered for relieving stress, yet the benefits of physical activities as stress reducers for the gifted have frequently been overlooked. The purpose of this study was to investigate the relationship among aerobic activity, stress, and memory ability in students in an elementary school gifted program. An exceptional aspect of this research was that the students were an integral part of their own study. As co-researchers they had a vested interest in what they were doing, enhancing the significance of the experience and heightening learning.

This action research project conducted in a mid-western school district with fourth and fifth grade students examined the impact of aerobic movement on physical indicators of stress and memory. The study lasted twelve weeks with data collected on physical indicators of stress, memory test scores, parent observations, interviews with students, a parent focus group session, observational data, student comments, and investigator/teacher journal. By infusing regular exercise into curricula, stress levels in students identified as gifted were examined. Students' scores on declarative memory tasks conducted with and without an accompanying aerobic activity were documented. Students learned of the delicate relationship between stress and memory as they studied the physiology of the brain.

Twenty-four hour retention rates of declarative memory items were higher when a 20-minute aerobic activity intervention preceded the memory activity. Perceived stress levels were lowered for 14 of the 16 co-researchers. Students indicated a positive attitude toward physical activity and its benefits for greater memory retention and reduction in stress. Student-driven action research can be a powerful educational tool.

Movement activities are a positive factor in student learning and should be incorporated into the school routine. Students developed an increased awareness of the short term benefits of exercise which could catalyze aerobic activity as a regular part of the school day.

This dissertation is dedicated to those amazing people of my past, my present, and my future.

My father, Anthony B. Lampe, Ph.D, was the first of his family to go to college and persevered to the highest degree possible. He certainly could not have accomplished that without my mother, Dorothy C. Lampe, who supported him throughout his teaching career. My dad was my shining example of what it truly means to be a first-class teacher.

My brother, Bill Lampe, and my sister, Geralyn Meyer, Ph.D, have prayed for me and encouraged me ceaselessly. Thank you, Gera, for those many late night/early morning phone calls calming my anxiety and encouraging me. You both never, never stopped believing in me.

My children, Meghan, Caleb, Benjamin, and Kaitlin, have tolerated my absences and my long hours of studying, always supporting me and inspiring me with their own wonderful attitude toward education and family and offering me joy, love and laughter along the way.

Finally, and most of all, I dedicate this to my wonderful husband, David A. Ford, Ph.D, who believed in me, listened to me and loved me. As ever, forever, more than ever!

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Thank you to the sixteen fourth and fifth grade students and their parents who enthusiastically and courageously traveled this journey with me.

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CHAPTER 1

INTRODUCTION

Encompassing two to six percent of the general population, students identified as gifted include a diverse community. They come from all socio-economic strata and nationality. They have a wide range of talents and temperaments. Regardless of their differences, they share special needs. Like all students, those identified as gifted need support and attention from the adults in their lives. Many of the adults may not understand the uniqueness of such individuals. Few of their peers will truly understand them (Neihart, Reis, Robinson, & Moon, 2002).

The Office of Educational Research and Improvement (OERI) in the United States Department of Education (1993) defines giftedness as:

> Students and youth with outstanding talent, who perform or show the potential for performing at remarkably high levels of accomplishment when compared with others of their age, experience, or environment. These students and youth exhibit high performance capability in intellectual, creative, and/or artistic areas, possess an unusual leadership capacity, or excel in specific academic fields. They require special services or activities not ordinarily provided by the schools. Outstanding talents are present in students and youth from all cultural groups, across all economic strata, and in all areas of human endeavor. **(**p. 26**)**

Put more simply, these students have a potential for an extraordinarily high level of performance in one or many areas including intellectual, creative, artistic, or leadership. The students in this study have scored at the 96th percentile or higher on

the Wechsler Intelligence Scale for Children, which is their school district's ultimate criterion for identification of participants in the school's gifted program. The district does not test for creative, artistic or leadership qualities. Along with great gifts can come great challenges. Students may not be emotionally able to handle the situations in which they are thrust because of their giftedness.

Theory of Successful Intelligence

The theoretical basis for this study is Sternberg and Grigorenko's (2002) Theory of Successful Intelligence. This theory defines *successful intelligence* as

> the ability to succeed in life according to one's own definition of success, within one's sociocultural context, by capitalizing on one's strengths and correcting or compensating for one's weaknesses; in order to adapt to, shape, and select environments through a combination of analytical, creative, and practical abilities. (p. 265)

According to Sternberg, the gifted are those who are particularly suited to achieving this type of success. Sternberg offers a broader definition than that proposed by the Office of Educational Research and Improvement. In the United States educational systems, the emphasis is on the analytical and memory aspects of intelligence. According to Sternberg, those who are successfully intelligent embrace both creative and practical aspects of self. Furthermore, intelligence is not a static condition. Sternberg refers to it as a "developing expertise" (p. 267) and recommends the use of this model of successful intelligence when intervening for students identified as gifted.

Sternberg and Grigorenko (2002) caution that giftedness is a societal invention. Giftedness in a particular culture is what is valued in that socio-cultural context. Sternberg's conception of giftedness is broader, more complete and dynamic than mere assessment via achievement and IQ scores.

Giftedness and Stress

Definitions of giftedness may be as varied as the students studied. Students are unique, but share some common experiences. As with any child, stress can be a factor in daily life. Students identified as gifted experience stress for a variety of reasons. Expectations are typically set high by their parents, teachers and even themselves. They often have deep concern for the world and its problems. Sometimes these students have overly intense parents or, conversely, disconnected parents. Students with high IQs tend to be involved in many activities, are often bored in the classroom, experience loneliness, are often misunderstood by regular education teachers, tend to have more intense responses to negative life situations, and often do not fit in with their regular age peers (Strip & Hirsch, 2000; Peterson, 2009). These students can be vulnerable if they allow themselves to believe that their gifts are simply that, and hard work is not necessary to achieve in school or elsewhere. Perfectionism can be another strong influence on stress, especially if a child's parents are perfectionists or if various opportunities are avoided out of fear of failure. Students' multipotentiality, their ability to do well in many areas, can cause them not to pursue any one area to a high level of expertise (Neihart et al., 2002). Still another stressor comes from impatience with problems lacking an easy solution (Preuss & Dubow, 2004).

Response to stress takes on many forms (Strip & Hirsch, 2000). Students identified as gifted may become overly active and be unable to concentrate in school. Some students may be clinging and demanding of the support and attention of others. Students identified as gifted who are under stress can be bored, unmotivated, sullen, anti-social, or develop tics and other nervous habits.

Books and articles written for parents and teachers offer suggestions for combating this stress including relaxation, meditation, involvement in altruistic activities, or in non-academic activities (Strip & Hirsch, 2000). Other recommendations have included enhancing connectivity, encouraging self-efficacy and optimism, and using humor and creativity (Kitano & Lewis, 2005). Still other suggestions include bibliotherapy, support groups, moral exemplars, networking, counseling, positive self-talk and scheduled relaxation (Delisle, 2000, Bradley, 2006). Physical activities as stress reducers in the gifted are rarely mentioned.

The Role of Exercise

As with all students, those identified as gifted have unique capabilities that should be enhanced through any means possible, including through physical activities. If students are happily engaged in physical movements, improved memory capability may result (Clancy, 2006). Hence, the emotional lift afforded by exercise can play a positive role in memory.

Science has demonstrated the benefits of exercise to general well being. Exercise promotes heart health, reduces cholesterol, strengthens muscles, and improves breathing. This information has been available for decades, but more recent research over the last twenty years shows that exercise also has a significant effect

within the brain. Regular aerobic exercise causes new neurons to form and increases the number and strength of connections between neurons (Kramer, Erickson, & Colcombe, 2006).

The brain has the ability to reorganize itself throughout a person's lifetime. New neural pathways can form. This changeability is the plasticity of the brain. Exercise mobilizes the genes that may benefit brain plasticity processes. Brain-derived neurotrophic factor (BDNF) is a growth factor that can stimulate synaptic efficacy, neuronal connectivity, and use-dependent plasticity. John Ratey (2008) refers to BDNF as "miracle-gro for the brain" (p. 40). In a study of rats and mice which had running wheels placed in their cages, a positive correlation was found between running distance and levels of BDNF protein. The more the rats and mice exercised, the higher their levels of BDNF (Cotman & Berchtold, 2002). Exercise also increases the brain's uptake of insulin-like growth factor-1 (IGF-1), which increases BDNF, and therefore promotes brain plasticity. Any mechanism that increases levels of BDNF can enhance learning. Exercise is one of the mechanisms that can increase levels of BDNF (Cotman & Berchtold, 2002).

If physical activity can significantly improve cognition and overall brain health in laboratory animals, it may be hypothesized that success can also come to students who are similarly engaged. In his book, *Learning With the Body in Mind*, Eric Jensen (2000) wrote, "It is the complex interplay between mind and body that engages the learning brain" (p. 15). The brain was once conceived as having descending influence on the body, but the brain and body are in two-way

communication via the autonomic nervous system and "seemingly small changes … can accumulate over time" (McEwen, 2004, p. 2).

Jensen (2000) reminds his readers that "our brain is designed for moving, not sitting" (p. 17). The attention system in the brain is activated by movement, and certain movements can stimulate release of the body's natural motivators, which could also offset the stress response.

The Stress Response

Ursin and Eriksen (2004) proposed a cognitive activation theory of stress. They refer to the stress response as an *alarm system*, which usually occurs when there is a discrepancy between what is and what one perceives should be. Stress can be helpful when it leads to higher alertness. However, to use this alarm system analogy, the initial occurrence of the stressor is not damaging, but if the alarm continues to sound, long-term damage can occur to the immune system causing illness (Ebrecht, Hextall, Kirtley, Taylor, Dyson, & Weinman, 2004) or impairing memory (Oei, Everaerd, Elzinga, VanWell, & Bermond, 2006). Stress helps our bodies adapt to the changing circumstances at hand, but if the stress is extended it can cause "impaired immunity, atherosclerosis, obesity, bone demineralization, and atrophy of nerve cells in the brain" (McEwen, 2004, p. 1). Ursin and Eriksen (2004) contend that once a person learns appropriate coping mechanisms, stress is much less threatening to overall well-being.

Inquiries have noted chronic stress in children. One study found that many modern urban dwellers have high cortisol levels (an indicator of stress) continuously, especially individuals with low socio-economic status (Lupien, King, Meaney, &

McEwen, 2001). In Lupien et al.'s study no significant difference was noted in the memory function of high and low socio-economic status students regardless of cortisol levels. However, Oei et al (2006) did find in another study that high levels of cortisol affect working memory. What accounts for the different results? Perhaps it is the acute surge of the cortisol in Oei et al's study that played a different role as opposed to the chronically high levels noted by Lupien and others. Secondly, Lupien et al. (2001) studied academic memory, which refers to that memory held in long term storage and used when needed for retrieval. Oei et al (2006) studied working memory, which refers to those items that are held in the brain temporarily so actions can be taken with that information and then processed as necessary for each individual situation. Our research study focused on working memory.

Another study (Johnston-Brooks, Lewis, Evans and Whalen, 1998) found that high density living situations (the number of people dwelling in a home) can cause chronic stress which led to increased school absences for the students in the study. The researchers theorized that the allostatic load for the students was too great.

What is allostatic load? The human body strives to maintain stability. When faced with any situation (predictable or unpredictable) the body will adapt and then work to restore homeostasis. The actions required by the body to adapt through change are known as allostatic load (McEwen, 2004). When a person faces prolonged stressful situations, the body can go into allostatic overload. The cumulative effect can eventually have adverse consequences on the basic physiological functions.

Prolonged stress also can affect neurons in the hippocampus. The hippocampus is an important part of the brain's memory system (Christie &

Cameron, 2006), is involved in acquisition of semantic knowledge (Eichenbaum, 2004), and is one of the first targets of stress (McEwen, 2007). Yet, physical activity can reduce the effects of prolonged stress (McEwen, 2007).

One of the neurotransmitters released during exercise is dopamine, also referred to as the learning neurotransmitter (Ratey, 2002). Problems with working memory correlate with dopamine deficiencies. We are able to maintain our focus from one event to the next with the aid of dopamine (Ratey, 2002). In children of high intelligence, one of the characteristics of their brain may be the ability of not only the frontal lobes, but also the posterior (occipital) lobes, to store and rehearse spatial information in working memory (Sousa, 2003). Thus, such children may have a larger working memory capacity resulting in more reliance on that working memory and a greater vulnerability to dopamine deficiencies.

Students identified as gifted may experience high levels of stress. Stress increases cortisol levels as part of the allostatic load. High cortisol levels inhibit memory in the brain. Exercise has been shown to reduce cortisol levels. If students identified as gifted incur a great deal of stress and their allostatic load becomes an overload, then they may not be able to reach their full potential. Regular exercise could enhance their learning experiences by reducing their stress levels, enhancing brain function and promoting memory. In addition, regular exercise can become a lifetime coping skill.

One indication of allostatic overload may be the cardiovascular response. The body cannot maintain allostatic overload without consequence. Heart rate and blood pressure may take longer to return to baseline levels or may elevate in excess of the

rate required in a given situation (McEwen, 2004). Perhaps a workable coping skill, such as exercise, could give students identified as gifted a tool to combat stress and maintain physical health.

Purpose of this study

The purpose of this study was to describe the relationship among aerobic activity, stress and memory ability in students in an elementary school gifted program.

Background

Movement integrates and anchors new information and experiences into our neural networks (Hannaford, 2005). Ironically, during this era of pressure on schools to produce stronger testing results, some schools have chosen to cut back on time allotted for physical education and/or recess in order to devote more instructional time to students (Chaille, 2001). In my own school district, schedules have been altered to now require students enrolled in the middle school gifted program to miss Physical Education classes on alternating days.

Students identified as gifted are particularly vulnerable to the stresses of the school day. Often these students struggle with the discrepancy between their cognitive abilities and their vulnerability towards life's challenges. They have asynchronous development, which is an uneven advancement in cognitive, emotional, and physical development. The cognitive realm may be more highly developed than the emotional area. Many of these initial difficulties cause problems for gifted students into adulthood (Shwean, Saklofske, Widdifield-Konkin, Parker, &

Kloosterman, 2006). As adults, they still experience troubles with perfectionism, self-esteem, social inadequacies, and behavior.

Students identified as gifted tend to feel stress in four main areas. One area is their academic life which consists of their grades, homework, projects, and other intellectual school activities. Family life is another area of stress because students tend to be particularly sensitive to any concerns or pressures in the home. Social life can be a source of stress because students are often the victim of bullying or ostracizing. Finally, their own personal lives contribute to their stress. They place high demands on themselves. “Gifted students are probably their own biggest stressors” (Patel, 2009, p. 12).

“Americans have always struggled with praising education but being suspicious of those who learn too much” (Davidson & Davidson, 2004, p. 52). The brightest students in America waste most of their time in school and therefore pay a very high intellectual price. The lag between their talents and their opportunities causes distress. The anti-intellectualism in America leaves bright students on their own (Davidson & Davidson, 2004). A study in the National Association for Gifted Children’s “State of the States” reports general education teachers in 72 percent of the states are not required to have any training on the nature and needs of gifted and talented students at any point in their careers (NAGC website, 2010). Such decisions are made “because spending public money on low achievers feels charitable, but investing in high achievers doesn’t induce the same self-righteousness” (Davidson & Davidson, 2004, p. 64).

Marcia Gentry (2006) complains that No Child Left Behind "rings hollow for gifted students and for students who need quality education the most" (p. 26). Many gifted programs have focused on enhancing learning opportunities without emphasizing sufficiently the affective development. "The provisions that the school and community make for students identified as gifted would appear to be a significant issue" (Schwean, Saklofske, Widdifield-Konkin, Parke, & Kloosterman, 2006, p. 33). It is not enough to strive to meet the intellectual needs of students in the gifted programs. Schools should help students learn coping mechanisms and resilience. Resilience is the phenomenon of surviving and thriving in the face of adversity (Kitano & Lewis, 2005). The fact that students identified as gifted do not often face academic struggles early in school makes them more vulnerable later when academics and social issues become more pronounced. Learning coping mechanisms would appear to be one of the necessary provisions that the school and community should provide.

I have the privilege of working with the students as they progress through elementary school. In a typical gifted class session, they will engage in higher-level skills in mathematics, critical thinking, creative writing, vocabulary building, research, creativity, group work, and debate/discussion. Such academic pursuits are certainly worthwhile and necessary as preparation for further schooling. As the gifted specialist in their lives, I offer additional support in the affective aspect of their development.

This action research study empowered the students as co-researchers and afforded them the opportunity to assess their areas of affective strength as they

discovered the possibilities of aerobic activity's effects. As a teacher in the field of gifted education, I have a unique perspective on the daily life of students in the classroom. I was able to observe the students, the "co-researchers", in this study in a naturalistic setting and be a participant in all aspects of the inquiry open to any interesting developments at any time. Several questions guided this inquiry.

Research Questions

The purpose of this study was to investigate the relationship among aerobic activity, stress, and memory ability in students in an elementary school gifted program.

The following research questions were explored:

1. What physical movement activities would maintain the interest of fourth and fifth grade students identified as gifted in a suburban school setting?
2. What, if any, changes would occur in perceived stress feelings reported by the students and their parents after increases in school aerobic activities?
3. How would performance on measures of declarative memory capabilities be affected by aerobic exercise?
4. What would the students identify as their preferred coping strategies both at the beginning of the study and at the conclusion?
5. What changes would occur in students' physical indicators of stress taken before and after aerobic activities?
6. What, if any, attitude changes toward physical exercise would be noted in fourth and fifth grade students acting as co-researchers after three months of interventions?

Significance

Neihart and her colleagues (2000) appeal for more research in the field of gifted education. In fact, they state that "research of many kinds is sorely needed" (p. 285). In particular, they advocate for studies that would discover effective approaches, interventions, or supports for both students and their families.

Young students who learn to use mechanisms such as exercise to enhance relaxation and learning have the opportunity to grow into adults who may continue to utilize kinesthetic strategies to cope. Recalling Ursin & Eriksen's (2004) cognitive activation theory of stress, such kinesthetic strategies as exercise may alleviate the duration of the *clanging alarm*, thus preventing long-term damage to the immune system causing illness. Handling stress is a learned skill (Bradley, 2006); this skill needs to be modeled and taught. Any deleterious changes caused by chronic stress may be reversible if caught in time (McEwen, 2004).

Federal education mandates reflect little concern for the well-being of the nation's gifted and talented youth (Peterson, 2009). Teachers in the field of gifted education can more proactively "promote healthy social and emotional development" for their vulnerable students (p. 280).

If an educational technique existed that were low cost, easy to implement, required little additional instructional time, was accessible to the majority of the student body, and succeeded in reducing stress and enhancing memory, schools everywhere would seize such a solution.

Delimitations

1. Only those fourth and fifth grade students who previously had been identified using the district's gifted identification system were included in this study.
2. The length of this study was limited to the first semester of the 2010-2011 school year.

Assumptions

1. The fourth and fifth grade students were representative of middle/upper middle class fourth and fifth grade students in public school gifted programs throughout the Midwest.
2. The parents/guardians engaged honestly in the focus group session, honestly completed responses to monthly inquiries, and sincerely answered the students' questionnaire concerning stress.
3. Declarative memory was accurately measured using a variety of 20-item groups of simple, concrete nouns.
4. Cardiovascular Stress Responsivity and Cardiovascular Reactivity were indicators of chronic stress.

Definition of Terms

Aerobic Exercise - 20 minutes of purposeful, aerobic movement combining various combinations of jumping jacks, jogging, skipping, dancing, and jumping rope (see Appendix A)

Allostasis – maintaining stability through change

Allostatic Load (or overload) – cumulative result of an allostatic state

Cardiovascular Reactivity – the response of heart rate and blood pressure to a mentally stressful activity

Cardiovascular Stress Responsivity – a return to baseline measures of blood pressure and heart rate following mental stress

Cortisol – a corticosteroid hormone or glucocorticoid produced by the adrenal cortex in response to stress

Giftedness – students who score in the 96th percentile on the full scale Wechsler Intelligence Scale for Children - IV (WISC-IV) and demonstrate a potential for a high level of performance in one or more academic areas (NAGC website)

Homeostasis – stability of physiological systems that maintain life

Memory - recalling words from a 20-word list or 20-item group (generated by teacher researcher) after 5 minutes and 24 hours

Neurogenesis – the creation of new neurons in the brain

Neurotransmitters – chemicals which modulate signals between one neuron and another.

Stress – as self-reported via a normed stress inventory; completed by both the student and the parent/guardian as observer

Synaptogenesis – the creation of new synapses connecting two neurons in the brain

Organization of the Study

Chapter Two will discuss the literature regarding giftedness, the effects of aerobic activity on memory and stress, the issues of stress in students identified as gifted, and the action research protocol. Following this review, Chapter Three will delineate the methods for the case study of fourth and fifth grade groups of students

identified as gifted, identifying the data collection and analysis. Results of empirical tests of cardiovascular stress responsivity levels before and after exercise, performance on memory tasks, and observations of students will be analyzed in Chapter Four along with a discussion of reflected insights in this action research study. Finally, Chapter Five will discuss the results and implications for practice and future research.

Summary

Much has been written regarding: 1) the benefits of exercise for all, 2) the unique stressors of students identified as gifted, and 3) the capacity for exercise to enhance learning and combat stress. Yet few studies have combined these within an actual classroom. This study combined the three factors and documented the feasibility of infusing exercise into fourth and fifth grade curricula. Additionally, it offered an opportunity to analyze the effects of exercise on stress reduction and memory enhancement in students identified as gifted. Parent input provided another perspective on the study. Finally, each student experienced the role of a researcher in an action research project culminating in a research presentation for their school and a local university.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

It is not easy being gifted. The challenges and stressors that one experiences can add complications to a young person's life. "Gifted education is a crucial aspect of schooling in the United States and abroad" (Sternberg & Davidson, 2005, p. vii). Understanding giftedness is an essential component for educators who can help students acquire the tools to help them find success both in the classroom and in life. This chapter details the study of giftedness, its characteristics and challenges. Further, it explores Sternberg's theory of successful intelligence and the research on the brain and plasticity. The benefits of exercise are explored as well as the detrimental effects of stress. Chapter Two concludes with a description of action research.

Giftedness

As early as the beginning of the 20th century, Terman and Baldwin (1926) wrote of schools in San Francisco that "sifted for bright children" (p. 3) who measured above 125 on the Binet Intelligence test. They were surprised to learn that the bright children did not possess the characteristics thought to characterize intellectually precocious children, namely "sickliness, eccentricity, one-sidedness and lack of social adaptability" (p. 3).

Now at the beginning of the 21st century, the National Association for Gifted Students (NAGC) estimates that there are approximately three million academically gifted students in grades K - 12 in the United States. That is approximately six percent of the population (NAGC website).

There are abundant definitions of giftedness. Delisle and Galbraith (2002) suggest this definition:

> Giftedness can be defined as the ability to solve complex problems in effective, efficient, elegant, and economical ways . . . a gifted individual is one who can use existing knowledge when necessary and can apply known methods when appropriate, therefore reaching solutions based on the best available knowledge and methods. However, a gifted individual can also abandon existing knowledge and concepts, redefine problems, devise new methods, and reach entirely different solutions. (p. 16 – 17)

Winner (1996) summarizes the definition describing the three basic qualities of giftedness: precocity, marching to one's own drummer, and a rage to master. Gifted people learn earlier than their age level peers, usually learn in unique ways, and are driven intensely to learn in selected areas of interest.

Characteristics of Giftedness

Students identified as gifted tend to have above average abilities, high task commitment and creativity. They have a potential for an extraordinarily high level of performance in one or many areas including intellectual, creative, artistic, or leadership. Typically, students in the gifted realm learn quickly and retain what is learned, observe keenly, and sustain concentration for long periods of time. Many are avid readers and may grasp mathematics concepts readily. They can be extraordinarily sensitive and have an intense awareness of the world's problems (Delisle, 2000). Although, the national definition of giftedness does not mention IQ,

most states still include some mention of it requiring scores in the top first to fifth percentile for admission into a school district program (Jolly, 2009).

Leta Hollingworth is known as the foremother of gifted education, (Silverman, 2009). She believed that educators were to take a great deal of the responsibility for the support of students identified as gifted. “Before we can educate the genius, we must discover him in childhood” (Hollingworth, 1938, p. 306). Annemarie Roeper (1982) is the founder of *The Roeper Review,* which is an internationally refereed scholarly journal about all things gifted. She added to this charge of Hollingworth by stating “because people don’t understand the gifted, they confuse giftedness with pathology and give them pills instead of understanding” (p. 21).

Regardless of their differences, they share special needs. Just like all children, those identified as gifted need support and attention from the adults in their lives. Many adults may not understand the uniqueness of such individuals (Neihart et al, 2002). One facet of the gifted is their “overexcitabilities.” To understand the students involved in this study, it is necessary to have some understanding of overexcitabilities.

Overexcitabilities and the Gifted

Kazimierz Dabrowski first proposed the idea of “over-excitabilities” in the first half of the twentieth century (Daniels & Piechowski, 2009). This Polish psychiatrist and psychologist found that the exceptional people he encountered during the turmoil of the World Wars had some common traits. These artists, writers, and actors experienced their world intensely. They were born with a developmental

potential that, if handled correctly, could lead to what he termed “positive disintegration.” This negative sounding phrase actually refers to “dismantling as a prelude to construction and subsequent creation at a higher level” (Daniels & Piechowski, p. 6). Dabrowski (1964) writes “disintegration is described as positive when it enriches life, enlarges the horizon . . . and brings forth creativity” (p. 10).

Certain features, overexcitabilities, were found to be more prevalent in those identified as gifted as compared to the general population (Tieso, 2007). In time, Dabrowski’s theory has come to be associated with gifted identification in a way considered much more robust than an IQ test or other single measure (Bouchard, 2004). The five areas of overexcitabilities (OEs) are not tied to academic achievement in any way. Rather, they are innate characteristics of a person that span one’s life. Although the word contains the root word “abilities,” they are actually ways, or modes, of experiencing one’s world (Bouchard, 2004).

Using overexcitabilities as a way to identify giftedness allows students to be identified who might otherwise be overlooked. Additionally, when we think of these innate characteristics, we can more easily accept the concept of giftedness as a lifelong situation. Giftedness is a lifetime trait, not merely a young child’s situation or a school-time persona. Perhaps the best way to appreciate the sixteen children in this study is to view them individually through the lens of overexcitabilities. It is important to understand the five overexcitabilities and how they manifest themselves.

Living With Overexcitabilities (OE)

The five overexcitabilities are psychomotor, emotional, intellectual, imaginational, and sensual. The psychomotor overexcitability is characterized by

those students who are highly active and energetic, talk quickly, and have a zealous enthusiasm. Those students with an emotional OE will experience feelings to the extreme, even affecting them physically, developing strong attachments to people, places or things. A need to understand and gain knowledge, to analyze and feed an insatiable curiosity is an indication of the intellectual OE. Individuals who can create their own, detailed fantasy world, and experience vivid, intense dreams are exhibiting an imaginational OE. Finally, people who are highly sensitive to sounds, smells, even tags on the back of a shirt are people with a sensual OE.

It can be argued that most people have these experiences at one time or another. However, a person with these overexcitabilities *must* experience life this way. It is their only mode of filtering their world. Intelligence tests can measure the number of correct answers a student gives, but they cannot measure the strength of that student's need to know something. A creative person may have imaginative thoughts, but a person with an imaginational OE experiences the imagery of the world on a physiological level. Of course, children love to move, but a person with a psychomotor OE *needs* to move, *has* to move, *must* move.

More Challenges of Giftedness

Students identified as gifted are challenged by many of their defining characteristics. In addition to overexcitabilities, students are challenged by perfectionism and multipotentialities (Neihart et al., 2002). The experience of perfectionism may include a constant need for approval and an expectation that one should never fail. Many students struggle to meet the high expectations they put on themselves and those placed on them by parents, peers, and teachers. Because they

experience success quite early and often, it becomes more difficult to cope with adversity or less-than-perfect results later (Delisle & Galbraith, 2002).

Multipotentiality is the ability to do many different things well and with enjoyment. The seemingly limitless potential for students identified as gifted may initially appear to be of great advantage since they can explore so many facets of their personality. However, frustration arises when an individual tries to decide where to let go of some interests in order to develop others. This can lead to uncertainty and sometimes confusion as students reconcile their interests with the expectations of those who influence their lives (Greene, 2006).

Just as the challenges of giftedness abound, so do the identification procedures used by schools across the country. The definition used by a school determines the foundation for developing and funding the program for the students (Delisle & Galbraith, 2002). A working definition of intelligence helps establish the school district criteria.

Theory of Successful Intelligence

Sternberg and Grigorenko (2002) have developed a theory of successful intelligence which is a departure from the psychometric theories. It is based on Sternberg's triarchic theory of intelligence which includes the component subtheory (knowledge acquisition), the experiential subtheory (task performance), and contextual subtheory (adapting to one's environment). Sternberg's theory of successful intelligence states that successful intelligence is:

> The ability to succeed in life according to one's own definition of success, within one's sociocultural context, by capitalizing on one's strengths and

> correcting or compensating for one's weaknesses; in order to adapt to, shape, and select environments; through a combination of analytical, creative, and practical abilities. (Sternberg & Grigorenko, 2002, p. 265)

This theory focuses on both capitalizing on one's strengths and compensating for one's weaknesses. It is one's ability to adapt. Sternberg and Grigorenko (2002) recognize that students identified as gifted include the analytically gifted, creatively gifted, and practically gifted. Others are gifted in a balanced way. Perhaps they are not extremely strong in any of these three areas, but may be well balanced and know when and how to use each ability. Most notably, this theory contends that these areas can be developed over time. "An individual is successfully intelligent by virtue of developing the skills needed to achieve success as she or he defines it" (Sternberg & Grigorenko, p. 266). Further, although solutions that are considered successful may vary from culture to culture, the need to recognize the problem and come up with strategies for solving problems is cross-cultural.

