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The Effects of Brain Gym® Activities on Second-Grade Students' Academic Performance and Handwriting Skills

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THE EFFECTS OF BRAIN GYM® ACTIVITIES ON SECOND-GRADE STUDENTS' ACADEMIC PERFORMANCE AND HANDWRITING SKILLS

by

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Objective: The purpose of this quantitative study was to determine the effects of Brain Gym® activities on second-grand students' academic performance and handwriting skills.

Method: Results were obtained by administering the Test of Handwriting Skills (THS) to two classrooms in a Northern Michigan Elementary School and having both teachers complete a self-developed Academic Performance Form on each student participating in the study. The data from was analyzed using a *t*-test for the THS and mean scores for the self-developed Academic Performance Form.

Results: Findings suggest a significant difference ($p < .05$) in the number of letters produced in 20 seconds and spacing of letters. Non-standardized testing showed a decrease in attention to task scores between pre- and post-testing.

Conclusion: Brain Gym® activities were shown to positively effect handwriting skills. These findings support the research of Drabben-Thiemann and Donczik. Findings also suggest that there is no significant difference in academic performance following Brain Gym® activities. Further research on the effects of Brain Gym® activities in the school environment is recommended.

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CHAPTER 1

INTRODUCTION

Background Information

Brain Gym® is a series of twenty-six movement activities that was developed by Paul E. Dennison, Ph.D., and Gail E. Dennison to help individuals "draw out their full potential as learners" (Dennison & Dennison, 1994, p. 1). It promotes whole brain learning "through simple integrative movements which focus on specific aspects of sensory activation and facilitate integration of function across the body mid line" (Hannaford, 1995, p. 112). Brain Gym is based upon three simple premises:

1. Learning is a natural, joyous activity that continues throughout life.
2. Learning blocks are the inability to move through the stress and uncertainty of a new task.
3. We are all 'learning-blocked' to the extent that we have learned not to move (Dennison and Dennison, 1994, p. 2).

Brain Gym activities are used in many classrooms across the United States as well as in other countries to help typically developing children and even those with special needs to sit still, listen, focus on letters, numbers, and other figures, and use their eyes to track from left to right (Freeman and Rentschler, 1998). Many learning situations deal for the most part with the following steps: "sensory input, integration and assimilation, and action." Brain Gym facilitates each step of the learning process "by waking up the mind/body system, and bringing it to learning readiness" (Hannaford, 1995, p. 112).

In the educational setting, the ultimate goal is for students to learn and remember new concepts. "Learning, memory, and thought require the manipulation of knowledge about previously acquired knowledge. To think, learn, and remember, we need to

interpret or convert this knowledge into action (Ratey, 2001, p. 178)." In today's school systems, students are frequently expected to sit in a chair for a majority of the school day. There are some opportunities for movement breaks during gym class, recess, and when walking from one class to another class. However, some schools are being faced with major budget cuts. Thus fine arts classes (i.e. music, drama, etc.) and gym classes are being removed from school programs. School staff also have a tendency to take away recess as a punishment for negative behavior. The amount of movement opportunities students receive during the school day is becoming increasingly limited. However, it is important to remember that "our physical movements can directly influence our ability to learn, think, and remember" (Ratey, 2001, p. 178).

Not only is movement being limited in our schools, there are also an increasing number of students in special education. In the last 15 years, more parents of special education students (with mild to severe disabilities) are advocating for their children and having their children placed full time in general-education classrooms. Many regular-education teachers "usually have had little if any special education training and, therefore, are unprepared to educate students" (Special Education, 1998, pg. 5) with varying disabilities. Such disabilities may include, Learning Disabled, Speech Impaired, Emotionally Impaired, Educable Mentally Impaired, Physically Impaired, Trainable Mentally Impaired, Severely Multiply Impaired, Early Childhood Developmental Delay, Hearing Impaired, Autistic Impaired, Severely Mentally Impaired, and Visually Impaired (Special Education, 1998). These disabilities are frequently associated with difficulty organizing sensory information and with motor movements. There may be poor cognitive development, and there may be vision problems that are not easily detected by a typical school vision screening (Scheiman, 2002). However, in 1975 a federal law that relates to

special education was developed. This law is the Individuals with Disabilities Education Act (IDEA, PL 101-476) and it "requires that all children with disabilities receive a 'free, appropriate education' that meets their individual needs" (Special Education, 1998, pg. 1). It also requires that "special education be provided in the least restrictive environment possible, to ensure that special education students are not unnecessarily segregated or treated in a way that is not equal to that of general-education pupils" (Special Education, 1998, pg.1).

The National Center for Educational Statistics reported that in 1996 there were "76,543 students" (National Center for Education Statistics, online, 2004) in public schools within the state of Michigan with a current Individualized Education Program (I.E.P.). An I.E.P. is a legal document that identifies a student's academic needs and specifies the educational setting that best meets the student's individual needs (Special Education, 1998). In the 2001-2002 school year, there were "232, 592 students" (National Center for Education Statistics, online, 2004) with a current I.E.P. This is a significant increase of 156,049 special education students in Michigan over a five-year period.

With the growing number of regular and special education students, an increase in varying learning styles, and with the continual demand for higher scores on standardized tests, teachers are faced with many challenges. It is important to remember that all people (special education students, regular education students, teachers, etc.) have different learning styles. What works for one individual may not work for another. Some people are kinesthetic learners and they need physical movement in order to retain spoken information. Some students need fewer environmental distractions from sounds and some students need less visual stimulation from classroom clutter (Kranowitz, 2003).

One way to aide in the challenge of meeting all students' learning styles may be to incorporate short spurts of different movement activities into a classroom routine. Many types of movement activities can be used. The unique feature of Brain Gym® is that the activities can easily be included into a daily classroom routine. Many Brain Gym® activities encourage children to cross the visual and physical midline of the body, adjust posture and balance, control gross and fine motor movements, maintain focus and attention, and identify spatial relations to other objects and people in the environment (Dennison & Dennison, 1994). In addition, Brain Gym® activities are purported to encourage the development of reading skills (crossing the visual midline, oral reading, and reading comprehension), thinking skills (organization skills, spelling, and math), writing skills (eye-hand coordination and creative writing), self-awareness (clear listening and speaking, self concept, and whole-body coordination for sports and play) (Dennison & Dennison, 1994). Some school occupational therapists, physical therapists, and speech and language pathologists are knowledgeable in the area of Brain Gym® activities and can be a helpful resource for developing a classroom routine using the Brain Gym® activities.

Problem Statement

Smooth and coordinated movements, visual focus and attention, academic skills, and handwriting skills are all important to learning, thinking, and retaining information. There is limited research and literature to support the perception that the use of Brain Gym® activities throughout the school day improves students' academic performance and handwriting skills.

There have been a minimal number of studies completed on the use of Brain Gym® activities in the school environment (Donczik, 2001; Dennison, 2001; Freeman, 2000). Freeman (2000), states that perhaps one by one, schools across the nation will inquire about how to get Brain Gym® at their school site.

It was proposed in this study that the daily use of Brain Gym® activities throughout the school day is beneficial to all students (with and without disabilities). This study was conducted to determine if those students who completed Brain Gym® activities on a daily basis showed a significant difference on standardized test scores and classroom academic performance as compared those students who did not complete the Brain Gym® activities.

Purpose

The purpose of this quantitative study was to determine the effects of Brain Gym® activities on academic performance and handwriting skills in elementary school children. Academic performance was investigated using a self-designed Academic Performance Form.

Research Question

The research question that guided this study is as follows: Do children who participate in Brain Gym® activities demonstrate improvement in academic performance and handwriting skills as compared to those children who do not participate?

The following questions directed this study:

1. Are there fewer letters reversed in the experimental group as compared to that of the control group?
2. Is there a difference in the number of letters the students are able to write in 20 seconds following daily Brain Gym activities?
3. Is there improvement in spacing of letters following daily Brain Gym activities?
4. Is there greater attention to task following daily Brain Gym activities as compared to the control group?
5. Is there an increase in the academic performance score following daily Brain Gym activities as compared to the control group?

CHAPTER 2

REVIEW OF RELATED LITERATURE

Literature Review

A review of the literature was conducted in regards to Brain Gym® activities and those areas that are very closely related to the effects of Brain Gym® activities. Brain Gym® was developed as a form of Educational Kinesiology (Edu-K). This is the "study and application of natural movement experiences to facilitate learning. It focuses on the performance of specific physical activities that activate the brain for optimal storage and retrieval of information" (http://www.braingym.org/faq.html). Brain Gym® helps prepare individuals of all ages to "practice and master the skills required for the mechanics of learning" (http://www.braingym.org/faq.html). It focuses on the physical as opposed to the cognitive component of the learning process. Brain Gym® activities can be used to enhance any learning environment. This may include a staff meeting, a professional conference, a sports program, an art program, and a school classroom.

When discussing Brain Gym®, it is important to review three main areas of development. These include the brain and learning, movement, and sensory integration.

The Brain and Learning

The human brain is a complicated and continuously changing dynamic "ecosystem" (Ratey, 2001, pg. 11). The brain is composed of several structures and is important for a number of functions. There are crucial connections made in the brain that help the brain and body work together in a smooth and coordinated fashion. These connections are also "constantly integrating movement, the senses, and emotions"

(Hannaford, 1995, pg. 71). "The unique set of connections which each of us makes from the very first moment we encounter the world, shapes our understanding of the world and of ourselves" (Hannaford, 1995, pg. 70). Understanding some of the basic brain structures and functions is an important part of making sense out of the Brain Gym® theory, activities, and related research.

Brain Stem.

The brain stem is a structure that is responsible for involuntary movements. These "automatic motor reflexes...keep our heart beating and our lungs breathing. Instant reactions that come under the behaviors of 'fight or flight' such as panic and rage are also initiated in the brain stem" (Sunbeck, 2002, pg. 14). These reflexes send a signal alarming the muscles and internal organs of an environmental situation. Our ultimate goal is to assess the situation and make a decision for a response before reacting to a "primitive survival reflex that does not understand the difference between actual physical danger and emotional stress that is not (immediately) life threatening" (Sunbeck, 2002, pg. 14).

Cerebellum.

The cerebellum receives sensory information from the environment and sends messages to the motor areas of the cortex (higher in the brain) to regulate movement. It "coordinates the body's actions to ensure that movements go together in efficient sequences" (Morris, 1996, pg. 50). The cerebellum is able to recall the automatic sequences of movement for the extent of our lives. Thus, to "alter poorly learned behaviors we must stop the cerebellum's automatic initiation of the action sequence and

shift back to slower voluntary muscle movements" (Sunbeck, 2002, pg. 14) that take place in our brain stem.

Cerebral Hemispheres.

Our right and left cerebral hemispheres appear very similar in structure, yet function very differently. Our right hemisphere receives information from the left side of the body and visual fields. "Research indicates that the right hemisphere excels at visual and spatial tasks, nonverbal imagery (such as visual images, music, and environmental noises), face recognition, and the perception and expression of emotion" (Morris, 1996, pg. 56). On the other hand, our left hemisphere receives information from the right side of the body and visual fields. "In most people, the left hemisphere is dominant in verbal tasks, such as identifying spoken and printed words and speaking. It has been suggested that the left hemisphere may also operate more analytically than the right hemisphere" (Morris, 1996, pg. 56).

Corpus Callosum.

