THE EFFECT OF BRAIN GYM® ON ACADEMIC ENGAGEMENT FOR CHILDREN WITH DEVELOPMENTAL DISABILITIES

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Following recent legislative initiatives in education requiring evidence-based practices, schools have implemented various instructional programs characterized as evidence-based. *However, it is important to question whether these methods are truly effective. One example of a methodology currently promoted and used in schools is an educational kinesiology program called Brain Gym®. Brain Gym® is reported to improve various education related skills. The purpose of this study is to investigate the effect of Brain Gym® on academic engagement for children with developmental disabilities. In this study, Brain Gym® was compared to an alternate intervention, simple physical activity, which did not conform to Brain Gym® guidelines. Neither intervention produced consistently positive effects for academic engagement. Based on these findings, it is questionable whether Brain Gym® can successfully be used with children with developmental disabilities to improve engagement. These results can inform the decision-making process of selecting evidence-based practices in education.*

In recent years, legislation such as the No Child Left Behind Act of 2001 or the 2004 revision of the Individual with Disabilities Education Act have prompted schools in the United States to begin choosing instructional practices that are evidence-based. However, not all instructional practices are equally effective. Some produce more positive student outcomes than others. It would seem logical that teachers would adopt the most effective practice for classroom implementation. However, it is not always that simple. Research must be conducted in order to determine which programs are effective for different groups of children, including those with developmental disabilities.

The lack of certainty about which programs are evidence-based may leave educators questioning which programs are maximally effective for a particular population. An example of a program currently promoted for use in schools is Brain Gym®. Brain Gym® is an educational philosophy as well as a set of specific physical movements promoted by Brain Gym® International (BGI). These movements are said to lead to optimal learning. According to the Official Brain Gym® Website (Brain Gym International, 2014, para. 3):

Clients, teachers, and students have been reporting for over 20 years on the effectiveness of these simple activities. Even though it is not clear yet ‘why’ these movements work so well, they often bring about dramatic improvements in areas such as:

- Concentration and focus
- Memory
- Academics: reading, writing, math, test taking
- Physical coordination
- Relationships
- Self responsibility
- Organizational skills
- Attitude

Brain Gym® is an educational kinesiology program that is promoted and implemented internationally in over 87 countries. Additionally, Brain Gym® materials have been translated into over 40 languages. According to the Brain Gym International website, introductory training courses in the use of Brain Gym® are available in ten countries (BGI, 2014).

Brain Gym® is an intervention designed by educators and reading specialists, Paul and Gail Dennison, in the 1970s to improve various outcomes including attention, memory, and academic skills. This intervention requires the participants to engage in a variety of movements to help the body recall the movements from the first stages of life when they were learning to coordinate the hands, eyes, ears, and whole body (BGI, 2014). Brain Gym® consists of 26 simple movements that are believed to enhance academic and behavioral performance by activating both hemispheres of the brain through neurological repatterning to promote whole-brain learning (Hyatt, 2007; Dennison & Dennison, 2007). It is purported that by integrating left and right sides of the brain, learning problems, emotional, and psychological stress will be eliminated allowing individuals to optimize their learning experience (Dennison & Dennison, 2007; Spaulding, Mostert, & Beam 2010). While there are many qualitative studies supporting the use of this intervention, few empirical research studies are available. Of the empirical studies available, all show positive effects of Brain Gym®. However, they also have methodological flaws, which obscure the effect of the intervention (Hyatt, 2007). The lack of empirical research as well as methodological flaws in existing research is problematic in determining whether Brain Gym® should be considered evidence-based.