Sternberg does not discount IQ tests as a standard for gifted identification. Such tests provide useful information about students' analytical abilities. However, IQ tests provide little information about practical and creative abilities. In addition to the IQ tests, which are tests of memory and analytical abilities, Sternberg recommends standardized tests of achievement that measure more developed memory and analytical competencies such as the Iowa Test of Basic Skills or the Stanford Achievement Test. Sternberg lists six other possible criteria including teachers' grades and comments, which assess memory and analytical abilities, his own STAT (Sternberg Triarchic Abilities Test) which measures all three aspects of intelligence,

teacher questionnaires, student questionnaires, and evaluations of student products and tasks. Interestingly, many of these standards measure memory capabilities. Several factors influence memory capabilities, including our own brain development.

Brain Development

The human brain is composed of white matter and gray matter. The gray matter contains the neurons and has been called the topsoil of the brain (Fields, 2008). The densely packed neuronal cells are the place where mental computation takes place and memories are stored. For many years the white matter, what Fields (2008) likens to the bedrock of the brain, was thought to be passive tissue. New studies now show that this brain bedrock that makes up nearly half of the brain is important to intelligence. It is composed of millions of communication cables. If the neurons host our thoughts and memories, the white matter cells control their movement throughout the brain. When learning a complex skill, changes occur in white matter. For example, pianists had denser growth of white matter in the area of the brain associated with making music. A higher development of white matter correlates directly with higher IQ. Conversely, students suffering severe neglect have much less white matter (Fields, 2008).

Another important factor is the myelination of the nerves. This is the formation of myelin, a fatty tissue, that surrounds the shaft of the nerve. The myelination of long communication tracts influences the speed and efficiency with which impulses will travel (Fields, 2008). Myelination occurs at various times during our ongoing development. A great deal occurs in the first two years of life, but many pathways are not fully myelinated until adulthood. Experiences can influence such

myelination (Johnson, 2001). Animals inhabiting a more stimulating environment demonstrated greater growth in myelinated fibers in the corpus callosum, the part of the brain where the two hemispheres connect and communicate (Greenough, Black & Wallace, 1987).

White matter activity and myelination are not the only changes happening in our brains throughout our lifetimes. The gap between neurons that neurotransmitters bridge is known as the synapse. The hippocampus of the adult brain can generate new synapses rapidly in response to neural activity. Synapses form in response to experience, so the more complex the environment, the better for synaptogenesis to take place (Greenough, et al 1987). Not only are new connections formed, but the strength of those connections, the Long Term Potentiation known as LTP, can be influenced. The hippocampus is thought to be the site of memory formation (McEwen, 2007). Forming strong connections in the hippocampus may, therefore, increase memory and learning.

Greenough et al (1987) demonstrated the creation of new synapses following physical activity. Other studies have focused on brain plasticity. This refers to the brain's ability to structurally change at the cellular, molecular, or system levels. In simple terms, learning is a high-order of brain plasticity. Cotman and Berchtold (2002) studied the hippocampus. They demonstrated activities that would be predicted to benefit brain plasticity processes. They found ways to increase the brain's uptake of insulin-like growth factor-1 (IGF-1), which probably increases BDNF, which can promote brain plasticity. Van Praage, Kempermann and Gage (1999) studied the dentate gyrus (a part of the hippocampus) as well. They were able

to increase cell proliferation and cell survival in adult mice. Therefore, we know the brain can grow and change. How can we foster such a process positively?

Increased cognitive functions during infancy and childhood are the result of patterns of interaction between different regions of the brain. This appears to be an activity-dependent process similar to that seen as adults are acquiring new skills (Johnson, 2001). Neurogenesis and synaptogenesis can both increase and decrease during a lifetime (Kramer, Colcombe, McAuley, Scalf, & Erickson, 2005). The action that may promote and prolong positive changes in the brain is exercise.

Exercise's Influence on the Brain

The benefits of exercise promote heart health, reduce cholesterol, strengthen muscles, and improve breathing to name just a few benefits. This information has been available for decades, but what is new is that research over the last twenty years has begun to show that exercise has a significant effect within the brain. Regular aerobic exercise can actually cause new neurons to form and increase the connections between neurons (Kramer, Erickson, & Colcombe, 2006).

Exercise is hypothesized to benefit brain plasticity processes. Brain-derived neurotrophic factor (BDNF) is a growth factor that can stimulate synaptic efficacy, neuronal connectivity, and use-dependent plasticity (Cotman & Berchtold, 2002). A mechanism that increases levels of BDNF can enhance learning. Exercise increases levels of BDNF.

Rats and mice which had running wheels placed in their cages had higher levels of BDNF protein that were increased as the running distance was increased (Cotman & Berchtold, 2002). In another study, rats injected with BDNF were found

to have a long-term increase in synaptic strength, the long-term potentiation (LTP) (Messaoudi, Ying, Kanhema, Croll, & Bramham, 2002). Exercise results in increased cell proliferation, survival, and neuronal differentiation in the hippocampus of adult mice (Van Praage, et al, 1999). It is important to learn if such results are found when studying adult humans.

Researchers found a clear and significant effect of aerobic fitness training on cognitive function in older adults, specifically in the area of executive control (planning, scheduling, working memory, interference control and task coordination) (McAuley, Kramer & Colcombe, 2004). Older adults with greater levels of aerobic fitness demonstrated significantly less grey matter loss in the frontal, temporal, and parietal lobes, and significantly less tissue loss in the anterior and posterior white matter tracts.

Aerobic fitness increases both the gray matter (the neurons) and the white matter (the connecting units) even after a relatively short training regimen (Weuve, Kang, Manson, Breteler, Ware, & Grodstein, 2004). In fact, if there is a fountain of youth for older adults it may very well be in aerobic exercise. The incidence rate for Alzheimer's disease was significantly higher for individuals who exercised fewer than three times per week compared with those who exercised more than three times per week (Kramer, et al, 2006).

Similar results can be seen in students who exercise. Students in Napierville, Illinois, improved reading achievement scores when fitness classes were scheduled immediately before reading instruction (Ratey, 2008). In another study, students in school-based intervention programs were deemed more fit based on an increase in

physical activity measured by accelerometers, an increase in aerobic fitness, a reduction of body fat and an increased quality of life measured by a child health questionnaire (Zahner, Pruder, Roth, Schmid, Guldimann, Puhse, Knopfli, Braun-Fahrlander, Marti, & Kriemler, 2006). This finding is important since highly fit students have higher attention levels and quicker response times than their counterparts who are not as fit (Hillman, Castelli & Buck, 2005). This indicates a greater number of neurons being recruited for the task. Physical activity has a positive association with cognition. Participation in physical activity correlates with improvements in cognitive performance (Sibley & Etnier, 2003).

Certainly, physical activity of some kind is beneficial to people of any age. Brains are more pliable and alert in those who are physically involved. Which activities most benefit students in the classroom as they learn? Physical activity in schools takes many forms including Physical Education classes for a specified length of time for a certain number of days per week. Students also have opportunities for activities in the classroom, at recess, before school and after school. Physiological mechanisms such as increased blood flow and alterations in neurotransmitters are stimulated by exercise.

A variety of activity programs including treadmill activity, strength training, gross motor activities, daily running, or physical games that lasted for four weeks up to two years, all showed similar results. All groups had increases in their post-exercise cognition results (Sibley and Etnier, 2003). Participation in physical activity correlates with improvements in cognitive performance. Movement of any kind can be beneficial to students. Can exercise in a social setting be a beneficial mix?

Stress Effects on the Gifted Brain

Another factor that can influence learning, especially memory, is stress. Although stress is a part of everyone's life in some way, it can be more intense for students identified as gifted because they are "usually more sensitive, introspective, and emotional" (Bradley, 2006, p. 9). Students identified as gifted score at least two standard deviations above the norm on a standard IQ test. And the profoundly gifted child, scoring more than three standard deviations above the norm, has few intellectual peers at school (Peterson, 2009). Standard instructional methods are not used to educate students scoring two standard deviations below the norm; nor should they be used to teach the students identified as gifted.

Several characteristics are associated with giftedness. These include sensitivity, intensity, overexcitabilities, and perfectionism. Students tend to be over involved in many activities and have very high standards; often they place these standards on themselves. They are acutely aware of world events and very sensitive to slight disruptions in the home. Because of their abilities, they sometimes are given developmentally inappropriate family responsibilities. (Peterson, 2009). Yet, as they experience asynchronous development, their cognitive abilities often far outpace their social/emotional levels, thrusting them into difficult states.

Too often these students, who can achieve so highly, will allow this recognition to form their identity. They may, indeed, excel outwardly but on the inside may be extremely anxious (Patel, 2009). If high achievement defines them, what becomes of them when they don't succeed at something? Once students reach

proficiency, is a teacher's job completed? These students may not be left behind, but are often lost and ignored. Certainly, this is a contributor to their stress.

Stress may not always be a negative, however. Stressful situations can inspire us physically and emotionally to perform at our highest level. The athlete making the final surge for the finish line, the manager completing a task as the deadline looms, or the student studying for the final exam are all situations in which stress can be helpful (Bradley, 2006). It is the prolonged stress with no time to recover that makes stress a negative factor. The point at which stress becomes overwhelming will differ for individuals (Patel, 2009). McEwen (2004) refers to the condition of chronic stress as allostatic load. When a person is continually striving to remedy imbalance, the altered state can finally "produce wear and tear on the regulatory systems in the brain and body" (McEwen, p. 3).

Informed educators should be aware of both the sources and indicators of stress in students. The general areas of stress for students identified as gifted can include academic, social, family and self (Patel, 2009). Academically, students feel great pressure to succeed. Socially, they don't always have intellectual peers or classmates who see the world as they do. In family life, students are hypersensitive to any underlying discord and often are given greater responsibilities than their age may warrant. Finally, students identified as gifted may strive for perfectionism and may even exacerbate the problem by procrastinating rather than turning in an imperfect assignment (Patel, 2009).

Some indicators of a child who is stressed may include headaches, stomachaches, excessive crying, hostility, withdrawal, panic, and apathy. One reason

for this may be that students identified as gifted have tremendous coping skills in the face of difficult situations. The irony is that because of their unique problem-solving abilities, students are able to cope in difficult situations better than many of their peers (Peterson, 2009). They can pick up on nuances in situations and very quickly process possible solutions. This does not negate their stress. It is not the situation or its outcome that causes the stress, but rather the interpretation of those events (Bradley, 2006). Successfully navigating through a difficult situation does not remove any stress that the situation may have caused. This scenario can make some of the students' concerns "invisible, certainly not easily demonstrated when arguing for services" (Peterson, 2006, p. 43). School counselors may not be trained to understand or to respond appropriately to the concerns of students with high ability (Peterson, 2009).

Actual differences have been noted in the brains of those students identified as gifted (Sousa, 2003; Geake, 2008). Variances have been observed in the EEGs of students especially when performing tasks involving visuo-spatial memory (Jin, Kim, Park & Lee, 2007).

Students identified as gifted tend to rely heavily on their working memory and have not developed as many alternative coping mechanisms. Beilock (2007) theorizes that one factor that contributes to the stress of gifted students is that stress consumes their working memory, therefore, they have more difficulty than most. Could exercise be a positive factor in alleviating this stress? As Dr. Uner Tan, a Turkish neuroscientist and evolutionary biologist, wrote in an email:

> Activating the extensor motor system would increase the well being, acting as an anti-depressive therapy without drugs. On the other hand, such a training would increase the reticular activating system, attention, learning etc... Therefore, you can study the effects of increasing the extensor motor system during your aerobic activities...I am sure your gifted children will be more creative and stress-free if you activate their extensor motor system. (Personal communication, 3/10/10)

Stress and Allostatic Load

Ursin and Eriksen (2004) proposed a cognitive activation theory of stress. They refer to the stress response as an alarm system, which usually occurs when there is a discrepancy between what is and what one perceives should be. Stress can be helpful when it leads to higher alertness. It can actually be constructive when it gives the adrenaline boost or the extra motivation needed to complete a project (Patel, 2009). However, too much stress can impede learning. The amount of stress will vary with each individual. Damage can occur to the immune system causing illness (Ebrecht et al., 2004), impairing memory (Oei et al., 2006), causing sleeplessness, cardiovascular disease or even changes to the structure of the brain (McEwen, 2004).

Cortisol is released during stress (Hanrahan, McCarthy, Kleiber, Lautgendorf, & Tsalikian, 2006; Blair, Granger, & Razza, 2005). In fact, salivary cortisol has been used as a biomarker in detecting stress. A unique mechanism exists in the brain known as the hypothalamus-pituitary-adrenal (HPA) axis. In response to stress, physical or emotional, the autonomic nervous system stimulates the hypothalamus to release corticotropin-releasing hormone (CRH) causing the pituitary to release

Adrenocoritotropic hormone (ACTH) which causes the adrenal gland to release gluco-corticoid which can be measured in the saliva as cortisol (Chrousos & Gold, 1992). High levels of cortisol affect working memory (Oei, 2006). Ursin and Eriksen (2004) contend that once a person learns appropriate coping mechanisms, stress is much less threatening to overall well-being.

McEwen (2004) argues for a more precise definition of stress using the terms *allostasis* and *allostatic overload*. The body mediates to restore balance when necessary, such as raising blood pressure upon awakening in the morning, increased appetite in response to increased activity, or elevated alertness in a potentially dangerous situation. The body generally distinguishes between the normal levels essential for life and those necessary to restore the balance. However, when the systems involved in allostasis are elevated in a sustained manner (i.e. during recurring or chronic stress), then the body is in an allostatic state. If this state persists to the point that the mechanisms are no longer simply responding to an event, the body is in allostatic overload. Every system of the body responds to changes and challenges, but when the changes are overused or inefficiently managed, damage to body systems can occur.

Johnston-Brooks, Lewis, Evans and Whalen (1998) studied the affect of stressful life circumstances on fifth and sixth grade boys. Noting that organisms under chronic stress may experience physiological depletions due to allostatic load and have an over reaction to a stressor, Johnston-Brooks et al. (1998) measured the cardiovascular reactivity in subjects following a mental stressor. Baseline heart rates and blood pressure were measured and then subjects were asked to play a computer

game or count backwards by threes from a given number. Again blood pressure and heart rates were measured during the mental stress activity. Average baseline readings were subtracted from stress level measurements to yield the cardiovascular reactivity. Subjects in chronic stress situations had a higher cardiovascular reactivity indicating an over reaction to stress. This also correlated with increased absence days from school in the past year.

Steptoe, Feldman, Kunz, Owen, Willemsen and Marmot (2002) studied the cardiovascular stress response in adults. In addition to measuring baseline levels and heart rate/blood pressure levels during the mental stress activity, the scientists also measured the levels 15-20 minutes and 40-45 minutes following the activity. The investigators theorized that individuals under chronic stress would have more difficulty reaching homeostasis (baseline readings) after a stressful situation even after 45 minutes. Their research indicated a relationship between cardiovascular stress response levels and chronic stress.

As the human body responds to life situations, mediators must be turned on at the proper level and turned off when the stress is over, “The dentate gyrus region of the hippocampal formation continues to produce new neurons in adult life, and this neurogenesis is suppressed by acute and chronic stress and elevated by antidepressant treatments” (McEwen, 2004, p. 5). Could exercise be a component of an antidepressant treatment?

Exercise

“Of all the fitness components, cardiorespiratory endurance has the greatest implications for lifelong health” (Haywood & Getchell, 2001, p. 200). Educators need

to understand the potential of physical activities so that students can be challenged to find their appropriate level of fitness (Haywood & Getchell, 2001). It is essential to distinguish among the terms physical activity, exercise, and physical fitness. Physical activity can include any bodily movement that requires energy. Exercise, on the other hand, is one type of physical activity, differentiated in that it is used with a goal toward greater physical fitness. Finally, physical fitness is a set of health- or skill-related attributes (Caspersen, Powell & Christenson, 1985).

Within the realm of physical activity, there are several ways to categorize the various activities in which students engage in the course of a school day. One such differentiation system is that of Summerford (2009). She draws a distinction among movement, physical activity, and exercise. She refers to movement as simply not being stationary. Physical activity is described as voluntary movement that is more involved than basic movement. Finally, the term exercise refers to physical activities which raise the heart rate into a target zone for a minimum of 20 minutes. All types of movement are necessary and helpful. For this study, our focus was on Summerford's third type of activity, known as exercise, since we engaged in activities that raised the heart rate for a minimum of 20 minutes.

Regular aerobic exercise can actually cause new neurons to form and increase the connections between neurons. Exercise increases cell proliferation and survival of those cells in the brain (Van Praage, et al, 1999). Physical exercise has been correlated with academic achievement in many areas including mathematics and reading (Castelli, Hillman, Buck, & Erwin, 2007). Even in studies in which researchers found no significant difference in academic grades between students who

were enrolled in a school physical education program and those students not enrolled, the students who reported involvement in vigorous activity outside of school performed better academically than their counterparts who were not involved in similar extra-curricular physical activities (Coe, Pivarnik, Wopmack, Reeves, & Malina, 2006). The students enrolled in physical education classes showed no *decrease* in academic achievement in comparison to their counterparts who had an additional hour of academic instruction.

Unfortunately, over the decades, students are following the sedentary lifestyle trend of adults. Students get less and less active with each year of age (Rivkin, 2007). Activity not only builds motor skills and confidence, but supports the brain through stressful situations.

Physical education has been a part of schooling in America since the 1800s (Pate, Davis, Robinson, Stone, McKenzie, & Young, 2006). Students customarily engaged in recess as well as biking or walking to school. With the increasing rates of childhood obesity and the decline in overall activity, there is a renewed call for schools to incorporate movement in the day. Although physical education is mandated in schools and daily physical education classes are recommended, the School Health Policies and Programs Study (SHPPS) of 2000 reported that only 6.4 percent of middle schools provided daily Physical Education classes (Pate, et al, 2006). Even as students participated in their Physical Education classes, the study went on to find that students participated in moderate to rigorous physical activity in these classes less than 40 percent of the time.

Students who are active tend to mature into adults who are active and healthier. In one study women who had engaged in one hour of Physical Education class five days per week as children continued to exercise as adults three or more times per week (Haywood & Getchell, 2001). Men who reported being athletic as children had higher oxygen uptake levels (a sign of physical fitness) than their non-athletic counterparts (Haywood & Getchell, 2001). The correlations between youth and adult activity were low but significant.

Psychomotor Theory of Human Mind

Tan supports a strong relationship between cognition and exercise. In his "Psychomotor Theory of Human Mind," Tan (2007) contends that it is not the duality of mind and brain that we need to be concerned with; but, rather, the "mind-brain-body triad as a functional unit…essential in health and disease" (p. 1109). The motor system, language system and mind co-evolved in history and are closely tied together. According to Tan's theory, movement occupies a central position in cognitive function. The cerebellum is not just involved in voluntary and involuntary movements, but plays a role in thought. It plays a role in planning, regulation, and attention.

Therefore, it is not the dualism of the mind and brain that must be considered, but the triarchy of mind, brain and body. The connection between mind and body is evident as we study how students learn. For example, across cultures, students transition in their mathematic skills as they learn their numbers by physically counting on their fingers in the initial stages of learning the counting skill. Young children learn songs with accompanying motions as they incorporate the meaning of

the song with the lyrics. Children display a natural affinity for the triarchical connection.

This study will attempt to advance the understanding of this mind/brain/body connection as the fourth and fifth grade students in a Midwestern classroom study themselves, their memory abilities, and their stress levels while engaging in physical activities in this action research project.

Action Research

This was a qualitative, or naturalistic, study. In a qualitative study, researchers can state the problem but must modify the study throughout. The children in this study were able to take ownership and responsibility for their own learning. Bransford, Brown, and Cocking (2000) say that one of the challenges of school "is to build on children's motivation to explore, succeed, understand, and harness it in the service of learning" (p. 102).

Heron and Reason (2006) advocate for research to be conducted *with* people rather than *on* people. They refer to this method as cooperative inquiry. A positive effect of this kind of work is that it guards against the research being too theoretical. When the people being studied are acting as co-researchers, practical issues must necessarily be considered in the research. People can actually advocate for their own change making it more real and, perhaps, more lasting. As the group finds basis for similarities, they can use these as their foundation for action. As they find differences, they see a need to negotiate actions (Stringer, 2008).

Action research empowers people to "act in ways they never thought possible" (Stringer, 2008, p. 27). This research study, by including parents and

students, was able to draw from their collective wisdom. Additionally, the participants were able to learn more about scientific studies as they conducted their own research.

Students should have a stronger voice in their schooling (Mitra, 2006). As displayed in Mitra's (2006) Pyramid of Student Voice, the student's role develops from that of simply being heard by administration to actually being a part of the change process in schools. Action research is a venue for addressing a particular problem in a particular setting (Merriam, 2009). For these reasons, this research study involved the students as co-researchers to explore avenues for the use of aerobic activities to promote positive effects at school.

In the following chapter, the methods used in this action research project are outlined. The exploration of the unique blend of exercise, stress, memory and giftedness in the fourth and fifth grade gifted classroom are detailed.

CHAPTER 3

METHODS

Introduction

The purpose of this mixed method study was to describe the relationship among aerobic activity, stress and memory ability in students in an elementary school gifted program.

Several questions guided this study. These included:

1. What regular physical movement activities would maintain the interest of fourth and fifth grade students identified as gifted in a suburban school setting?
2. What, if any, changes would occur in perceived stress feelings reported by the students and their parents after increases in school aerobic activities?
3. How would performance on measures of declarative memory capabilities be affected by aerobic exercise?
4. What would the students identify as their preferred coping strategies both at the beginning of the study and at the conclusion?
5. What changes would occur in students' physical indicators of stress taken before, during and after aerobic activities?
6. What, if any, attitude changes toward physical exercise would be noted in fourth and fifth grade students acting as co-researchers after three months of interventions?

Research Design

This study focused on student experiences in a bounded system, namely fourth and fifth grade gifted classrooms with a total of sixteen students (eleven fourth-grade students and five fifth-grade students). This mixed method action research study focused on outcomes from a particular program of physical movement and measures of aerobic activity on memory, perceived levels of stress, coping tools, and cardiovascular measurements. Students documented their own growing awareness of the physiological effects of exercise and reflected on the effect of aerobic activity on their stress levels and declarative memory. They were co-researchers in an action research project and presented their findings at a regional qualitative research conference.

Setting

This study was conducted during the first semester of the 2010 – 2011 school year in an elementary school in a suburban school district in the Midwestern United States. I chose this setting because I am the gifted specialist in this school and have the opportunity to work closely with students on a weekly basis throughout the school year. I have a trusting relationship with their parents since I have worked with their children for one to four years.

Although the study took place from October until mid-December, the following March, the fifth graders were co-presenters at the Midwest Qualitative Research Conference. In addition to summarizing their research, they fielded questions from conference participants.

Participants

The students (twelve girls and four boys) in my gifted classroom were invited to participate in this study as co-researchers. The students are from families of middle to upper-middle socio-economic status. At the time of the study they were nine, ten or eleven years of age. Each child chose his or her own “research name” to protect confidentiality in this study. Only data from students whose parents had signed informed consent forms and students who had signed assent forms were included in the research results. All students participated in the research activities as part of the classroom curriculum. The activities included a study of the anatomy and physiology of the brain, the effects of movement on brain plasticity, how to construct a research design, and participation in the experiments.

As the gifted specialist at this school. I have a Bachelors Degree in Elementary Education, a Masters in Education, and a K – 12 Gifted Certification from the state in which I teach. I have been teaching for over twenty years and have been working with students identified as gifted for four years.

An Institutional Review Board approval (see Appendix B) was attained before any research data was collected.

Students as Researchers

The fourth- and fifth-grade curriculum unit was a study of the brain, the ways movement affects the brain, and how to plan and implement a research design. As a part of this unit, students:

- Completed a study of the physiology and anatomy of the brain

- Constructed and completed individual High/Medium/Low Activity assessments to assess classmates and family
- Completed a State/Trait Anxiety Instrument (See Appendix C)
- Participated in regular aerobic activities, including twenty minutes per week of purposeful, aerobic movement combining various combinations of jumping jacks, jogging, , skipping, dancing, and jumping rope at least once a week (see Appendix A for schedule).
- Participated in an open-ended interview with the teacher/researcher (Appendix D)
- Conducted and participated in experiments testing memory both with and without engaging in exercise
- Participated in experiments measuring physical indicators of stress including blood pressure and heart rate during the semester both with and without engaging in exercise
- Presented findings to the school community at the conclusion of the study
- Presented findings at the Qualitative Research Conference at the University of Missouri – St. Louis in March, 2011.

The Data Time Line in Table 1 delineates each activity in relation to when it occurred during the study.

Table 1
Data Time Line, 2010 – 2011

Ford - Data Collection							
TIMELINE	Aug	Sep	Oct	Nov	Dec	Mar	May
Introductory Meeting							
Brain Unit							
Cardiovascular Testing							
Researcher Guest Speakers							
Parent Focus Group							
Memory Tasks/Movement							
Student Questionnaires							
Parent Responses			once	each	month		
Student Journals			through	out	study		
Parent Questionnaires							
Teacher Journaling		often	through	the	study		
Movement Activities			every	other	week		
Observations			through	out	study		
Open-ended student interviews							
Students Present Findings							
Present at QualCon							

In this district the gifted program is known by an acronym. In the interest of preserving the anonymity of the young co-researchers, we refer to the district gifted program using a fictitious title. It will be known as “TRITONS.” Likewise, to ensure their confidentiality, the students selected fictitious research names. The chosen names were: Fifth graders: Rambo, Dr. Rocky, Dr. Dawnstar, Sir Issac Drewly, and Isabella; Fourth graders: Cocoa Turtle, Maria, Claireadell, Peace Out, Green Guy,

Shmoo, Sushi Monkey, Grease Monkey, Waterice, Awesome Awesome, and Annie. The students used these names to set up individual journals on Google Docs.

Physiology of the Brain

As students engaged in the research activities, they concurrently learned about the physiology of the brain through an academic unit including topics such as the nervous system, anatomy of the brain, the stress response, memory, plasticity, mental disorders, neuroscientists, and exercise. The fifth graders enjoyed a read-aloud book entitled, *Phineas Gage: A Gruesome But True Story About Brain Science* (Fleischman, 2004).

Activity Assessment

As an introduction to the concept of assessment, each student developed an activity assessment, administered it to the rest of the class and to immediate family members. Students collected the results and shared them with the class.

Neuroscientists Visit

During the third week of our research study, we were visited by three graduate students in the department of Neuroscience at a local university. They engaged the children in an experiment on the brain's ability to compensate when vision is altered and in another experiment displaying the way messages are sent from neuron to neuron in the brain. The highlight of the visit was the chance for the students to study and handle a sheep brain, a mouse brain, a human brain, and a human spinal cord.

Data Collection

Data were collected from ten sources, each of which will be separately described.

- Student questionnaire using the State-Trait Anxiety Inventory for Students (STAIC) based on the research of Charles D. Spielberger, (1973)
- Parent questionnaire using the same instrument (STAIC), asking parents to answer on behalf of, but not in consultation with, their children
- Anecdotal observations in the classroom conducted periodically
- Focus group with parents of the students in this gifted classroom
- Open-ended interviews conducted periodically with the students individually during the research experience
- Measurements of cardiovascular stress responsivity/reactivity taken during each week's memory activity using a blood pressure monitoring cuff
- Declarative memory tasks conducted both after an aerobic exercise experience as well as on specified days with no aerobic activity
- Journal notations from the teacher/researcher's journal and student/researcher's journals
- Collected responses from parents to questions posed via email at three times during study
- Student research presentations with accompanying self-assessment.

Triangulation was obtained using the multiple sources of data listed above. Although the number of students was limited (N = 16), the multiple sources of data collected ensured a more valid study since this yielded a richer, more complex picture.

Student Questionnaire. The State-Trait Anxiety Inventory of Students (STAIC) was developed in 1973, and is considered a valid instrument for assessing

anxiety levels for students of this age group (Seligman, Ollendick, Langley, & Baldacci, 2004). Initially, students were introduced to the concept of "an assessment" and how these instruments are used in different aspects of life. Each student had the opportunity to produce an assessment of his/her own about activity levels of peers and family. Students offered these assessments to peers and collected results, as an introduction to the concept.

To begin the research study, we introduced the STAIC and reviewed each statement to ensure student understanding. Students completed the 20-question STAIC Form C-2, T-Anxiety scale, as a pre-test. Students were asked to answer "hardly ever," "sometimes," or "often" to 20 statements such as "I worry about making mistakes," "I get upset at home," and "I have trouble deciding what to do." This is a normed instrument which yields a percentile indicating a child's overall perception of his or her stress trait or state.

The T-Anxiety scale assesses the overall anxiety level of a student (trait). The second portion of the STAIC, the S-Anxiety scale, Form C-1, assesses how a student feels "right now," the state of the child at that moment (state). Students completed the T-Anxiety scale two times, once at the beginning of the study and once at the conclusion of the study. The S-Anxiety scale was completed at the time of the third memory/exercise activity.

The STAIC was especially constructed to measure anxiety in nine- to twelve-year-old students. According to the testing materials, the alpha reliability of the STAIC S-Anxiety Scale is .82 for males and .87 for females. For the T-Anxiety scale, the alpha coefficients were .78 for males and .81 for females (Spielberger, 1973).

Parent questionnaire. Parents were given the same 20-question STAIC T-Anxiety Scale inventory at the midpoint of the study. Questionnaires were returned from fourteen of the sixteen children's parents. As per an e-mail received from Mind Garden, Inc. (personal communication, 10/5/09), it is recommended that this instrument be given to parents to complete on behalf of, but not in consultation with, their children. The communication stated, "You might wish to consider asking parents to take the STAIC from their perspective, about their child" (personal communication, 10/5/09). For purposes of confidentiality, parents used the same research name that their children originally created.