The corpus callosum is the area in the brain that connects the right and left cerebral hemispheres. "Under normal conditions, the left and right cerebral hemispheres are in close communication through the corpus callosum, and they work together as a coordinated unit" (Morris, 1996, pg. 54). "For instance, normal communication across the corpus callosum takes about 25 milliseconds. Imagine an enormous multiple lane bridge connecting a local community. The main disadvantage of being on one side of the bridge is the time it takes to get across it. A 25-millisecond delay in communication between the cerebral hemispheres only becomes critical when reaction time in bilateral tasks determines success or failure" (Sunbeck, 2002, pg. 16). Other bilateral tasks where information must travel from one hemisphere to the other include holding a piece of

paper with one hand and writing with the other hand, catching a ball, and cutting a piece of paper.

Lobes of the Brain.

The four lobes of the brain include the occipital lobe, the temporal lobe, the parietal lobe, and the frontal lobe. The occipital lobe is located at the top of the spine. It "receives and processes visual information" and is the place where we "experience shapes, color, and motion in the environment" (Morris, 1996, pg. 51). The temporal lobe is located just anterior to the occipital lobe, near the ears. It is the "primary 'smell center' in the brain" and "plays an important role in complex visual tasks such as recognizing faces. It also receives and processes information from the ears, contributes to balance and equilibrium, and regulates emotions and motivations such as anxiety, pleasure, and anger" (Moriss, 1996, pg. 51). The parietal lobe is located on top of the temporal and occipital lobes. This lobe "receives sensory information from all over the body" and it plays a role in "spatial abilities, such as the ability to follow a map or to tell someone how to get somewhere" (Morriss, 1996, pg. 52). The frontal lobe is located just behind the forehead. It "accounts for about half the volume of the human brain" (Morris, 1996, pg. 52) and "seems to permit and anticipate goal-directed behavior" (Morris, 1996, pg. 53). The frontal lobe has also been linked to emotional temperament and deals with "planning and thinking" (Sousa, 2001, pg. 17).

Limbic System.

The limbic system is typically known as the "emotion center" of the brain. There are "two of almost everything in the limbic system" (Sunbeck, 2002, pg. 17), one for each hemisphere. "The limbic system can send emotionally charged signals directly to the muscles and internal organs that are as powerfully convincing as any primitive survival

reflex" (Sunbeck, 2002, pg. 17). The limbic system is the place where sensory defensiveness takes place and is "central to emotions, memory, pleasure, and learning" (Ratey, 2001, pg. 63). When an event is perceived as a disaster, "the neurotransmitter adrenaline is released and the mind/body responds with a series of survival-oriented reactions" (Hannaford, 1995, pg. 54). An increase in adrenaline also produces the neurotransmitter cortisol, which "decreases our ability to learn and remember. If instead we choose to perceive the event as a learning experience, an adventure, other neurotransmitters"...are released that "increase our ability to establish or reorganize neural networks so that we may effectively think and remember" (Hannaford, 1995, pg. 55). The way in which we perceive an event, "colored by our emotions, determines our response to it and our potential for learning from it" (Hannaford, 1995, pg. 54). Thus, in order to "learn, think or create, learners must have an emotional commitment" (Hannaford, 1995, pg. 56).

Eye and Visual Fields.

"Vision is a very complex phenomenon, with only a small percentage (less than 10%) of the process occurring in the eyes. The remaining 90% of vision takes place in the brain" (Hannaford, 1995, pg. 45). Our eyes are designed to change and adjust to movement and light differences as well as give us sensory information about our environment. According to Sunbeck, we have four visual fields. "The outer half of our vision in each eye, called peripheral vision, is sent to the contralateral (opposite) hemisphere" (Sunbeck, 2002, pg. 22). Hence, the far left peripheral fields send information to the right side of the brain, the far right peripheral fields send information to the left side of the brain, and central vision (directly in front of us) sends the same information to both hemispheres. Once the information reaches the brain, the brain can

then filter the information and send information from one hemisphere to the other through the corpus callosum so that a motor (muscle/body) response can be made. It is possible to have 20/20 visual acuity in both the right and left eyes, yet still encounter difficulties using both eyes efficiently. "Visual efficiency refers to the effectiveness of the visual system to clearly, efficiently, and comfortably allow an individual to gather visual information at school, work, or play" (Scheiman, 2002, pg.47). Some common differences with visual efficiency are as follows: accommodation – "the ability to change the focus of the eye so that objects at different distances can be seen clearly" (Scheiman, 2002, pg. 47); binocular vision – "the ability of the visual system to fuse or combine the information from the right and left eyes into one image" (Scheiman, 2002, pg. 51); amblyopia – this is commonly called "lazy eye" and is a condition in which "the visual acuity is less than 20/20" and "it is not an optical problem, rather it is a neurophysiological problem in which the visual pathway from the eye to the visual cortex does not develop normally or deteriorates due to some type of interference during the sensitive period" (Scheiman, 2002, pg. 61); and ocular motility disorders – this may include eye movement disorders, tracking difficulties, and problems with visual scanning, many of which are necessary skills in a classroom environment.

In a study of 144 first and second grade students in a public school, "data on 25 measures of visual efficiency were subjected to two- and three-way Analyses of Variance. Binocular function, visual acuity, discrepancies in acuity, and color deficiencies were all found to be statistically significant in impeding beginning reading" (Young, 1994, pg, 276). A summary of the data showed that "visual factors are a primary cause of beginning reading failure and that most current school screenings are inadequate in scope and rigor" (Young, 1994, pg. 276).

Brain Cells.

There are two known types of brain cells: nerve cells and glial cells. Nerve cells, also known as neurons, are the "functioning core for the brain and the entire nervous system" and glial cells "hold the neurons together and act as filters to keep harmful substances out of the neurons" (Sousa, 2001, pg. 20).

> Unlike other cells, the neuron has tens of thousands of branches emerging from its core, called dendrites. The dendrites receive electrical impulses from other neurons and transmit them along a long fiber, called the axon. There is normally only one axon per neuron....A neuron can transmit between 250 and 2,500 impulses per second. Neurons have no direct contact with each other. Between each dendrite and axon is a small gap of about a millionth of an inch called a synapse...The neuron sends out spikes of electrical activity (impulses) through the axon to the synapse where the activity releases chemicals stored in sacs (called synaptic vesicles) at the end of the axon (Sousa, 2001, pg. 20-21).

The chemicals that are released, called neurotransmitters, aid in the process of exciting or inhibiting the nearby neurons (Sousa, 2001). "This is the body's way of communicating between the external and internal environment," and "this constant molecular communication can be restructured, depending on usage, undergoing coherent, synchronized changes as learning occurs" (Hannaford, 1995, pg. 23). Thus, our brain is like a "free-form information network" (Hannaford, 1995, pg. 24) with endless limitations.

As learning takes place, information enters the body through our senses (this will be discussed in a later section), travels through the nerves in our central nervous system, and enters our brain. This is where axons send information to dendrites, neurotransmitters are released, and a decision is made for a body response. If the axons are sending the wrong information to the dendrites, learning, movement, vision, etc. can all be affected. Thus, the whole brain/body system "must be active in order to take in

information, select what is important about that information, integrate it with existing patterns and finally, to anchor it with movement" (Hannaford, 1995, pg. 87).

> Real learning – the kind of learning that establishes meaningful connections for the learner – is not complete until there is some output, some physical, personal expression of thought. Much of learning involves the establishment of skills that enable us to express our knowledge. Speaking, writing, computing, drawing, art, playing music, singing, moving gracefully in dance and sports: the development of our knowledge goes hand in hand with the development of the skills that support and express our knowledge (Hannaford, 1995, pg. 87).

When we use the muscles in our bodies, we are building these skills by creating connections between our neuromuscular and cognitive systems. "Learning is not all in your head. The active, muscular expression of learning is an important ingredient of that learning process" (Hannaford, 1995, pg. 87).

Movement

Movement is a vital part of our everyday lives. It is a complex process that involves both the physical body and the brain. Information from our environment is sent through our central nervous system to different parts of our brain (as discussed earlier). Our brain then interprets that information and responds. Finally, information is sent from our brain through our central nervous system to the muscles in our body. Thus, "what the brain communicates to the body depends largely on what messages the body is sending to the brain" (Ratey, 2001, p. 159-160).

In the early stages of development, movement is a very basic concept. "Every movement is a sensory-motor event, linked to the intimate understanding of our physical world, the world from which all new learning derives" (Hannaford, 1995, pg. 96). Movement begins with the right and left sides of the body working independently of each other. There is little cross-over from the right and left sides of the body to the right and

left sides of the brain. For example, when an infant is presented with a one-inch block in each hand, he/she will drop one of the blocks and explore the block with the one hand, usually oblivious to the fact that the second hand is even available to help with the task. Next, the child will bring the block to midline and explore the block using both hands. This is followed by transferring the block from one hand to the other. As the infant matures, develops, and repeats the action over and over, the infant masters the skill and continues to explore his/her environment by grasping one block in each hand and banging them together at midline. Finally a child will be able to reach across midline to obtain the block. As the child continues to develop, the body begins to send information through the brain stem, cerebellum, and finally to the right and left hemispheres of the brain where it can be interpreted to make a whole-body response. At this point, information may cross from one hemisphere to the other through the corpus callosum. This is evident when a child will cross midline during play with no physical or verbal prompts. When both hemispheres of the brain become integrated, the brain and body are able to function as a whole (*Peabody Developmental Profile*, Second Ed., 2003 and Dennison & Dennison, 1994).

Bilateral movement activities activate both hemispheres in a balanced way. These activities work both sides of the body evenly and require coordinated movements of the eyes, ears, hands, feet, as well as the core muscles. Since both hemispheres and all four lobes of our brain are activated with these bilateral movement activities, cognitive function is heightened and ease of learning increases (Peabody Developmental Profile, Second Ed., 2003 and Dennison & Dennison, 1994). Thus, "learning involves the building of skills, and skills of every manner are built through the movement of muscles –

not just the physical skills of athletes, dancers and artisans, but also the intellectual skills used in classrooms and workplaces"(Hannaford, 1995, pg. 98).

Brain Gym® activities were developed to include three dimensions of movement. They were "discovered to either stimulate (Laterality Dimension), release (Focusing Dimension), or relax (Centering Dimension) students involved in particular types of learning situations" (Dennison & Dennison, 1994, pg. 1).

Laterality Dimension.

The laterality dimension involves "the skills necessary for easy two-sided (left-right) movement across the midline of the body" (Dennison & Dennison, 1994, pg. 3). The activities in the laterality dimension encourage the development of bilateral movement skills for crawling, walking, reaching, and depth perception. It is a prerequisite for smooth and coordinated movement patterns and also encourages ease of learning in the near-visual fields. These activities help students to enhance upper and lower body coordination abilities for gross (large muscle movements) and fine (small muscle movements) motor skills (Dennison & Dennison, 1994).

Focusing Dimension.

The focusing dimension encourages individuals to "develop and reinforce those neural pathways that enable them to make connections between what they already know in the back of the brain and the ability to express and process that information in the front of the brain" (Dennison & Dennison, 1994, pg. 16). The focusing dimension incorporates activities that lengthen muscles in the body and encourage relaxation, especially when in a new learning environment or when learning something new. These activities activate and reset our proprioceptors, "the 'brain cells in muscles' that give us information about

where we are in space" (Dennison & Dennison, 1994, pg. 16), to allow us to have improved access to the brain-body system (Dennison & Dennison, 1994).

Centering Dimension.