The absence of children with developmental disabilities represented in the existing research also creates a problem when determining whether Brain Gym® may be appropriate for use with children with autism. Of the research studies available, both empirical and qualitative, none were conducted for the purpose of evaluating the program for children with autism (BGI, 2003). Several studies focused on children with Attention Deficit Hyperactivity Disorder or Learning Disabilities. However, children with autism also are in need of interventions in the areas claimed to be improved by Brain Gym®. Autism is generally accepted to stem from biological or neurological differences in the brain (National Autism Center, 2012). According to BGI, engaging in the movements of Brain Gym® causes new neural pathways to grow (Dennison & Dennison, 2007). Therefore, Brain Gym® would be particularly important to evaluate for children with neurologically based disorders such as autism.

Literature Review

Theoretical Foundations

Throughout recent decades, several theories that align with the theoretical foundations of Brain Gym® have been developed and promoted. These theories include, neurological repatterning as put forth in the Doman-Delacato Theory (Doman, 1968), cerebral dominance (Orton, 1937), and perceptual-motor training (Barsch, 1965; Kephart, 1963). These theories promote movement and physical activity in order to *increase concentration, mental cognition, and academic performance* (Mahar et al., 2006, p 2086). According to Mahar et al., (2006) there is evidence that daily classroom-based physical activity increases on-task behavior during instruction.

Empirical Research

While many qualitative studies support the use of Brain Gym®, there is limited empirical evidence to support claims concerning the effects of Brain Gym®. The Official Brain Gym® Website (BGI, 2014) lists research and evidence supporting Brain Gym® and its theoretical foundations. However, most of the evidence is based on anecdotal or qualitative studies, many of which are published in the *Brain Gym® Journal* funded by BGI. Few publications appear in peer reviewed journals. Spaulding, Mostert, and Beam (2010) report that according to the Official Brain Gym® Website *64% of the studies were published in the Brain Gym® Journal or the Brain Gym® Magazine. Only five articles (13%) used an experimental research design…* (p. 23). Hyatt (2007) reviewed all empirical studies from those listed on the Brain Gym® website and only found five articles published in peer reviewed journals. Of those five, Hyatt reviewed only four because the fifth article (Wolfsont, 2002) included one of the research participants as an author.

Four empirical articles on the effects of Brain Gym® were reviewed by Hyatt (2007), Stephenson (2009), and Spaulding, Mostert, & Beam (2010). All four studies have positive findings supporting the efficacy of Brain Gym® activities. However, all four studies also have methodological concerns. Each of the four studies addressed different behaviors. Behaviors targeted include balance as measured by a stork standing task (Khalsa, Morris, & Sifft, 1988), response time (Sifft & Khalsa, 1991), perceptual motor skills (Cammisa, 1994) as measured by the Perceptual Motor Assessment for Children (Dial, McCarron, & Amann, 1988), and test performance (De los Santos, Hume, & Cortes, 2002). While the claims of Brain Gym® predict improvement in many areas of functioning, it is important to begin to develop a line of research identifying specific areas of improvement in education. Brain Gym® claims to improve broad areas of educational functioning such as attention and focus as well as more narrow areas such as reading, writing, math, and test taking (BGI, 2014). While some work has begun in these areas (e.g. test taking), researchers should systematically measure changes in performance in each area.

Another concern in the existing body of literature is the occurrence of either methodological inconsistencies or the lack of detail in published reports. Methodological concerns include lack of detail on type and amount of training in Brain Gym® procedures provided to teachers (Khalsa, Morris, & Sifft, 1988), no pretest data to establish equivalence of groups (Sifft & Khalsa, 1991), no control group (Cammisa, 1994), and lack of direct measures of behavior (De los Santos, Hume, & Cortes, 2002). The lack of detail on training brings into question the integrity of intervention implementation. Teachers without proper training in Brain Gym® methods may be more likely to implement the intervention incorrectly or inconsistently. The lack of pretest data is also problematic because it makes any differences noted at post-test difficult to interpret. The groups could have already differed prior to the beginning of implementation. Similarly the lack of a control group fails to control for maturation. Any improvements documented could have been due to the participants maturing or the passage of time instead of the intervention. Also, the effects of Brain Gym® are not compared to simple physical activity, which has already been shown to increase on-task behavior in children (Mahar et al., 2006). Finally, the lack of direct measures weakens the argument for meaningful behavioral or academic effects.