Observations. It is advantageous that I was with these students regularly throughout the study as their teacher. Observations could be conducted at any time during the study. Field notes were taken giving accounts of the exercise activities, the physical indicators of stress measurement sessions, the memory activities, students' comments, and unexpected happenings throughout the experience. My role in this study was as "collaborative partner" in that "the investigator and the participants are equal partners in the research process" (Merriam, 2009, p. 125).

I used an observational protocol with descriptive notes recorded in a Google Doc. Creswell (1998) recommends identifying who and what to observe and for how long. I took advantage of my constant participation in this study to capture unexpected moments that described unique occurrences. It was also beneficial to have regular times set aside to ensure that observations took place. Observations were conducted throughout the study.

Parent focus groups. The parent focus group session was a 60-minute open-ended session conducted by me as the teacher/researcher and held at the participating school one morning in the midst of the study. The parents in this group interacted with each other and explored the topics with sincerity. Question prompts (Appendix D) were used to elicit parents' attitudes toward their own stress and their child's stress. Other questions were used to note any similarities between the children and the parents as children themselves.

After completing the STAIC questionnaire, parents were encouraged to share their thoughts regarding their children's general activity levels, visible displays of stress, various coping strategies in stressful situations, parental experience with their own stress, general attitudes about giftedness and any topics that seemed of particular importance to the group. It was important to maintain flexibility with the topics covered. Kitzinger (1995) states that when "group dynamics work well the participants work alongside the researcher, taking the research in new and often unexpected directions" (p. 299). Since we had obtained permission, the session was audio recorded.

Open-ended student interviews. Interviews were conducted with the sixteen students one month into the study and once again nearing the completion of the study. Each student was interviewed for approximately ten minutes each time. (See Appendix B for questions.)

Merriam (2009) refers to this style of interview as a *semi-structured* interview since the questions served as a guide, but flexibility was a key component. It is more helpful to listen than talk during an interview. Students adapted to their role as co-

researchers and shared freely during the interview process. This sharing was critical even though they are more accustomed to someone in my role behaving as their teacher and taking more of a leadership role in conversations.

The initial interview questions were aimed at discovering the students' methods of coping, awareness of their own anxiety, and attitudes regarding giftedness as it relates to stress. (Appendix D) The closing interview questions were intended to gather summary data regarding the study and student attitudes toward the research process.

Cardiovascular stress responsivity/reactivitytests. Students took blood pressure readings (systolic and diastolic) and heart rate readings each week to establish routine and continuity. During the six memory trials, students attempted to follow a procedure in which blood pressure readings and heart rates were taken every three minutes for nine minutes to establish a baseline (BA). The students attempted to take the same readings at four other times: during the activity, just after the memory challenge, 20 minutes after the challenge, and 40 minutes after the challenge to indicate Cardiovascular Stress Responsivity.

We began practicing taking blood pressure and heart rate readings early in the semester using child-sized blood pressure cuffs and stethoscopes. Noticing the frustration of the students in taking blood pressure with the stethoscope and blood pressure cuff, I ordered "WrisTech Blood Pressure Monitors" from North American Healthcare. These monitors attach at the wrist and give blood pressure/heart rate readings in less than a minute. With these new devices, we were able to put our focus on the actual readings and what they might mean. Unfortunately, students still

experienced some frustration if the cuffs were not properly attached. An “ERR” message would appear requiring a new attempt. The frequency of this occurrence is portrayed in the student descriptions. Cardiovascular data was gathered on the first day only of each two-day memory activity.

Declarative memory tasks. Three different types of memory tasks were conducted, the same type of task was conducted on two subsequent weeks, followed by a different type of memory task for two weeks, and finally a third type of memory task for two weeks. This resulted in a total of six memory experiments. The first task consisted of twenty everyday objects (e.g. paper clip, yarn, marble, toothpick) glued to a 24” X 36” poster board (See Figure 1). Students were shown the objects for five minutes. Then the poster board was covered. Students were asked to list as many items as they remembered on a sheet numbered one through twenty. Twenty-four hours later, students were asked to list the same twenty items again. On the first day of this activity, the memory challenge was conducted after a twenty-minute aerobic activity. The following week a similar collection of items was taped on poster board and students were again challenged after five minutes of study and twenty-four hours later. However, this time there was no aerobic activity preceding the memory challenge.

The next week, another type of memory activity was conducted using the same parameters. This time the students were given a list of 20 four- and five-letter concrete nouns (e.g. house, bird, fan, girl) to study (See Figure 1) after exercise. After five minutes, they attempted to write down as many nouns as they could recall. Again, as before, they were challenged to recall this list 24 hours later. A similar, but

different, list was used on the following week, again this time without the preceding exercise.

Finally, students went to the “Neuroscience for Kids” (Neuroscience for Kids, brain games, paragraph 29) web site where 20 items are pictured on the computer screen for just 30 seconds (shown in Figure 1), then the items are removed from the screen. Students again attempted to recall what they had seen both immediately after exposure and at a 24-hour interval. Once again, this procedure was repeated one week later without the preceding aerobic activity and with a teacher-created computer display of 20 objects. See Figure 1 for sample memory activities from each of the three types. Although it presented difficulties, students tried to take cardiovascular readings before, during and after each activity.

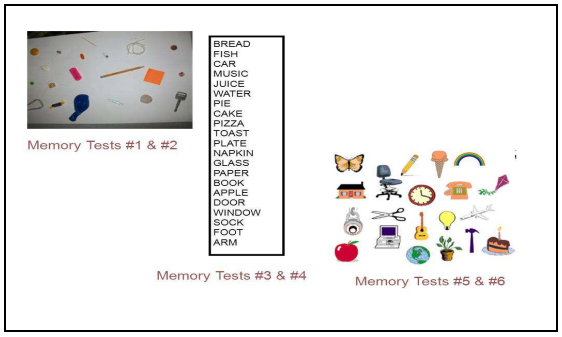

Figure 1. Sample Memory Activities

Stress can deplete dopamine levels. Dopamine has been called the *learning neurotransmitter* because of its link to long term memory (Ratey, 2002). Exercise can increase dopamine levels. This is the reasoning behind testing memory both with and without an exercise activity. The schedule is displayed in Table 2.

Table 2

Declarative Memory Tasks

Time	Memory Task	Two Memory Retrieval Activities	Aerobic Activity? (Conducted on Day 1 only)
1st activity, during Wk.1 of study	20 objects on a board	after 5 min of study 24 hrs. after studying objects	Yes
2nd activity during Wk.2 of study	20 objects on board	after 5 min of study 24 hrs. after studying objects	No
3rd activity during Wk.4 of study	List of 20 nouns	after 5 min of study 24 hrs. after studying nouns	Yes
4th activity during Wk 6 of study	List of 20 nouns	after 5 min of study 24 hrs. after studying nouns	No
5th activity during Wk 7 of study	Computer displayed	after 30 sec of study 24 hrs. after studying images	Yes
6th activity during Wk 8 of study	Computer displayed	after 30 sec of study 24 hrs. after studying images	No

Journal notations. Throughout the study, the students and I kept journals by entering weekly notations via the computer using Google docs. Since the students set security controls that allowed sharing of their documents with me, I was able to access the journals via the Internet and read through them on a weekly basis.

Collected responses. Each month for three months during the study, parents were sent, via email, two short-response questions to answer regarding their student observations during our research study. These questions are listed in Appendix E.

Student self-assessment. Students completed a self-assessment of their four-month study. As part of the course of study, students composed their own self-assessment as they reflected on the work they had done and the learning that had occurred.

Qualitative research conference presentation. During the final weeks of the study, we received notification that we would be presenting our research at the Qualitative Research Conference in March, 2011. The fifth grade student co-researchers attended the conference and presented their research in a roundtable discussion format. Students prepared for the conference during the month of February as they discussed what data they believed to be important to share, how to present their work, which students would speak on various topics, and how to field possible questions that might be posed. Students prepared a Power Point presentation, a pictorial display of their aerobic activities, and graphs of their cardiovascular data.

The research conference presentation was a gratifying end to the study. It was a culmination of all we had experienced as we shared our data. Although the fourth graders were not able to attend the Midwest Research Conference, they prepared their data for a display at a school-wide parent evening in May.

Student research presentation. Students presented their research findings at a springtime school celebration for the student body, staff, and parents.

Data Analysis

Student Questionnaires - were scored using the manual that accompanies the instrument. This instrument has been normed with 4th, 5th, and 6th grade students in the United States. Each response is given a possible score of 1, 2, or 3. Once the scores were totaled, students' scores were recorded and assessed resulting in a percentile score.

The results of the T-scale and S-scale inventories were dated and recorded by the teacher. At the end of the study, the individual changes in students' visible anxiety levels were noted.

Parent Questionnaire – Parental responses to the T-scale inventories were recorded and matched with the child's responses. These answers were tabulated using the formula prescribed in the manual (Spielberger, 1973).

Observations – As the observations were recorded, they were coded for themes using constant a comparative method (Glaser & Strauss, 1967). Open coding identified general ideas and axial coding tracked themes. This process helped the researcher note specific areas that may merit more detailed observations.

Focus Group – The focus group session was recorded and transcribed. I listened to the session four times and reviewed the transcription several times to arrive at the appropriate themes by constant comparative method (Glaser & Strauss, 1967). Initially, the transcripts were assessed using open coding. Eventually axial coding led to a narrower group of themes. These themes were noted in subsequent data collections. See Appendix F for initial coding themes.

Open Ended Interviews – The sixteen interviews, conducted individually with each student, were audio-recorded for reliability and transcribed. Transcriptions were coded. Themes were revisited in reviewing and coding both the naturalistic observations as well as the researcher's journal entries.

Cardiovascular Stress Responsivity/Reactivity Test – Students took weekly blood pressure and heart rate readings to establish continuity, familiarity, and to enhance their skills. Additionally, on the six memory activity days, students noted their results. The Cardiovascular Reactivity (CR) reading was determined by averaging the three baseline readings (BA) in each of the three areas (systolic, diastolic, and heart rate).

The Cardiovascular Stress Responsivity readings were the two readings obtained at the 20 minute post-activity mark (CSR1) and the 40 minute mark (CSR2). The students graphed their CR, CSR1 and CSR2 readings at the conclusion of the study (See Appendix H for student samples).

Declarative Memory Tasks – The results of the six memory tasks were also recorded by each individual student and graphed at the conclusion. Each result was the number correct out of twenty possible. The students compared their memory abilities to both their cardiovascular responsivity test and their activity/no-activity experience.

Journal Notations – All journal entries (teacher and student) were coded as well and reported.

Student Research Presentations and Self-Assessment – Final summaries of student data were an indicator of the learning that has taken place as well as the

attitudes of the students toward the research process, the physical activities, and the effects on memory and stress. Finally, the students shared in their journals their summative thoughts about the study.

Validating the Findings

Several strategies were used to promote validity. The data was triangulated as the research team used multiple data sources, as shown in Table 3, including journals, interviews, observations, questionnaires, and self-assessments.

Table 3

Sources of Collected Data

Student Question-naire	Parent Question-naire	Anecdotal Obs	Focus Group	Open-ended Interviews	Cardio-vascular	Memory Tasks	Journal Notes	Student Research	Parent Responses
Student	Parent	Rsrcher	Parents	Students	Students	Students	Rsrcher Students	Students	Parents

Research Bias

I began this study fully aware of my biases toward gifted students, activities, and stress. Through my work with this unique population of students, I have seen behaviors which I believe are manifestations of frustration, discontent and stress. In my discussions with these students, I have learned that regular physical activity is not a part of all of their lives. My study of current brain research leads me to suspect that one possible outlet for stress relief is exercise. However, I worked to maintain an open mind to data interpretation and meanings even if it contradicted my current beliefs. Through thick descriptions, attention to each student's learning needs, and critical self-reflection in my journaling, I presented a holistic picture of the students, the classroom, and the thinking of students identified as gifted. At the conclusion of

the study, I presented a detailed account of the methods, procedures, and decision points while carrying out this study.

Limitations

One limitation of this study is the relatively small, somewhat homogeneous sample size. The activity was limited to the fourth and fifth grade students in one school composed primarily of students from similar socioeconomic backgrounds.

Another limitation is the bias of the observer. Since the researcher is the teacher of these students and an advocate for gifted students, it is possible that bias played a role in the observations.

Memory is dependent on other factors besides aerobic activity. The emotional state of a 9-, 10-, or 11-year old child is changeable for any number of reasons. It is possible that on any given day, for any number of reasons, a student may not perform at the optimal level.

The effects of aerobic activity can vary based on a child's level of activity at the outset of this study. Students were asked to document activity that occurs outside of class.

Blood pressure and heart rate readings obtained by any person without sufficient medical training have limited accuracy. It is hoped that the experience of obtaining such readings, while learning more about the physiology underlying them, was a benefit.

Chapter Four presents the results and Chapter Five offers discussion, interpretations and implications for future practice, and proposes ideas for continuing inquiry.

CHAPTER 4

RESULTS

Introduction

What physical movement activities would maintain the interest of fourth and fifth grade students identified as gifted in a suburban school setting? Would such activities have an effect on students' perceived stress levels or their memory capabilities? Would engaging in such undertakings change attitudes toward exercise? Would declarative memory capabilities be affected by aerobic exercise? What would the students identify as their preferred coping strategies when dealing with stress? What changes would occur in students' physical indicators of stress taken before and after aerobic activities? Possible answers to these questions were waiting when this study began in the fall of 2010.

In this chapter we will meet the students that acted as co-researchers. We will learn about them through the results of their State Trait Anxiety Inventory for Children (STAIC) assessments, their own writings (Student Journals – SJ), their parents' writings (Parent Collected Responses – PCR), their interviews with me (Student Interviews – SI), the comments of their parents at a focus group session, their declarative memory data for each of the six memory activities conducted on day one and day two of each week, and through my own journaling (Investigator's Journal – J).

Each student's description concludes with a table summarizing the data for that student. The table will include the initial STAIC trait percentile score, six weeks of memory scores from days 1 and 2 (X/X) of each week, a STAIC State percentile

score conducted midway through the study, a parent STAIC trait percentile score, and the final STAIC trait percentile score.

Table 4

Sample Table for Each Student's Data by the Numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile

Table 5 displays a summary of the data collected for all sixteen students. In the pages that follow this collection of numbers will be transformed into sixteen individual stories as each student is introduced.

Table 5

Summary of Data by the Numbers for the Sixteen Co-Researchers

Summary	Initial STAIC Trait Pctl	Memory Act 1 out of 20 (w/ exer) Day ½	Memory Act 2 out of 20 (w/o exer) Day ½	Memory Act 3 out of 20 (w/ exer) Day ½	Memory Act 4 out of 20 (w/o exer) Day ½	Memory Act 5 out of 20 (w/ exer) Day ½	Memory Act 6 out of 20 (w/o exer) Day ½	Final STAIC Trait Pctl
Rambo	50	8/9	10/8	12/7	11/13	9/6	5/A	83
Dr. Rocky	63	12/12	11/6	19/16	15/10	6/2	8/A	30
Dr. Dawnstar	77	16/14	11/10	20/20	20/13	8/4	10/A	57
Sir I.Drewly	99	14/8	9/5	19/13	14/11	9/4	7/A	99
Isabella	39	10/11	16/8	18/14	13/7	5/4	6/A	26
CocoaTurtle	34	14/11	10/4	7/3	7/2	3/1	7/4	30
Maria	48	9/14	12/2	13/11	16/14	9/5	13/0	19
Claireadell	1	14/16	14/8	17/8	20/18	11/7	6/3	<1
PeaceOut	<1	16/16	13/11	A	13/12	4/3	6/3	<1
GreenGuy	96	14/14	14/11	14/10	11/A	A	A	A
Shmoo	78	7/10	7/2	5/8	9/7	6/3	5/4	76
SushiMonkey	83	14/11	11/5	11/8	11/5	A	5/2	12
GreaseMonkey	26	5/8	9/7	6/6	6/5	4/4	5/0	14
Waterice	35	9/10	10/4	6/6	9/6	8/4	10/5	35
AwesomeX2	34	16/14	13/A	17/15	19/12	11/9	A	24
Annie	87	10/11	8/5	10/8	A	5/4	6/3	28

A = Absent

Overexcitabilities were described in Chapter Two. Some students will have strong overexcitabilities in only one or two areas. Some may experience these perceptions to some degree in all areas. The sixteen children acting as co-researchers in this study experience life through more than one overexcitability. From my classroom observations and experience with the children, I have perceived a primary overexcitability that may help understand each child through that lens. In the brief accounts that follow, I will explore each student's research journey through the lens of that child. After meeting each student and viewing the study through his or her perspective, the larger picture of the study will be clearer. Although the use of the students' created research names may be cumbersome for the reader, it indicates the importance of each student's contribution to the study and the child-centered aspect of the research.

Who are the Gifted Children in this Study?

The Fifth Graders: Rambo, Dr. Rocky, Dr. Dawnstar, Sir Isacc Drewly, and Isabella

- **Rambo**

Overexcitability. Rambo is a fifth grade boy. From my observation, his most prominent overexcitability seems to be in the area of psychomotor, and it requires him to move as often as possible. Rarely will he sit in his seat for more than a few minutes before he begins tapping his foot, shaking his fingers, or using the closest item on his table to make some kind of movement with accompanying sound effect.

STAIC. On the initial STAIC "How I Feel" questionnaire, Rambo scored at the 50th percentile indicating that his perceived level of overall stress was average for a child his age. When his mother completed the same questionnaire, she indicated a

score at the 62nd percentile. Only three parents scored their children at a higher stress level than the child, and Rambo's mother was one of those parents. Often Rambo's mother would consult with me expressing her concern over whether her son was doing well and if his teachers were understanding and accepting of his fidgety behavior. Likewise, in response to the parent query regarding a change in the child's activity level as a result of this study, Rambo's mother said "I haven't really noticed a change in (his) activity level either" (PCR 1).

Interview. During our initial interview, Rambo appeared restless in his chair, leaning forward then sitting back, flicking his fingers to make a snapping sound. When asked his favorite way to spend a school day, he replied "You can't be relaxed at school. It's torture. Have recess and PE all day; no tests" (SI 1). I asked him if he thought gifted children experienced more stress than other children. He tapped his foot, considered, paused and finally said, "Can I continue this momentarily? Yes…because…yes…just yes…leave it at that" (SI 2). His fidgeting movements continued as he explained what he does when he is feeling worried or anxious. He demonstrated touching each finger one after the other with the pointer finger. "I don't know why; it's a habit. Sometimes I do this:" and he flicked his cheek with his thumb and forefinger (SI 2). Although he is an avid wrestler and competes often, he shared that his favorite aerobic activity is soccer. This may be because soccer was in season at the time of his interview.

Blood Pressure. Taking blood pressure readings was particularly stressful for Rambo. He wrote in his journal:

> The last two days have been really stressful because of all the blood and heart rate tests. The activities are pretty fun. I think we need a little bit more time on the movement activities. I'm starting to think I'm turning into a zombie because of the blood pressure readings. (SJ 26)

In his conclusion, he added,

> I usually didn't like having to always take my blood pressure every day. I didn't really like having to do that much blood pressure. I think I got really stressed when ever… my blood pressure was high because when my blood pressure was the highest I would always feel really, really stressed out. (SJ 27)

Table 4A

Rambo's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
50	8 / 9 20 20	10 / 8 20 20	12 / 7 20 20	53	11 /13 20 20	9 / 6 20 20	5 / Ab 20	62	83

Student journal. Rambo particularly enjoyed the movement activity that was designed by two fellow students. He wrote in his journal,

> Yesterday was interesting because Dr. Rocky and Isabella did the movement activity. Yesterday I got the highest memory score I ever got. The movement activity was very fun because we actually got to jump rope. (SJ 26)

At the conclusion of the study, when asked how the study had gone, Rambo replied, "sort of boring. It used up too much of our time so we couldn't do other stuff" (SI 8). However, in his final conclusion he shared,

> I want the world to know that if you do experiments it will take a very long time but in the end it will all turn out well for you if you stay focused and you will get (the) job done. (SJ 27)

Rambo was one of only two students in the study whose final STAIC Trait assessment indicated a higher stress level than at the beginning of the study.

- **Dr. Rocky**

Overexcitability. Dr. Rocky is a fifth grade girl. She is a quiet observer and a conscientious student with a need to find the right answer independently. Through my observation, it appears her primary overexcitability is intellectual, and it drives her to find the correct answer at any cost while her awareness of her emotional OE keeps her guarded and causes her to measure her responses to any situation. She has an acute concern for fairness, and her strongest displays of emotion in her normally guarded state will become apparent in the moment she perceives an inequity.

STAIC. On her initial STAIC measuring her overall state of stress, Dr. Rocky scored at the 63rd percentile, indicating a stress level higher than almost two-thirds of her age-level peers. Yet, her mother scored Dr. Rocky's stress level at the fifth percentile. This was the largest disparity between a parent and child score.

Interview. The act of sitting down with me to partake in an interview in this setting was an unusual dynamic and difficult for a student such as Dr. Rocky who typically appears more quiet and reticent. When asked to describe her perfect day, she

said it would be to “do nothing” (SI 1). When queried as to whether gifted children were more stressed than others, Dr. Rocky hesitated before stating, “I don’t know. Probably. I don’t know ‘cause we have more stuff in our minds; double the classes, catch up on work in homeroom” (SI 2). She can be counted on to complete all assignments on time, and it concerns her each week when she is in the gifted classroom missing work that is being assigned in her homeroom. Her favorite aerobic activity is basketball and when asked what she does when feeling worried or anxious, Dr. Rocky said, “Go outside and do something like kick a kickball on the roof” (SI 2).

It was Dr. Rocky and Isabella, another co-researcher, who designed one of the twenty-minute aerobic activities for the group during the fifth week of memory activities. Dr. Rocky completes tasks in a timely manner. All the children were given the challenge to design a twenty-minute exercise routine, but Dr. Rocky, with Isabella’s help, was the only student to actually have a routine prepared on time. She was proud of her activity. “Yesterday me and Isabella made an exercise. I like making an exercise because we are in charge. The exercise we made was hard but awesome” (SJ 19).

Journal. Dr. Rocky saw the relationship early on between her exercise and her memory. The first time she was challenged with the memory activity without prior exercise, she wrote “This week we didn’t do exercise and it’s harder to memorize. But I remembered things from last week” (SJ 19). The next time she was challenged to remember without exercise she wrote: “The memory activity was hard with no 20 minute exercise. So I only remembered 15 out of 20 instead of with exercise I remembered 18 out of 20” (SJ 19). Through the Parent Collected

Responses to email queries, Dr. Rocky's mother said she "had not noticed any changes in her attitude toward exercise" (PCR 4). But Dr. Rocky summed up her research in the following way:

> I realized that with exercise peoples brains work better, or they at least most of the time remember things better than not exercise. Also your heart rate is higher when you exercise, so with your blood flowing you remember things better. My systolic was always higher with exercise. When we did the exercise even though it was good for me, I thought the exercise was hard, but a lot of fun. When you are stressed just go outside and relax and play. In my data it proves that I remember more with a twenty minute exercise, coming from a long morning of school. In most of my data I had higher heart rate, and higher diastolic rate too. When doing a twenty minute fun exercise we did, running, jump ropes, running the bases, mind challenges, and others. My personal data shows that I did better with exercise than without exercise. I think all teachers should let their students have a movement break, so (t)he kids will have a chance to get refocused, and ready to consume more information. With fitness great things happen. For example with exercise kids are more focused and ready. Kids without exercise try to do the least amount of work. (SJ 18 – 19)

Table 4B

Dr. Rocky's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
63	12 /12 20 20	11 / 6 20 20	19 /16 20 20	57	15 /10 20 20	6 / 2 20 20	8 / Ab 20	5	30

Dr. Rocky was the most vocal of all regarding the shortened amount of time for Memory Activities #5 and #6. She complained that she was only given thirty seconds to view the computer screen whereas she had been given five minutes to view the items on a poster board and the lists of words. The moment the computer screen went blank, the normally reticent Dr. Rocky threw down her pencil and shouted that it wasn't fair and complained that the time was too short. The memory score for her Activity #5 was much lower than her previous four activities, and it seemed to bother her. Dr. Rocky is keenly aware of fairness around her, and she viewed this shorter amount of time as extremely unfair. She would not even write about it in her journal that day, and she reminded the class of the disparity on more than one occasion.

During the final interview, she was hesitant to share and gave brief responses. When asked how the research had gone, she said, "I don't know. It's been good" (SI 8). When asked what she found most interesting, she added, "I don't know… like, when you exercise how your heart rate goes up" (SI 8). Finally, I asked her what she had learned about the research process. She summed up the thoughts of many researchers when she stated, "It takes a lot of time to get enough research to come to a conclusion" (SI 8).

- **Dr. Dawnstar**

Overexcitability. Dr. Dawnstar is a fifth grade girl. She is artistic and is proud of her creativity. From my observation, her predominate overexcitability seems to be emotional, and it displays itself often as she demonstrates extremes in emotions.

She is rarely just slightly unhappy or a wee bit glad. Rather, when things do not go according to her plan she is devastated, will cry, stomp her foot, cross her arms and refuse to engage in other activities for a time. When she perceives that all is progressing well, she is ecstatic, laughing, twirling, and even singing her joy. She will immerse herself in worry and allow it to wash over her. When we studied the idea of a stroke, she needed lengthy reassurance that she did not have any of the symptoms at the time for stroke and took note of what to be aware of in the future. She will often ask classmates if they are mad at her for any reason.

When viewing the list of written words, she developed a mnemonic device to remember and happily offered her idea to the class. Immediately, she was concerned that this may have influenced the research but was proud that she came up with such a technique “I made a tuneful story with the memory words” (SJ 21).

Interview. Her sensual overexcitability seems to be another factor for Dr. Dawnstar. Even though she was told it may affect the results, she couldn’t help touching the items on the poster board and then writing about it afterward “We did a memory thing. I think I remembered stuff better when I touched them” (SJ 21). When asked to describe a perfect day, she said “TRITONS (class) because there’s not so much commotion. In (our regular) class there’s more people” (SI 1). In response to the statement that gifted children are more stressed than other children, she stated “True; because I feel more stressed than other people. Little things that are really stressful for me, like, let’s say there’s this little ticking noise; that bugs me” (SI 2). Her favorite aerobic activities are ballet and soccer. When asked what she does when

she is feeling worried or anxious, she said “my stomach gets like,” made a troubled face and added “makes me sick” (SI 2).

Student journal. Dr. Dawnstar has expressed a desire to be an orthopedic surgeon some day. She was fascinated by the visitors from the local university as they taught her interesting facts about the brain.

> There are many, many, many neurons in your brain. There have to be enough connections (at least half) for the neurons to carry on a message. You have to keep brains cold to preserve them. Brains are almost symmetrical on both sides. (SJ 21)

STAIC. On the STAIC assessment, Dr. Dawnstar’s perceived stress level was at the 77th percentile, which is the identical score her mother gave on the same assessment. Dr. Dawnstar’s father also completed the STAIC on his daughter’s behalf and scored her at the 50th percentile. In several personal conversations, Dr. Dawnstar’s mother expressed concern about her daughter’s stress, even fearing that it might skew the overall results of our study.

As the research progressed, Dr. Dawnstar displayed an understanding of a connection between exercise, memory and stress. “The memory words were hard today (second time doing it), probably because we did not exercise” (SJ 21). In her conclusion she wrote:

> On the first 4 weeks my memory went down when we didn’t exercise (however, I did touch the objects on the first time). Then on the last 2 weeks something very peculiar happened. I did better on the memory test when we did not exercise (but during that week we were only tested once, on the first

day, due to a snow day). But, I still believe that exercise helps your memory. (SJ 22)

Phineas Gage. With the fifth grade group, I began reading *Phineas Gage* by John Fleischman (2004). The book is subtitled "a gruesome but true story about brain science." Phineas Gage was a railroad worker and explosives expert from the 19th century who was involved in an accident in which a three and one-half foot tamping iron shot through his skull from below his left cheekbone and out the top of his head. Amazingly, Phineas survived the initial accident and lived another eleven years. What makes his story so important for neuroscientists is that it was the personality change that amazed those who knew him best. This was the first time scientists could see how an injury to the brain had different effects depending on which part of the brain was damaged. When the students were introduced to Phineas, they were troubled by the initial description, yet they were amazed and somewhat comforted when they heard that Phineas was politely and calmly discussing what had happened to him when the doctors were called in to treat him just minutes after the accident.

Upon hearing the first chapter, Dr. Dawnstar and Isabella spontaneously ran to the map of the brain that is hanging in my classroom with the various centers highlighted. They began speculating on which parts of the brain must have been affected if Phineas was still alive. Dr. Dawnstar said, "Well, he's still talking so it can't be his speech area." Isabella said, "maybe the part of his brain that got hurt will hurt his memory." I pointed out that Phineas was able to recall the accident and left it at that.

Table 4C

Dr. Dawnstar's data by the numbers

Initial *STAIC Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
77	16 / 4 20 20	11 /10 20 20	20 /20 20 20	60	20 /13 20 20	8 / 4 20 20	10/Ab 20	77/50	57

In the final interview, when asked what she learned, she stated "that exercise does help your memory" (SI 9) She was surprised to learn "that you can remember things in different ways and some ways work better than others" (SI 9). And, finally, when asked what she learned about the research process, she spoke for many when she stated "That research is hard" (SI 9).

Along with Isabella, Dr. Dawnstar wanted to do some laps on our school track before departing for the Qualitative Research Conference. She thought it would help her focus on the presentation. Her mother accompanied the group to the conference. After hearing the students' presentation, Dr. Dawnstar's mother asked if all teachers at the school could hear what the children had to say.

- **Sir Isacc Drewly**

Overexcitability. Sir Isacc Drewly is a fifth grade boy. Through observation, I determined that his main OE appears to be imaginational. He enjoys figure skating and any activity which allows him to show his imaginational OE. He writes long stories with adult humor and unique perspectives, and creates computer games and movies with great attention to detail and a developed sense of humor. Often he asked me if I were going to use what he wrote in "my book." He insisted that I have a

research name as well, and we decided I would go by “Medico” since that was the Italian term for doctor. Throughout the study, he is the only student who ever used that term for me.