The centering dimension helps to "re-establish neural connections between the body and brain, thus facilitating the flow of electromagnetic energy throughout the body" (Dennison & Dennison, 1994, pg. 23). The human body is a very complex electrical system. All sensory information that enters the human body changes into electrical signals along nerve fibers to the brain. At this point, the "brain sends out electrical signals along other nerve fibers to tell the visual, auditory, and muscular system how to respond. These currents travel at speeds of up to 400 kilometers (248 miles) per hour" (Dennison & Dennison, 1994, pg. 23). Similar to the way electrical systems in our homes and offices can become overloaded, our own neurological and physiological systems can become blocked and alter the normal flow of communication between the brain and body. The activities in this dimension encourage an increase in focus and concentration for successful learning to take place (Dennison & Dennison, 1994).

Traditional educational programs have typically been based upon the premise that learning is a mental activity and that "the physical components of learning – the visual, auditory, fine motor and postural skills – have been almost entirely ignored by educators" (http://www.braingym.org/faq.html). However, when learning involves both the brain and body systems, "we become active, self-motivated learners, able to take risks, explore new territory, and enjoy the peaks and valleys of the adventure, at any age and under any circumstance" (Dennison & Dennison, 1997, pg. 4). "The brain's motor function affects so much more than just physical motion. It is crucial to all other brain functions –

perception, attention, emotion – and so affects the highest cognitive processes of memory, thinking, and learning" (Ratey, 2001, pg. 175).

In the school environment, movement is used in many ways. The following are some examples of movement activities that are frequently used in the school environment: writing, walking, carrying a lunch tray, cutting with scissors, sitting in a chair, reading, etc. These may seem like simple activities that do not require much thought and effort. However, when these activities are analyzed, it is clear that they are very complex. For example, handwriting involves our eyes. Our eyes must be able to work together to maintain focus on the specific part of the paper where we are creating letters to form a sentence. "It has been estimated that 75 to 90% of all of classroom learning comes to the student via the visual pathways. If there is any interference with these pathways, the student will probably experience difficulty with learning tasks" (Heinke and Greenburg, 1981, p. 1). Some visual skills that are highly important for success in the school environment include:

Visual Acuity.

A typical example of acuity is 20/20 vision. "An individual with 20/20 acuity is considered to have normal ability to see small detail at the distance tested" (Scheiman, 2002, pg. 17).

Eye Teaming Skills (Binocularity).

Binocularity is the ability of the "visual system to fuse or combine the information from the right and left eyes into one image;" thus "the information arriving from each eye must be identical and approximately equal in clarity and size" (Scheiman, 2002, pg. 51-52). Sometimes one or both eyes are turned in, out, or up and this affects normal visual development.

Eye-Hand Coordination Skills.

Eye-hand coordination is the ability to coordinate vision with the movements of the hands and arms.

Visual Discrimination.

Visual discrimination is the ability of a child to "be aware of the distinctive features of forms, including shape, orientation, size, and color" (Scheiman, 2002, pg. 70).

Visual Figure Ground.

Visual figure ground is the ability of a child to perceive a form visually and to find this form hidden in a competing background.

Visual Closure.

Visual closure involves the ability to identify forms or objects from incomplete presentations.

Visual Memory.

Visual memory involves the ability of a child to "recognize and recall visually presented information. Spelling requires recall of visual information, as does word recognition in reading when we try to match the word on the page with an image that is stored in the brain" (Scheiman, 2002, pg. 70).

Visual Spatial Relations.

Visual spatial relations includes the ability to determine the position of objects relative to each other. This may include finding a form that is going a different direction than the other presented forms.

Visual Form Constancy.

Visual form constancy is the ability to see a form and to find that same form, even though the form may be smaller, larger, rotated, reversed, and/or hidden among other forms.

Visual Sequential Memory.

Visual sequential memory involves the ability to remember, for immediate recall, a series of shapes, words, letters, numbers, etc.

Handwriting also requires our brain to tell the muscles in our hand to grasp the pencil and move the pencil from the left side of the paper to the right side of the paper forming specific intricate letters and words to make a sentence. We must make certain to place enough space between each word so the reader can understand the sentence. Each sentence should be aligned horizontally to avoid wandering or curving sentences. At the same time, our other hand is supporting the paper so it does not move during the writing process. The consistent use of Brain Gym® activities may help improve those visual and motor skills required in handwriting.

In a 1992 study, twelve second-grade students who experienced learning difficulties met in small groups two times per week for five weeks. Each meeting included some Brain Gym® activities. "Post-testing, conducted one month after the groups were concluded, indicated measurable improvements in visual skill performance" (Brain Gym International - Research, 2003, pg. 12). Likewise, in 1996, Gail Dennison implemented a "five-week experimental Brain Gym program with fifteen preschoolers" in a Headstart School in California. The results of the study showed "improved drawing and

writing skills," "improved motor coordination," "an increase in focus and attention," and "better standing posture and balance" (http://www.braingym.org/gail.html).

Sensory Integration

From the moment we are born, "our brain receives sensory information from our bodies and surroundings, interprets these messages, and organizes our purposeful responses" (Kranowitz, 2003). We hear our mother's comforting voice, we see a toy across the room, we use our legs and arms together in a coordinated manner to crawl over to our toy, we maintain our balance when sitting to play with a toy, or we put our arm out to protect ourselves from falling when our dog bumps into us. These are all ways in which our body and brain work together to "use our sensations to survive, to learn, and to function smoothly" (Kranowitz, 2003, pg. 3). When we think of our senses, we tend to think of our five basic sensory systems. These include:

Tactile System (touch).

This system involves any kind of touch or movement of hair any place on our body. It gives us our boundaries and personal space. Examples of a dysfunctional tactile system are as follows: a child may get hurt and not realize it, often appears very active or fidgety, and/or purposefully bumps or strikes out at other children because he/she can not tolerate being close to others.

Visual System (vision).

This system involves what we see (including colors, distance, light, dark, depth, etc.). Examples of a dysfunctional visual system are as follows: the child loses place when reading, displays poor eye contact, and/or experiences difficulty matching and sorting objects.

Auditory System (hearing).

This system involves what we hear. Examples of a dysfunctional auditory system are as follows: the child becomes upset with loud or unexpected noises, hums or sings to screen out unwanted noises, and/or appears not to hear, even when his or her name is called.

Olfactory System (smell).

This system involves smell. Examples of a dysfunctional olfactory system are as follows: the child experiences difficulties with strong odors (garbage, perfumes, etc.) and/or displays an excessive need to smell items/people.

Oral System (taste).

This system involves our mouth and includes tastes, textures, and temperature in the mouth. Examples of a dysfunctional oral system include the following: the child licks others in order to interact and/or chews on pencils, clothing, or fingernails.

However, there are two additional sensory systems in our bodies: those include the proprioceptive system and the vestibular system.

Proprioceptive System.

This system involves movement, compression, stretch, or vibration at a joint. Examples of a dysfunctional proprioceptive system include the following: the child has stiff/uncoordinated movements, is clumsy and falls frequently, frequently falls out of chair, and/or writes or erases very hard (may even rip the paper).

Vestibular System.

This system involves movement of the head through space. It can be linear, angular, or rotating and tells us whether we are moving or still and whether the things around us are moving or still. Examples of a dysfunctional vestibular system are as

follows: the child engages in frequent spinning, jumping, bouncing, rocking, etc., takes unnecessary risks on the playground and in the gym (accident prone), avoids playground or gym activities, and/or experiences difficulties maintaining balance when sitting in a chair or standing.

Beginning as infants and continuing throughout our lives, we take information in to our body through our senses. This is where learning first takes place. Thus, "experiences and sensations are learning. Sensations form the base understanding from which concepts and thinking develop" (Hannaford, 1995, pg. 48). "As we explore and experience our material world" (both indoor and outdoor), "initial sensory patterns are laid down on elaborate nerve networks" (Hannaford, 1995, pg. 49). With each new or modified life experience, we update information in our brain and make movement, speech, coordination, reading abilities, etc. more fluid and consistent. "These initial sensory patterns become our reference points and give us the context for all learning, thought, and creativity" (Hannaford, 1995, pg. 49).

Sensory integration dysfunction "occurs when the brain inefficiently processes sensory messages coming from a person's own body and his or her environment" (Kranowitz, 2003, pg. 4). Many times individuals will present with unusual or maladaptive behaviors and/or movement patterns. It is very common for sensory integration dysfunction to co-exist with other disabilities, such as autism, Down syndrome, attention deficit hyperactivity disorder, pervasive developmental delay, etc. The behavioral characteristics of children with sensory integration dysfunction can be divided into two general areas. These include sensory avoiding behaviors and sensory seeking behaviors. A child who is sensory avoiding is typically under-responsive to sensory input from the environment. A child may slouch in his chair, drool frequently,

color very lightly on the paper, or avoid climbing on playground equipment. On the other hand, a child who is sensory seeking is typically over-responsive to sensory input from the environment. A child may move around in his environment very quickly and may even run on tip toes, chew/mouth on many items, appear to "have no fears," even in dangerous situations, or use very hard pressure when writing and even rip the paper. In either situation, "the child may misinterpret or be unable to use that information effectively" (Kranowitz, 2003, pg. 5). Thus, sensory activities can either calm or alert the body, depending on what is needed. Many times the same activity can calm a child who is over-responsive to the environment and also alert a different child who is under-responsive to the environment. Brain Gym® activities combine sensory input and movement skills. These activities can be easily incorporated into a daily routine with the use of pictures and/or daily schedules.

Studies have been conducted which support the use of Brain Gym® and Edu-K in a variety of settings. Drabben-Thiemann (2002) studied the use of Brain Gym® with alzheimer's patients at the memory clinic held by the Clinic for Neurology and the Clinic for Medical Rehabilitation and Geriatrics at Hannover's Henriettenstiftung in Germany. Drabben-Thiemann (2002) found that the sum of the points achieved (task 1: word lists, task 2: conversion of numbers, task 3: shopping, task 4: recalling a sequence of numbers in reverse order, and task 5: repeated word lists) in the second test run following Brain Gym® activities was 23% higher as compared to the first test run. However, when tests were carried out with the control group, the increase of points in the second test run was only 3% (pg. 3). It is reported by Drabben-Thiemann (2002) that the capacity for concentration seemed to have decreased in the control group and that the rather sudden

day-to-day changes of patients have to be considered. It should be noted that this was a small study (24 test subjects) and that the data may be insignificant.

Donczik (2001), studied the effect of Dennison Laterality Repatterning (DLR), a component of Brain Gym®, in 81 dyslexic students upon three factors in reading achievement:

1. Reading fluency, as measured by error rate
2. Speed of comprehension, as measured by number-sequencing tests
3. Short-term, working, and long-term memory, as measured by word-learning and letter-learning trials from the Luria 90 battery of learning tests.

Donczik (2001) reports that reading fluency improved with each of the five trials for those who completed DLR after the pre-test, and without the benefit of DLR after the pre-test, it decreased with each additional trial. This study shows that the DLR movement exercises influenced speed of comprehension, the ability to concentrate, and visually controlled attention over a sustained period of time and that results from the control group confirmed the expectation that such improvements do not occur without the DLR. It should again be noted that the differences between the pre-test and post test were not significant. According to Donczik (2001), in terms of short-term visual memory, there were clearly visible differences between the results of the pilot study and those of the control test. The post-test without DLR showed, on the average, insignificant improvements, just below the baseline. The results of this study indicate at least a minimal increase in performance of those students in the experimental groups.