Hyatt (2007) stated that due to methodological flaws in these empirical studies, there is no basis for claims made by BGI that Brain Gym® improves academic skills, listening and thinking skills, or learning disability deficits. Although, a large body of qualitative studies provides support for the effects of Brain Gym®, the empirical basis for these effects is lacking. Additionally, the four studies reviewed targeted very different types of outcome measures. The lack of a coherent research base focusing on a common outcome variable limits the consistency of the research as a whole. Moreover, Hyatt (2007) and Spaulding, Mostert, and Beam (2010) question the theoretical foundations of Brain Gym®.

However, even with the inadequacy of empirical support, Brain Gym® is still an often promoted intervention. Stephenson (2009) performed an internet search (using the search terms *Braingym*, *Brain Gym*, and *School*) to find what was being promoted to teachers and educators in Australia about Brain Gym®. Stephenson found that there were 4,290 website hits. The first 200 were visited to determine which audience was being targeted. Thirty websites and resources were found that explicitly recommended, endorsed, or mentioned Brain Gym® to teachers and educators. Most of these sites offered Brain Gym® as a form of professional development and all of them provided some level of support for Brain Gym® use in schools.

Purpose of the Study

Brain Gym® is an internationally promoted and implemented program with the potential to affect the learning of thousands of children across the world. In fact, Brain Gym International publishes a chronology of research studies (BGI, 2003). This chronology lists several qualitative studies describing the training and implementation of Brain Gym in a variety of locations and cultures such as the United States, India, Indonesia, Canada, and Israel. Although widely promoted and used, Brain Gym® must be tested for effectiveness in various populations. In the United States, children diagnosed with developmental disabilities such as autism receive individualized educational services provided by the public school system. It is important to determine whether Brain Gym® could be used to improve the educational outcomes of these children. This study seeks to provide information that can be used by educators in order to decide whether Brain Gym® is an appropriate intervention for children with developmental disabilities.

Several reviews of the empirical evidence for Brain Gym® (Hyatt, 2007; Stephenson, 2009; Spaulding, Mostert, & Beam, 2010) indicate that there are few empirical studies available. The empirical studies that have been examined contain methodological flaws that obscure the effects of intervention. There is also a lack of research focusing on common outcome variables, thus limiting applicability of the research findings. Although the empirical foundation for Brain Gym® is weak, the weakness is due to methodological flaws or inconsistencies in the research – not evidence of ineffectiveness or harm. In fact, all of the studies reported positive outcomes when using Brain Gym®. Therefore, it is difficult to determine if Brain Gym® activities are evidence-based given the available literature. The purpose of the current study is twofold. First, Brain Gym® will be implemented with children with developmental disabilities. Second, attempts will be made to correct some of the existing methodological flaws in the literature.

The primary purpose of this study is to empirically investigate the effect of Brain Gym® on academic engagement for children with developmental disabilities. Due to the dearth of information available related to effects of Brain Gym® on academic skills in children with developmental disabilities, this study should be considered exploratory. Therefore, a single subject research design will be used to determine individual patterns of effects over time on a small number of participants. Outcomes of this study will provide a foundation of data to inform the design of replication studies and group implementation.

A further purpose of the current study is to begin to address some of the weaknesses in the existing literature. The common methodological flaws include inconsistent outcome variables, inadequate information on training that teachers received for Brain Gym® techniques, lack of pretest data and control groups, and indirect measures. Each of these will be addressed in the design of the current study. Results of the current study will add to the literature on Brain Gym® and will inform practitioners when determining whether Brain Gym® is an evidence-based practice to improve academic engagement for children with developmental disabilities.