STAIC. He expressed worries about his home life and sometimes shared his concerns with me. When he completed the STAIC, he scored himself at the 99th percentile, the highest score in the class. His mother registered a high score as well; her results put his perceived stress at the 86th percentile. When assessing individual physical fitness levels, he wrote “If I had to pick who was the unhealthiest, it would be me” (SJ 24). Indeed, each time the class engaged in the twenty-minute activity, he was the first to stop. He would walk away, pretending not to be aware of what the next activity was supposed to be while looking at me and grinning, or he would just put his head down and say he was too tired. “I got tired and started to play on the playground, but Medico made me do the activity” (SJ 24). His mother did share that she observed at home he was “more willing to do physical activities with less complaining” (PCR 1). Later she wrote in a follow-up email that “attitudes improved at the beginning, but are decreasing now as the holidays are approaching” (PCR 4).

Interview. In the beginning of the study, when asked to describe a perfect way to spend a school day, he answered “Science and TRITONS (class) all day” (SI 1). In response to the statement that gifted kids are more stressed than others, he replied, “I don’t know if it’s true for all. I get stressed out a lot. I don’t know” (SI 2). He shared that his favorite aerobic activity is ice skating, but when he is feeling anxious he prefers to “play my video games because I like video games” (SI2). This would align with his imaginational OE.

Student journal. Sir Isacc Drewly enjoyed the visit from local scientists and wrote of it extensively:

> On Monday, some neuroscientists from (a local university) came in. The first station we visited was the Visual Motor Lab. We had to do things, and then we had to do them with really weird glasses. It was a real challenge.
>
> The second station was the Brilliant Brain Table. We got to touch a sheep brain and two human brains. Medico took photos, and they were really extreme! I also got to see a mouse brain, but I couldn't touch it.
>
> The third station was the Never-Ending Nerve Slab. We played a game with light bulbs.
>
> It was an experience I will NEVER forget! (SJ 25)

Sir Isacc Drewly displayed his co-researching abilities as he hypothesized an explanation for some surprising results:

> Yesterday, we did Dr. Rocky and Isabella's aerobic activity. I kind of slacked off, but that is weird because I got the highest memory score I ever had. Maybe it was that this week, we had to memorize words, not objects. Maybe because I usually don't know the names of some of the objects. Suspicious.... (SJ 25).

His conclusion summed up his research in this way:

> This unit was exhausting, well the exercise part was. I noticed during activities, my systolic kept going up and my diastolic kept going down. I certainly got a workout!

With exercise I got a better memory! My average memory score with exercise was 11.2! My average memory without exercise was 9.2! Big difference, right?

I want gifted students to know, working out is great! You get exercise and you can improve your memory. Just because you're smart doesn't mean you're perfect and you can always improve yourself and your memory. And you don't have to copy off us. You can find another memory experiment. Do I get a better memory by watching movies or eating popcorn? Can I get a better memory by playing kickball? The choices never end!

I learned many things about myself. I learned that exercise gives me a better memory. (SJ 25)

Table 4D

Sir Isacc Drewly's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
99	14 / 8 20 20	9 / 5 20 20	19 /13 20 20	76	14 /11 20 20	9 / 4 20 20	7/ Ab 20	86	99

In the final interview, Sir Isacc Drewly said that he found it most interesting that he "got more memory stuff right after exercise" and was surprised to see "that exercise could improve your memory score." He said that he would "start exercising more" (SI 8).

Upon arriving at the Qualitative Research Conference, Sir Isacc Drewly spontaneously began doing jumping jacks just prior to the presentation stating he was nervous and thought the exercise would help.

- **Isabella**

Overexcitability. Isabella is a fifth grade girl who is always smiling, drawing, or talking. Sometimes she is able to do all three of those activities at once. This seems to be her psychomotor overexcitability presenting itself. She wrote in her journal that in her class it is "a little hard to sit for a while" (SJ 28).

STAIC. On the STAIC she scored her stress level at the 39th percentile. Her parents did not return their version of the assessment for comparison. When asked to assess her family's fitness, she wrote:

> none of my family is the healthy 10 on my list. We do a lot of exercises and sports besides dad. We aren't fat and grumpy. The kids in my family are saying it is easy and hard to sit still for a while. (SJ 28)

Interview. She conveys the attitude that life is fun. When asked to describe her perfect way to spend a day, Isabella answered "having fun; playing around with friends" (SI 1). In response to the statement that gifted kids are more stressed than others, she smiled and told me "I don't know. I don't pay attention. I don't have a reason. No, because my friends are in TRITONS (class)" (SI 2). Her favorite aerobic activities are running and playing soccer. In response to the statement, "tell me what you do when you are feeling worried or anxious," she replied, "I don't know. I don't remember. Breathe. Like I normally do," and then she giggled (SI 2). Isabella worked with Dr. Rocky on designing the class's twenty-minute activity.

Student journal.

> My favorite part about the research was that I got to go outside and play and exercise with my friends and I even got to make an activity with Dr. Rocky. I thought that it was the most fun activity because it was outside and we got to choose fun things such as mirroring someone and then they would copy (try to) me or the person that is actually doing the thing where they have to make up something and the other person copies them. (SJ 29)

Isabella was particularly frustrated with the blood pressure readings. Although she never gave up or displayed a negative reaction, it was evidenced in her journal where she wrote “My blood pressure keeps getting frustratinger (sic) every time. I never have fun with these new blood pressures, the old ones are fun with a partners” (SJ 29). Another time she wrote:

> The research process was okay, but I didn’t really know why but I didn’t enjoy some of it I think it was taking the blood pressure it always didn’t read until the 5th time! The memory part of it was getting harder each time we did the blood pressure. (SJ 29)

Isabella was observant of her teacher’s stress as well. In early December, she said to me, “I can tell you have been stressed lately.” I was taken aback. I smiled, and asked, “How can you tell?” She said she noticed I was acting “jumpy” (PI 15).

As the study progressed, she began to hypothesize on how her memory could be affected as she recorded “The memory words was hard because I am so tired and

only remembered 7 of them and yesterday I got 13! I can't wait until Christmas" (SJ 29).

In her conclusion, Isabella wrote:

> I got a little less stressed after the activities but, when the memory activity came I got stressed because I always forgot and always got really stressed out. I thought that I would never survive because it was so exhausting, but I did get a really good workout when we went outside. Here is some advice to other gifted students you will really enjoy the workout, especially when you do it with your friends and family. (SJ 29)

Table 4E

Isabella's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile\	Final STAIC *Trait* Percentile
39	10 /11 20 20	16 / 8 20 20	18 /14 20 20	48	13 / 7 20 20	5 / 4 20 20	6/ Ab 20	None	26

Isabella's parents did not return a STAIC questionnaire or respond to email queries, but her mother accompanied the students to the research conference. After the presentation, she told me that all teachers should hear about this research and wondered if there would be a way to convey the information to the middle school teachers as well. Isabella and Dr. Dawnstar were exceptionally nervous about this conference and asked if they could go outside and run around the track a few times before departing for the conference.

When asked to sum up the research process, Isabella replied “don’t cross it out. Brains are important and weak” (SI 9).

The Fourth Graders: Cocoa Turtle, Maria, Claireadell, Peace Out, Green Guy, Shmoo, Sushi Monkey, Grease Monkey, Waterice, Awesome Awesome, and Annie.

- **Cocoa Turtle**

Overexcitability. Cocoa Turtle is a fourth grade girl. She harbors deep feelings and can immerse herself in sadness at will. Her family has been contemplating a move for the past year and each time she mentions the possibility of leaving the school, she cries. This seems to be a manifestation of her emotional overexcitability and is coupled with her great affection. She is prone to hugs and has often stated “I love you” to her teacher accompanied by a squeezing embrace. As she wrote thoughts in her journal, she added colored highlights behind each entry to reflect her mood at the time. She scored at the 63rd percentile in stress with no available comparison with a parent score.

Interview. When asked to describe a perfect way to spend a school day, Cocoa Turtle said “to run around the track and do some Social Studies and Math and play outside and relax.” In fact, she is the only student to complete successfully all of the prescribed aerobic activities without pausing to rest. At one point, she slowed a bit, but she never completely stopped. When asked to react to the statement that gifted children are more stressed than their peers, Cocoa Turtle said, “I think it’s because you do harder stuff. Instead of harder, it’s really, really harder. In the regular classroom we do elementary and fourth grade stuff” (SI 1). I asked her what she does

when she is feeling worried or anxious and she told me "I sweat in my palms and tap my feet a lot. I don't want to think about it, what's bothering me like we're moving to a new house on Wednesday" (SI 2). Her favorite aerobic activities are yoga and soccer.

Student journal. She articulated a difference in performance based on the different types of memory tasks as noted in her entry: "The word memory test is wayyyyy harder than the object test. My totals were 5 and 3. I think other students should try this. In (their regular) class, TRITONS (class), and everywhere!!!" (SJ 7). Later she wrote, "Next time I'm stressed I'm going to do some wood choppers and a back bend" (SJ 8).

In her summary, Cocoa Turtle wrote (with purple highlighting):

> I really liked doing the exercises and neuroscientists that came to our school. I did not like the memory test AT ALL! I would change to doing more exercises then the memory test so we're more fit. I learned that neurons were small enough to fill more than 1 million! I now exercise a lot more to keep me healthy!!! (SJ 8)

Table 4 F

Cocoa Turtle's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile\	Final STAIC *Trait* Percentile
34	14 /11 20 20	10 / 4 20 20	7 / 3 20 20	63	7 / 2 20 20	3 / 1 20 20	7 / 4 20 20	None	30

When asked what was most surprising about the study, Cocoa Turtle commented on the brain anatomy as well as the activity research when she replied,

> I thought the whole brain like through the middle was all attached. But there's only one spot that actually attaches to the brain. . . I learned that doing a back bend kind of wakes you up more and I really like the wood chopper. (SI 4)

- **Maria**

Overexcitability. Maria is a fourth grade girl. She needs constant reassurances that she can be successful and would much rather allow someone else to complete a difficult task for her if possible. She will give up after a short time and declare that a task is too hard. Through my observation, her main overexcitability seems to be emotional, and it manifests itself in her overwhelming sadness when faced with a challenge that she suspects she will not be able to complete successfully. When she is content with her current situation, she will laugh and giggle triumphantly, but is guarded and will quietly watch to see that she is doing as well as her peers.

STAIC. On the STAIC she scored herself with a perceived stress level at the 48th percentile. It is unclear which parent returned which of the two forms, but one parent scored her at the 48th percentile as well and the other parent completed the assessment with a resulting score at the 34th percentile.

Interview. When asked the perfect way to spend a school day, she responded "go to Hawaii" (SI 1). I asked her if she thought gifted students experienced more stress than others, and Maria replied, "I don't get much stress unless it's with my family because my brothers are crazy and stupid. I don't get stressed because I know

what's going on and I stay focused at school" (SI 1). Her favorite aerobic activity is soccer. When she feels worried or anxious, she said "I sweat. My feet start…I tap my feet a lot. My head gets heavy and I don't know what to do. I don't feel good" (SI 2).

Student Journal. Maria had some frustration with the blood pressure readings as expressed in her journal. One entry stated "It's soooo frustrating" (SJ 13). Another entry revealed more emotion when she wrote, "We did too many blood pressure readings. We did seven readings! And on the 5th one it went up to 300 and my hand turned purple!" (SJ 14). Like Dr. Rocky in fifth grade, Maria was the only one of her fourth-grade peers to express frustration with the shorter amount of time allowed for the final round of memory tests using the computer screen and a thirty-second display. In fact, when she was handed the answer sheet to record her memory of the twenty displayed objects on the second day of the non-exercising week, she looked at the paper, looked at me, and just returned the paper. I asked her to just write down what she remembered. She lowered her eyes and told me she could not remember anything. She wrote, "I did not like the memory test on the computer because it only gave you thirty seconds and we usually have 5 minutes," but just after that entry she added, "I think that exercising is good because then you can stay fit and healthy" (SJ 13).

Her mother concurred with this assessment. In a response to an email query, she shared:

> (her) attitude regarding exercise has always been good. We have talked about how exercise is good not only to be strong physically, but also mentally. Also, for heart health! She is very aware of the benefits of keeping active.

(She) likes the study you are doing. She has mentioned how she learnt to take blood pressure readings using an automatic instrument since the manual was too difficult to use.

She doesn't like the pressure she feels on her arm while someone is taking her bp.

She talked about how the kids had to skip so as to increase the heart rate. So she gets the concept of increasing heart rate while exercising. (PCR 4)

Table 4G

Maria's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
48	9 / 14 20 20	12 / 2 20 20	13/ 11 20 20	63	16 /14 20 20	9 / 5 20 20	13 / 0 20 20	48/34	19

When asked to summarize the study, Maria said, "I got kind of tired but I still liked it" (SI 5). I asked what she liked about it, and she replied:

It keeps me healthy and I learned that you can really, um, well we learned about how like when you're older not many adults are that active so if you exercise when you're little you can be really active when you're older. (SI 5)

Finally, I asked her what surprised her about the study. She told me:

I don't have that good of a memory like I sometimes forget what my mom tells me to do and I sometimes forget to do homework, but when I do that (exercise) I remember almost half of it. (SI 5)

- **Claireadell**

Overexcitability. Claireadell is a fourth grade girl. She often brings items to the classroom to share. These are items she has found around her home that interest her because of their unusual color or shape. This is one indication to me of what seems to be her sensual overexcitability. When her mother asked her about the neuroscientist visit, her comment was that "she was surprised about what color (the brain) was" (PCR 3). She enjoys being in the water and is an avid swimmer. When asked her favorite aerobic activity, she told me "Swimming, definitely" (SI 2).

STAIC. Both she and her father scored her stress level at the 1st percentile. By the end of the study, her final STAIC trait score was even lower, scoring at the <1st percentile. One journal entry for Claireadell was a spontaneous entry of "I love me and myself and I LIVE TO LOVE ME" (SJ 5). Although she has told me that she would like to get high grades, she will calmly accept any score earned.

Interview. In the initial interview, Clareadell told me that a perfect way to spend a school day was to do Science. I asked her if she thought gifted students get stressed more than others. She replied, "I don't get stressed very much. I would say (student name) is stressed because sometimes in our class if he gets a question wrong on his morning work, he would start crying" (SI 2). If she is feeling worried or anxious, she said she would "get my mom and dad if they're around. I (would) say 'Can you help me. I don't know what to do'" (SI 2).

Student journal. Claireadell experienced more frustration with the blood pressure readings than perhaps any other student. It may be due to her small wrist size. It may be that her sensual OE made her extra sensitive to the cuff around her

wrist, and she hesitated to put it on too tightly. She wrote in her journal, “I hate blood pressure thingys!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! They squeezed me and at the end they just came up error every time I tried it!” (SJ 5). Often she would look at me with concern as she tried again and again to get a reading that did not report “ERR” (error).

In the final interview, Claireadell reported:

> during our memory tests I found out that on the last one I remembered more than on the other ones. I have a good memory. Well, I think I noticed I have a good memory. Because my mom asks me stuff that she doesn’t remember.

Table 4H

Claireadell’s data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
1	14 /16 20 20	14 / 8 20 20	17/ 8 20 20	26	20 /18 20 20	11 / 7 20 20	6 / 3 20 20	1	<1

Her final statement about the research was regarding her blood pressure. She turned to me and said, “On my blood pressure, it doesn’t work” (SI 5).

- **Peace Out**

Overexcitability. Peace Out is a fourth grade girl. She smiles often, but appears to have difficulty tolerating less than perfection in herself and others. Through my observations, it seems her primary overexcitability is intellectual. This makes challenges intriguing and energizing. She is quick to point out errors in writing or calculations and rarely makes such errors herself. Yet she is humble and quiet regarding her intellectual successes. Her perfect day in school, as she told me in an

interview, is to spend it reading. Her STAIC trait assessment score was less than the 1st percentile. Her mother's score for her was also quite low, placing her at the 12th percentile in relation to her age level peers. This was one of the three cases where a parent scored the child higher than the child scored herself.

Interview. When queried regarding the level of stress gifted children experience compared to their peers, Peace Out said, "I think they all respond to stress the same. It's not like we get stressed more easily just because we're gifted" (SI 1). Her favorite aerobic activity is jumping rope, and when she is feeling anxious or worried, she will "watch TV. It lets you focus on something else" (SI 2).

Student journal. Initially, she did not have as much concern with the blood pressure readings as she wrote in her journal, "I liked all the blood pressure stuff. The only thing I didn't like was doing it over and over again" (SJ 11). She also wrote, "I think other schools should do this because it is fun" (SJ 12).

Parent focus group. Peace Out's mother was one of the four parents who was able to participate in the Parent Focus Group session. When asked if there were any similarities between parent and child, Peace Out's mother shared:

> I don't think (she) worries as much as I do probably, but it's hard to tell with her sometimes. She's not always very good about expressing her emotions at all. I used to be a little bit that way. I used to be more shy, too, and she tends to be a little bit shy. (PFG 3)

All parents agreed that the children were under stress. When asked what sort of things caused that stress, Peace Out's mother told me:

> when she has to do new things. She gets very stressed out and she does not want to try them. I don't know if that's...you know...this is just me reading into it...maybe it's a sense of perfectionism. Um…she isn't a perfectionist about many things, but just trying new things. I think she's scared to try them. Or to speak in front of others. Um. She's very dramatic. You wouldn't know it either, because you don't, you don't see it at school and she doesn't want to be in plays and she does not like to be the center of attention. (PFG 4)

And when asked how each parent thought the child coped with stress, Peace Out's mother's reply was:

> Sometimes she yells. She used to have a really bad problem with temper tantrums when she was in kindergarten or first grade and she managed to overcome...I think that was her not being able to control the situation more than anything, but she more…umm…sometimes she'll get a little bit snotty like an adolescent a little bit and other times like when she gets excited about things and she doesn't quite know how to cope with them she just acts goofy. I don't know how to explain it any other way. She'll just …she'll get a little bit loud, and she'll start saying things that don't make sense, and it's annoying to me (laughs) trying to sort of…you know that's how she deals with the extra excitement or emotion when she doesn't know how to deal with it. (PFG 7)

I asked Peace Out's mother if she thought her daughter was aware that her behavior was a manifestation of her stress. She replied:

> I don't think (she's) aware; no I really don't. I think you know we expect a lot of these kids and they are pretty young and we expect them to know how to deal with their emotions and they don't always. I mean (she) was very stressed last night because we picked her up from her dad's and we brought her home and I had bought her some dresses because I'm getting married and and I thought "try them on for us," and she was like "I don't like any of these." And they're all on the floor and I thought, "What is going on here?" and I was smart enough to know something was going on and so when I went in and talked to her, she said, "I don't look good in dresses." So sometimes I think it's us taking the time to listen to them and not get frustrated at their behavior, you know, and and she she didn't know that's why she was feeling that way until I talked to her and sort of calmed her down and so… (PFG 9)

Finally, each parent was asked what advice they would like to give the child. Peace Out's mother shared:

> I think you just have to learn to have faith because you can get through pretty much anything and history will tell you that and I try to remind her of that sometimes you know like "it's going to be fine; remember the last time this happened. You just have to get through this and tomorrow you're going to look back and it's going to be fine." (PFG 9- 10)

She continued:

> Setting a good example is a really good thing and I think um…I tend to be very calm in, like, stressful situations because I'll just take action and I know my mom is not like that and I used to think I don't ever want to be flipping out

about something so that you can't take action and I think (she) tends to flip out about things a little bit because she doesn't know how to just "okay, we're just going to do this." And it may be the wrong thing but sometimes you just have to take action and do something so I hope she can be calm in those kinds of situations. (PFG 13)

Peace Out wrote just after the final memory activity:

The research project was good because we got to learn about the brain and we got to hold a real brain! It was bad because we had to do all the blood pressure which was annoying. The thing I would change how much we do the research and make sure we got more time to do it. I learned a lot from it. I learned that the brain has many parts. My life is different now because I know more about the brain. (SJ 11)

Table 4I

Peace Out's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
<1	16/16 20 20	13/11 20 20	absent	30	13/12 20 20	4/3 20 20	6/3 20 20	12	<1

When asked to summarize the entire project in an interview, Peace Out told me "it's important to exercise for your brain. I'm exercising more. Jump rope" (SI 3). When asked to give advice to future student researchers, she wrote:

> My advice to other gifted students is to try this activity because it is one of the most interesting things I've ever done before. I didn't like the exercise because it got me really tired. But I think that if you exercised every day like that it would really make a difference. The research was kinda hard but it was definitely worth it in the end. The memory was hard but it helped our brain because we had to learn how to remember pictures. If you are feeling stressful just take a little break and let your brain relax. I felt calm during the whole activity every time. I want the world to know that you should exercise more even if your not big. I think fitness is a great idea because it is not only fun but it is good for you too. Future research suggestions are to do the unit more often and in our regular classroom to do it. (SJ 12)

- **Green Guy**

Overexcitability. Green Guy is a fourth grade boy. Through my observations, he seems to have the intellectual overexcitability. He thrives off of a challenge and craves difficult tasks. He enjoys College Algebra and participates in after-school Math enrichment programs. He sees patterns quickly. He manages to convey a happy, calm persona. He is accustomed to earning high grades in all subjects.

STAIC. Throughout this study, his underlying level of stress was apparent only through his writings, assessments, and his interviews. He scored himself at the 96^{th} percentile with stress as compared to his age level peers. His mother also rated a high stress level for her son with a score at the 86^{th} percentile.

Interview. When asked how to spend a perfect school day, Green Guy told me "probably a TRITONS day, a day with no tests and a good lunch – potatoes" (SI

1). I told him that some people would say gifted children experience more stress than other students and he said, “Probably I would feel the same. My parents give me more homework because they say I can do more” (SI 2). His favorite aerobic activity is “just running around and playing with (his) sister” (SI 23), and when he is feeling anxious, he just wants to lie down.

Journals. Like many of his co-researchers, Green Guy was not happy about the many blood pressure readings. “Yesterday was horrible, we took a lot of blood pressure readings” (SJ 3). His mother responded to an email query in which I asked what has been discussed at home regarding the study. Her reply:

> (He) told me what he did for this study and the "result" of the test in last two weeks. I didn't comment on the result and as trying to stay "neutral,” I didn't comment on it either. I just said we always need to repeat the test to draw conclusion.
>
> He has been increasing his activities in a way. He exercises a little bit more and he jumps and hops and moves around more in the house. When he walks he tends to run inside and outside of the house.... He said exercise is good for his brain. (PCR 1)

Table 4J

Green Guy’s data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
96	14 /14 20 20	14 /11 20 20	14 /10 20 20	99	11/abs 20	abs	abs	88	absent

Each student participated in one *state* assessment of the STAIC. This assessment would indicate their level of stress at that particular moment in time. It was given just before the 3rd memory activity began. Most students' response levels were consistently near or below the 65th percentile for the state assessment. It is interesting that Green Guy was one of only two whose *state* assessment was at the 99th percentile.

During one of the brain physiology presentations, I told the students about brain derived neurotrophic factor (BDNF) and how it has been shown to help build neurons and strengthen connections in the brain. I told the students that exercise has been shown to increase the production of BDNF. Immediately Green Guy stood up and started jumping up and down, then running in place.

Green Guy was away for the final month of the study. We were not able, therefore, to conduct a final interview during the research study window nor were we able to give a final assessment of his STAIC trait score.

- **Shmoo**

Overexcitability. Shmoo is a fourth grade girl. I have observed that her main overexcitability seems to be the psychomotor. Her psychomotor OE presents itself in her enthusiastic attitude toward the smallest details of her day. She is talkative and anxious to share all that has happened since the last time we met. She moves from activity to activity, quickly engaging in the next conversation, and can change her persona from that of a happy-go-lucky child to a mature young woman in a moment. She is involved in dancing outside of school and reports that it is her favorite form of aerobic activity.

STAIC. She scored herself at the 78th percentile on the STAIC and her father scored her at the 48th percentile.

Interview. In the initial interview, she told me her favorite way to spend a perfect day is to "roam around during recess and look around, play 4-square, read, write, do things that relax me" (SI 1). When asked if gifted children have more stress than others, she said, "Since I don't know everything, this is my estimate: non-gifted students feel intimidated by gifted students. Gifted students are facing hard work. Gifted students are intimidated by work; non-gifted students by gifted students" (SI 1).

> When asked what she does when she is feeling anxious, she told me she will go in my room, take a nap, listen to music, write in my journal, play a game with my parents. Dancing relaxes me because I'm used to it. I think if you are used to one thing, that's relaxing. (SI 2)

Parent focus group. Her father concurs. He was one of the four parents who participated in the Parent Focus Group Session. When asked if he sees similarities between Shmoo and he or his wife, he told me "both (of us) because we tend to worry about too much …at night, like her brain turns on and then it's like 'turn off so you can go to sleep'" (PFG 2). He reported more about Shmoo's stress:

> Around everybody else they're wonderful and they're great to be around. And then they get home, and it's like that's when the melt down comes; that's when the screaming at the adult comes…and her problem, she stresses out if she has problems with something difficult for her to do the first time. She doesn't handle failure or having to practice something. In other words, you

> should be able to do something (the first time.) And same as our oldest one, because she was also gifted, and it's like, if school comes easy, everything should be the same way so dancing, ice skating, and any...any type of activity should be the same thing. You do it once and you got it down because school's like that...like they can read something and they understand it...so if school is that easy then why should we have to practice all of this other stuff? And that's where the real…and we battle it with both of them. Or if they practice, if they practice and if they do it and don't get it right. It isn't like they don't want to practice, but they don't like the fact that it's not right when they do it. And then they get frustrated and they don't want to do it anymore. (PFG 5)

So when asked how Shmoo copes with stress, he simply stated "yells at mom and dad" (PFG 6) then added:

> Usually she would get upset or she'll just want to like just shut down and just veg out. So just get away from it completely and go sit by the TV or go in the playroom or something but or she'll just or you know she'll throw a temper tantrum "Oh, that's too hard," you know she's like "do this" and it just turns into a big meltdown. So it's one of the two either she melts down or completely vegs out. (PFG 8)

Did he experience the same type of stress as a child? "As far as me, I don't remember what I did. As far as I don't remember if I got stressed out that much as a kid; I do now" (PFG 8).

All parents at the Focus Group session agreed that the word stress does not come up at home. When asked what advice he would give to his daughter to help her cope, he shared:

> Just that...if it's something you can do something about then decide what you can and can't do and just do that and be happy with it; be satisfied. And if it's something like, for instance, you cannot if something's out of your control then you just have to forget about it. If you can't control it, then worrying about it isn't going to do you any good. If you're going to worry about something, worry about those things that you can have an effect on. I think you just do the best you can and then be happy with it. (PFG 12)

Journal. Shmoo had difficulty with the blood pressure readings as her peers did. One day she journaled, "I am a ZOMBIE because my blood pressure was not working!!!!!!" (SJ 16) However, on another day, she wrote, "Yesterday we took many heart rate readings, I loved it. The only thing I did not like was the memory game" (SJ 15). And in her conclusion, she wrote,

> Today I will be doing a summary about the last few weeks, the positives like, we got to touch a...BRAIN!!!!@TRITONS!!!!
>
> Now we are on to the negatives, like I didn't really like all the blood pressure, and all the memory activities. (SJ 16)

Table 4K

Shmoo's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day ½	Memory Activity 2 (w/o exer) Day ½	Memory Activity 3 (w/ exer) Day ½	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day ½	Memory Activity 5 (w/ exer) Day ½	Memory Activity 6 (w/o exer) Day ½	Parent STAIC Percentile	Final STAIC *Trait* Percentile
78	7 / 10 20 20	7 / 2 20 20	5 / 8 20 20	99	9 / 7 20 20	6 / 3 20 20	5 / 4 20 20	48	76

Shmoo was the other student of the two whose *state* score at the beginning of Activity 3, was at the 99th percentile. In our concluding interview, I asked Shmoo how her study had gone. She told me, "I'm learning how exercise and not exercising affects your brain. Like in my score, I've noticed with exercise, I've gotten a better memory score" (SI 4). She was surprised at "all the different parts (of the brain) and how all your memory and all your important information can stay in that one little thing" (SI 4). She has learned this: "When I feel stress, I like to take a break, look at it again, and break it up into small parts" (SI 4).

- **Sushi Monkey**

Overexcitability. Sushi Monkey is a fourth grade girl with a vivid imagination. From my observation, it seems she has an imaginational overexcitability which gives her a theatrical flair. She participates in extracurricular dramatic opportunities throughout the school year. She enjoys writing and art and appreciates any outlet for her creativity and humor. She is always happy to share her creations with the class, is quick with a smile, and will sing when the opportunity presents itself. She is accustomed to doing well in her classes and expects great things of herself.

STAIC. Her STAIC trait reading was at the 83rd percentile while her mother's score was at the 62nd percentile.

Interview. Her favorite way to spend a perfect day at school is "free writing and (to) do multiplication. Those are my strongest subjects" (SI 1). When asked if she concurs that gifted children are more stressed, she said, "I don't think that's true with me but I don't know everybody. I get stressed when I come to my weakness or have a minimum amount of time for a test" (SI 1). What does she do when she is feeling anxious? "Tap my foot a lot, hands sweat, take my time, get a piece of loose leaf and figure it out" (SI 2). Her response to the question about what is her favorite type of physical activity: "I love soccer and I like to work my arm strength like climbing ropes and trees" (SI 3).