The results of the previous studies offer evidence that Brain Gym® activities may have an effect on children and adults with varying abilities. Thus, incorporating Brain Gym® activities into a daily classroom routine appears to be beneficial for students of many ages.

Summary

Although the literature states that engaging children in movement activities encourages brain development, little research with statistically significant sample sizes were found in the literature review of Brain Gym®. Further research is needed in this area. In chapter 5, the present study provides recommendations for future Brain Gym® research studies.

CHAPTER 3

METHODOLOGY

Study Design

This quantitative research study was designed to assess the effects of Brain Gym® activities on second-grade students' academic performance and handwriting skills using both standardized and non-standardized testing materials. The Test of Handwriting Skills (THS) was the standardized test chosen to assess the students' handwriting skills, while the Academic Performance Form (developed by the researcher) was designed for the teacher to complete using a rating scale to obtain quantifiable data. Data from the testing materials was obtained and analyzed quantitatively.

Subjects

The subjects for this study were twenty-nine second-grade students at Kingsley Elementary School. A sample of convenience was used when determining the subjects for this study. Two out of the 4 second-grade classrooms at Kingsley Elementary School were randomly selected to participate in this study. One classroom was selected to be the experimental group, while the other classroom was selected to be the control group. There were fourteen students with signed parental consent forms in the experimental group and fifteen students with signed parental consent forms in the control group. Participants were between 7 and 9 years of age and no comparison was made between male and female participants.

Advanced permission from the Kingsley Elementary School Principal, Karl Hartman, was obtained (see APPENDIX B) prior to beginning the research. Participation in the data collection of this study was voluntary. At any time throughout the study, parents and/or guardians had the option to refuse to allow their child to participate, stop their child from participating, or refuse, for themselves or their child, to answer any questions without prejudice, penalty, or risk of any loss of service. The specific Brain Gym® activities were implemented by the classroom teacher with direction by the research investigator.

The potential risks in participating in this study included a minimal amount of physical activity and movement in and/or around the classroom. The Brain Gym® activities were introduced as part of the classroom routine for the purpose of this study. Possible risks included bumping into a desk or another student, loss of balance, and/or a slightly elevated heart beat (no more than what a student might experience in gym class). As in all research, unforeseen risks to the participants was possible. No accidental injuries occurred during the research process; however, if an accidental injury were to occur, appropriate emergency measures would have been taken. No compensation or additional treatment would have been made available except as otherwise stated in the consent form that was sent home to the parents and/or guardians.

Instruments

This study used two different forms of testing materials: the Test of Handwriting Skills (THS) by Morrison F. Gardner and the Academic Performance Form (developed by the researcher) (see APPENDIX A).

The THS is a standardized test and "was developed to measure how a child writes with his or her hand, letters and words and sentences and numbers, either spontaneously or from dictation or by copying" (Gardner, 1998, pg. 14). The THS was designed to be "administered individually or to a group of children" (Gardner, 1998, pg. 23). This test is comprised of both manuscript and cursive methods of writing. The manuscript version of the THS was intended "for children 5 years to 8 years, 11 months" (Gardner, 1998, pg. 15). The present study assessed second-grade students' manuscript writing abilities. The students were tested in a group setting within the classroom environment.

The THS was designed to measure ten different areas of handwriting skills:

Subtest 1. AIRPLANE
Writing spontaneously from memory upper-case manuscript or cursive, letters of the alphabet in alphabetical sequence, along with speed of writing (number of letters produced in 20 seconds).

Subtest 2. BUS
Writing spontaneously from memory lower-case manuscript or cursive, letters of the alphabet in alphabetical sequence, along with speed of writing (number of letters produced in 20 seconds).

Subtest 3. BUTTERFLY
Writing from dictation upper-case manuscript or cursive, all letters of the alphabet out of alphabetical sequence.

Subtest 4. FROG
Writing from dictation lower-case manuscript or cursive, all letters of the alphabet out of alphabetical sequence.

Subtest 5. BICYCLE
Writing from dictation nine single numbers out of numerical order.

Subtest 6. TREE
Copying twelve upper-case manuscript or cursive, selected letters of the alphabet out of alphabetical sequence.

Subtest 7. HORSE
Copying ten lower case manuscript or cursive, selected letters of the alphabet out of alphabetical sequence.

Subtest 8. TRUCK
Copying six words (21 letters) lower-case and upper-case, manuscript or cursive.

Subtest 9. BOOK
Copying two sentences (six words, 29 letters) lower-case and upper-case, manuscript or cursive.

Subtest 10. LION
Writing from dictation six words (21 letters) (Gardner,1998, pg. 14-15).

The Academic Performance Form is a non-standardized, self-developed form that was developed to obtain teacher feedback regarding student performance in reading, mathematics, handwriting, and attention to task. Scoring ranges from 1 to 4, with 1 being major errors in the noted areas and 4 being no errors. The Academic Performance Form has a total score of 28 and this allows an academic performance percentage to be determined for data analysis. Some examples of the criteria on the form are as follows:

Reading

4	3	2	1	Score
- Demonstrates initial overall understanding and grasps the essential elements of the total text.	- Demonstrates initial overall understanding and generally reflects a grasp of the essential elements of the ext.	- Initial understanding of the text is incomplete and the response may reflect a grasp of some of the essential elements of the text.	- Demonstrates little initial understanding and the response focuses on one or more minor details rather than the essential elements of the text.	

Mathematics

4	3	2	1	Score
- No math errors.	- No major math errors or serious flaws in reasoning.	- May be some serious math errors or flaws in reasoning.	- Major math errors or serious flaws in reasoning.	

Handwriting

4	3	2	1	Score
- There are no extra visible marks or smudges on the paper.	- There are 1-2 visible marks or smudges on the paper.	- There are 3-5 visible marks or smudges on the paper.	- There are more than 5 visible marks of smudges on the paper.	

Attention to Task

4	3	2	1	Score
- Requires 1 or fewer redirection to task daily.	- Requires 2-3 redirections to task daily.	- Requires 4-7 redirections to task daily.	- Requires more than 7 redirections to task daily.	

Procedure

A sample of convenience was used with this study. Two out of the 4 second-grade classrooms at Kingsley Elementary School were randomly assigned to participate in this 9-week study. One classroom was randomly assigned to be the control group, while the other classroom was assigned to be the experimental group.

Class lists for the 2 classrooms were obtained with students names, parents names, phone numbers, and mailing addresses. Two separate phone scripts were written (see APPENDIX C), one for the experimental group and one for the control group, to inform parents of the study and to obtain verbal interest in the study. If verbal interest was granted over the phone, a consent document (see APPENDIX D) was sent home for a parental signature. Two separate consent documents were developed, one for the experimental group and one for the control group. The consent document for the experimental group included information on Brain Gym® activities and testing materials, including asking permission to pre- and post-test the child. The consent document for the control group asked for permission to pre- and post-test the child and explained that the students would participate in regular classroom activities with no Brain Gym® activities. Included in each consent document mailing was a self-addressed stamped envelope to return the signed document. Once the consent documents were signed and returned, student assent was obtained (see APPENDIX E). Two student assent statements were developed, one for each classroom, for the teachers to read to the students. Each student

then responded individually by saying "yes" or "no" as to whether or not they give their assent to participate. This was all completed before any testing was completed. All students in the experimental group participated in the Brain Gym® activities. However, the data was not used for the study unless the consent document was signed and student assent was given to the teacher.

Prior to any pre-testing, both teachers were trained to administer the THS and to complete the Academic Performance Form. The experimental group teacher also went through a one-time training session to complete all of the Brain Gym® activities selected for the study. These activities were structured for the teacher with pictures (see APPENDIX F) and specific directions to complete each activity. The Brain Gym® activities were completed in the classroom during regular classroom time. The Brain Gym® activities were introduced as part of the classroom routine and the teacher engaged her students in approximately 10 minutes of Brain Gym® activities on a daily basis.

Each morning the teacher engaged her students in a readiness routine called P.A.C.E. (Hannaford, 1995). "PACE stands for Positive, Active, Clear, and Energetic learning" (Hannaford, 1995, pg. 117). PACE is a 3-4 minute exercise that "is usually done at the beginning of the school day, after recess and after lunch to effectively prepare the student for learning" (Hannaford, 1995, pg. 117). A brief description of the P.A.C.E. activities is as follows:

E: WATER – Drink some water.

C: BRAIN BUTTONS – Place one hand over the navel, then with the other hand, gently "rub the indentations between the first and second ribs directly under the collar bone (clavicle), to the right and left of the sternum" (Hannaford, 1995, pg. 118).

A: CROSS CRAWL – "Touch the right elbow to the left knee and then the left elbow to the right knee" (Hannaford, 1995, pg. 119). These movements should be done slowly.

P: HOOK-UPS – Start by crossing one ankle over the other. "The hands are then crossed, clasped and inverted" (Hannaford, 1995, 120).

Table 1 contains pictures of the P.A.C.E. activities.

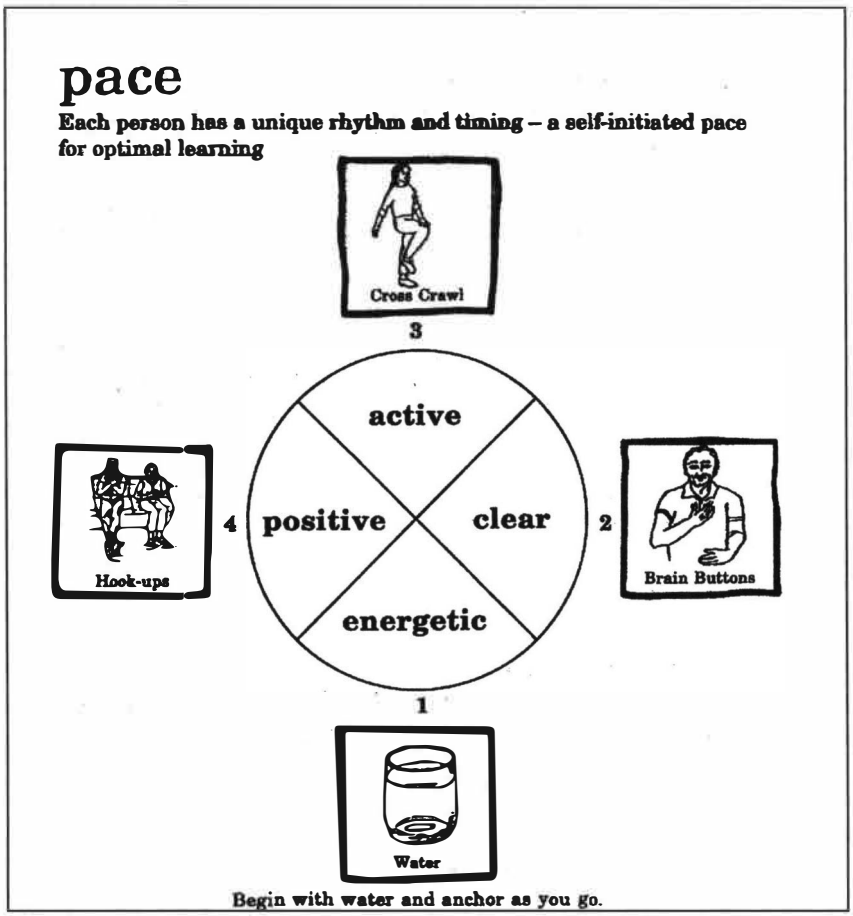

Table 1: P.A.C.E. activities taken from the Brain Gym Handbook by Paul E. Dennison, Ph.D. and Gail E. Dennison, 1997.