Method

Participants

Participants were recruited from a small university-based after-school program for children with autism and developmental delays in which supplementary academic and vocational instruction was provided. All children receiving academic instruction were included in this study. Those receiving only vocational instruction were not included. The subjects were three males between the ages of seven and nine years old with developmental disabilities. All subjects are referred to using pseudonyms in order to protect confidentiality. Isaac and Aaron were both seven years old with diagnoses of autism. Jason was nine years old with multiple disabilities including oppositional defiant disorder, attention deficit/hyperactivity disorder, and auditory processing disorder. Jason was included in the study because the school psychologist at his school reported that he also exhibited symptoms consistent with an Autism Spectrum Disorder. All participants followed one-step directions and accurately imitated physical movements. Jason and Aaron received reading instruction while Isaac participated in math instruction.

Setting and Materials

Sessions were conducted in a university-based clinic in which each child received one-on-one instruction. Each participant worked in a separate work area that included a table, two chairs, and work materials. Instructional materials used in each session included Corrective Reading ©, Distar Math ©, or teacher-made phonics activities. All intervention procedures were implemented at the students' work area or in the hallway outside of the classroom.

Measures

Academic engagement was chosen as the primary outcome variable because it is a behavior that is necessary in order to benefit from academic interventions, it is a behavior that all three of the participants needed to improve, and it is consistent with the claim that Brain Gym® improves focus and concentration. While previous studies have focused on very specific outcomes such as the response time (Sifft & Khalsa, 1991), perceptual motor skills (Cammisa, 1994), and academic test performance (De los Santos, Hume, & Cortex, 2002), academic engagement is a skill that is applicable to all areas of academic performance and will serve as a foundation for future research. Academic engagement for all subjects was defined as 1) sitting in a chair with bottoms on the chair and feet and chair legs on the floor, 2) eyes oriented toward the instructor or paper/materials, 3) remaining quiet or appropriately responding to instructor's directions or questions; 4) hands either on the table, activity, appropriate utensil, or in lap.

Academic engagement was measured using a 30 second time sample. Every 30 seconds the data collectors recorded whether the child was engaged or not. Data was collected daily during the first ten minutes of academic instruction. The first ten minutes of instruction was chosen because the children typically took their first break after ten minutes. During the break, the children selected from a variety of activities to complete. In order to avoid any break-time activities influencing data, it was determined that data collection would stop prior to the first break. Percentage of intervals with academic engagement was compared across baseline and two interventions for each subject.

The recording procedure was also chosen in response to the need for more direct measures of outcomes within the Brain Gym® literature. While one study reported teacher ratings of academic test performance (De los Santos, Hume & Cortes, 2002), a time sample provides a more direct measure of moment by moment performance and will allow for repeated measurement across days to reveal any patterns in behavior over time.

Design

A single-subject research design was selected in order to monitor data patterns over time for each individual. In order to address the lack of pretest data reported in previous research (Sifft & Khalsa, 1991), a baseline was implemented within the single subject design. Each subject first completed a baseline phase in which no intervention procedures were implemented. This lasted for one to two weeks and served as a type of pretest to which intervention results were compared.

A second flaw in research design reported in previous studies was the lack of a control group (Cammisa, 1994). While single-subject research designs do not include control groups, they do incorporate features to simulate a control condition. In order to do this, an alternating treatments design was chosen. In this design, the intervention of interest (Brain Gym®) is alternated with a second treatment, which serves as a control condition within each participant. These two interventions were randomly alternated across sessions. Whether each participant engaged in Brain Gym® or the control intervention each day was selected based on a coin toss for each session with the requirement that the same intervention could not be selected for more than two consecutive days. This requirement was implemented in order to prevent a participant from going for more than one week without engaging in each intervention.