Student journal. The students were all encouraged to conduct an activity assessment of their classmates and their families. She summarized the results for the students by writing

> Everyone in the class is fit and we have all done pretty well with our balance of exercise. Overall, we as a class are pretty good at daily exercise, although some of us need to work on it we're a pretty great team! So keep up the good work TRITONS class! (SJ 9)

Sushi Monkey noticed that her memory score was not as high the first time she attempted the activity without exercise. She wrote in her science log,

> Today we took blood pressure. (as usual) I'm not gonna tell you what it was because I usually don't tell you & the other (journal entries) will be jealous. Anyway on the memory test last week I did well. I got 14 out of 20 (after

> exercising) and 11 the next. … I realized that this week i didn't do well & that was the day after we saw the second poster of random thingie magigers (sic). I only remembered the things on the poster from last week. Weird right?! (SJ 9)

She also agreed with some of her peers when she observed that the memory activity without objects was more difficult. "I thought that it was harder with words than with objects" (SJ 9). Another source of concurrence with her peers was her attitude toward taking blood pressure. She wrote "the blood pressure ratings are frustrating me because I usually have to try doing it again and again like 10 – 15 times" (SJ 9).

In response to the question of whether the parents have seen a difference in activity levels of children, Sushi Monkey's mother responded, "I've noticed that (she) has wanted to go outside & ride her bike more (when it was nice outside). I've also noticed that she has been playing more actively with (her brother)" (PCR 3).

On the day of the third memory activity (with exercise) during the exercise activity two students were seated, one was rolling in the grass, and one complained of a stitch in her side after less than five minutes of cardio activity. I casually said to the group, "you should be able to jog for five minutes at a time." Sushi Monkey said, "Mrs. Ford, are you concerned about the world if we can't jog for very long?" (J 11).

Table 4L

Sushi Monkey's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
83	14 /11 20 20	11 / 5 20 20	11 / 8 20 20	63	11 / 5 20 20	absent	5 / 2 20 20	62	12

Sushi Monkey had the most extreme drop in initial and final STAIC trait scores dropping from the 83rd percentile to the 12th percentile. "I will now sum up our research project. I love, love, love learning about all the interesting things about the brain!**"** (SJ 10).

When asked what she learned, Sushi Monkey shared, "I've learned that exercise is good for the brain and it can relieve stress. And I've learned about memory" (SI 5). When asked if anything has changed, she said, "Yeah, I think I exercise more" (SI 5).

Her final summation in her journal was: "Although all our work, blood, sweat, and tears is done, I will never forget this unit" (SJ 10).

- **Grease Monkey**

Overexcitability. Grease Monkey is a fourth grade boy. He spends many hours in a fantasy world of his own creation and sometimes has to be tapped on the shoulder or hear his name repeated in order to be attentive again in the classroom setting. He seems to exhibit an imaginational overexcitability. His imaginational OE is also his best coping mechanism for any concerns in his life.

STAIC. On the STAIC questionnaire, he amended one of the questions. On the statement "I worry about my parents," three response choices were given: hardly ever, sometimes, often. Grease Monkey penciled in "always" on this line and circled it. He scored himself at the 26th percentile, and his mother scored him at the 7th percentile. As is expected with his strong imaginational OE, his favorite way to spend a perfect school day is "reading a book" (SI 1).

Interview. When asked to respond to the statement that gifted children experience more stress than others, he said, "I think that's true. I get a lot more stress than other people, not really on a Math problem, but like on a test where I get something wrong" (SI 2). He said when he feels anxious, he will "put (his) head down on (his) desk" (SI 2) and his favorite aerobic activity is football, where he is the quarterback.

Parent focus group. His mother attended the Parent Focus Group session and commented on Grease Monkey's quarterbacking opportunity.

> See, that's why I put him in sports because I think that will help him learn to fail. I think. He needs that, so they didn't do very well so he had a lot to deal with, plus he was quarterback so that's a lot of stress and I told (his dad), I was like, because he was the coach, and I was like "ooh, are you sure you want to put him at quarterback?" That is like...high stress. And he's doing well. (His dad's) like, "you have to learn to control your emotions." You know, you do have to, when you're on the field, you can't say, "ooh, oh my gosh" and all your teammates see it. But I think that's one thing, you know

> sports or anything like that and you know…they will fail…so it teaches him that it's okay. (PFG 6)

When asked if she saw similarities between herself as a child and her son, she shared:

> I used to get upset at little things… uhh lost a button…I'd cry. I remember that. (chuckle) I'd cry and I'd cry. Now I think back and I think "Why did I cry?" So stuff like that. And when I lost. I rode horses and it was very difficult to lose. But I lost a lot in the beginning, so, but I got better at horsemanship and losing. I became a good loser. Because…I was I was...it was hard, though. My mom, my mom was just, you know, she thought, "Gosh, my daughter cries all the time." So…they used to call me "cry baby." I was…I was the youngest of 5 so that was my… it was my nickname. I don't know if it was because they all picked on me or you know, I don't know. But, a, no I don't know if my sisters and brothers were that way; I don't think so. (PFG 1 – 2)

I asked her how her son coped with stress now and what indicators she sees. She remarked that he used to manifest more frustration,

> I got him out of that, though. I …you know…I said "you can never get anything on the first try," I said, it's …"you just got to practice and practice" and now I think he kind of understands, but when he was young...oh my gosh! He would start crying and "I can't get it. I can't get it." And he'd hit his head on the table and now he's…so…he's learning. (PFG 6)

And now she sees:

> He gets quiet. You know and the eyes start blinking. I don't know if that's just upset or if that's stress. I'd think it's more upset that he failed. And so...he just holds back the tears now. So it's like he's…he's doing it at least. (PFG 7)

When asked if she had any stress in her life, she shared:

> I don't get stressed at all at work. Rarely. Because I'm like, you know what, people? Cause we always have deadlines. I mean they're always and they're always running late so I'm just like, "you know what?" I don't stress because I'm like "I'm not gonna do that." Nope. If people start getting on me, then I'm like "get away." (Laughs) But that's about all. I don't stress any more; I try not to. It's just not good for you. (Laughter) (PFG 8)

What advice would she give to Grease Monkey now to help him cope?

> Take a breath. That's what I say. Nothing is that…um…important that you have to stress yourself about, that's what I think…'Cause I used to be all the time stressed. I mean stressed a lot because I wanted to get things done. Now it's like nothing gets done…nope. (PFG 9)

Each week we took three baseline readings for blood pressure and heart rate. On more than one occasion Grease Monkey did not like his readings. He questioned them and said, "This can't be right." He wanted to clear the screen and try again. I told him to just record what he saw. I noticed that during the final baseline reading, he wanted to redo the reading (J 6). During the focus group session, his mother stated,

"I'm always second guessing. It's hard to make a decision about, you know, when I go to the store. (Laughter) 'Should I take that one? There's one over here. Do I want that one?' I'm always second guessing" (PFG 10).

When asked in an email to note changes in Grease Monkey's activity level, she stated that he "really likes to dig in to problems…gather as much information as he can then ponder. I have noticed lately he is very much in research mode…constantly wanting to look something up or asking a lot of questions" (PCR 3).

Table 4M

Grease Monkey's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
26	5 / 8 20 20	9 / 7 20 20	6 / 6 20 20	37	6 / 5 20 20	4 / 4 20 20	5 / 0 20 20	7	14

Grease Monkey displays a great capacity for remembering minute details about his world, but he displayed little concern for the memory activity results. While his peers wanted to maximize their results and at times displayed a competitive nature, he was content to participate.

> During the summation interview, Grease Monkey said the research was: really good. Really, really good. Because we got to try a whole bunch of different stuff. Everything was interesting. I learned how to take blood pressure…exercise is probably going to make your brain work less because you're focused on the exercise. (SI 7)

- **Waterice**

Overexcitability. Waterice is a fourth grade girl with a kind heart and a sensitivity toward relationships. Most of the students in this study appear to display a single predominant overexcitability. Waterice seemed to display both a sensual and an intellectual overexcitability. Her sensual and intellectual OEs make her keenly aware of all that is transpiring around her. She is easily offended by a slight from a friend at recess and will be devastated for the rest of the day. But she will generously share her time and talent with anyone whom she determines is in greater need than her. She dives deeply into a subject and wants to learn all that she can, then has a need to share what she has learned with all around her. While reading with a partner on the subject of memory, she shouted out "So that's why my mawmaw can't remember stuff" (J 14).

STAIC. Her STAIC trait score was at the 35th percentile. Her mother completed the same assessment on Waterice's behalf and scored Waterice at the 28th percentile.

Interview. She said a perfect day at school would be "one with no yelling and nobody yelling at you. The teacher not blaming you and you get in trouble (because) if someone does something wrong and you yell at them, they blame you" (SI 1).

When asked if she agreed that gifted children were more stressed, she answered "I don't know 'cause especially in Math some of my friends will still be thinking about it and I'm done…So it's stressing for them" (SI 2). She plays soccer and is the goalie. When she is worried or anxious, "I put my head down and not

listen. If I'm worried about something I do this (squeeze fingers over bridge of nose)" (SI 2).

Student journal. Waterice found the list of words easier to memorize than the objects glued to the poster board. "The word list was easiest" (SJ 17). Yet, nearer the end of the study she journaled "I like pics best because it is easier to remember pics" (SJ 17).

She concluded just three weeks into the study "I remember more with exercise" (SJ 17). In fact, her mother submitted an anecdote via email.

> A couple of days ago, the 2 of us were in the car and I realized I had forgotten something and teased her that she should have reminded me. She said, "well, I guess I should have exercised this morning if you wanted me to remember things!" (PCR 5)

Parent focus group. Waterice's father participated in the Parent Focus Group session. He commented,

> (She) seems more like my wife and she worries about a lot and the same thing last... It's funny…some of the questions…last couple of nights she's had trouble sleeping. My in-laws are out of town and the alarm went off at their house so they had to call us and she found out about that today. And nothing happened. You know, I don't know if the wind blew it and made it go off, so we had to go check on it. But she didn't sleep last night because she was worried about that. So when I got home, I went in and told her everything was fine and she went to sleep. (Her mother) is kind of like that, she went over, and they both also over react to some things. (PFG 2)

When asked what sorts of things cause stress for his daughter, he said, "Getting dressed in the morning" (PFG 3). Then he added,

> It's more that she has her idea of what she wants to wear and we say, I mean, 'cause I don't know what matches and what doesn't match, but you know if it doesn't match or if she puts on short sleeves and it's cold outside. She'll freak out about not finding (the right thing). (PFG 3 – 4)

He asked a question of the whole group:

> Do you guys think that...like (Waterice) seems like she's totally opposite at home…then what she is at school. When we talk to her teachers, you know, you guys seem to think she's kind of easy going. She's...a...stressed out at...at home or... It just seems like at home she has...I don't know...she's like more high strung, you know? (PFG 4)

In reply to the question regarding whether he was stressed as a child, Waterice's father stated, "You know, I can't remember much of my childhood. We probably moved thirteen times before I was in high school. So you just learn to deal with stuff like that" (PFG 6). I then asked if he was stressed as an adult.

> A couple of years ago I was stressed a lot at work. It caused some neck problems. And I thought, "you've got to let that go." I don't know. I just hold it in I suppose, you know you've got stress with the house and the kids and everything and work. You just deal with it. (PFG 8)

So what advice would he have for Waterice today?

> That old saying, "worry about the things you can change, and don't worry about the things you can't." I want her to learn to let go of the things that aren't that big and focus on what's important like that. Or just not let it bother her. You know, learn to not let the little things bother you as much. It's funny after, you know, after she's had, you know, her meltdown or whatever and once you start getting her calm you can talk about it and she'll say, "yeah, it really wasn't that big of a deal." But it doesn't seem to help next time. But when the next time comes, she doesn't look back on that previous time. And then we say, "Remember last time?" I can't remember what she lost or something. I said, "we'll find it; it's not, you know, it's a big item, it's a house, it's somewhere in here." (PFG 9 - 10)

Near the conclusion of the focus group session, Waterice's father wanted to add a further comment regarding his daughter's stress:

> You know there's one more thing I was thinking. It's funny with her because at home sometimes mistakes are hard for her. But playing sports? She plays goalie and you think, (that's stress) but if she lets one in she just moves on. Somehow, I don't know how. She'll get mad for a second but then she just moves on. No, she'll try something new in sports. Well, she's pretty good about trying something new any time, but for some reason, sports don't seem to affect her as much, like you know, the funniest thing, she was playing volleyball and she was serving. She got four serves in a row and she was serving for game point and she completely whiffed on it and she laughed at herself…We almost cried. We were sad for her. (PFG 12)

Waterice's mother commented on the activity level query with this comment:

> I have not seen any changes in (her) activity level - however, she has JUST finished participating on 2 soccer teams and has her last volleyball game this weekend so she was pretty active prior to the study starting. (PCR 2)

When I asked Waterice at the end of the study what she has learned, she told me "the fact that exercising makes you happier" (SI 6). She continued,

> It's kind of been a lot of different activities. It's kind of actually been fun. We've gone outside and had an activity every week. And the memory tests have been kind of fun.
>
> Well, I guess if I get stressed I'd exercise instead of…Umm, if I'm like watching TV I might just like move my leg around. When I go outside and play with these boys up the street a lot, I'm the only girl, we ride bikes and race. (SI 6)

Table 4N

Waterice's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
35	9 / 10 20 20	10 / 4 20 20	6 / 6 20 20	21	9 / 6 20 20	8 / 4 20 20	10 / 5 20 20	28	35

Waterice purposefully did movement activity while reading an article on the importance of exercise. She paused and said to me, "Mrs. Ford, my grandma was telling me that she is having trouble remembering some things. I told her about our

research and told her to start doing some exercising. She said she had never heard of this before." I said to Waterice, "You may have helped her a lot." Waterice smiled and said, "Yeah." (J 18).

- **Awesome Awesome**

Overexcitability. Awesome Awesome is a fourth grade girl. From what I have observed, she seems to have an intellectual overexcitability. She wants to be challenged and expects to meet any challenge that comes her way. She holds herself to a high standard and will efficiently and quickly accomplish any task allowing her competitive spirit to energize her. Her initial STAIC perceived stress level placed her at the 34th percentile for her age peers. Her mother scored Awesome Awesome at below the first percentile.

Interview. When asked to describe her perfect way to spend a school day, she told me "reading and doing Math" (SI 1). Does she think gifted children are under more stress than other students? "I don't really think so. Sometimes I do, but it's not a lot" (SI 1). When I asked her what she does when she feels anxious or worried, she told me, "I think I lay down, find a good book and read" (SI 2). Her favorite aerobic activity? "I like to chase my brother around and pick him up. He weighs twenty pounds. I can carry him up and down the stairs" (SI 3).

Student journal. She, too, had comments about blood pressure readings:

> I thought taking blood pressure was easy but when Waterice tried she could not hear my heart beat she thought I was dead! The sphygmomanometer hurt but I did not mind. My arm got red but it changed color. (SJ 2)

Later she wrote in her journal, “I thought it was fun but it put me under pressure because I was also trying to take my blood pressure” (SJ 2). Even her mother reported on an email response, “She says she gets frustrated with the blood pressure when she can’t get the right reading” (PCR 1).

Regarding her activity level, her mother also reported no noticeable change in activity levels as a result of the study. She “is a very active child with dance four times a week and soccer two times. I can’t tell any difference in her activity level” (PCR 1). She responded similarly to another query one month later with the comment,

> I have not seen any changes in (her) exercise level. She is a very active child. She takes 7 hours of dance per week, soccer and always bouncing around the house. She likes to exercise and has high energy all the time! (PCR 3)

Her mother also said that Awesome Awesome told the family that the research “stimulates her brain” (PCR 3).

Table 4O

Awesome Awesome’s data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
34	16 /14 20 20	13/abs 20	17 /15 20 20	50	19 /12 20 20	11 / 9 20 20	abs	<1	24

In the final interview, Awesome Awesome said,

> It’s gone pretty well. I really like it because I get to learn some amazing things from it. Like what can happen to the brain and how the brain works. What I

> found most interesting was that we got to touch a brain. And we can probably do whatever we want in research. (I was surprised) that I liked it and I liked learning about the brain. I might read a book possibly. (SI 3)

When asked if she had made any changes regarding exercise, she said, "No, not really. Because I was pretty active before" (SI 3).

- **Annie**

Overexcitability. Annie is a fourth grade girl who is hesitant to loudly express what she knows but anxious to quietly share it with one or two people who will listen. She receives strong support from her parents and is armed with a confidence that she knows her parents will back her no matter what. She seems to display an emotional overexcitability through her vulnerability and sensitivity to perceived harsh words or behavior from friends. When she learned the story of Phineas Gage, the railroad worker who survived eleven years after a three-foot tamping iron shot through his skull, her mother reported that Annie did not sleep the following night because of her worries. Similarly, she wrote in her journal after the neuroscientist visit, "I think TOUCHING BRAINS is THE MOST DISGUSTING thing ever" (SJ 18).

STAIC. She scored at the 87th percentile on the STAIC trait assessment. Only three parents submitted questionnaires that indicated a higher stress level than the child. This is one of those cases. Her mother scored Annie's stress at the 99th percentile.

Interview. A perfect way for Annie to spend a school day is "playing games like BINGO" (SI 1). When told that some people say that gifted children are more

stressed than peers, she answered “I agree with them because gifted students, like don’t, since they’re gifted, they don’t like to get anything wrong. So they stress out to get everything right” (SI 1). Her favorite aerobic activity is skipping at school and when she is anxious, she will “try to relax…by playing with (her) dog and watching TV” (SI 2).

Student journal. She was the only student to make no comments regarding blood pressure readings. But she did report, “I did not like taking so many tests and running" (SJ 18). Midway through the study, she wrote her theory in her journal: “It helps your memory if you exercise” (SJ 18). Her mother saw a similar attitude displayed at home. She shared this story in an email response:

> (She) has talked with us about the brain and shared some of what she has learned. She is using exercise more. For example, last week she was running in place while working on multiplication & division. Later that evening, she said that she thinks "exercise helps the brain work". Her attitude towards exercise is more positive than before, and she is more aware of the need for exercise, rather than exercise occurring incidentally as part of playing a sport. Surprisingly, she even mentioned summer swim team as good exercise, which during last summer she vowed not to participate in again.
>
> She has complained, daily or nearly daily, about only having one 15-minute recess each school day, and now says that it is not long enough, that it's not even part of lunch break, etc. etc. I'm very glad she had a chance to participate in this study and appreciate your research! (PCR 4 – 5)

Table 4P

Annie's data by the numbers

Initial STAIC *Trait* Percentile	Memory Activity 1 (w/ exer) Day 1/2	Memory Activity 2 (w/o exer) Day 1/2	Memory Activity 3 (w/ exer) Day 1/2	STAIC *State* Percentile w/ act 3	Memory Activity 4 (w/o exer) Day 1/2	Memory Activity 5 (w/ exer) Day 1/2	Memory Activity 6 (w/o exer) Day 1/2	Parent STAIC Percentile	Final STAIC *Trait* Percentile
87	10 /11 20 20	8 / 5 20 20	10 / 8 20 20	68	absent	5 / 4 20 20	6 / 3 20 20	99	28

Annie's mother "remarked that she worried about her daughter's stress level, then told me that she worries that her daughter spends too much time sitting in front of the TV" (J 12). With inclement weather preventing outdoor exercise, we were doing our indoor exercise on the week of the fifth memory activity. I asked Annie if she could do this type of activity at home as well. She said, "you couldn't do this while watching TV, you might miss part of the show" (J 15).

Interpretation of Results

Literature cites the unique stresses of students identified as gifted (Neihart, et al, 2002). When asked what types of things cause stress, the students in this study quickly shared: "When everyone expects me to get the answers right," "When it's not good enough," "Always trying to be better," "Being a nerd." (J 1)

The Initial Interview

The initial interview with the students elicited responses to four statements:

- Describe a perfect and relaxing way to spend a school day.
- Some people say that gifted students experience more stress than other students, how do you respond to that?

- Tell me what you do when you are feeling worried or anxious.
- What is your favorite type of physical or aerobic activity?

Nine of the sixteen students disagreed with the comment that gifted children are more stressed and expressed feelings similar to Awesome Awesome's when she said that she sometimes felt stress, but not often. Seven students acknowledged the stress they feel either from their parents' expectations, the demands of school, or their own internal stressors. Recall that Annie shared:

> I agree with them because gifted students, like don't, since they're gifted, they don't like to get anything wrong. So they stress out to get everything right. (SI 1)

When asked what they do when feeling worried or anxious, each student was ready with a response, implicitly acknowledging that stress and anxiety were real feelings for each of them. No student paused to question the concept of their own anxiety. Their replies helped to answer the first part of the research question: "**What will the students identify as their preferred coping strategies both at the beginning of the study and at the conclusion?**" The students shared coping mechanisms that included reading books, watching television, tapping feet, journaling, getting help from parents, laying down, napping, playing video games, fidgeting, playing with the dog, kicking a kickball, and putting their head down on a desk. Few techniques involved aerobic activity; I queried what a favorite type of physical activity would be. The children were able to offer a variety of activities including soccer, dancing, skipping, jumping rope, yoga, football, swimming, basketball, ice skating, running, ballet, and rope climbing.

Memory and Cardiovascular Readings

Taking the cardiovascular readings became a source of stress in itself. Students expressed concern and frustration with the multiple readings. Therefore, the original plan of taking seven cardiovascular readings on both memory activity days of all six weeks was amended to taking the readings only on the first day of activities each week.

One question that this study hoped to answer was: "**How will performance on the measures of declarative memory capabilities be affected by aerobic exercise?**" Although there were some students who achieved slightly higher scores on the non-exercise days, the overall trend indicated that exercise had a positive influence on memory. During the first two memory activities, students studied twenty images displayed on a poster board. When they exercised prior to the activity, average retention was 102 percent. Without exercise, the students' average retention 24 hours later was 58 percent. During the second set of memory activities, students studied a list of 20 words naming concrete nouns. When they exercised prior to the activity, average retention was 79 percent. Without exercise, the students' average retention 24 hours later was 73 percent. The third set of memory activities challenged the students to study 20 objects displayed on a computer screen for thirty seconds. When they exercised prior to the activity, average retention 24 hours later was 59 percent. Without exercise, the students' average retention after 24 hours was 45 percent. Figure 2 displays average class memory results after each of the six memory activities with exercise and without exercise.

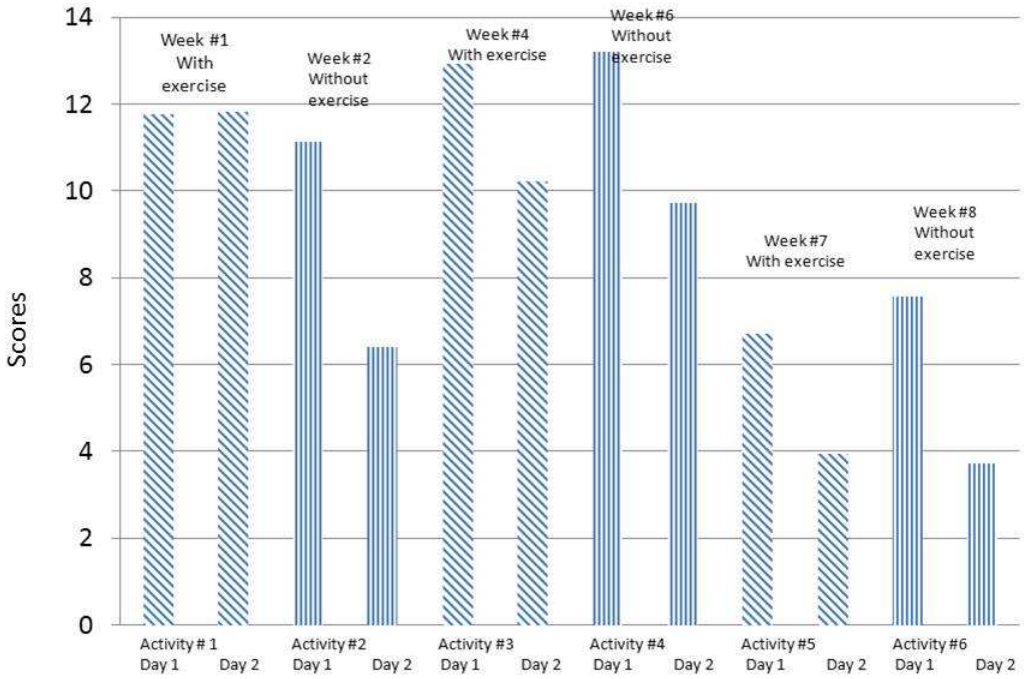

Figure 2. Memory Activities With and Without Exercise Noting 24-Hour Retention

Perhaps the most interesting results indicate that retention twenty-four hours after the initial memory activity was higher with exercise. Students did not see this chart, nor discuss the overall trends, until after the six weeks of memory activities were concluded. This was an attempt to keep the children from affecting their own results, if even subconsciously.

Neuroscientists Visit

During the third week of our research study, we were visited by three graduate students in the department of Neuroscience at a local university. As previously described, they engaged the children in two experiments and offered the opportunities to observe and handle brains and a spinal cord. That afternoon visit was the highlight of the study for many of the students. When parents visited the school for a variety of

reasons during the following months, each parent mentioned their child's excitement regarding the neuroscientists visiting.

Parent Collected Responses

One of the first questions sent to parents asked what conversations they may have had with their child regarding exercise. Also, I asked what changes, if any, they had noticed in the child's activity level. Ten of the sixteen children's parents responded to the first round of questions. Three of the respondents indicated some increase in activity or an indication of a positive attitude toward exercise. The remaining seven parents returned comments sharing that they did not notice changes in activity levels, but that the child was already active.

Midway through the research, another email was sent to parents eliciting their answers to the questions: "What conversations have you had with your child about our study?" and "What changes, if any, have you noticed regarding your child's exercise level or attitudes regarding exercise?" Seven parents responded. Awesome Awesome's mother wrote that our research activities were fun and Dr. Rocky's mother admitted no conclusions had been drawn yet. Maria's mother shared her support for the study and for her daughter's attitude regarding exercise.

Parent Focus Group

During Week Five of the study, I offered a Parent Focus Group session on a Monday morning prior to school starting. Although eight of the students' parents indicated they would attend, due to illness and scheduling conflicts, four parents were present for the session. Two fathers and two mothers took part, all parents of fourth graders. The participants appeared honest and forthcoming with their opinions.

The session began with the parents completing the State Trait Anxiety Inventory for Children (STAIC), answering each question as the parent believed his/her child might respond. A copy of this questionnaire was also sent home to all parents who could not attend the focus group session. Fourteen of the sixteen children's parents completed the questionnaire. The results are displayed in Table 6. Three of the respondents scored their children at a higher stress level than the children had scored themselves. Two parents scored their children at the same level. The remaining nine parents scored their children as having a lower Stress level in terms of percentiles than the children had scored themselves.

Table 6

Comparison of STAIC Scores Child/Parent

Research Name	Child Score (in percentiles)	Parent Score (in percentiles)	Difference?
Rambo	50	62	higher
*Peace Out	23	31	higher
Annie	87	99	higher
Claireadell	1	1	same
*Waterice	35	35	same
Green Guy	96	88	lower
*Shmoo	78	48	lower
Sushi Monkey	83	62	lower
*Grease Monkey	26	14	lower
Awesome Awesome	34	<1	lower
Dr. Rocky	63	5	lower
Dr. Dawnstar	77	50	lower
Sir Issac Drewly	99	86	lower
Maria	48	34	lower
Isabella	39	no response	NA
Cocoa Turtle	24	no response	NA

*Parent attended focus group session

I chose the theme for the parent focus group session to be stress (See Appendix D). First we discussed the stress that the parents experienced in their lives both as adults and as children. Each parent agreed that the child behaved in one way at school and often exhibited a different personality in the safety and comfort of the home. Peace Out's mother shared her daughter's concerns and said, "you don't see it at school" PFG 3.

The parents went on to share what types of conditions trigger such behaviors. Sometimes it might be getting dressed in the morning, a sense of perfectionism, or having to practice because an activity was not yet mastered. Grease Monkey's mother recognized that sports were a trigger for him, but she added that sports will allow him to fail, thus learning that failure is okay.

When asked how each child coped with stressors, answers included throwing things, yelling at mom or dad, or getting quiet. We noted the similarities between the parent's childhood and the child's life; namely, that the parents were unaware of stress in their own childhood and conjectured that their children were unaware of their own stress as well.

What Have the Students Learned?

Near the conclusion of the study, the students again engaged in one-on-one interviews with me. I asked them how the study had gone, and what they had learned. Some responses related directly to the exercise brain link. One of the research questions posed at the beginning of this study was "**What, if any, attitude changes toward physical exercise will be noted in fourth and fifth grade students acting as co-researchers after three months of interventions?**" Perhaps the most

transformative result, when comparing the six research questions, is the students' attitudes toward physical exercise. Students shared multiple comments regarding the connection between exercise and memory. They shared their surprise that they seemed to remember more with exercise, that the activities were fun, and that some ways to memorize worked better than others.

Other responses related to the research process itself. Students shared that the process had gone well, was interesting, sometimes difficult, and sometimes surprising. It was not all positive comments. Rambo told me the research study was "sort of boring" (SI 8). On the other hand, Awesome Awesome stated, "It's gone pretty well. I really like it because I get to learn some amazing things from it. Like what can happen to the brain and how the brain works" (SI 6). And, certainly, the frustration with the blood pressure monitors was a negative aspect for many of the students.

Student Journaling

Throughout the study, the students and I kept journals on the computer. Entering large amounts of text is cumbersome for most children this age. After a 20-minute exercise activity, taking multiple cardiovascular readings, and participating in a memory activity, I asked the students to go to their computers and write in their journals. For some students, this was a daunting task and typing a sentence or two was the most that could be expected. A typical writing style of my fourth and fifth grade students is that they will write their current thought with little preamble or description, such as "Right now my blood pressure has mostly been the same. I have a compliment party today" (SJ 26). It can at times be difficult to grasp the larger

concept to which they may be referring. For example, on October 26, Claireadell simply wrote, “I love me and myself. And I live to love me” (SJ 5), on December 6, Shmoo wrote “Today we looked at a computer screen. I wanted to do it individually” (SJ 15), and on November 30 Peace Out wrote “it makes me really understand that it’s really a severe cause and that you shouldn't joke around about it” (SJ 12).