In addition to P.A.C.E., the teacher engaged the students in a minimum of 6 Brain Gym® activities at random times throughout the day. This took approximately 7 minutes out of the school day. These activities included some of the P.A.C.E. activities and a brief description is as follows:

1. WATER: Take a drink of water. "Two-thirds of the human body (about seventy percent) is made up of water. All of the electrical and chemical actions of the brain and central nervous system are dependent of the conductivity of electrical currents between the brain and the sensory organs, facilitated by water" (Dennison, et al., 1994, pg. 24).

2. THINKING CAP: "The student uses his thumbs and index fingers to pull the ears gently back and unroll them. He begins at the top of the ear and gently massages down and around the curve, ending with the bottom lobe" (Dennison, et al., 1994, pg. 30).

Picture taken from Brain Gym®: Teachers Edition Revised, 1994.

3. ARM ACTIVATION: The student reaches one straight arm overhead while the other arm helps resist the movement of the arm that is overhead. The student is encouraged to try to push the straight arm forward, backward, and to both sides while the arm that is straight tries to resist the push (Dennison, et al, 1994).

Picture taken from Brain Gym®: Teachers Edition Revised, 1994.

4. CALF PUMP: The student presses down the heel and lengthens the tendon in the calf. This is similar to a runner stretch (Dennison, et al., 1994).

Picture taken from Brain Gym®: Teachers Edition Revised, 1994.

5. CROSS CRAWL: "Touch the right elbow to the left knee and then the left elbow to the right knee" (Hannaford, 1995, pg. 119) and repeat. These movements should be done slowly.

Picture taken from Brain Gym®: Teachers Edition Revised, 1994.

6. LAZY 8: The student draws a dot in the middle of a piece of paper. The student starts at the dot and begins by moving his/her writing utensil in a diagonal motion up and to the left. He/she continues this motion so that is looks like a sideways 8 on the paper, in the air, or on the chalkboard. (Dennison, et al., 1994). See Table 2 below.

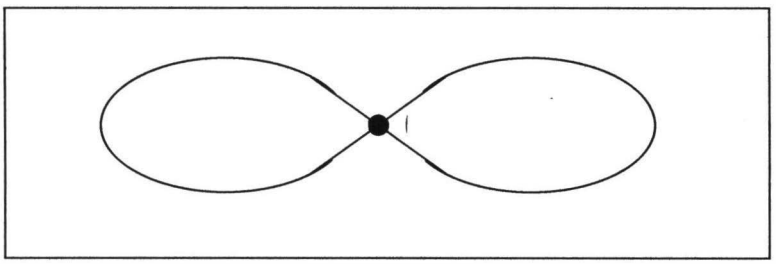

Table 2: Example of a Lazy 8

For this study, the P.A.C.E. activities were completed at the beginning of the school day and the other 6 activities were completed at least one time throughout the remainder of the school day. It was suggested to the teacher that the Brain Gym® activities be completed after recess, before a test, before the students would be asked to remain seated for a longer period of time, and/or when the students were becoming restless or having a difficult time maintaining attention to the task. The decision for when to carry out the 6 Brain Gym® activities was left to the teacher's discretion. The teacher was also given a blank calendar and asked to write down the activities, including P.A.C.E., completed for each day (see APPENDIX G).

CHAPTER 4

DATA ANALYSIS / RESULTS

Data Analysis

Of the 41 phone calls that were made to the second-grade students' parents, 38 parents agreed to have the consent document mailed to their home (20 from the experimental group and 18 from the control group). There were a total of 29 returned parental consent documents (14 from the experimental group and 15 from the control group). The response rate was 76%. It should be noted that due to student absences on the day of the testing, a total of 25 students participated in the study (12 from the experimental group and 13 from the control group). The percentage data was analyzed according to the combined 66% response and attendance rates. Quantitative analyses were used for data analysis.

Results

The first research question posed was whether there would be fewer letters reversed in the experimental group as compared to that of the control group This was not supported with a t-test ($p > .05$) for both pre- and post-testing using sub-tests 1-4 of the Test of Handwriting Skills. Sub-tests 1 and 2 involve writing the capital letters A-Z and lower case letters a-z in order. Sub-test 3 involves writing each capital letter of the alphabet that the teacher says in random order, while sub-test 4 involves writing each lower case letter of the alphabet that the teacher says in random order. There was also a $p > .05$ correlation between the number of letters reversed for pre- and post-testing in both the experimental group and the control group. However, the level of significance for the

experimental group pre-and post-testing correlation was slightly greater than $p < .05$ ($p = .057$) (see Table 3). A paired sample test indicated significant difference at $p < .05$ for the number of letters reversed with the experimental & control group post-testing. Significant differences at p. <05 were determined when this same test was run on the following groups: experimental and control pre-testing, experimental pre- and post-testing, and control pre- and post-testing.

Paired Group	Testing	N	Correlation	Significance
Experimental & Control	Pre-	12	-.312	.324
Experimental & Control	Post-	12	-.145	.653
Experimental	Pre- & Post-	12	.563	.057
Control	Pre- & Post-	13	-.309	.305

Table 3: Number of Letters Reversed Based on Scaled Scores of the Test of Handwriting Skills Sub-tests 1-4 using a *t*-test

The second research question focused on the difference in the number of letters the students are able to write in 20 seconds following daily Brain Gym® activities. Sub-tests 1 and 2 of the THS are timed sections that involves writing as many capital and lower-case letters of the alphabet in order within 20 seconds. This question was supported with a t-test ($p < .05$) when correlating pre- and post-testing results for the experimental group. On the other hand, when the control group pre-and post-testing was compared, there was a $p > .05$. A comparison was also made between the control and experimental groups pre-testing and again for post-testing. When this t-test was run, there was a $p > .05$ for both, indicating no significant changes.(see Table 4).

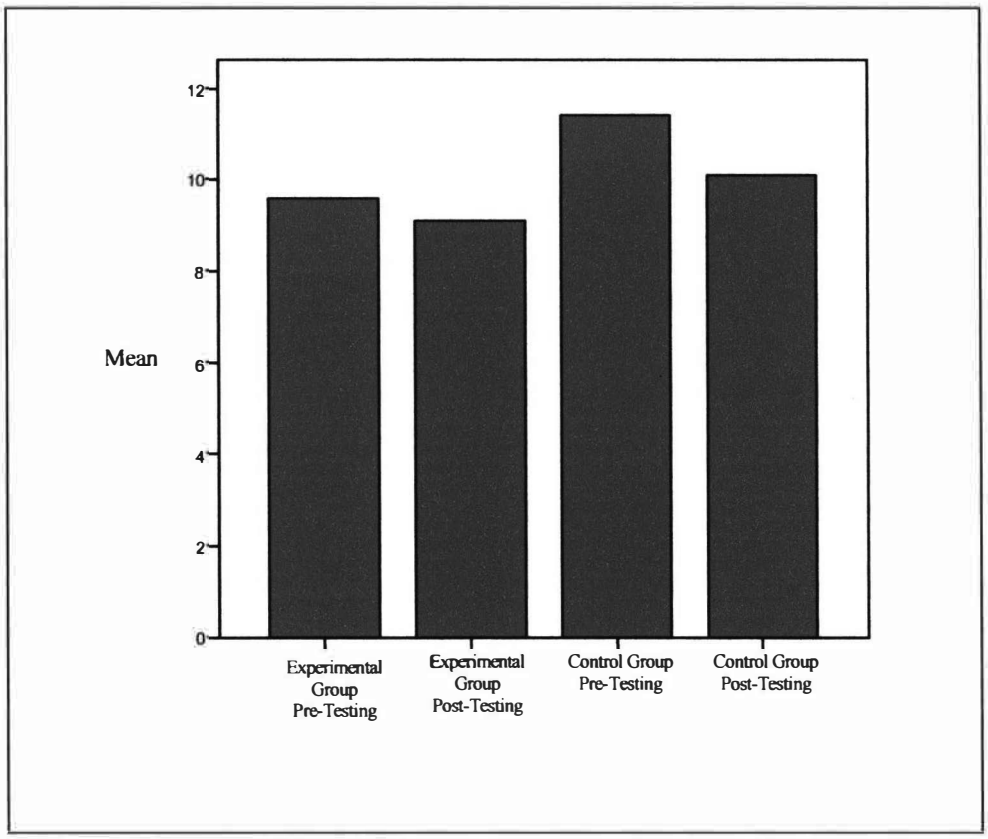

Table 4: Number of Letters Produced in 20 Seconds Based on Scaled Scores of Sub-tests 1 & 2.

The third research question, which sought to determine if there would be improvement in spacing of letters following daily Brain Gym® activities, was supported with significant results ($p < .05$). Yet, when a t-test was completed on the control group where there were no daily Brain Gym® activities, there was also $p < .05$. Data for the spacing of letters was obtained from sub-tests 1-4 of the THS (as noted above). When comparing the mean scaled scores of each group (pre- and post-testing), there is an increase in mean scores for the experimental group (pre-testing =12.92 and post-testing = 16.67) and a slight decrease in scores for the control group (pre-testing = 17.15 and post-testing 16.85) (see Table 5).

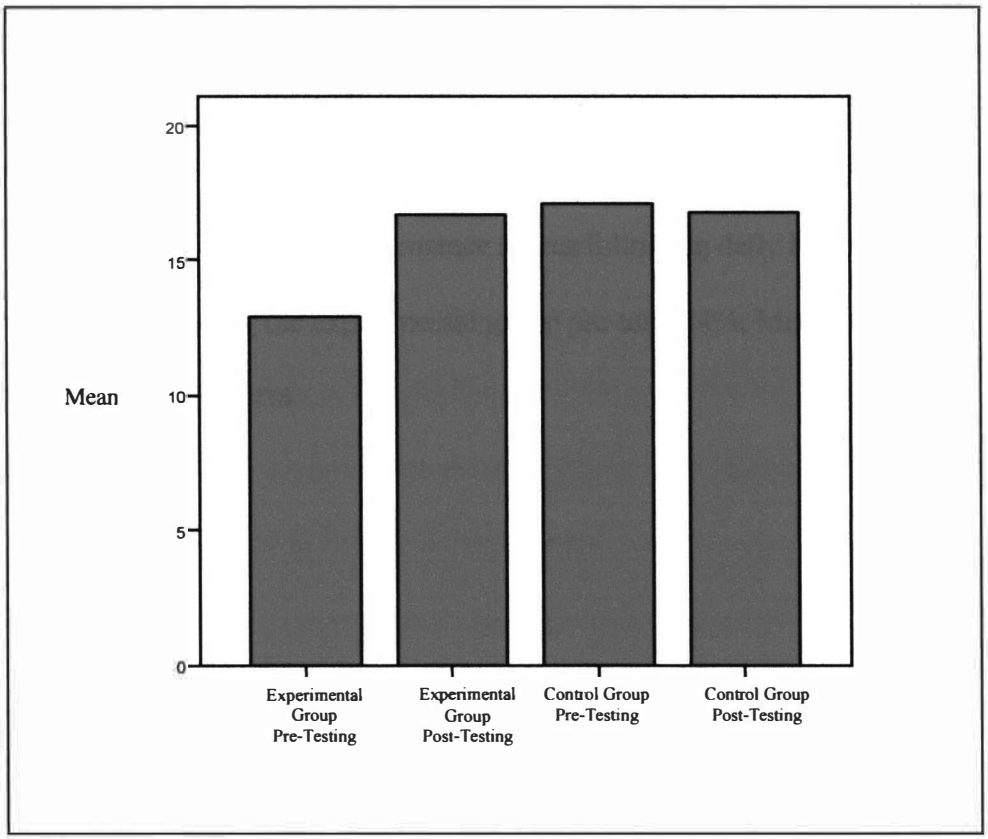

Table 5: Number of Letters Touching Based on Scaled Scores of Sub-tests 1-4.