Using this type of research design, specific patterns of data would indicate whether Brain Gym® was effective or ineffective as compared to the control intervention. Although the effects of Brain Gym® are characterized as *rapid* (Dennison & Dennison, 2007, p. 2), it is unclear in the Brain Gym® training manual (Dennison & Dennison, 2007) whether the effects of Brain Gym® will be immediate or whether the child must experience Brain Gym® over a period of time to see effects. Therefore, two patterns of data could emerge indicating that Brain Gym® is an effective intervention in the current study. First, if the effects of Brain Gym® are immediate, then data during Brain Gym® sessions will produce consistently higher average percentages of engaged time when compared to the control intervention. Alternatively, if the effects of Brain Gym® are cumulative over time, then both the Brain Gym® and the control intervention should show slowly increasing trends over time as the child experiences a cumulatively larger number of Brain Gym® sessions. However, if Brain Gym® is ineffective, then one of two data patterns would emerge. The data for Brain Gym® may overlap with the control intervention so that neither intervention is superior in percentage of engaged time. Alternatively, the percent of engaged time for Brain Gym® may be consistently lower than the control intervention. Data for each participant will be evaluated to determine the effect of Brain Gym® based on these guidelines.

Baseline

During Baseline, subjects were given no instructions and were allowed to occupy themselves with any quiet activity that required mostly fine motor movements (e.g. Play-doh®, games, coloring, and toy figurines). These activities lasted between 8 to 10 minutes prior to beginning academic instruction. During baseline, academic engagement was measured during the first 10 minutes of academic instruction.

Intervention

Prior to intervention, all researchers (including those implementing the intervention) successfully completed the twenty-four hour Brain Gym® 101 training to become certified in conducting Brain Gym® activities. This level of training increases the likelihood that Brain Gym® is implemented as designed and is an improvement over previous studies in which the amount of training in Brain Gym® was not specified (Khalsa, Morris, & Sifft, 1988). The current investigation compared two interventions (Brain Gym® and control) to promote academic engagement among children with disabilities. Interventions took place prior to beginning academic instruction each session.

Brain Gym ®. The Brain Gym® intervention consisted of completion of Brain Gym® activities. At the beginning of the session, participants completed four movements. Brain Gym® does not provide a recommended number of activities, therefore, movements were selected so that one movement activity from each category (Midline Movements, Energy Exercises, Deepening Attitudes, and Lengthening Activities) was represented. Some Brain Gym® movements (e.g. Space, Earth, Brain, and Balance Buttons) were omitted due to controversial placement of the hands on body parts (e.g. tailbone and groin areas; Hatton, 2003). However, all other Brain Gym® movements were included. Sessions were conducted 2-3 days per week for 7-8 weeks depending on subject availability. Subjects chose one of four cards, each with a picture depicting a movement from one of the categories. The instructor led the subject in that activity by describing and modeling the movement. The movement activity was sustained until the subject ceased to engage in the movement, requested to stop, or 30 seconds had elapsed. Thirty seconds was chosen because it is the minimal amount of time recommended for Brain Gym® activities (Dennison & Dennison, 2007). This process was repeated until the subject had chosen all four cards.

Control Intervention
In order to assess whether Brain Gym® was effective, a control intervention was compared. Since engaging in a physical activity has been shown to improve on-task behavior in the classroom (Mahar et al., 2006), it was determined that the control intervention should also include physical activity, but not conform to the Brain Gym® movements. This type of control intervention will allow the researchers to determine if Brain Gym® is more effective than simple physical activity. The control intervention consisted of walking in the hallways outside of the classroom (8-10 minutes). For two of the participants (Jason and Aaron), scavenger hunts were implemented in order to increase motivation to engage in the walking activity. During scavenger hunts the students walked through the hallways until they located hidden items (toys or books). The remaining participant (Isaac) seemed to enjoy walking in the hallways and did not require an activity to increase motivation to participate.

Reliability
Reliability of data collection was obtained for approximately 50% of sessions for each subject by two independent observers. After each session, data from each observer were compared and inter-observer agreement percentages calculated. Inter-observer agreement was measured across all conditions and participants. Inter-observer agreement ranged from 89%-100% with a mean of 95.3%.