Nevertheless, there is still much to be learned from reading their thoughts as they entered them on the computer. Periodically, students did partner reading on various topics on the brain. They shared their fact findings in their journals. “Abusing alcohol or using illegal drugs may cause memory problems” (SJ 2). “Today I learned that you should wear helmets because head injury can cause memory loss” (SJ 4). “The brain determines if the information is important” (SJ 8). Sushi Monkey wrote

> Today me and my partner Claireadell learned all about memory. We all know that we have multitalented brains. Our brains have many different parts. An important part of the brain that helps memory is the hippocampus. The gray matter of the brain is the biggest outermost layer of the brain. One more thing... memory isn’t perfect. (SJ 10)

The “Stress” of Blood Pressure

A recurring theme in the journal entries was the frustration experienced with the taking of blood pressure. “It was really hard to listen” (SJ 6), “the blood pressure ratings are frustrating me because I usually have to try doing it again and again like 10-15 times” (SJ 10). “Yesterday was horrible because we took a lot of blood pressure readings” (SJ 3). “I liked all the blood pressure stuff. The only thing I didn’t like was doing it over and over again” (SJ 11). “We did too many blood pressure

readings. We did seven readings! And on the 5th one it went up to 300 and my hand turned purple!" (SJ 13). **"**Dear Peers, I am a ZOMBIE because my blood pressure was not working!!!!!!!!!" (SJ 16). "I didn't really like all the blood pressure" (SJ 16). "Yesterday and today my blood pressure was going up and down. How weird!" (SJ 24). "The last two days have been really stressful because of all the blood and heart rate test" (SJ 26). "My blood pressure is getting crazy" (SJ 28). "I thought it was fun but it put me under pressure because I was also trying to take my blood pressure" (SJ 2). "I couldn't hear Grease Monkey's heart rate at all. He couldn't hear mine either. It's soooo frustrating" (SJ 13). Claireadell wrote "yesterday we did blood pressure and I hate blood pressure thingys (sic)!!!!!!!!!! They squeezed me and at the end they just came up error every time I tried it!" (SJ 5). Awesome Awesome wrote:

> I thought taking blood pressure was easy but when Waterice tried she could not hear my heart beat she thought I was dead! The sphygmomanometer hurt but I did not mind. My arm got red but it changed color. (SJ 2)

Perhaps Isabella summed it up best when she wrote, "My blood pressure keeps getting frustratinger (sic) every time. I never have fun with these new blood pressures" (SJ 29).

Fitness of the Participants

Besides the challenge of blood pressure readings, another challenge was the fitness level of the children. The topic of class fitness appears early in each student's journal entry because the students were challenged to conduct a student fitness assessment of their peers and family. For the most part, the students viewed their

peers as having active, healthy lifestyles as evidenced by the following comments. “Overall I would say my class is in good fit” (SJ 7).

Others wrote “Overall everybody is healthy. I noticed that most people sleep 8 hours a day. Most people exercise for 30 minutes a day” (SJ 11). “Most people ride bikes. 1 person plays more then ten sports. Most people are fit” (SJ 17). “I think most of my classmates are fit” (SJ 21). “More people do more than 2 sports. Most people run. A lot of people eat healthy. Over all I would say that most people are fit” (SJ 18). Greenguy wrote:

> I learned that I had some crazy classmates like ones that are in a car for an hour a week, or ones that never sleep, have two minutes of homework, or exercise for fifty hours a week. However, most people watch television for seven to eight hours a week, and exercise for ten hours a week. Overall, I would say that the class is pretty fit but should cut down on their TV. (SJ 3)

Isabella wrote:

> I decided that we are not the healthiest or unhealthiest class. We sometimes sit around play video games but we do play plenty of sports and I think we’re not unhealthy we are saying we normally bus or car (to school) but that’s not very effective and more active than last year and a little hard to sit for a while. (SJ 28)

One research question posed at the outset of this study was “**What physical movement activities would maintain the interest of fourth and fifth grade students identified as gifted in a suburban school setting?**” While fitness was a

concern throughout the study, the students demonstrated a greater enthusiasm for the physical activities that were designed by other students.

The "Stress" of the Memory Activities

Just prior to the third memory activity, students each completed a STAIC inventory assessing their *state* of stress. This is an indication of how they were feeling at that moment. Originally, the students were going to complete a *state* inventory before each memory activity. Again, the students were overwhelmed with the aerobic activity, six to seven cardiovascular readings, entering their memory results, and journaling. The additional task of completing a twenty-question assessment was too daunting for them, so we completed only one. I decided to wait until the students had experienced a memory activity both with and without exercise before adding the *state* assessment. Thus, the third activity was deemed the right time to have the children complete the form.

The state scores ranged from the 21st percentile to the 99th percentile. For the most part, the students who had scored a higher percentage on their state assessment were the ones who had a higher score on the trait assessment. The students with the highest number of recall items were not the ones with the highest or lowest state results. Educators know that a certain amount of stress can enrich hippocampal learning which is tied to memory (Jensen, 2005). Perhaps that is indicative of the results shown in Table 5.

The third of the three sets of memory activities caused the most controversy. This activity entailed the students viewing pictures on a large screen in the classroom. The images were programmed to display for only thirty seconds whereas in the

previous memory activities, students were given five minutes to study the objects or word lists. Dr. Rocky, Maria, Claireadell, Cocoa Turtle, and Shmoo all commented on their dissatisfaction with the timing discrepancy.

Student Conclusions

When asked to write their conclusions from the study, the journal entries were quite varied. Grease Monkey succinctly wrote “Last day typing. I like everything. Nothing I want changed. I learned a lot. Now I’m a lot smarter today” (SJ 1).

Awesome Awesome wrote: “I thought this was a great thing that many people don’t get to do and I loved it! I think everyone should have a fun time with this. You should try it” (SJ 2). Sushi Monkey shared that she will never forget this unit. Shmoo had mixed feelings about the study since she enjoyed neuroscientist visit, but disliked the blood pressure and memory activities. Waterice wanted to make a lasting difference as she shared “I think we should make a video about what we do and a exercise break” (SJ 17). Although most students regarded the visit from the neuroscientists as a highlight, Annie wrote “I think that TOUCHING BRAINS is THE MOST DISGUSTING thing ever” (SJ 18).

Teacher Journaling

It is interesting to read through my own journaling. Although I authored the words, the elapsed time has made the journal read like a work of another in many ways. I wrote of a “Wellness Committee” meeting at my school at the earliest stages of this project. Staff members prepared a presentation for the Parent Teacher Organization. The topic of the elimination of recess was broached and the school nurse said, “What is all this talk about recess and movement? Aren’t the children at

school to learn? Not to move?" (J 4) She is certainly not alone in that belief. Knowledgeable, well-intentioned professionals in the field of education do not all agree on the proper place of movement and recess in the school day, especially in this era of high stakes testing even of our younger students (Ohanian, 2002).

A recurring theme in my own journal was my surprise at the lack of fitness demonstrated by the students in my class during the 20-minute exercise activity. "Most of them stopped to rest during the five-minute cardio routine" (J 6). Only "two of the eleven (fourth grade) students were able to (move) continuously during the entire second round of cardio….Is this indicative of their overall fitness?" (J 6) I conferred with the Physical Education teachers. One teacher said I "have been teaching for over 20 years and I've seen a definite change during that time" (J 7). I mused that it may be "a lack of resilience. When children encounter a difficulty, is their first response to bear down and stick it out or to bail out and change course?" (J 7-8) When asked if their child was active, parents generally responded positively. But I wrote:

> I did not find a single parent who commented that their child consciously engaged in activity every single day for at least 20 – 30 minutes (at a time). I question whether any dance lesson or soccer practice requires a continuous expenditure of activity for 20 minutes without a stop. Is this essential? (J 9)

In mid-November when the fourth graders were again outside for a 20-minute aerobic activity, only one of the twelve students could maintain the five-minute cardio activity. Sushi Monkey said, "Mrs. Ford, are you concerned about the world if

we can't jog for very long?" (J 10). The fifth graders had an equally difficult time maintaining the five-minute cardio routines without a break.

Again, I spoke with our Physical Education teachers. One teacher said she was "'concerned about the lack of aerobic ability' among her students…She said, 'I don't understand. We do running club. But these kids can't maintain cardio activity for any length of time.'" (J 13) She went on to report of a suggestion by the coordinator of Physical Education for the district to

> have formal assessments for our students followed by individual interventions for students who have significant deficits in their aerobic health….we have Individual Educational Plans for students who are struggling academically, and we should have similar interventions in place for students who could improve physically." (J 13)

Sir Issac Drewly said in regard to the exercise routine "we'd be fit people if we did this every day at home" (J15). In my journal, I wrote of a television broadcast I came upon from almost fifty years ago in which Stan Musial was being named the leader of the President's Council on Physical Fitness (Goodson & Todman, 1964). The interviewer said to Stan, "I must say it's a challenge, if we are to read some of the statistics in the paper, our young folks need to be inspired to a greater interest in physical fitness" (J 13). Fifty years ago adults were concerned about the fitness level of children.

Another recurring theme in my own journal was that of stress and how it manifests itself. Apparently, it was even evident in me as on one occasion, I wrote: "Isabella said to me today, 'I can tell you have been stressed lately.' I was taken

aback. I smiled, and asked, ‘How can you tell?’ She said she noticed I was acting ‘jumpy.’ From the mouths of babes” (J 15). While “acting jumpy” is evidently a coping mechanism for me, my journal notations included an observation that Cocoa Turtle kept “looking away from the list during the 5 minutes allowed for memorizing. When I asked her why, she said, ‘This is hard. I can’t do it’” (J 13). Later when discussing the general topic of mental disorders, Dr. Dawnstar needed reassurance that she would not fall victim to a stroke. One parent wrote to me of her concern that her daughter had been experiencing such an extreme amount of stress in her home life that her readings might skew the results of our study at school.

Decision Points

When considering decision points through the study, one was the decision to buy blood pressure/heart rate monitors that attach to the wrist because “the frustration with blood pressure” (J 3) continued throughout the study.” Another decision point was a choice I made during the final memory activities. The first two sets of memory activities (4 different activities) each allowed five minutes for the students to study the objects/words being memorized. The final set of memory activities involved an online program which displayed images for 30 seconds. This drastically reduced amount of time was an obvious source of frustration for the students. After I witnessed that during Memory Activity #5, I had to decide whether to allow a longer amount of time for Memory Activity #6, to be done without accompanying exercise. I decided that even though it would cause further frustration, I had “to display items for just 30 seconds so that I can truly compare (the) next week’s ‘no exercise’ memory activity with this week’s ‘with exercise’ activity” (J 16).

Another significant decision point was to require fewer cardiovascular readings from the students. Ideally, we would have obtained seven readings on each of the memory activity days. This proved such a frustration to the students that it almost became a lesson in coping with stress of its own. I decided to require readings on Day One of each week and let them be optional on Day Two of each week.

In the initial coding process, several themes initially arose including: exercise, stress, parent stress, stress triggers, different personalities, perfectionism, research, blood pressure, fitness, attitudes, brain, allostasis, movement at school, coping, sleep, memory, role models/parent/child support, parent/child similarities, no acknowledgement of stress, resilience, and parent support. As the coding process was refined, three larger themes emerged: stress, coping, and fitness.

Research Conference Presentation

During the final weeks of our study, we received word that we would be presenting our research at the Qualitative Research Conference in March. Dr. Dawnstar said, “Wait, are we really going to go there?” (J 16) Dr. Rocky asked, “Can we get lab coats to wear?” (J 16)

Another decision point in the research process was to only bring the fifth graders to the research conference. Although the fourth graders were very disappointed, it was not logistically possible to bring sixteen students to the conference.

In preparation for the conference, the fifth-grade students gathered all of their cardiovascular data. I explained to the students that up to this point their data were just numbers. In order to have meaning, we needed to find what the numbers showed

us. Working with a spreadsheet program, students entered all of their data and graphed the results. See Appendix G for examples. This was a painstaking process. I explained to them that entering the data was indeed tedious work and using the program to make the graphs was fun, but the real research began when they studied the resultant graph and searched for meaning. This experience was a powerful part of the study. This was the first time the students saw the graph of the overall memory scores on days with and without accompanying exercise.

On the morning of the research presentation the students nervously gathered in the lobby of our school awaiting transportation to the conference setting. Dr. Dawnstar and Isabella asked me if they could run outside to the track and run some laps to reduce their stress. When we arrived at the conference venue, Sir Issac Drewly began doing jumping jacks because he was “so nervous.”

The students presented their research in three cycles and responded to questions posed by attendees. Four parents attended the session with the students. After the presentation, one of the mothers remarked, “I wish all of their teachers could hear this data.” Another mother asked me if I could arrange for the children to give a presentation to the entire staff. Although the parents had been supportive of the research from the beginning, seeing and hearing the presentation by their children seemed to crystallize their attitudes toward exercise and its correlation with learning.

Because the fourth graders did not accompany us to the research conference, they displayed their research results for all those who attended our school celebration of the year’s achievements on a special evening in May.

Cardiovascular Data

Cardiovascular data became more of an activity for the students and a way to create an awareness of its existence than an actual data source. Leaving detailed systolic, diastolic, and heart rate readings in the hands of ten- and eleven-year-olds is an interesting task. In the ideal experimental design, students would take readings at prescribed intervals with 100% accuracy. With the frustration of the blood pressure cuffs, it is likely that cardiovascular data was already being altered the moment the students saw the box being opened that contained the blood pressure monitors.

Students drew three baseline readings approximately three minutes apart. They took the average of their three baseline readings as reading one. The second reading was taken immediately at the onset of the memory activity (with or without exercise). A third reading was done immediately after the memory activity. A fourth reading was taken twenty minutes after the event, and the fifth reading was done forty minutes after the event. Many students had incomplete data. The students created excel files and graphed what cardiovascular readings they had alongside their memory scores. A sample of cardiovascular data for three students is shown in Appendix G.

When examining the cardiovascular results, we looked for the student's cardiovascular ability to return to baseline after a stressful event. With typical chronic stress levels, cardiovascular readings should be restored to baseline within forty minutes after the stressful event (Johnston-Brooks, et al, 1998).

Although definitive data could not be culled from this aspect of the study, the co-researchers gained an awareness of the existence of cardiovascular data. Future

studies would benefit from ample practice with the blood pressure monitors and a regimented schedule for recording each reading. Ideally, cardiovascular monitors resembling wrist watches that monitor and record data would be the best way to accumulate the data.

One research question to be studied was "**What changes will occur in students' physical indicators of stress taken before and after aerobic activities?"** Since the cardiovascular data collection was met with such frustration or a lack of success by students at various times during this study, it is difficult to pinpoint exact changes in physical indicators of stress. The raw data on students' cardiovascular readings are displayed in Table 7.

Table 7

Summary of Beginning/Ending Heart Rates for Six Memory Activities

Summary	Initial STAIC Trait Pctl	Memory Act. 1 with exercise	Memory Act. 2 without exercise	Memory Act. 3 with exercise	Memory Act. 4 without exercise	Memory Act. 5 with exercise	Memory Act. 6 without exercise	Parent STAIC Pctl	Final STAIC Trait Pctl
Rambo	50	76/77	81/83	75/53	86/67	42/82	NA/66	62	83
Dr.Rocky	63	89/98	91/82	99/114	102/90	118/97	103/79	5	30
Dr.Dawnstar	77	77/60	75/66	74/91	80/49	107/95	74/79	77/50	57
Sir I. Drewly	99	76/82	87/71	76/80	90/81	110/101	106/87	86	99
Isabella	39	90/99	89/89	77/96	91/73	110/94	98/101	None	26
CocoaTurtle	34	76/53	87/110	79/88	72/94	86/91	78/88	None	30
Maria	48	86/92	88/104	91/94	96/90	84/NA	89/94	48/34	19
Claireadell	1	82/74	85/71	81/84	75/69	131/87	90/91	1	<1
PeaceOut	<1	117/108	100/104	84/NA	119/117	105/113	95/101	12	<1
GreenGuy	96	97/102	83/84	88/83	98/68	abs	abs	88	abs
Shmoo	78	95/128	92/104	103/110	89/77	80/95	129/na	48	76
SushiMonkey	83	92/100	89/98	92/108	91/94	107/83	NA	62	12
GreaseMonkey	26	96/87	90/111	80/78	73/84	87/NA	82/84	7	14
Waterice	35	72/90	80/71	83/99	88/81	79/79	89/74	28	35
Awesome X2	34	90/94	94/99	92/119	101/87	NA	NA	<1	24
Annie	87	130/105	97/85	76/NA	113/115	101/NA	124/114	99	28

When looking at the heart rate data only, we would expect to see a restoration to the initial baseline reading within forty minutes of the stressful (memory) activity.

It is helpful to view the chart data above while noticing the perceived stress ratings. According to the theory of allostatic load, the children experiencing a greater chronic stress would have more difficulty returning to original baseline readings within forty minutes. Yet this was not what the results indicate. This could be due to inaccurate measurements, misjudgment regarding what was the actual stress-inducing activity, or stress levels not physiologically affecting students yet. More lengthy explanations for this will be discussed in Chapter Five.

Finding Meaning in the Data

The overall theme of this study is displayed in Figure 3. When considering the situation of the child identified as gifted, we studied the relationships among memory, stress, and movement.

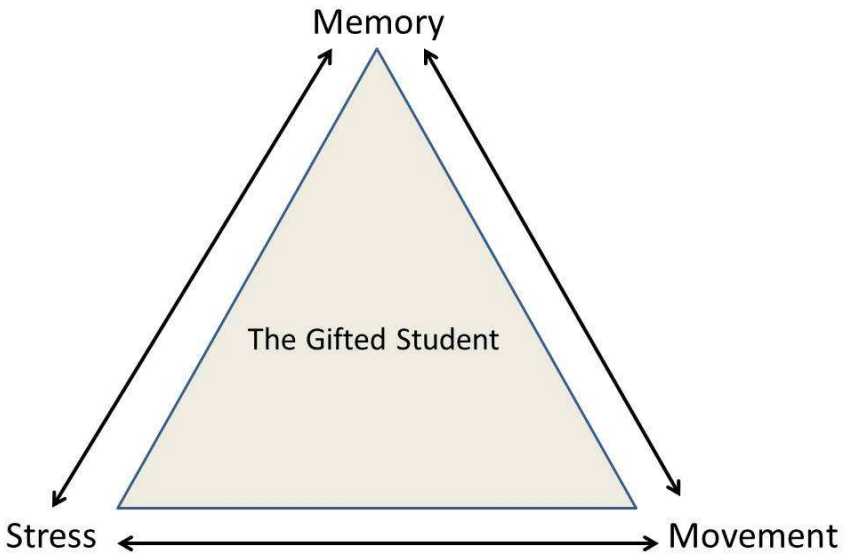

Figure 3. The relationships among memory, stress and movement in the student identified as gifted.

Just as the students were challenged to make meaning of their data, it was incumbent upon me to do the same. When this study began, my greatest curiosity was to learn what effect, if any, movement might have on learning, especially memory. However, as the experience continued, three major themes emerged. The first was stress and its unique triggers, both during the research process and in day-to-day living. The second theme was coping, the strategies employed by students, and the role of parents in assisting their children. The third theme was the perceived and actual levels of fitness and exercise in the lives of this group of fourth and fifth grade students identified as gifted.

Stress

On the State-Trait Anxiety Inventory for Children, students' scores on the initial trait assessment ranged from the 1st percentile to the 99th with six of the students scoring above the 75th percentile for anxiety. The children completed a trait assessment at the beginning of the study and at the end. See Table 8.

Table 8

Comparison of STAIC Trait Assessments at beginning and end of study

Research Name	First STAIC C-2 trait assessment (percentiles)	Second STAIC C-2 trait assessment (percentiles)	Change?
Maria	48	19	60 % decrease
Sushie Monkey	44	12	73% decrease
Peace Out	<1	<1	no change
Shmoo	100	99	1% decrease
Annie	87	28	68% decrease
Greenguy	96	Abs	NA
Waterice	28	6	79% decrease
Claireadell	1	<1	0.8% decrease
Cocoa Turtle	24	10	58% decrease
Awesome Awesome	34	24	29% decrease
Grease Monkey	26	7	73% decrease
Dr. Dawnstar	77	57	26% decrease
Rambo	50	83	66% increase
Dr. Rocky	63	12	81% decrease
Isabella	39	4	90% decrease
Isacc Drewly	100	100	no change

One research question was "**What, if any, changes will occur in perceived stress feelings reported by the students and their parents after increases in school time aerobic activities?"** Based on the results of the State Trait Anxiety Inventory for Children, perceived stress levels were reduced for 12 of the 16 students, remaining constant for two other students, with incomplete data for another. In fact, the average change in perceived stress level from the beginning of the study to the end was a 41 percent decrease in perceived stress.

One student indicated a higher overall stress level at the end of the study. This was Rambo who shared comments previously mentioned such as his overall assessment of the study: "sort of boring. It used up too much of our time so we couldn't do other stuff" (SI 8). Yet Rambo was also the student who said, in response to the query "Are gifted children more stressed than other children?" "Yes…because…yes…just yes…leave it at that" (SI 2).

As previously mentioned, only Rambo's perceived stress level appeared to be higher. In addition, students demonstrated that exercise was an option when confronting stressful situations.

Hidden Stress?

The children in this study appear to harbor deep feelings of which we are not always aware. To further illustrate that point, when their parents were asked to complete the identical survey and answer as they thought their children would, the majority of parents scored their children lower than the children did themselves. Three parents scored their children at a higher level. One of these parents remarked in

an email, “I worry about my daughter’s stress level. She spends so much time sitting in front of the TV.”

During the Parent Focus Group session, all in attendance agreed that 1) the children showed many indications of their stress at home, and 2) the children were not aware of their own stress. Interestingly, when queried about their own childhood, the parents indicated that they, too, were not aware of any stress during childhood.

We know that children identified as gifted are more likely to worry about world events (Delisle & Galbraith, 2002). They have “more stuff on (their) minds” (SI 2). “I get stressed out a lot. I don’t know” (SI 2). While studying disorders that can occur in the brain, a child heard about strokes and could not move on to the next topic until we had reassured her about the many symptoms of stroke and that she was not a likely candidate at that time.

Yet, the question remained whether or not the students recognized the stress in their own lives. When asked if they thought gifted students were under more stress than others, the reactions were varied. Some students did not see it or notice. Others recognized stress as it occurred in their school day, and one child felt the stress, but could not articulate the cause as he stated, “Yes…because…yes…just yes…leave it at that” (SI 2).

Dealing with Stress

Remarkably, although not all students recognized their stress, each child was able to share what they do when they get stressed, although I used the phrase “worried or anxious” with them instead of the word, stress: “My stomach gets sick” (SI 3). “I sweat, tap my feet a lot. My head gets heavy. I don’t know what to do and I

don't feel good" (SI 2). "I sweat in my palms and tap my foot. I don't want to think about it" (SI 2).

Boredom is a cause of stress (Thackray, 1981). Each student in this study has expressed being bored at one time or another during the regular school day. However, the students do not recognize boredom as a trigger. In fact, one student expressed, "I don't know, especially in math, some of my friends will still be thinking about it, and I'm done so it's stressing for them" (SI 1). This student finished a math assignment and was waiting for the next activity, but she assumed the real stress was on those students who were still engaged in the activity.

A distinction must be made between acute stress and chronic stress. Life situations can be a source of chronic stress. One has to wonder what is concerning Grease Monkey when he added the extra box marked "always" on the survey next to the statement "I worry about my parents." In order to explore any possible chronic stresses, students responded to the statement, "Describe a perfect day" with the assumption that a "perfect day" would contrast with an upsetting, stress-inducing day. Most students found their refuge in school, which is not surprising considering this is an area of their lives where they have experienced success. A perfect day was described as "Reading and doing math," "Science," "Read, write, do things that relax me," "do some social studies and math and play outside and relax," "free writing and do multiplication." (SI 1) Three of the students wanted to be in the gifted classroom all day every day. This speaks to the literature which found that gifted children prefer to be around their gifted peers (Neihart et al, 2002). However, Rambo said, "You can't be relaxed in school. It's torture. Have recess and PE all day. No tests" (SI 1).

Green Guy added that a perfect day would be “a day with no tests and a good lunch – potatoes” (SI 1). And Maria suggested, “Go to Hawaii” (SI 1).

But Waterice displayed a deeper concern when she described her perfect day: “One with no yelling and nobody yelling at you; the teachers not blaming you and you get in trouble. (Because) if someone does something wrong and you yell at them, they blame you” (SI 1).

Blood Pressure Readings and Stress

During the course of this research study, an obvious source of acute stress was the taking of blood pressure. Initially, we used blood pressure cuffs and stethoscopes and attempted to take a partner’s blood pressure. This proved to be incredibly frustrating and fairly inaccurate as demonstrated by the student who simply stated, “he doesn’t have a blood pressure, so I couldn’t find it” (J 2), or another student who complained, I “used the sphygmomanometer and I nearly died” (SJ 28).

We switched to wrist devices that automatically gave readings of systolic, diastolic and heart rate. However, often the screen would display “ERR” indicating an error had occurred, and the blood pressure had to be redone. Claireadell seemed to speak for many when she remarked, “I hate the blood pressure things” (SJ 5). Recall that Awesome Awesome’s mother sent an email stating, “She says she gets frustrated with the blood pressure” (PCR 1). This was a concern for all. In their journals, the students wrote such thoughts as “It was bad because we had to do all the blood pressure which was annoying” (SJ 12), “Yesterday was horrible, we took a lot of blood pressure readings” (SJ 3), and “the blood pressure readings are frustrating me” (SJ 10).

From a researcher's point of view, the blood pressure frustrations became an excellent vehicle to witness first hand my students experiencing stress. The reactions ranged from a student quitting for the day while another screamed out "Sooooo frustrating" (SJ 13), and a third asked me to "make it work." Others quietly persevered or found a way to use humor during the situation: "I am a zombie because my blood pressure is not working" (SJ 16).

Other Triggers of Stress

Students identified as gifted are accustomed to success in school. Failing at a task can be difficult for them. Perfectionism is a recognized source of stress for many students in this group. At a focus group session with parents, the mothers and fathers recognized this as well. In addition to perfectionism, the parents pointed out other stress triggers that they observed in the home. Some of these triggers included public speaking, a lack of control, encountering new situations, or even getting dressed in the morning.

Stress can cause sleep issues for some students. One student made a new box on the STAIC next to the statement, "It is hard for me to fall asleep at night" and wrote "totally." This student's father shared his concerns as well. "Like her brain turns on and then it's like 'turn off so you can go to sleep'" (PFG 2). A fellow parent concurred, sharing that his daughter has had trouble sleeping as well. I asked the students to indicate by a show of hands who had trouble sleeping, and every student raised a hand. Sleeplessness caused by stress can compound the stress itself.

Yet amidst the stresses the students face in school and at home, they are generally a positive group with many smiles and much laughter throughout the days

in our class. The students are active and busy both during and after school. Outside of school they participate in music lessons, on athletic teams, in scouting activities, in drama classes, in math clubs, on gymnastics teams, and in dance lessons. They share eagerly about their siblings, parents, and friends. The students rarely miss school for health reasons and have an insatiable curiosity for learning. So have they found successful ways to cope?

Coping

A recent article in the *Phi Kappa Phi Journal* explored the use of energy drinks and prescription medications by college students, especially those who are trying to maintain high grades while being involved in all aspects of collegial life (Lane, 2010). Apparently, for some students the preferred method of coping involves artificial stimulants.

It was fascinating to explore the methods my students are using at their young age and to ponder what they would be doing in just eight or nine years when they would be striving to maintain those high grades and be involved in all aspects of collegial life. The habits and techniques learned in fourth and fifth grade would certainly have an influence on decision making in later years.

At the outset of the study, I asked the students what they like to do when they are feeling stressed, anxious, or nervous. Again, the responses were varied: “I go to my room, take a nap, listen to music, write in my journal, play a game with my parents” (SI 2); “I think I lay down, find a good book and read” (SI 2); “I try to relax myself by playing with my dog and watching TV” (SI 2); “I do this (touches each finger one after the next with the thumb). I don’t know why; it’s a habit. Sometimes I

do this (flicks cheek with thumb and finger)" (SI 3). "Play my video games because I like video games" (SI 3).

Many of the comments showed adult thinking, "When I feel stressed, I like to take a break, look at it again, and break it up into smaller parts" (SI 4). Another student stated simply, "Breathe" (SI 3) One student shared her home support by saying if she's worried, she "gets (her) mom or dad, (and) says 'Can you help me? I don't know what to do'" (SI 2).

Sir Isacc Drewly commented that when he gets upset, he likes to "punch through a wall" (J 15). At the other extreme, a fourth grader said, "I put my head down on my desk" (SI 3). Just as the responses varied, it was intriguing to hear the parents share the coping strategies observed in the home. One parent mentioned "she will throw a fit" (PFG 6). More than one parent shared that "yell at mom and dad" (PFG 6) was an observed method.

Duality of Stress and Coping

In the course of the parent focus group session, it became apparent that there was a duality to the children's lives. Perhaps this, in itself, is one method of coping. One parent mentioned how dramatic her daughter was, but "you wouldn't know it either, because you don't see it at school" (PFG 4). Another parent said his daughter's behavior in the home was the opposite of that displayed in school. Continuing with this topic, another father said his daughter may be wonderful to be around outside of the home, but she let herself release her frustrations in the home environment.

The students are finding their own ways to cope, and they have discovered that for some home is a secure place where they can release their anxiety and

frustration. Because the students have this safe haven where they are supported, parents have observed various coping strategies such as “she’ll just want to shut down and just veg out” (PFG 7) or “sometimes she yells” (PFG 7). “She’ll get a little bit snotty like an adolescent” (PFG 7). One parent commented, “it’s one of the two, either she melts down or will completely veg out” (PFG 7).