The fourth research question asked if there is greater attention to task following daily Brain Gym® activities as compared to the control group. This is a non-standardized sub-test with scores ranging from 1-4 (1 = requires more than 7 redirections to the task daily and 4 = requires 1 or fewer redirections to the task daily). Attention to task scores decreased following daily Brain Gym® activities for the experimental group from pre-testing (86%; Mean = 3.42) to post-testing (79%; Mean 3.17). On the other hand, scores for the control group increased from pre-testing (79%; Mean = 3.15) to post-testing (81%; Mean 3.23). The data is not supportive of this research question.

The fifth research question examined the effect of academic performance scores of the experimental group following daily Brain Gym® activities as compared to the control group. No significant results were obtained. The academic performance scores

are comprised of a non-standardized form with scores ranging from 1-4 in the following areas: reading, mathematics, handwriting, and attention to task (4 is the best score). There is no change in academic performance scores following daily Brain Gym® activities when comparing the experimental group pre-test (84%; Mean = 23.5) and post-test (84%; Mean 23.6) scores.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

Discussion

This study explored the effects of Brain Gym® activities on second grade students' academic performance and handwriting skills. The results of this study support the hypothesis that daily Brain Gym® activities yield a positive effect on some components of handwriting performance. Students who engaged in daily Brain Gym® activities (n = 12) significantly increased the number of letters produced in 20 seconds and the spacing of letters on the THS. Students in the control group (n = 13) did not show a significant increase in the number of letters produced in 20 seconds, yet they did show a significant improvement in the spacing of letters. These findings lend support to Drabben-Thiemann's 2002 study that suggests that there is an overall increase in performance (23%) on repeating word lists, conversion of numbers (words to numerical values), shopping items, repeating a sequence of numbers backwards, and repeating word lists.

The results do not support the hypothesis that daily Brain Gym® activities positively support Academic Performance skills (Reading, Mathematics, Handwriting, & Attention to Task). Following daily Brain Gym® activities, there were no significant positive changes in the experimental group with attention to task or overall academic performance. According to Donczik (2001), Dennison Laterality Repatterning (DLR) significantly helped to lessen errors in reading fluency, speed of comprehension, and memory performance. The intention of DLR is to change "automatic movement and

reflex movement to conscious choice" (Dennison and Dennison, 1997, pg. 19) and it is a component of Brain Gym®.

Limitations to Current Study

First, this study had a small sample size. Only 2 out of the 4 second-grade classrooms at the identified school participated in the study, and 25 out of the total 42 students (60%) in those two classrooms participated in the study. All of the students were from the same school and geographic area; thus, the scope of the study was limited to a primarily Caucasian population.

Second, many times a student's individual home environment may have an effect on school performance. Unexpected events may also take place while on the school bus prior to entering the school building that may affect the student's entire school day, thus affecting school performance.

A third limitation to the study is the 9-week period over which the study took place. This short time period limits the accuracy of the data that was collected. The study was completed from February through April of 2004. There is typically a high rate of sickness and snow days in the school systems during these months. Thus some students may have missed some of the classroom tasks as well as the Brain Gym® activities.

A fourth limitation to this study is the teacher's health and attendance was not guaranteed during the 9-week test period. Likewise, many times schools will schedule assemblies (both expected and unexpected) and those may have interfered with the scheduled Brain Gym activities. Another limitation is that new students could have

arrived at the school during the middle of the school year; however, this did not occur during the present study.

Implications for Future Research

Several implications for future research can be identified from the findings of the current study. A larger sample size and an extended time period (at least one school year) would be useful for improving the accuracy of the results. Starting the research at the beginning of the school year vs. mid-school year may help improve the comfort level of the teacher integrating the Brain Gym® activities into the classroom routine.

Future research could focus on comparing the effects of the Brain Gym® activities on those students in special education as compared to those students in regular education. Sometimes students in special education have a difficult time crossing the visual and physical midline of the body; thus, reading skills and handwriting skills may be affected. On the other hand, students in regular education may be able to cross the midline on the body easily; consequently there may be a greater improvement in reading and handwriting skills following Brain Gym® activities in the special education students as compared to the regular education students.

It may also be beneficial to evaluate student's motor coordination skills before and after the completion of Brain Gym® activities. Such skills may include catching a ball from a distance of 5 feet, throwing a tennis ball at a target 5 feet away, walking on a balance beam 6 inches off the ground for a distance of 12 feet, and standing on one foot with hands on hip for 10 seconds. A test for younger children that could be used for this type of study could be the gross motor portion of the Peabody Developmental Motor

Scale (2nd edition). This type of testing may be useful in that motor coordination skills are required for gym class, music class, band and art class, and playgroup activities.

Other areas to consider exploring would be visual motor skills and visual perceptual skills. When in school, students need to be able to copy information from the chalkboard to the paper on the desk, follow words on a page from left to right to read, remember how to spell words from one day to another, and use numbers in the correct alignment to add and subtract. A test that would involve visual motor skills is the Test of Visual-Motor Skills Revised (TVMS) and a test that would involve visual-perceptual skills is the Test of Visual-Perceptual Skills (TVPS). These tests, or any other similar testing materials, would be great for providing standardized scores and measuring student performance on basic classroom tasks.

Replicating this study in different parts of the United States could provide a better representation of the population as well as incorporate a variety of teaching styles and learning mediums into the overall study. Some school districts will use the Denealian Method for teaching handwriting and other schools will use the Zaner Bloser Manuscript for teaching handwriting. Replicating this study would allow for comparison of scores between handwriting methods.

Conclusion

Overall, this study indicates that (a) the spacing of letters and the number of letters produced in 20 seconds as measured by the THS significantly increased following daily Brain Gym® activities; (b) overall academic performance skills as measured by the self-developed Academic Performance Form showed no significant differences following daily Brain Gym® activities. This study also shows that there is a continued need for

future research in the area of Brain Gym® and movement activities in a classroom setting.

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APPENDIX A

Testing Materials

Academic Performance

Name:_____ **Date:**_____

Reading

*Reading Level:*_____

Global Understanding of Reading

4	3	2	1	Score
- Demonstrates initial overall understanding and grasps the essential elements of the total text.	- Demonstrates initial overall understanding and generally reflects a grasp of the essential elements of the ext.	- Initial understanding of the text is incomplete and the response may reflect a grasp of some of the essential elements of the text.	- Demonstrates little initial understanding and the response focuses on one or more minor details rather than the essential elements of the text.	

Mathematics (A=mechanics of mathematics; B=demonstrated knowledge of mathematics)

	4	3	2	1	Score
A	- No math errors.	- No major math errors or serious flaws in reasoning.	- May be some serious math errors or flaws in reasoning.	- Major math errors or serious flaws in reasoning.	
B	- Shows complete understanding of the questions, mathematical ideas, and processes.	- Shows substantial understanding of the problem, ideas, and processes.	- Response shows some understanding of the problem.	- Response shows a complete lack of understanding for the problem.	

Handwriting (A = letter formation; B = neatness of handwriting; C = relationship of letters to the line)

	4	3	2	1	Score
A	- Each letter is formed correctly.	- All but 1 letter are formed correctly.	- 80% of the letters are formed correctly.	- 50% of the letters are formed correctly.	
B	- There are no extra visible marks or smudges on the paper.	- There are 1-2 visible marks or smudges on the paper.	- There are 3-5 visible marks or smudges on the paper.	- There are more than 5 visible marks or smudges on the paper.	
C	- All letters are located correctly in relationship to the lines.	- The size of 1-3 letters are slightly larger or smaller than the space allowed by the line.	- The size of 4-6 letters are slightly larger or smaller than the space allowed by the line.	- The size of more than 6 letters are slightly larger or smaller than the space allowed by the line.	

Attention to Task

4	3	2	1	Score
- Requires 1 or fewer redirection to task daily.	- Requires 2-3 redirections to task daily.	- Requires 4-7 redirections to task daily.	- Requires more than 7 redirections to task daily.	

Total Score... _____

Total Possible Score... 28

TEST OF HANDWRITING SKILLS (THS)

MANUSCRIPT or CURSIVE
Individual Record Form

Name: _____ Sex: _____ Grade: _____

School: _____ Examiner: _____

Date of Test: _____ year _____ month _____ day

Date of Birth: _____ year _____ month _____ day

Chronological Age: _____ year _____ month _____ day

*If the number of days exceeds 15, consider as a full month and increase the months by one.

TEST RESULTS:		RAW SCORES	STANDARD SCORES	SCALED SCORES	PERCENTILE RANK	STANINE
Subtest 1	Airplane					
Subtest 2	Bus					
Subtest 3	Butterfly					
Subtest 4	Frog					
Subtest 5	Bicycle					
Subtest 6	Tree					
Subtest 7	Horse					
Subtest 8	Truck					
Subtest 9	Book					
Subtest 10	Lion					
Subtest 1 and 2 No. of letters in 20 secs.						
Subtests 1–4 No. of letters reversed						
Subtests 1–4 No. of letters touching						
Subtests 1–4 No. of letters lower case for upper case						

Referred by: _____

Reason for Referral: _____

_____

Description of Subject's Behavior: _____

_____

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(800) 422-7249
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THS SCORING RECORD FORM

MANUSCRIPT or CURSIVE

Subtest 1 Airplane	Subtest 2 Bus	Subtest 3 Butterfly	Subtest 4 Frog	Subtest 5 Bicycle	Subtest 6 Tree	Subtest 7 Horse	Subtest 8 Truck	Subtest 9 Book	Subtest 10 Lion
A	a	A	a	8	L	d	w	Z	m
B	b	C	c	6	N	c	a	e	y
C	c	P	p	5	S	r	x	b	
D	d	D	d	2	V	p		r	f
E	e	N	n	7	M	b	k	a	i
F	f	W	w	3	U	u	i	s	s
G	g	R	r	4	O	e	n		h
H	h	B	b	9	A	m	g	l	
I	i	K	k	0	Z	k		o	a
J	j	Z	z		R	j	b	v	n
K	k	E	e	TOTAL	W		e	e	d
L	l	G	g		X	TOTAL	d		
M	m	J	j					j	b
N	n	S	s		TOTAL		q	a	l
O	o	H	h				u	z	u
P	p	F	f				i	z	e
Q	q	O	o				z		
R	r	T	t					D	f
S	s	V	v				J	a	l
T	t	L	l				i	v	i
U	u	Q	q				m	i	p
V	v	M	m					d	
W	w	X	x				s		v
X	x	I	i				t		e
Y	y	U	u				a	o	s
Z	z	Y	y				r	p	t
								e	
TOTAL	TOTAL	TOTAL	TOTAL				TOTAL	n	TOTAL
								s	
No. of letters in 20 seconds	No. of letters in 20 seconds							g	
								i	
								f	
No. of letters Reversed	No. of letters Reversed	No. of letters Reversed	No. of letters Reversed					t	
								s	
Total letters touching	Total letters touching	Total letters touching	Total letters touching					TOTAL	
No. of lower case ltrs for upper case ltrs & vice versa	No. of lower case ltrs for upper case ltrs & vice versa	No. of lower case ltrs for upper case ltrs & vice versa	No. of lower case ltrs for upper case ltrs & vice versa						

NOTE: Neither a basal nor a ceiling is required. Give all items.