Results
Results for each subject are presented in Figures 1 – 3. Academic engagement for Jason (Figure 1) ranged from 20%-50% during baseline with a mean of 37%. Baseline data showed a clear downward trend. During sessions with Brain Gym®, academic engagement ranged from 28%-35% with a mean of 32%. Control intervention data ranged from 0%-51% with a mean of 24%. Both Brain Gym® and control data show an increasing trend over time. Although Brain Gym® had a slightly higher mean, the control data indicate a steeper increase in the trend. By the end of the intervention phase, percent of engaged time during the control intervention had surpassed Brain Gym®. Neither intervention produced substantially better academic engagement when compared to baseline. While the results for Jason do show increasing trends in both interventions, which could indicate a cumulative effect of Brain Gym®, the relatively steeper slope of the control data weakens this conclusion. Conclusions are also weakened due to the small number of sessions completed by Jason. Due to an extended illness causing frequent absences, Jason was forced to end treatment early.

Isaac’s baseline data for academic engagement (Figure 2) ranged from 68%-90% with a mean of 79%. Baseline data show a clear downward trend. Academic engagement during Brain Gym® ranged from 68%-98% with a mean of 74%. Data for the control intervention ranged from 51%-96% with a mean of 69%. Brain Gym® data showed no trend with one outlying data point on session 12. Control data increased steadily throughout all sessions. Neither intervention was clearly superior to baseline. While Brain Gym® resulted in a slightly higher mean percentage of engaged time when compared to the control condition, the control data showed an upward trend eventually surpassing Brain Gym® by the end of the intervention period. This seems to indicate that Brain Gym® was ineffective for Isaac.

Academic engagement for Aaron (Figure 3) ranged from 0%-69% during baseline with a mean of 46%. Baseline was variable with no clear trend. Academic engagement ranged from 42%-96% during Brain Gym® with a mean of 63% and a clear downward trend. During the control intervention, data ranged from 58%-79% with a mean of 68% and a slightly upward trend. For Aaron, Brain Gym® resulted in a high percentage of academic engagement in the first session and then decreased rapidly throughout the sessions while the control intervention increased over time with a slight drop in the last session. Neither intervention produced academic engagement substantially higher than baseline. For Aaron, Brain Gym® was ineffective when compared to the control condition.