At this point, the parents shared stories of how they support their children by allowing the meltdowns and listening to concerns. Do the parents of these children see similarities between their own lives and that of their children? Remember that when the parents were asked if they experienced stress in their own childhood, they responded “You know I can’t remember much of my childhood” (PFG 7).

Will today’s children make similar comments about their own childhood someday? The pictures that the parents paint are of students who have anxiety, but are coping, with support. When queried, the parents agreed that the word, stress, never comes up in the home. And yet, one comment shared by a father was, “She’s stressed out at home; it just seems like at home she’s more high strung” (PFG 4).

The parents acknowledged stress in their own lives as adults and saw some similarities between themselves and their children. I asked the parents, “What do you hope your child will know about managing stress?” The depth of support they have for their children was obvious as they offered suggestions.

The students do not always see the stresses in their own lives. Perhaps it is difficult to observe the forces acting upon us. It is apparent that stress certainly exists in the lives of these children. They seem to have supportive home lives, which is not true for all children. One aspect of this study was to observe what effects, if any,

exercise would have on reducing feelings of anxiety. Of the many coping mechanisms available, could exercise be added to that list as a tool to use when needed?

Theme of Exercise/Fitness

Early in the study students were challenged to conduct an activity survey of their classmates and families to determine their fitness level. Each child was asked to reach a conclusion regarding this survey. One student summed it up by stating, “Most people think they are pretty athletic” (SJ 26) and another wrote “Overall everybody is healthy” (SJ 11). Parents indicated through several emails that their children were active.

Yet, when we began our weekly twenty-minute aerobic activity, no student could complete the entire twenty minutes without at least a short break consistently throughout the study. The activity consisted of one minute of warm up, five minutes of cardio (jumping rope, jumping jacks, jogging, skipping, jumping), two minutes of reaction time activity (students mirroring movements of a leader), three minutes of brain engagement activities, three minutes of balancing, five more minutes of cardio, and one minute of cool down. Not one of the sixteen children could maintain both five-minute cardio sequences without a short or even a substantial rest. At some points during the activity, students would lie down, sit down, or just stand still.

One of the Physical Education teachers told me that he has seen a definite decrease in aerobic capabilities during his twenty-year tenure. He attributes it to the sedentary lifestyle that so many of our students are leading now.

Fitness: Chronic Concern?

As I wrote previously, this may not be a unique issue to our time. As was mentioned, John Daly shared a similar concern with Stan Musial in 1964 (Goodson & Todman, 1964). Do we always assume that the youth today are not as physically fit as previous generations? Yet, the concern for our time is real. The district coordinator in my school district broached the idea of formal assessments and individual interventions for students who have significant deficits in aerobic health. Studies cited earlier in this paper presented evidence regarding the positive effects of movement on both physical and mental health. Unfortunately, our students today are engaging more in organized sports and less in free play, if they are getting outside to play at all. A recent journal article from Leek, Carlson, Cain, Henrichon, Rosenberg, Patrick, & Sallis) (2010) recounts a study in which children wore activity monitors while engaging in the organized sport of soccer or baseball/softball. The authors note that "vigorous physical activity is relatively rare" (p. 297) averaging less than sixteen minutes for boys and less then ten minutes for girls each day. Even while participating in practices and games, the monitors the players wore told the story that youth were inactive about thirty minutes during an average practice. "Based on current findings, it appears that youth sports practices are making a less-than-optimal contribution to the public health goals of increasing physical activity and preventing childhood obesity" (Leek, et al, 2010, p. 298). Yet, parents believe that having their children involved in organized sports will meet their fitness needs. During our study, no parent shared that a son or daughter was involved in vigorous, sustained physical activity for twenty minutes or more.

As our movement activities continued throughout the study, the attitudes of the students regarding exercise changed. A parent shared in an email, “I’ve noticed that she has wanted to go outside and ride her bike more. I’ve also noticed that she has been playing more actively with her brother” (PCR 3). A student wrote in her journal, “I think other students should try this….in (our regular) class, TRITONS (class), and everywhere” (SJ 7). Her classmate commented that after this study, she learned “that exercise makes you happier” (SI 6). Another student committed to exercising more, and this was evidenced when her mother sent an email that stated, “shooting basketball hoops seemed to help her decompress from the constrictions of school better than TV did” (PCR 2). Later that evening, her mother reported that she said, “exercise helps her brain work” (PCR 2).

One student commented, “We’d be fit if we did this every day at home” (J 16). This student struggled to participate in the full five-minute cardio workout. He commented at one point, “If I had to pick who was the unhealthiest, it would be me” (SJ 24). Yet, he is involved in extra-curricular athletic activities. His mother shared through an email that he is “more willing to do physical activity without complaining” after this study (PCR 1).

Motivations for Fitness

Various motivations exist for helping our students see the value of exercise. One motivator might be long term health. As one student told me at the conclusion of the study, “When you’re older, not many adults are that active so if you exercise when you’re little you can be really active when you are older” (SI 5). Another student journaled, “I think exercise is good because then you can stay fit and healthy”

(SJ 14). One student's mother wrote to say, her daughter is "very aware of the benefits of keeping active" (PCR 4).

Possibly the greatest motivation for encouraging our gifted students might be the connection between brain benefits, academic success, and movement. Students acted as co-researchers to study the effects movement would have on their brain, specifically their memory abilities. Not all students saw definite relationships. But for many, the results were enlightening. Recall that when a fourth grader was asked to summarize her study, she wrote, "My theory is that it helps your memory if you exercise" (SJ 18).

Several comments were written by students regarding the benefits of exercise to enhance their learning. "I remember more with a twenty minute exercise" (SJ 19). "With exercise I got a better memory" (SJ 25). "Exercise is probably going to make your brain work less because you're focused on the exercise" (SI 7). "It's more important to exercise for your brain. I'm exercising more" (SI 6). Finally, one student summed up her study by writing, "I've learned that exercise is good for the brain and it can relieve stress" (SI 5).

Annie was running in place while working on multiplication and division. I observed students in my own class purposefully standing and moving while reading a science paper. On the day I introduced the students to BDNF and shared that it was sometimes referred to as Miracle Gro for the brain, Green Guy immediately stood up and began doing jumping jacks.

As their teacher I noticed differences in the students on our non-exercise days. My journal includes observations that they were restless and appeared nervous when

we did not exercise. After giving a presentation to the Home and School group on the benefits of movement for learning, two staff members informed me that they were going to start exercising immediately. Unfortunately, many schools are sending a different message by contracting the amount of time available in the day for free play and movement. Ironically, this change is being made with the intention of improving test scores.

Research Process

Our research process was a discovery with no pre-determined results. It was met with frustration and excitement. When asked what they thought of the research itself, the students gave a variety of comments, both positive and negative, but indicating an awareness of the magnitude of the task.

Along the way, students had to face a disconnect between what they thought would happen and what actually did happen. This forced them to process through to a new conclusion. “I can remember stuff from last week still, but I can’t remember as much from this week” (J 9). “The memory words were hard because I am so tired” (SJ 29). “I kind of slacked off, but that is weird because I got the highest memory score I ever had (SJ 26). She went on to hypothesize “Maybe it was that we memorized words, not objects” (SJ 25). “The section I focused on I remembered most” (SJ 26). “The movement activity was very fun because we actually got to jump rope” (SJ 26). “The word memory test was way harder than the object test” (SJ 7).

After reading an article on memory, a student shouted out, “So that’s why my mawmaw can’t remember stuff” (J 14). Another student developed a trick for memorizing a list of twenty written words, and she shared this with the group. At the

end of the study, she concluded, “You can remember things in different ways and some ways work better than others” (SI 9).

One of the fourth grade students’ mothers told me she thinks her daughter may become a scientist after this experience. Another mother wrote, “I’ve noticed lately he’s very much in research mode” (PCR 3).

These students want to learn. They will certainly learn best when stress is held to an optimal level. Whether movement and exercise actually reduce their stress and enhance their learning, or whether they simply believe it to be so, the results are quite similar. “My life is different now because I know more about the brain” (SJ 12). This experience has been empowering for the students. “Now I’m a lot smarter today” (SJ 1).

In the following chapter I will discuss the interpretations and implications of this research study for educators, parents, teacher educators, students, and administrators. Additionally, I will give suggestions for future research.

CHAPTER 5

DISCUSSION OF RESULTS

Introduction

At a time in our history when our educational decisions can have global implications, it is imperative that we support our students and nurture their talents. Fourth and fifth grade students identified as gifted experience their own unique stressors and have their preferred ways of coping. “Gifted education is a crucial aspect of schooling in the United States and abroad” (Sternberg & Davidson, 2005, p. vii), and it is vital that we help gifted students realize that stress is a part of their giftedness and that many possibilities exist for coping. This is a key component in nurturing their talents and expanding their possibilities. Students are not gifted only while they are in school. Children identified as gifted will be gifted adults who will benefit from a large array of tools to use in living successfully with their giftedness.

The purpose of this study was to investigate the relationship among aerobic activity, stress, and memory ability in students, acting as co-researchers, in an elementary school gifted program. Students practiced obtaining cardiovascular readings with some measure of success. They discovered how their bodies react to fitness challenges and what effects exercise had on their memory. They explored the possible influence that exercise may have on their perceived feelings of stress. The research process is a daunting task for ten- and eleven-year old children, especially with the necessity for consistency and attention to detail. Yet the results were compelling.

Children as Co-Researchers

An exceptional aspect of this research was the fact that the students were an integral part of their own study. Student voice is a powerful feature of education. "Students have always had a vested interest in their education but they rarely get the chance to affect what and how schools teach" (McKibben, 2004, p. 79). As children implement changes through the process of action research, they are learning in a unique and wonderful way.

Since this was their first foray into action research, it was necessary to guide the students. However, the future holds promise for the students to play a more integral part in the process while independently and responsibly implementing changes of their own design. "The idea of students as researchers who explore their own lives and connect academic information with their own lived experience is alien to many schools" (Kincheloe & Steinberg, 1998, p. 13). The sixteen co-researchers are poised to inspire such a change in their future school experiences. Bognar and Zovko (2008) argue that action research is only meaningful if students can partake of it "on their own terms, on the basis of their own needs, interests and self-chosen values" (p. 1). This, then, is the next goal for the co-researchers. It will be helpful for them to realize the results of this study, especially regarding the relationships among memory, stress and movement.

Relationships Among Memory, Stress and Movement

We studied three different relationships: stress and memory, memory and movement, stress and movement. At the epicenter of the relationships are the children identified as gifted. The results were interesting, made more so by the fact that the

children who were the focal point of the study, were also the ones conducting the research. The innocence and enthusiasm of the co-researchers gave a special relevance to the results. “I now exercise a lot more to keep me healthy” (SJ 8). “I realized that with exercise people’s brains work better” (SJ 19). “To relieve stress I think it would be good to exercise and then just relax for a while” (SJ 22). “With exercise I got a better memory” (SJ 25). “My life is different now because I know more about the brain” (SJ 12). We often seek out the thoughts of experts. Who are the experts of what life is like for children identified as gifted at this time in our history? Obviously, it is the children, my co-researchers, themselves.

Although all three relationships were studied throughout the experience, during the course of this research the focus would change depending on the events and the students. It is instructive to view the results through the lens of the three relationships.

Stress and Memory

A certain amount of stress can be helpful (Bradley, 2006). The heightened awareness can enhance our memories. Many can picture a particularly poignant moment experienced in the past in which they can still recall minute details of the event. Or imagine a student on the night before an exam when all senses are heightened to recall the information needed for a successful result. Stress can enhance the recall.

Yet, excessive amounts of stress experienced at a catastrophic moment or compounded over time in a chronic stress condition can impair memory (Oei et al, 2006). Visualize that situation when an event is so alarming that a person later

comments, “I don’t even remember driving home” or “People asked me questions and I couldn’t even remember my phone number.” “When something bad happens, the brain leverages the entire body to register that feeling, and that feeling becomes associated with that event” (Eagleman, 2011, p. 68). Chronic stress impedes a child’s learning in a similar way. Children who experience chronic stress may have higher cortisol levels which can impede working memory (Oei et al, 2006). Perhaps the stress load of a ten- or eleven-year-old student in the gifted spectrum is tolerable. Yet, what happens over years and years as the daily stresses of giftedness compound?

In our research, we found no relationship between the STAIC trait assessment of perceived stress results and memory scores. In fact, two of the highest memory recall scores were from students, one of whom who scored at the 77th percentile for stress while the other scored at the 1st percentile. No conclusion is apparent. But, the observation of note from the trait scores measured by our students is that at the outset of the study eight of the sixteen students self-assessed their overall stress as at or greater than the 50th percentile. Fourteen of the sixteen co-researchers indicated a stress level greater than one-fourth of their age-level peers as indicated by their responses on the State Anxiety Inventory for Children. By the end of the study, only four of the sixteen students scored higher than the 50th percentile, and only nine of the sixteen students indicated their stress was higher than one-fourth of their peers. The results of this survey are just one measure of the students’ stress. Recall that the average change in perceived stress level from the beginning of the study to the end was a 41 percent decrease in perceived stress percentiles. The parents indicated a concern that the students may not be fully aware of their own stress.

Can memory influence stress? Certainly, any situation which calls to mind a previously unpleasant event could trigger an acutely stressful moment. The students' memory of their frustrations with obtaining blood pressure readings appeared to raise acute stress levels each week. One student, Claireadell, had more difficulties obtaining a reading than any other student. Her *trait* readings at the beginning and end of the study were at the 1st percentile and at the <1st percentile, respectively. Yet, before the third memory activity when students completed a *state* inventory on how they were feeling "right now," Claireadell's score was at the 26th percentile. In comparison, that percentile indicates a heightened level of stress for her. She went on to recall twenty of the twenty items on the memory challenge that day. Did her stress heighten her alertness? It remains to be seen if accumulated stress would have eventually had a negative impact.

Children identified as gifted rely on their working memories (Sousa, 2003). It is difficult to assess how the stress levels affected memory. Since children identified as moderately gifted tend to exhibit "prodigious memories" (Lovecky, 1994, p. 119), some decrease in memory capacity may go unnoticed in a typical classroom. If a heightened capacity for memory was decreased, would it be apparent in the course of a typical school day? Or would the child's "prodigious" memory become, merely, an adequate memory capability?

Children identified as moderately gifted have a large memory capacity, thus there could be a greater chance for past negative memories to elicit stressful feelings. Recall that Waterice's father told of an event triggered because Waterice remembered a previous negative incident that seemed trivial to her father. Stress and memory was

one of the three relationships studied. Another was the link between memory and movement.

Memory and Movement

One of the most fascinating findings from the study was the relationship observed between memory and movement. On average, students had greater retention when the memory challenge was given immediately following an aerobic activity. What is even more exciting is that the students acknowledged the relationship based on their personal experiences with the research. They developed a sense of worth and confidence that would hopefully promote a greater resilience to handling life's difficulties. If a memory of an unpleasant event can trigger feelings of stress, possibly memories of success could bolster student confidence. We know physical activity has a positive association with cognition (Sibley & Etnier, 2003). The encouraging results observed by the students may solidify their commitment to the possibilities of movement in their own learning. The third leg of our research triangle examined the connection between stress and movement.

Stress and Movement

As we awaited our trip to the research conference, two of the fifth graders wanted to run laps around the school track to ease their stress. Upon arrival, a third student did jumping jacks just before the presentation. As soon as we were finished, all of the students asked if they could run across a portion of the campus. And they did.

The students had learned about stress and the possibilities of using exercise to alleviate that stress. Perceived stress ratings decreased as indicated on the STAIC trait

results for 12 of the 16 students as displayed in Figure 4. Only one student recorded a higher trait score at the conclusion of the study. Looking at average scores, the students indicated an overall 41 percent decrease in perceived stress. The parents were asked to assess their child's stress during the process and indicated an average trait reading lower than the initial readings by the students.

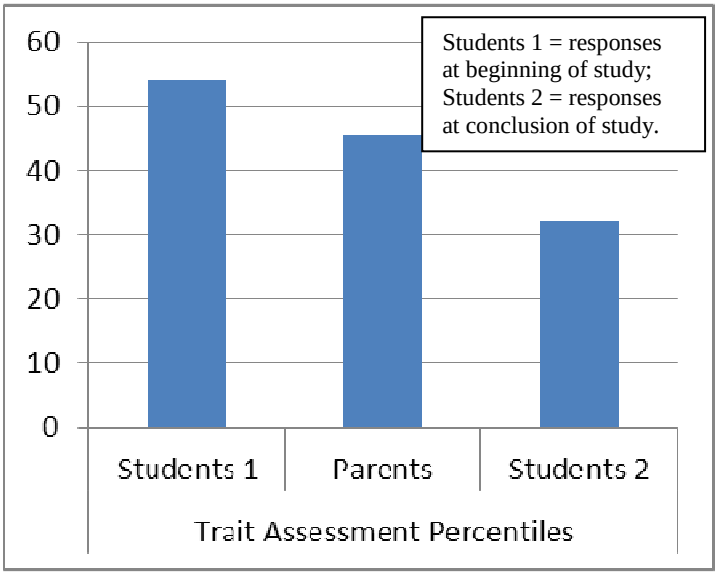

Figure 4. Averages of perceived stress level assessments of 16 students, beginning (Students 1) and end (Students 2) of study and their parents.

Studying the three relationships throughout this study helped us answer the research questions proposed at the beginning of the study.

Research Questions Answered

- **Research Question #1**: What physical movement activities would maintain the interest of fourth and fifth grade students identified as gifted in a suburban school setting?

The students demonstrated a greater enthusiasm for the physical activities that were designed by other students. This may be due to the novelty of the activities or the importance that an activity takes on when it is owned by the students. When students are involved in designing a lesson and understand the goals of the lesson, they are more emotionally invested and attached to the learning (Immodino-Yang & Faeth, 2010).

Ideally, a task should to be relevant to the doer in order to be completed successfully (Jensen, 2005). Perhaps it is not the movement itself that will maintain the students' interest, but the purpose or relevance behind the movement. The fact that the students participated in this study as co-researchers added a relevance to the activities that may be lacking in a study in which such changes were imposed by a teacher without explanation.

The combination of mind, body and feelings make up our different brain states and are easily affected by our internal and external environment. These states are constantly in flux. Engagement of our students is really a matter of managing their states (Jensen, 2005). If we can change the state, we can change the behavior and seize the moment for learning. The way to get students actively involved in an activity is to first get them into an active "state." The state "is the body's environment for making decisions" (Jensen, 2005, p. 110). With six steps, our students can be in the proper state to engage meaningfully and enthusiastically in an activity. These steps include: 1) Eliminate threats, 2) Set daily goals that incorporate student choice, 3) Work to have a positive influence, 4) Manage student emotions and teach them to

manage their own emotions, 5) Provide relevant and coherent activities, and 6) Give feedback (Jensen, 2005).

Clancy (2006) recommends a combination of four movements that can maintain motivation and engage the students. A successful movement activity would incorporate all four areas. The first exercises are the contralateral and cross-the-midline exercises. Contralateral movements are those that engage limbs on opposite sides of the body in movement simultaneously. When the limbs move across the body to the opposite side, that is crossing the midline. The second exercise type stimulates the vestibular system which gives us information about our body in space. Movements that involve spinning, balance, posture, or rocking will awaken our vestibular system. Stretching exercises performed slowly and accompanied with deep breathing can relax and rejuvenate. Finally, aerobic activities will stimulate blood flow and give a heightened sense of well being (Clancy, 2006). Our 20-minute exercise routine encompasses many features of this suggested combination.

This variety of movement activities, made meaningful to the students, and practiced when they are in an optimal state maintained the interest of the fourth and fifth grade students. As noted above, giving the students this information and allowing them to take ownership of the activity is a powerful method of maximizing student engagement.

- **Research Question #2**: What, if any, changes will occur in perceived stress feelings reported by the students and their parents after increases in school time aerobic activities?

Based on the results of the State Trait Anxiety Inventory for Children, perceived stress levels were reduced for 12 of the 16 students and remained constant for two other students. One student indicated a higher perceived level of stress and one student was unable to participate in the final assessment. In addition, students indicated through their writings, interviews, and activities that exercise was an option when confronting a stressful situation.

When completing the inventory on behalf of the child, the majority of parents (ten of the fourteen respondents) scored their child as having a lower stress level than the child recorded. This disparity may, in fact, be a source of childhood stress. Perhaps the children did not sense that their parents truly understood their feelings of stress.

Coddington (1984) listed 36 events which could be a source of childhood stress. Besides the more obvious items, such as the death or severe illness of a parent, sibling, or pet, a move, a divorce, or loss of family time and income, Coddington listed other more surprising events. He indicated that being told you are attractive by a friend, failing to achieve something you really want, being invited to join a social organization, and an outstanding personal achievement can all be sources of stress for children. In the mind of a gifted child, what is considered an outstanding personal achievement? Of course, only the child can correctly address that question.

Coddington's colleague, James Humphrey (1998) added daily stressors for children that included such things as "when teachers don't treat me like a person," "when I don't get credit for something I did," " unfair punishment," "teachers who

think they know it all," and "kids who make fun of me." This list resonates in the life of the child identified as gifted.

In the gifted child, additional sources of stress may include the asynchronous development of the child, the quest for perfectionism, the overexcitabilities mentioned previously, not finding peers who see the world the way they do, and the reaction of others to the gifted child. "Adults often have little sympathy for the gifted child's excessive stress" (Webb, Gore, Amend, & DeVries, 2007, p. 129).

It is not the events listed above that cause the stress, but rather our reactions to those events. It is not the role of the adults in a gifted child's life to point out the causes of stress, but it is crucial that those adults support the child and aid in helping the child manage individual stress. We must teach positive self talk and offer opportunities to fail safely in order to build that resilience in our students identified as gifted. In my classroom, we celebrate mistakes as indications that the opportunity for learning exists. We have student-made signs that say, "If it's easy, you won't find it here." When a student proclaims, "This is hard," the children know that I will respond with a smile and the words, "Thank you, that's so wonderful to hear." I remind the students that I will never steal their chance to struggle.

If the students in this study report experiencing a lessened sense of stress, this is indeed a positive result. Whether these reduced perceptions of stress are due to the increase in aerobic activity is unclear. The parents in the Parent Focus Group indicated that the word stress was never even mentioned at home. Possibly the fact that the topic was exposed and discussed was a stress reliever in itself.

- **Research Question #3**: How would performance on measures of declarative memory capabilities be affected by aerobic exercise?

Overall, declarative memory scores were stronger with accompanying exercise. An intriguing finding was that retention after 24 hours was stronger in most cases with accompanying exercise. Students' average retention after exercise was 80 percent, while the average retention without exercise was 59 percent. One student remarked that she could remember words from the previous week, when she had exercised, but she could not remember the words from the day before, when she had not exercised before the memory challenge.

An activity which causes greater participation in movement can carry long term benefits for the students. Exercise has beneficial effects on the neurological system including increasing the number of capillaries around neurons which brings more blood and oxygen to the brain, stimulating the production of dopamine and serotonin which enhances mood and relieves depression, increasing the production of endorphins which enhance alertness, improving reaction times, and stimulating the growth of nerve cells (Jensen & Dabney, 2000).

Enhancing mood works to enhance learning. "Emotion guides learning…much like a rudder guides a ship" (Immodino-Yang & Faeth, 2010, p.73). Not only is the brain engaged when the children are moving, but the movement's effects on mood provide a stabilizing force that strengthens the learning as well.

"Despite the extraordinary quantity and quality of brain-based research that calls for motion activities to be utilized in the instructional setting, these types of activities are not being consistently implemented in classroom practice"

(Summerford, 2009, p. 2). Whether movement is employed to anchor learning, to energize students or to have fun, it is obviously an essential element to the classroom. As the students saw their positive results with memory scores being enhanced when combined with movement, they were motivated to participate in movement activities, which may increase their decision to move in a positive learning cycle.

- **Research Question #4:** What would the students identify as their preferred coping strategies both at the beginning of the study and at the conclusion?

Students did not identify a major change in their preferred coping strategies. It is unclear, however, that fourth and fifth graders are consciously aware that they are employing specific strategies to cope.

Acute stress and chronic stress are handled with different coping strategies. Perhaps this study made the students more aware of their acute stress and more at ease in discussing those situations that trigger it. In the midst of acute stress, a student may rely on strategies that bring immediate relief such as a verbal outburst, crying, temporarily withdrawing from the moment by closing one's eyes or changing a situation, or employing a quick physical flare-up. Recall that Sir Isacc Drewly said he wanted to punch a wall. In addition to aerobic activities, another study might teach students the benefits of slow, relaxation movements to combat acute stress.

Incorporating physical activity as a regular part of one's lifestyle may serve more as a buffer for chronic stress. It remains unclear whether the fourth and fifth grade students have adopted this concept. Although the parents indicated they saw their children under stress, the parents agreed that the children themselves may not be

aware of their stress. The “carrot” that may keep the children physically active may be their discovery that exercise enhanced their learning.

It has been recommend that “school-aged children should participate every day in sixty minutes of moderate to vigorous physical activity that is enjoyable and developmentally appropriate” (Strong, Malina, Blimkie, Daniels, Dishman, Gutin, Hergenroeder, Must, Nixon, Pivarnik, Rowland, Trost, & Trudeau, 2005, p. 736). We must have a greater emphasis on such activity in the schools. Unfortunately, some of the parents in this study believe their children are getting enough physical activity through their organized sports and dance activities. Leek et al (2010) would disagree. In their investigation, they found that fewer than one-fourth of the youngsters they studied obtained the recommended sixty minutes of moderate to vigorous physical activity during sports practice. The younger the children, the more time is necessarily spent on instruction or waiting in line. “It should not be assumed that youth sports are highly active” (p. E2).

In response to the email query regarding a child’s activity level, parents replied by listing which sporting events were on the child’s weekly calendar. Actually, this was not a direct answer to that question. Simply jumping rope, jogging in place, riding a bike, or working a continuous circuit on a playground apparatus would afford the benefits that Strong et al (2005) recommend. Each student that participated in the Midwest Regional Qualitative Research Conference was given a jump rope as a token of appreciation and as an inspiration to continue to be aerobically active.

- **Research Question #5**: What changes would occur in students' physical indicators of stress taken before and after aerobic activities?

Since the cardiovascular data collection was met with frustration or a lack of success by students at various times during this study, it is difficult to pinpoint exact changes in physical indicators of stress. Additionally, the very act of attaining the measurements became a source of stress.

In a future study, the emphasis could be strictly on the heart rate. This would be an easier concept for the students to understand and a simpler reading to obtain without the need for monitors.

When looking at the heart rate data only, we would expect to see a restoration to the initial baseline reading within forty minutes of the stressful (memory) activity. According to the theory of allostatic load (McEwen, 2004) the children experiencing a greater chronic stress would have more difficulty returning to original baseline readings within forty minutes. One would expect the children with the lowest perceived stress scores to have the easiest restoration of heart rate after the stressful event, the memory activity. Yet there is no clear relationship between perceived stress levels and heart rate restoration.

Several factors may explain the disparity. First of all, these readings were obtained by young children, some of whom were under at least a small amount of acute stress just by virtue of taking their cardiovascular readings. Additionally, the children were solely responsible for accurately recording those readings and entering them in their data log. It cannot be stated with certainty that heart rate readings were not inadvertently written as systolic readings or vice versa. Not all readings were

taken at the proper intervals due to lack of successful first attempts by some of the students.

Another factor to consider is that the children's perception of their own stress may not be an accurate depiction of the stresses in their lives. Parents shared a disparity between the behaviors they observe in the home and their thoughts regarding the child's awareness of stress. It is possible that the co-researchers under- or over-emphasized their stressful feelings depending on many factors in their lives at the time they completed the surveys.

Additionally, the memory activity itself may not have been a stressor for some children. It was essential that I maintained a balance between emphasizing the importance of accurate, best possible memory retrieval while not over stating the case to the point where students may be tempted to engage in unethical behaviors to achieve a higher memory score. It may be that for some students, the memory activity was not a "big deal" and nothing to cause great alarm.

Finally, the general fitness level of each student would play a role in determining their cardiovascular fitness. For some students who are more aerobically fit, baseline readings may be restored more quickly. Nevertheless, it was a fascinating study and one that would be curious to repeat with the right parameters.

This would be especially interesting to make into a family activity that would involve parents, siblings, and the co-researcher on a weekly basis in the home. It may have the hidden benefit of engaging the entire family in a regular aerobic activity.

- **Research Question #6:** What, if any, attitude changes toward physical exercise would be noted in fourth and fifth grade students acting as co-researchers after three months of interventions?

Perhaps the most transformative result, when comparing the six research questions, is the students' attitudes toward physical exercise. Months after the study was completed, the students continued to ask for "movement breaks" when studies were tedious. When I notice a lull in my students' interest level and observe that they are not in an optimal state for learning, I voice my observation and tell them it is time to move. The students who acted as my co-researchers never question this suggestion.

The younger children in the school's gifted program happily engage in movement activities whenever I make the recommendation as well. But in years past, the older children (fourth and fifth graders) would sometimes offer resistance to my suggestion. I have not experienced that reluctance with these students even once since this study has taken place.

When the fourth graders were offered the opportunity to prepare a movie that could serve as the culmination of their school year, they debated and finally agreed to produce a message on the benefits of exercise to enhance learning. They produced a movie called "Exercise on Trial" in which they presented several vignettes depicting the effects of exercise in different situations (test taking, piano playing, solving math problems and puzzles). The students gave humorous portrayals of the positive and negative results when exercise was neglected or when it accompanied the challenge. At the conclusion of the movie a fourth-grade spokesperson turned to the camera and

said, “So, America, keep moving.” Her fellow classmates leaped up behind her and shouted, “Exercise rocks!”

At the conclusion of the research conference presentation, the four mothers who accompanied the students spoke enthusiastically about the results. An educational outreach to other parents and teachers could bolster a positive attitude toward movement and its relationship to learning and stress management.