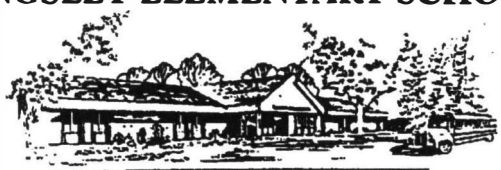
To obtain the raw score for the Manuscript Version, total the child's scores for each subtest and record this total at the bottom of each subtest column. Each total should then be recorded on the face sheet, under "test results." Do the same for number of letters written in 20 seconds, number of letters reversed, total score for letters touching, and number of upper-case letters for lower-case letters and vice versa. For the Cursive Version, total only the child's scores for each of the 10 subtests and the number of letters written in 20 seconds; letters reversed, letters touching, and upper-case letters for lower-case letters and vice versa are not included

APPENDIX B

School Permission Letter

KINGSLEY ELEMENTARY SCHOOL

MICHAEL P. JURGENSEN
Superintendent
403 Blair Street • P.O. Box 580
Kingsley, MI 49649
(231) 263-5262 ext. 210
FAX (231) 263-5282



NCA Accredited by the North Central Association of Colleges and Schools
MAP Accredited by the Michigan Accreditation Program

KARL A. HARTMAN
Principal
311 Clark Street • P.O. Box 580
Kingsley, MI 49649
(231) 263-5262 ext. 217
khartman@kingsley.k12.mi.us
FAX (231) 263-3813

June 11, 2003

To Whom It May Concern:

Ms. Kristen Rievert has my permission to conduct research in classrooms at Kingsley Elementary School as a part of her graduate research program at Western Michigan University. She has contacted two teachers who are more than willing to facilitate this research program in their classrooms.

Please direct any questions regarding this matter to me.

Sincerely,

Karl A. Hartman

Karl A. Hartman, principal
Kingsley Elementary School

KINGSLEY ELEMENTARY SCHOOL
28090-5898
KINGSLEY, MICHIGAN

APPENDIX C

Phone Scripts

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
A Group

Hello,

My name is Kristen Rievert and I am an occupational therapist at the Intermediate School District. I am currently working on my Master's Degree through Western Michigan University. I am conducting a research project on Brain Gym activities with second-grade students at Kingsley Elementary School. Your child's class has been selected to participate in this study. The purpose of the study is to determine the effects of Brain Gym activities on handwriting skills in elementary school children. This would involve taking a handwriting test as well as participating in some fun movement activities led by the teacher on a daily basis.

Do you have any questions about this project? Would you be interested in learning more about this study and consider allowing your child to participate in this study?

If yes, Would it be okay for me to send you a detailed letter describing the project and a form to sign and return to me as soon as possible? Thank you for your time.

If no, thank you for your time.

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
B Group

Hello,

My name is Kristen Rievert and I am an occupational therapist at the Intermediate School District. I am currently working on my Master's Degree through Western Michigan University. I am conducting a research project on Brain Gym activities with second-grade students at Kingsley Elementary School. Your child's class has been selected to participate in this study. This would only involve taking a simple handwriting test.

Do you have any questions about this project? Would you be interested in learning more about this study and consider allowing your child to participate in this study?

If yes, Would it be okay for me to send you a detailed letter describing the project and a form to sign and return to me as soon as possible? Thank you for your time.

If no, thank you for your time.

APPENDIX D

Consent Documents

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
A Group

Dear Parents or Guardians,

I am an occupational therapist currently working at the Traverse Bay Area Intermediate School District. I am working towards my Masters Degree at Western Michigan University in Kalamazoo, Michigan. Your child has been invited to participate in a research project entitled "The Effects of Brain Gym Activities on Second-Grade Students Academic Performance and Handwriting Skills," with Dr. Ben Atchison from Western Michigan University's Department of Occupational Therapy. The purpose of my study is to determine the effect of Brain Gym activities on handwriting skills in elementary school children.

Brain Gym is a series of quick, fun, and energizing activities that are used to encourage whole brain learning. These activities help children "sit still, listen, focus on letters and figures, and track from right to left with their eyes." Some of these activities involve physical activity for a short amount of time, while other activities can be completed when seated. These movement activities will be directed by the teacher and completed at various times during the school day.

Your permission for your child to participate in this project means that your child will be administered the Test of Handwriting Skills and your child's teacher will complete an Academic Performance Form on your child. The testing will take place during January and again in March or April and will involve about one class period. Your child will be tested in a group setting by your child's classroom teacher, who has been trained in test administration. Your child will be free at any time, even during the test administration, to choose not to have the test results be part of the study. If your child refuses or quits, there will be no negative effect on his/her school programming. Although there may be no immediate benefits to your child for participating, there may eventually be benefits to the school district and subsequently to other students. If these Brain Gym activities are found to improve academic performance and handwriting, then other classrooms may have the opportunity to use them as part of regularly scheduled classroom activities.

All test data and information will remain confidential. That means that your child's name will be omitted from all test forms and a code number will be attached. The principal investigator will keep a separate master list with the names of the children and the corresponding code numbers. Once the data are collected and analyzed, the master list will be destroyed. All other forms will be retained for at least three years in a locked file in the principal investigator's office. No names or identifying information will be used if the results are published or reported at a professional meeting.

The only risks anticipated in this study include a minimal amount of physical activity and movement in and/or around the classroom and minor discomforts typically experienced by children when they are being tested (e.g. boredom, mild stress owing to the testing situation). All of the usual methods employed during standardized testing to minimize discomforts will be employed in this study. As in all research, there may be unforeseen risks to the participant. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or additional treatment will be made available to you except as otherwise stated in this permission form.

You may withdraw your child from this study at any time without any negative effect on services to your child. If you have any questions or concerns about this study, you may contact either Kristen Rievert at 231-276-5036 or Dr. Ben Atchison at 269-387-7270. You may also contact the Chair, Human Subjects Institutional Review Board at 269-387-8293 or the vice president for research at 269-387-9298 with any concerns that you have.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not allow your child to participate in this study if the stamped date is older than one year.

Your signature below indicates that you, as parent or guardian, can and do give your permission for

_____ (*child's name*)

- to be tested with the Test of Handwriting Skills and for completion of the Academic Performance Form
- for general classroom data/scores to be reported to his/her teacher and/or school principal
- to participate in daily Brain Gym activities as part of a scheduled classroom activity

_____ _____
Signature Date

Permission obtained by:_____ _____
Initials of researcher Date

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
B Group

Dear Parents or Guardians,

I am an occupational therapist currently working at the Traverse Bay Area Intermediate School District. I am working towards my Masters Degree at Western Michigan University in Kalamazoo, Michigan. Your child has been invited to participate in a research project entitled "The Effects of Brain Gym Activities on Second-Grade Students Academic Performance and Handwriting Skills," with Dr. Ben Atchison from Western Michigan University's Department of Occupational Therapy. The purpose of my study is to determine the effect of Brain Gym activities on academic performance and handwriting skills in elementary school children.

Your permission for your child to participate in this project means that your child will be administered the Test of Handwriting Skills and your child's teacher will complete an Academic Performance Form. The testing will take place during January and again in March or April and will involve about one class period. Your child will be tested in a group setting by your child's classroom teacher, who has been trained in test administration. Your child will be free at any time, even during the test administration, to choose not to have the test results be part of the study. If your child refuses or quits, there will be no negative effect on his/her school programming. Although there may be no immediate benefits to your child for participating, there may eventually be benefits to the school district and subsequently to other students. If these Brain Gym activities are found to be useful, then other classrooms may have the opportunity to use them as part of regularly scheduled classroom activities.

All test data and information will remain confidential. That means that your child's name will be omitted from all test forms and a code number will be attached. The principal investigator will keep a separate master list with the names of the children and the corresponding code numbers. Once the data are collected and analyzed, the master list will be destroyed. All other forms will be retained for at least three years in a locked file in the principal investigator's office. No names or identifying information will be used in the results are published or reported at a professional meeting.

The only risks anticipated are minor discomforts typically experienced by children when they are being tested (e.g. boredom, mild stress owing to the testing situation). All of the usual methods employed during standardized testing to minimize discomforts will be employed in this study. As in all research, there may be unforeseen risks to your child. If an accidental injury occurs, appropriate emergency measures will be taken; however no compensation or treatment will be made available to me or your child except as otherwise specified in this permission form.

You may withdraw your child from this study at any time without any negative effect on services to your child. If you have any questions or concerns about this study, you may contact either Kristen Rievert at 231-276-5036 or Dr. Ben Atchison at 269-387-7270. You may also contact the Chair, Human Subjects Institutional Review Board at 269-387-8293 or the vice president for research at 269-387-9298 with any concerns that you may have.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not allow your child to participate in this study if the stamped date is older than one year.

Your signature below indicates that you, as parent or guardian, can and do give your permission for

_____ (*child's name*)

- to be tested with the Test of Handwriting Skills and for completion of the Academic Performance Form
- for general classroom data/scores to be reported to his/her teacher and/or school principal

_____ _____
Signature Date

Permission obtained by:_____ _____
Initial of researcher Date

APPENDIX E

Assent Documents

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
A Group

You are invited to be in a research project that involves something called Brain Gym Activities. The purpose of the study is to see if certain movement activities would help you learn better. Some of these fun activities might be taking a drink of water, stretching, making a silly sideways "8" on paper or in the air, or even some fun exercises that are similar to what you do in gym class.

You will be given a handwriting test during one class period in January and again in March or April. You will not get extra credit, and if you do not want to have your test results be part of the study, there will be no effect on your school grades. Even if you agree to today to participate by saying "yes" or "no," you can change your mind at any time when we begin testing or at any time during the 9 weeks.

Your name will not be on any of the forms. The researchers will use a code number instead. The researches will keep a list of names and code numbers that will be destroyed once the researchers have shared any important information with your teacher.

If you agree to participate in this study, please respond by saying "yes" or "no."

Western Michigan University
Department of Occupational Therapy
Ben J. Atchison Ph.D., OTR, FAOTA
Kristen M. Rievert, OTR
B Group

You are invited to be part of a research project that involves something called Brain Gym. The purpose of the study is to see if certain movement activities would help you learn better, however the only part of this study that you will be involved with is taking 1 simple handwriting test.

You will be given the handwriting test during one class period in January and again in March or April. You will not get extra credit, and if you don't want to have your test results be part of the study, there will be no effect on your school grades. Even if you agree to today to participate by saying "yes" or "no," you can change you mind at any time when we begin testing or at any time during the 9 weeks.

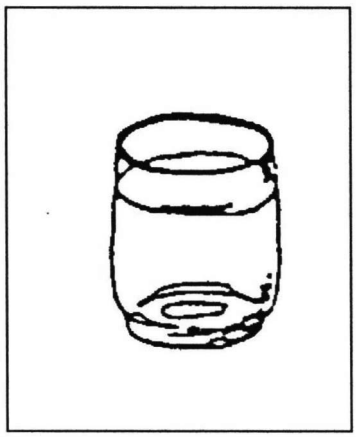
Your name will not be on any of the forms. The researchers will use a code number instead. The researches will keep a list of names and code numbers that will be destroyed once the researchers have shared any important information with your teacher.