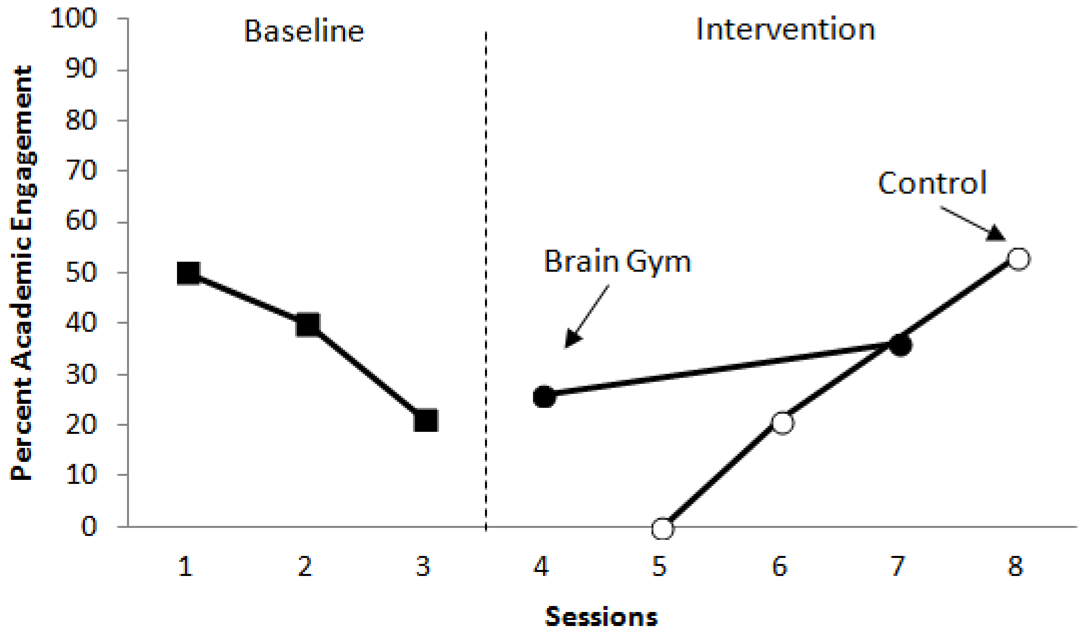

Figure 1: Alternating treatments design for Jason comparing baseline, Brain Gym ® and control conditions.

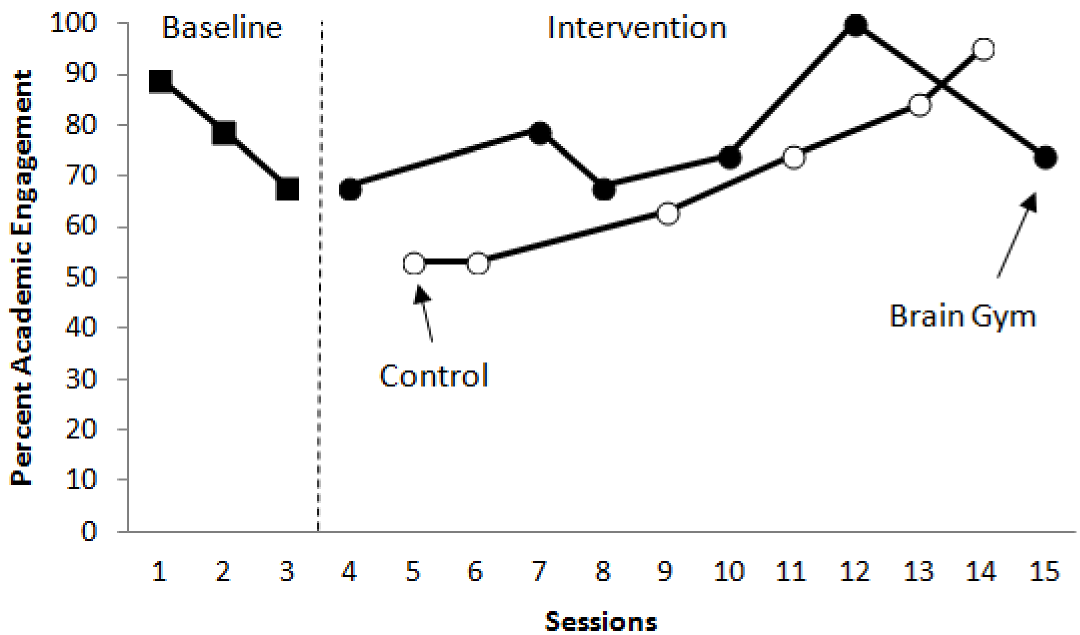

Figure 2: Alternating treatments design for Isaac comparing baseline, Brain Gym ® and control conditions.

Discussion

As an internationally promoted and implemented program, Brain Gym® has the potential to impact the learning of children around the world. However, given the time and effort required to implement this program, it is important to verify the effectiveness of Brain Gym®, especially as it relates to children with developmental disabilities. This study provides preliminary evidence in order to help educators make informed decisions when choosing whether to use Brain Gym® for this population.

The results of this study show that Brain Gym® does not produce clear and substantial differences in academic engagement when compared to a control (physical activity) intervention or baseline (unstructured fine motor activity) for children with developmental disabilities. Since classroom-based physical activity alone has been shown to increase on-task behavior (Mahar et al., 2006), it would be important for Brain Gym® to produce improvements in academic engagement above and beyond simple physical activity in order to prove this intervention to be necessary. However, this was not the case in the current study. In fact, the control condition produced consistently positive trends in academic engagement for all three participants while Brain Gym® only produced a positive trend in one participant who was only exposed to two Brain Gym® sessions.