A self awareness that movement can enhance their attention and learning is a life-long tool that the children can carry with them into higher education and life. Webb (2007) advocates for three factors to be present for a child to lead a successful and healthy life. Those components are stress management, self-awareness, and interpersonal skills. Successful movement activities can incorporate all three components. We want our children to be confident and believe in their own abilities to make thoughtful decisions and encounter success. It is vital that they are aware of both the causes of stress in their lives and their ability to cope with those stresses in a positive way.

The child who enjoys movement activities develops a sense of worth and confidence which promotes a greater resilience to handle life’s difficulties. In turn, that resilience strengthens the child who may be more energized to participate in movement activities in a wonderful symbiotic relationship.

Suggestions for Future Studies

This study was conducted with fourth and fifth grade students identified as gifted. Each student appeared reasonably fit with no obvious physical limitations. The children and their parents indicated a certain level of involvement in physical

activities outside of the regular school day. Subsequent studies might consider students not identified as gifted, students older or younger, students of various fitness levels, or a study of greater length.

If parents engaged in a similar study, coming together on a regular basis to partake in memory challenges with and without aerobic activities, they might see similar results. Regardless, having the parents engaged in the same tasks, would lend credence to the study and possibly engender greater support and compliance during the non-school hours. Similarly, having a group of teachers involved in a like study may change perceptions in the regular classroom or in the school as a whole.

It would be interesting to pursue comparable studies noting differences between genders. Do boys or girls benefit more from exercise? And does the length of aerobic activity time required to see a benefit differ for boys compared to girls?

Certainly, declarative memory would not be the only tasks that could be affected by aerobic activities. Would movement activities have a greater or lesser effect on other types of memory such as episodic or procedural memory? Are there more effective ways to test memory with children? Spatial reasoning, time on task, and efficiency of learning may also be altered by prior movement activities.

Although this research study was conducted with students in a gifted setting, certainly all children have their own sources of stress. What are the common sources of stress among children in a regular classroom? How might they differ from their classmates identified as gifted? What are the chosen methods of coping?

Are there better, less frustrating, methods for assessing children's cardiovascular levels in the classroom before, during and after such activities?

Perhaps only gathering heart rate data would be a sufficient measure for younger students, especially when data is derived by the children themselves. Heart rate monitors worn continuously on the wrist that can record and store data may alleviate some frustrations. What else can we learn from such data?

It is likely that the results of many of these studies would show interesting results. Having the students entrenched in the study as co-researchers added a significant dimension. It gave the students a vested interest and purpose in what they were doing and enhanced the results. This facet should be considered if similar studies were to be conducted in the future.

Although more questions remain at the end of this process, compelling evidence was gained from the study. The benefits of exercise to enhance the lives of the children in the study are an exciting possibility. Its applications to education are worthy of consideration.

Applications to the Classroom

What can teachers begin doing today as a result of this study? Frequently an article is published in a newspaper, magazine, journal, or newsletter regarding fitness, movement, exercise, and/or recess. All indicate the benefits of regular physical activity. Many bemoan the sedentary society we live in or the lack of movement opportunities in school due to pressures to raise test scores.

The answer seems quite simple. Move! Throughout the school day, teachers must find opportunities for students to move. If recesses have been cut back or canceled at a school that is no reason for a teacher not to take students outside. A walk around the school building while discussing a topic in Social Studies is a

wonderful way to incorporate movement and learning. Math problems? Shout out the problem and have students jump the number of times equal to the answer. Recount a sequence of events with a partner while passing a ball back and forth. Construct a story that passes from person to person while running from one point to another. Impart facts to the class while each student mirrors the slow stretches of the teacher.

Are teachers hesitant to allow students to move in unorthodox ways while learning in the classroom? The typical kindergarten classroom may allow many opportunities for movement. Why do we see those opportunities decline as the students get older? As you are reading these words, are you sitting still? When was the last time you moved?

As teachers we must engage in purposeful movement activities. We read in front of our students to indicate our love of reading. We share passages we have written so our students know that we are writers, too. We want our students to know that we are life-long learners. Our actions speak louder than our words. Are we physically fit? Do our students know that we take time before or after our school day to maintain our own cardiovascular health?

The educational community must relay the importance of physical activity to the young citizens in its charge. Both by example and by incorporating movement into our lesson plans, we can incorporate necessary movement into all aspects of the school day.

Applications to the School and District

Do our schools provide opportunities for parents and other community members to be physically fit? Schools could offer evening fitness classes for parents, Saturday morning fun runs, or Sunday afternoon bike rides.

Many schools offer breakfast programs for children. Certainly, a healthy breakfast is a crucial element of a successful day. How many schools and districts have a movement component included as well? This is certainly a less costly addition to the children's preparation for the day. Many students arrive at school after a lengthy bus ride. It is wonderful that they have a breakfast available. A movement activity before the start of a rigorous school day would also offer substantial benefits.

As school districts continue to bolster curriculum and show that the community's investment is being spent wisely, it is important that administrators realize that simply lengthening a school day or increasing instructional time is no guarantee of greater achievement or higher test scores. Sitting in a desk longer will not ensure more learning.

Children come to school eager to learn. Parents send their children to school entrusting that the school will support children's academic growth. Certainly, teachers and administrators want to see every student achieve. Every possible advantage must be pursued for the benefit of all. If an activity can have a positive effect on a child at minimal cost of time and money, it should be supported by all who care about the future of our children. Districts should adopt policies that incorporate movement as a necessary component of the educational day.

It is difficult to imagine any administrator, school board member, curriculum supervisor, or school principal who would not support the health of the students in their charge. A healthy student can take greater advantage of the many opportunities offered in the course of a school day. A vigorous approach to incorporating movement in a school day is an essential component of ensuring the health of the students.

Applications to Teacher Educators

Our universities are incubators of education's future. In the teacher education field, it is not only necessary to impart knowledge but to infuse the art of teaching into the preparation of our pre-service teachers. We teach by example as often as possible utilizing strategies that our future teachers may one day use in their own classrooms. How often do we allow time for movement in such university classes? Certainly a thirty-second physical activity interlude conducted periodically during a presentation would serve to reinvigorate the students as well as to demonstrate the benefits of such a teaching methods.

A future teacher has a great deal to learn in a short amount of time. It is vital that the professors responsible for imparting knowledge to the pre-service teachers remind these students about "the complex interplay between mind and body that engages the learning brain" (Jensen, 2000, p. 15).

Applications to Parents

Should our schools mirror the home? Or should our homes mirror our schools? That may be a debate for another time and another study, but unquestionably children would benefit from consistency between the two

environments. School days are getting longer in many areas which translates to less time at home. When students return home at the end of a school day, there are precious hours remaining until it is time to sleep. Certainly rest and relaxation are necessary components of anyone's day. However, some time allotted for movement activities would be time well spent.

Parents can model such behavior for their children by monitoring fitness regimens. As children see that fitness and daily activity are important to parents, the inspiration for the children follows naturally. Would it ever be possible to walk to school? If family dinners are considered an essential feature of student success, how much more powerful would it be if the dinner were followed by a family walk? Could the morning start ten minutes earlier with some stretching activities?

The home is the greatest support for the school. A fitness partnership between the two entities could only serve to better the lives of the students. An ideal home-school partnership would support family activities by decreasing the amount of homework if it is deemed that too much homework is precluding necessary family activity time.

Informational meetings in which parents and guardians can learn of the importance of aerobic activity in learning will go far to bolster the support of parents as they strive to support their children.

Applications to Students

Perhaps the best advice for students would come from other students. Sir Issac Drewly shared:

> I want gifted students to know, working out is great! You get exercise and you can improve your memory. Just because you're smart doesn't mean you're perfect and you can always improve yourself and your memory. (SJ 25)

If a similar study were to be conducted in gifted classrooms across the globe, students may have a heightened awareness of the short term benefits of exercise; which could catalyze aerobic activity as a regular part of each student's day.

So much of a child's educational experience is based on what is permitted or presented. Incorporating movement into the regular school day may still require a degree of permission, but integrating movement and aerobic fitness into a lifestyle can be in the control of the student. The sense of control can yield attitudes of self-worth and resilience which can empower the student. This is not only true for the child identified as gifted, but certainly a worthy goal for all students.

Conclusion

What, then, is the key component of this research? Is it giftedness and stress? Is it how movement activities in classrooms can affect learning? Is it aerobic activity and how it can contribute to combatting stress? Is it the benefits of students being actively involved in their own action research? Yes. Imagine the possibilities as children identified as gifted learn to recognize that stress is a natural part of life and discover movement may be an option in coping with that stress. As they learn to advocate for themselves to incorporate movement activities into the learning environment, they will be armed with powerful tools for lifelong success. As key players in their own learning improvement study, the positive changes will likely have more lasting effects.

It is not easy being a gifted student. As the students shared what causes them stress, they listed: "when people bully me because I'm gifted," "when everyone expects me to get the answers right," "when it's not good enough," "being a nerd," "always trying to be better" (J 2).

Gifted children tend to derive pleasure from a challenge, to be fiercely independent, and to be somewhat introverted (Winner, 1996). These qualities add up to a childhood experience that is "both more pleasurable and fulfilling, and more painful, isolating, and stressful than that of the average child" (Winner, p.213).

Regular exercise is beneficial and can act as a tool to deal with stress. Hence, we should find ways to inculcate this attitude in our school children. With children identified as gifted, the finding that memory can be enhanced with prior movement activity may be the "hook" that brings exercise into focus for the students. Granted, this may not be the primary reason for exercise and movement to be a regular part of a classroom curriculum, but it may be the driving force that brings it to the attention of the students.

Children may have difficulty seeing the larger picture of exercise as a long term life choice with profound benefits. Demonstrating to children that short term exercise will be helpful in the immediate time frame with declarative memory tasks will bring aerobic activity to the forefront. Once students are aware of the possibilities of exercise, the prospects of long term life choices that include movement activities begin.

Most of the students in this study indicated a reduction in perceived stress at the conclusion. Perhaps the exercise itself was not the reason. It is possible that the

exercise before a memory activity gave the children a feeling of control over certain outcomes that helped alleviate stress. This proactive attitude bodes well for future life choices. Just as our research indicated that the students were unaware of their own chronic stress, they may also be naïve regarding the role that exercise can play over the long term to ward off the negative impact of the stress.

Children identified as gifted have unique characteristics and challenges. With supportive families, knowledgeable teachers, and a strong sense of self-efficacy, students will grow to be confident adults armed with coping strategies that will help them to become successful citizens in our world.

As Dr. Rocky said, “With fitness great things happen.”

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APPENDIX A

20 Minute Aerobic Activity Suggested Plan
(per suggestion of Dr. Tom Loughrey, UMSL, personal communication, July, 2010):

1 min – Warm up
5 min – Cardio
2 min – Reaction Time activities
3 min – Brain Gym activities
3 min – Balance activities
5 min – Cardio
1 min – Cool down

APPENDIX B

Institutional Review Board Approval Letter

University of Missouri St. Louis

OFFICE OF RESEARCH ADMINISTRATION

Interdepartmental Correspondence

The UM-St. Louis Human Subjects Committee reviewed the following protocol:

Name: Denise M. Ford

Title: An Action Research Inquiry Into the Relationship Among Aerobic Activities, Memory and Stress With Students

This proposal was approved by the Human Subjects Committee for a period of one year starting from the date listed below. The Human Subjects Committee must be notified in writing prior to major changes in the approved protocol. Examples of major changes are the addition of research sites or research instruments.

An annual report must be filed with the committee. This report should indicate the starting date of the project and the number of subjects since the start of project, or since last annual report.

Any consent or assent forms must be signed in duplicate and a copy provided to the subject. The principal investigator is required to retain the other copy of the signed consent form for at least three years following the completion of the research activity and the forms must be available for inspection if there is an official review of the UM-St. Louis human subjects research proceedings by the U.S. Department of Health and Human Services Office for Protection from Research Risks.

This action is officially recorded in the minutes of the committee.

Protocol Number	Date	Signature - Chair
100809F	9/20/10	C J Davis

APPENDIX C

STAIC "How I Feel" Questionnaires Forms C-1 and C-2

HOW-I-FEEL QUESTIONNAIRE

Developed by C.D. Spielberger, C.D. Edwards, J. Montuori, and R. Lushene

STAIC Form C-1

Name: _____ Age: _____ Date:_____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement carefully and decide how you feel *right now*. Then put an X in the box in front of the word or phrase which best describes how you feel. There are no right or wrong answers. Don't spend too much time on any one statement. Remember, find the word or phrase which best describes how you feel right now, *at this very moment*.

1. I feel	❑ very calm	❑ calm	❑ not calm
2. I feel	❑ very upset	❑ upset	❑ not upset
3. I feel	❑ very pleasant	❑ pleasant	❑ not pleasant
4. I feel	❑ very nervous	❑ nervous	❑ not nervous
5. I feel	❑ very jittery	❑ jittery	❑ not jittery
6. I feel	❑ very rested	❑ rested	❑ not rested
7. I feel	❑ very scared	❑ scared	❑ not scared
8. I feel	❑ very relaxed	❑ relaxed	❑ not relaxed
9. I feel	❑ very worried	❑ worried	❑ not worried
10. I feel	❑ very satisfied	❑ satisfied	❑ not satisfied
11. I feel	❑ very frightened	❑ frightened	❑ not frightened
12. I feel	❑ very happy	❑ happy	❑ not happy
13. I feel	❑ very sure	❑ sure	❑ not sure
14. I feel	❑ very good	❑ good	❑ not good
15. I feel	❑ very troubled	❑ troubled	❑ not troubled
16. I feel	❑ very bothered	❑ bothered	❑ not bothered
17. I feel	❑ very nice	❑ nice	❑ not nice
18. I feel	❑ very terrified	❑ terrified	❑ not terrified
19. I feel	❑ very mixed-up	❑ mixed-up	❑ not mixed-up
20. I feel	❑ very cheerful	❑ cheerful	❑ not cheerful

HOW-I-FEEL QUESTIONNAIRE

STAIC Form C-2

Name: _____ Age: _____ Date:_____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement carefully and decide if it is *hardly-ever*, or *sometimes*, or *often* true for you. Then for each statement, put an X in the box in front of the word that seems to describe you best. There are no right or wrong answers. Don't spend too much time on any one statement. Remember, choose the word which seems to describe how you usually feel.

1. I worry about making mistakes	❑ hardly-ever	❑ sometimes	❑ often
2. I feel like crying	❑ hardly-ever	❑ sometimes	❑ often
3. I feel unhappy	❑ hardly-ever	❑ sometimes	❑ often
4. I have trouble making up my mind	❑ hardly-ever	❑ sometimes	❑ often
5. It is difficult for me to face my problems	❑ hardly-ever	❑ sometimes	❑ often
6. I worry too much	❑ hardly-ever	❑ sometimes	❑ often
7. I get upset at home	❑ hardly-ever	❑ sometimes	❑ often
8. I am shy	❑ hardly-ever	❑ sometimes	❑ often
9. I feel troubled	❑ hardly-ever	❑ sometimes	❑ often
10. Unimportant thoughts run through my mind and bother me	❑ hardly-ever	❑ sometimes	❑ often
11. I worry about school	❑ hardly-ever	❑ sometimes	❑ often
12. I have trouble deciding what to do	❑ hardly-ever	❑ sometimes	❑ often
13. I notice my heart beats fast	❑ hardly-ever	❑ sometimes	❑ often
14. I am secretly afraid	❑ hardly-ever	❑ sometimes	❑ often
15. I worry about my parents	❑ hardly-ever	❑ sometimes	❑ often
16. My hands get sweaty	❑ hardly-ever	❑ sometimes	❑ often
17. I worry about things that may happen	❑ hardly-ever	❑ sometimes	❑ often
18. It is hard for me to fall asleep at night	❑ hardly-ever	❑ sometimes	❑ often
19. I get a funny feeling in my stomach	❑ hardly-ever	❑ sometimes	❑ often
20. I worry about what others think of me	❑ hardly-ever	❑ sometimes	❑ often

APPENDIX D

Student Open-Ended Interview Questions

Student Open-Ended Interview Questions at beginning of study:

.Describe a perfect and relaxing way to spend a school day.

Some people say that gifted students experience more stress than other students, how do you respond to that?

Tell me what you do when you are feeling worried or anxious. What you would like to do?

What is your favorite type of physical or aerobic activity?

Student Open-Ended Interview Questions to be used near completion of study:

How has your research study gone?

What have you found most interesting about this study?

What has surprised you about our study?

APPENDIX E

PARENT FOCUS GROUP SESSION
November, 2010

Handout: *Helping Gifted Students with Stress Management*

ERIC EC Digest #E488
Author: Leslie S. Kaplan
1990

From handout: Stress is the body's general response to any intense physical, emotional, or mental demand placed on it by oneself or others. While racing to meet a deadline, dealing with a difficult person, or earning a poor grade are all stressful, so are the excitement of playing a lively game of tennis, falling in love, and being selected to join a special program for gifted students.

Question Prompts:

What similarities do you see between you and your child?

What do you see as some situations that raise your child's level of stress?

How are these situations different or similar to those that may have caused stress in your childhood?

What types of behaviors indicate to you that your child is approaching or has reached a threshold of too much stress?

Typically, how does your child cope when the stress has become overwhelming?

How does your child's stress level affect the rest of the family?

What did you do as a child and what do you do now when your own stress becomes a concern?

What do you hope your child knows about managing his or her own stress?

APPENDIX F

Parent Collected Response Questions

End of Week 3:

Now that we've been working in our research for over a month, what conversations have you had with your child about our study?

What changes, if any, are you noticing in your child's activity level?

End of Week 6:

Now that we've been working in our research for over two months, what conversations have you had with your child about our study?

What changes, if any, have you noticed regarding your child's stress level or attitudes regarding stress?

End of Week 9:

Now that we've been working in our research for over three months, what conversations have you had with your child about our study?

What do you think has changed with your child or family because of this study?

APPENDIX G

Initial Coding Themes

Exercise	Brain
Stress	Allostasis
Parent stress	Movement at school
Stress triggers	Coping
Different personalities	Sleep
Perfectionism	Memory
Research	Role models/parent/child support
Blood pressure	Parent/child similarities
Fitness	No acknowledgement of stress
Attitudes	Resilience
Parent support	

.

As the coding process was refined, three larger themes emerged:

Stress

Coping

Fitness.

APPENDIX H

Student Data Graphed by Co-Researchers

The students created excel files and graphed their cardiovascular readings alongside their memory scores. The state/trait scores are added for interest. Three students' scores are displayed. Grease Monkey's state/trait results placed him in the lower third of overall percentiles. Dr. Rocky's state/trait results indicate that she is in the middle third in perceived stress indicators. Sir Isacc Drewly's scores placed him in the upper third for perceived stress.

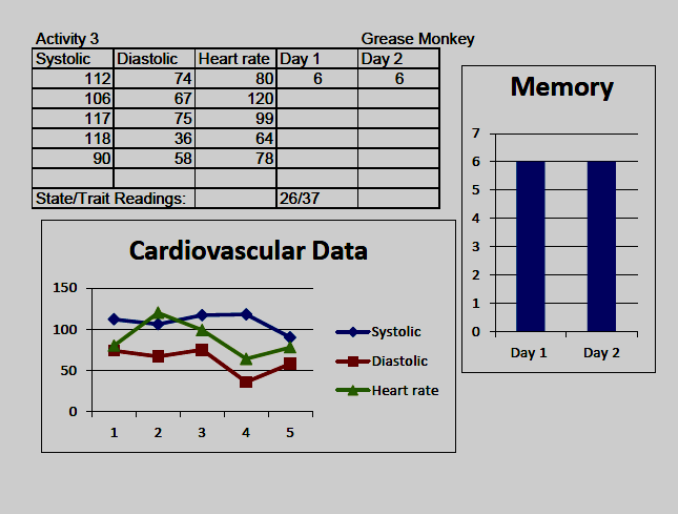

Figure H1. Grease Monkey's State/Trait Results for Activity 3, with exercise (as displayed at the school event in May).

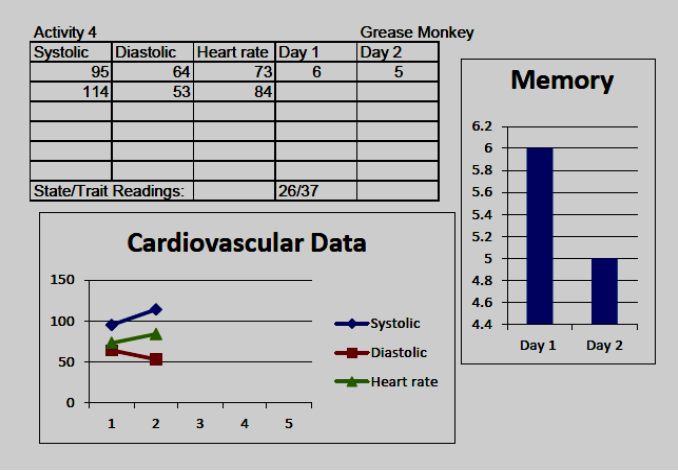

Figure H2. Grease Monkey's State/Trait Results for Activity 4, without exercise (as displayed at the school event in May).

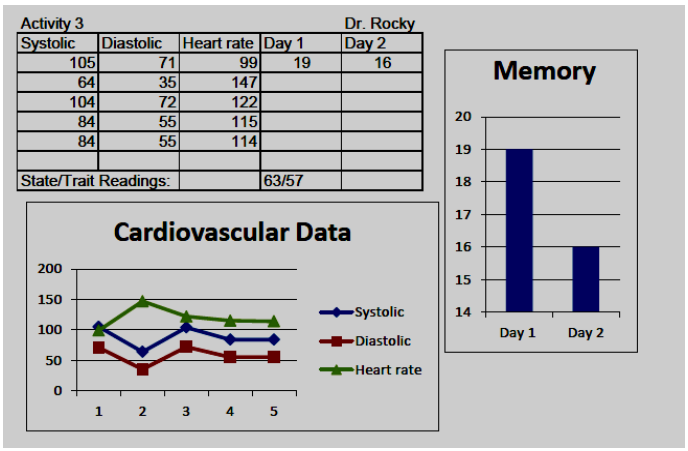

Figure H3. Dr. Rocky's State/Trait Results for Activity 3, with exercise (as displayed at the school event in May).

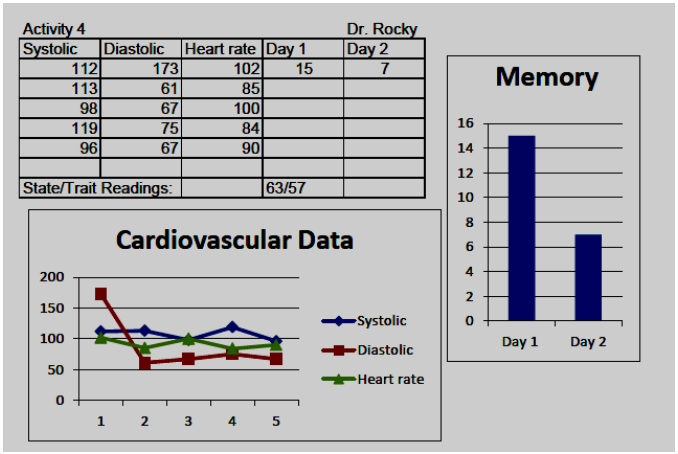

Figure H4. Dr. Rocky's State/Trait Results for Activity 4, without exercise (as displayed at the school event in May).

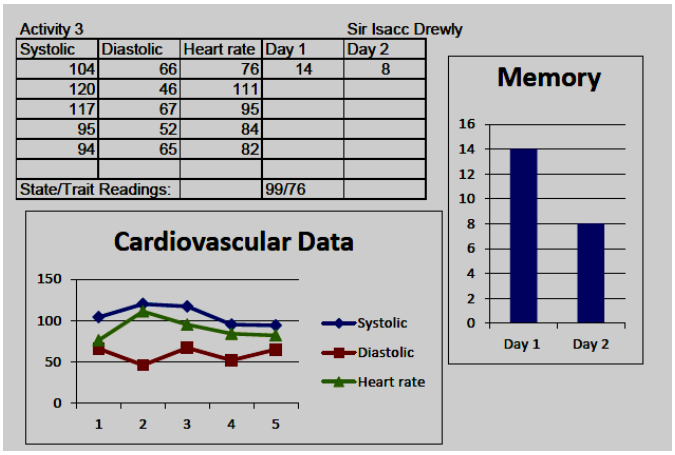

Figure H5. Sir Isacc Drewly's State/Trait Results for Activity 3, with exercise (as displayed at the school event in May).

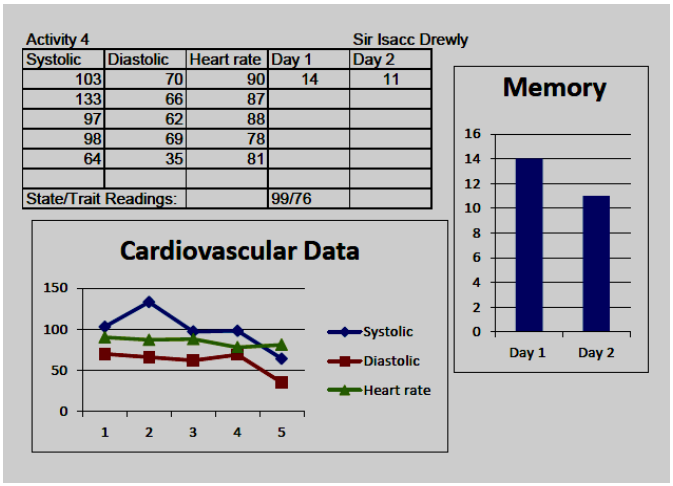

Figure H6. Sir Isacc Drewly's State/Trait Results for Activity 4, without exercise (as displayed at the school event in May).

APPENDIX I

Informed Consent for Child Participation in Research Activities

Division of Teaching and Leaning

One University Blvd.
St. Louis, Missouri 63121-4499
Telephone: 314-516-5483
Fax: 314-516-5348
E-mail: dmf4gb@mail.umsl.edu

Informed Consent for Child Participation in Research Activities
ACTION RESEARCH INQUIRY - RELATIONSHIP AMONG AEROBIC ACTIVITIES, MEMORY, STRESS

Participant _____ HSC Approval Number 100809F

Principal Investigator Denise M. Ford PI's Phone Number 314-415-6742

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1. Your child is invited to participate in a research study conducted by Mrs. Denise Marie Ford and Dr. Deborah Moberly. The purpose of this research is to study the relationship that aerobic activities may have with memory as well as the stress levels of children.

2. a) In your child's classroom, we will learn together about how our brain works and how stress may have an effect on both our blood pressure/heart rate levels as well as our memory capabilities. All students in the class will do a number of activities related to this subject in the fourth/fifth grade curriculum. Your permission is requested to use your child's data from these activities in this research project. Your child is not asked to do anything outside of the normal classroom activity.

   Approximately 16 students will be involved in this research.

   b) The amount of time involved in your child's participation will be 4 months, the length of this curriculum unit.

3. There are no anticipated risks involved in us using your child's class work as data. There are no direct benefits for your child's participation in this study. However, your child's participation will contribute to knowledge about stress and children.

4. Your child's participation is voluntary and you may choose not to let your child participate in this research study or to withdraw your consent for your child's participation at any time. You or your child will NOT be penalized in any way

should you choose not to participate or to withdraw. Children may choose not to participate even if parents give permission for such participation. There are a variety of activities and centers available in the classroom that your child may choose as an alternative to the proposed study activities.

5. We will do everything we can to protect your child's privacy. As part of this effort, your child's identity will not be revealed in any publication or presentation that may result from this study. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection). That agency would be required to maintain the confidentiality of your child's data.

6. You will be offered the opportunity to complete a survey on two separate occasions asking questions regarding your child's perceived level of stress at the time of the study and as an overall general state of mind. Some of these questions may be sensitive in nature. You may choose not to answer any or all of the questions in the survey.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Denise Ford at 324-425-6742 or Dr. Deborah Moberly at 314-516-6821. You may also ask questions or state concerns regarding your child's rights as a research participant to the Office of Research Administration, at 516-5897.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my child's participation in the research described above.

Parent's/Guardian's Signature Date	Parent's/Guardian's Printed Name
Child's Printed Name	
	Denise M. Ford
Signature of Investigator or Designee Date	Investigator/Designee Printed Name

APPENDIX J

Assent to Participate in Research Activities (Minors)

One University Blvd.
St. Louis, Missouri 63121-4499
Telephone: 314-516-5483
Fax: 314-516-5348
E-mail: dmf4gb@mail.umsl.edu

Assent to Participate in Research Activities (Minors)

ACTION RESEARCH INQUIRY - RELATIONSHIP AMONG AEROBIC ACTIVITIES, MEMORY, STRESS

1. My name is Mrs. Denise Ford.

2. I am asking you to take part in a research study because we are trying to learn more about the effects of exercise on children. We wonder if exercise can help reduce stress and enhance memory.

3. If you agree to be in this study you will let me use your schoolwork as data. I will collect your journals, cardiovascular and memory test results and analyze them. You will not have to do anything except for your regular class work.

4. Being in this study should not harm you in any way.

5. If you don't want your data to be used in this study, it doesn't have to be used. Remember, being in this study is up to you, and no one will be upset if you don't want to participate or if you change your mind later and want to stop. Even if your parents have agreed that you can contribute, you still have the option of not allowing your data to be used. We will have our regular classroom activities, which you will be expected to do just as with all of our school work. But if you don't want to be involved in the interviews and/or research conference, there will be a variety of alternative activities and centers available in the classroom that you may choose to engage in while these are taking place.

7. You can speak to the counselors at any time if there are things you want to talk about as we learn more about how our brains work and how we deal with stress. You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me at 314-415-6742 or email me at dford@pkwy.k12.mo.us.

8. Signing your name at the bottom means that you agree to be in this study. You will be given a copy of this form after you have signed it.

9. All information will be kept under lock and key and when results of the research are published or discussed at conferences no identifying information will be included.

_____ _____

Participant's Signature Date Participant's Printed Name

_____ _____

Participant's Age Grade in School Parent Signature Date