If you agree to participate in this study by taking the simple handwriting test, please respond by saying "yes" or "no."

APPENDIX F

Brain Gym® Activity Pictures

Water



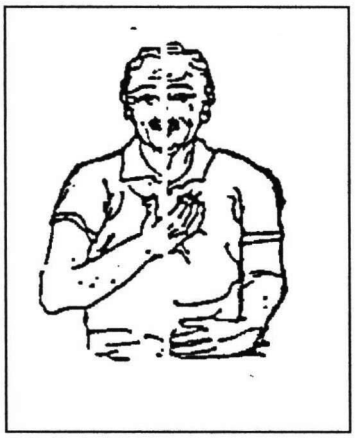
Water

"Water is an excellent conductor of electrical energy. Two-thirds of the human body (about seventy percent) is made up of water. All of the electrical and chemical actions of the brain and central nervous system and dependent on the conductivity of electrical currents between the brain and the sensory organs, facilitated by water." It is also noted that water is "best absorbed by the body when provided in frequent small amounts" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 24, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage your students to drink water throughout the school day.
- It is suggested that you (the teacher) bring in bottles for each student or send a note home and have each student bring in a bottle.
- Have each student place the bottle somewhere accessible on or near their desks.
- Encourage the students to re-fill the bottles at designated times during the day so as to avoid interrupting the learning environment.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Brain Buttons



Brain Buttons

"The Brain Buttons (soft tissue under the clavicle to the left and right hand of the sternum) are massaged deeply with one hand while holding the navel with the other hand" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 25, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- As shown above, encourage students to make a "C" with their right hand (using the thumb, index finger, and middle finger) and place in the soft tissue just under the collar bone. Begin moving these points with the right and for about 30 seconds.

- At the same time, encourage student to place their left hand on their belly button.

- Switch hands (right hand on belly button and left hand makes a "C" and begins moving) and repeat for about 30 seconds.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Cross Crawl

Cross Crawl

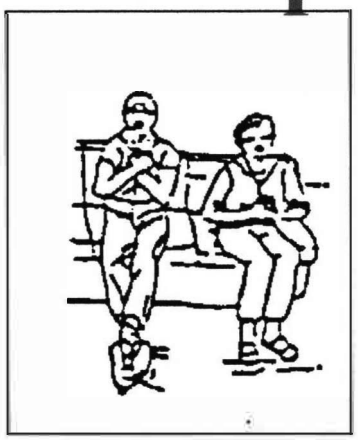
"Similar to walking in place, the students alternately moves one arm and its opposite leg and the other arm and its opposite leg. Because Cross Crawl accesses both brain hemispheres simultaneously, this is the ideal warm-up for all skills which require crossing the body's lateral midline" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 4, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage students to touch their right elbow to their left knee and then their left elbow to their right knee ***slowly***.

- Repeat this motion for about 1 minute.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Hook-ups



Hook-ups

"Hook-ups connect the electrical circuits in the body, containing and thus focusing both attention and disorganized energy. The mind and body relax as energy circulates through areas blocked by tension" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 31, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage students to cross their right foot over their left foot (either standing or sitting).

- Next, encourage students to extend their arms straight out in front of themselves, turn thumbs down, cross their right arm over their left arm, connect their hands together, and move their connect hands towards their chest. Hold this position for about 30 seconds.

- Then, switch so that the left foot moves over the right foot and left arm over right arm. Again, hold for about 30 seconds.

- Finally release arms and legs and then touch finger tips together at midline (thumbs, index fingers, etc.) and hold for up to a minute.
- This is very relaxing.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Thinking Cap

Thinking Cap

"This activity helps the student focus attention on his hearing. It also relaxes tension in the cranial bones. The student uses his thumbs and index fingers to pull the ears gently back and unroll them. He begins at the top os the ear and gently massages down and around the curve, ending with the bottom lobe" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 30, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage students to gently rub their ears at the same time, starting at the top and rolling down to the bottom. Imagine you are unrolling your ears.

- Do this activity 3 times.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Arm Activation

Arm Activation

"Arm Activation is an isometric self-help activity which lengthens the muscles of the upper chest and shoulders. Muscular control for both gross-motor and fine-motor activities originates in this area. If these muscles are shortened from tension, activities related to writing and the control of tools are inhibited" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 18, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage students to reach up high (to the ceiling) with their right arm. Then place the left hand over their head and on the right elbow (as shown above).

- While continuing to reach up with the right arm, try to push the right arm forward (with the left hand), away from the body (right), backward, and towards the body (left). DO NOT ACTUALLY ALLOW THE RIGHT ARM TO MOVE – hold it still). About 30 seconds.

- Switch arms and repeat – reach the left arm up high and position the right hand at the elbow of the left arm. About 30 seconds.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

The Calf Pump

Calf Pump

"The Calf Pump…is a movement re-education process to restore the natural length of the tendons in the feet and lower legs. At times of perceived danger, these tendons shorten to prepare for the act of running…By pressing down the heel and lengthening the tendon in the calf, one discharges this fear reflex, and the muscles can return to a normal tonus" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 20, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Encourage students to stand so that a chair or a wall is in front of their bodies.
- Position hands on the top of the chair or wall.
- Extend the right leg back (keep it straight – heel not on floor) and keep the left leg in place (knee bent – as shown above). Similar to a runners stance.
- While exhaling, lower the right heel to the floor and hold for a few seconds. Repeat a 3 times.
- Repeat this activity with the left leg extended back.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

Lazy 8's

Lazy 8's

"Drawing the Lazy 8 or infinity symbol enables the reader to cross the visual midline without interruption, thus activating both right and left eyes and integrating the right and left visual fields. The 8 is drawn on its side and includes a definite midpoint and separate left and right areas, joined by a continuous line" (Brain Gym – Teacher's Edition Revised, Paul E. Dennison & Gail E. Dennison, 1994, pg. 5, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

- Using a blank piece of paper, draw a small circle/dot in the center of the paper.

- Start at the center of the dot and move "up to the left and around. Cross the middle and up. Around, down, and back to the middle." Use the whole piece of paper and watch the pencil as it moves around the Lazy 8.

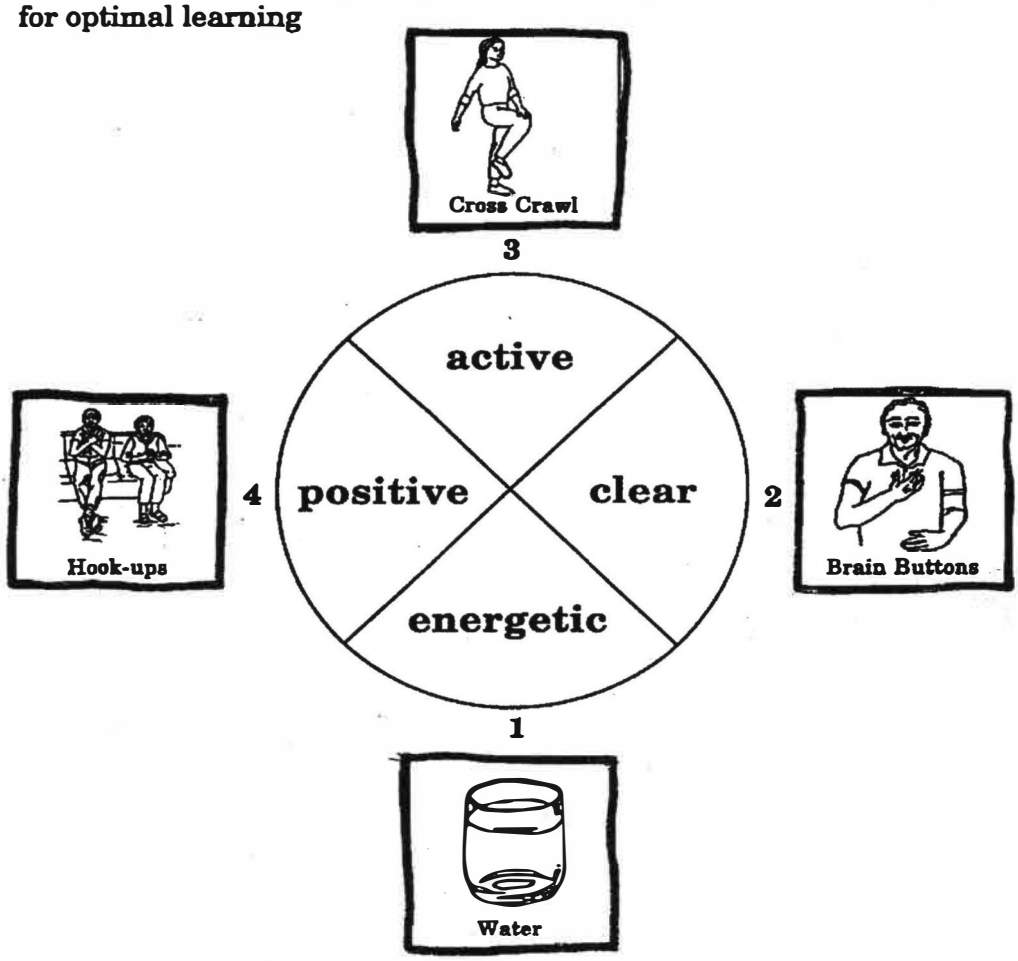
- Repeat this motion about 10 times slowly.

Picture taken from Brain Gym®, Teachers Edition Revised, 1994.

PACE

(Brain Gym® Handbook– The Student Guide to Brain Gym, Paul E. Dennison & Gail E. Dennison, 1997, pg. 5, Edu-Kinesthetics, Inc., P.O. Box 3395, Ventura, CA 93006-3395).

Each person has a unique rhythm and timing – a self-initiated pace for optimal learning



Begin with water and anchor as you go.

APPENDIX G

Calendar Example

January 2004

Please identify which Brain Gym activities were completed on each school day using the following codes.

W = water **CP** = calf pump **AA** = arm activation
CC = cross crawl **BB** = brain buttons **L8** = Lazy 8's
TC = thinking cap **HU** = hook-ups **PACE**

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February 2004

Please identify which Brain Gym activities were completed on each school day using the following codes.

W = water **CP** = calf pump **AA** = arm activation
CC = cross crawl **BB** = brain buttons **L8** = Lazy 8's
TC = thinking cap **HU** = hook-ups **PACE**

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	12	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29						

March 2004

Please identify which Brain Gym activities were completed on each school day using the following codes.

W = water **CP** = calf pump **AA** = arm activation
CC = cross crawl **BB** = brain buttons **L8** = Lazy 8's
TC = thinking cap **HU** = hook-ups **PACE**

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

April 2004

Please identify which Brain Gym activities were completed on each school day using the following codes.

W = water **CP** = calf pump **AA** = arm activation
CC = cross crawl **BB** = brain buttons **L8** = Lazy 8's
TC = thinking cap **HU** = hook-ups **PACE**

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

APPENDIX H

HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Centennial 1903-2003 Celebration

Date: December 9, 2003

To: Ben Atchison, Principal Investigator
Kristen Rievert, Student Investigator for thesis

From: Mary Lagerwey, Ph.D., Chair Mary Lagerwey

Re: HSIRB Project Number: 03-09-26

This letter will serve as confirmation that your research project entitled "The Effects of Brain Gym Activities on Second-Grade Students' Handwriting Skills" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: October 15, 2004

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