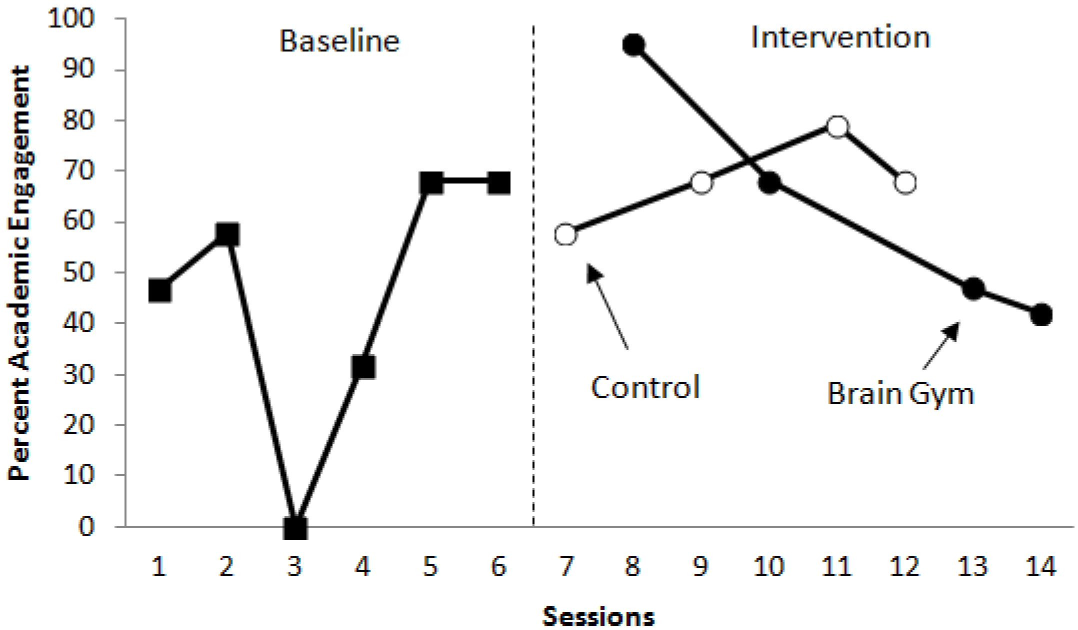

Figure 3: Alternating treatments design for Aaron comparing baseline, Brain Gym ® and control conditions.

In this study, treatment lasted over the course of about two months. Each participant engaged in Brain Gym® up to two times per week and performed four Brain Gym® movements for approximately 30 seconds per movement. While future research should be conducted to assess whether exposure to Brain Gym® over a longer period of time or a stronger dosage may produce effects, there are some obstacles to be overcome first. All three participants showed a lack of motivation to perform Brain Gym® activities. Occasionally, subjects were resistant to performing the Brain Gym® activities. This is especially likely for children with developmental disabilities who may be less fluent at following directions or imitating models. Two subjects (Jason and Aaron) occasionally chose to only perform the activities for a few seconds. Consistent with Brain Gym® methods, the child was allowed to choose the duration of each movement. However, longer durations may have produced different effects. One solution to this problem may be to increase motivation by providing a reinforcer for successful completion of each movement (i.e. stickers). However, the inclusion of reinforcers in the Brain Gym® intervention would fundamentally change the intervention and prevent testing the effects of Brain Gym® as a stand-alone intervention.

While this study fails to support the claims of BGI that engaging in Brain Gym® can produce substantial improvements in concentration and focus, it does provide more detailed information about the effects across time for a small number of participants with developmental disabilities. It also addresses several of the methodological concerns identified in the previous literature. Based on the findings of the current research, Brain Gym® would not be considered an evidence-based practice for increasing engagement in children with autism and other developmental disabilities. These results can further inform teachers, administrators, and policy-makers in the process of identifying evidence-based practices for use in school settings.

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