

PALAESTRA, Attn: Martin Block, Editor, Kinesiology Program, University of Virginia, 210 Emmet St., S. Box 400407, Charlottesville, VA 22904-4407 PH 434.924.7073 · E-mail: meb7u@virginia.edu · Website: www.palaestra.com (Manuscript: Ms#17-022)

EFFECTS OF A DRUMS ALIVE® KIDS BEATS INTERVENTION ON MOTOR SKILLS AND BEHAVIOR IN CHILDREN WITH INTELLECTUAL DISABILITIES

Carrie Ekins¹, Jacqueline Boehr, Henry Schulz², Peter R. Wright³, Dean Owens⁴, Wendy Miller

¹ Drums Alive® UG, 86500 Kutzenhausen, Germany

² Chair of Sports Medicine, Technische Universität Chemnitz, Thüringer Weg 11, 09126 Chemnitz, Germany

³ Department of Sport and Health Sciences, Oxford Brookes University, Oxford, United Kingdom

⁴ Professor, Embry-Riddle Aeronautical University, JBMDL, New Jersey, USA

Key Words: *Polyrhythmic, Multi-modular, Multi-discipline, Enriched environment, Sportive Drumming, Diverse Abilities (a.k.a. special needs)*

Abstract

Over the past three decades in the United States, behavioral and learning disorders emerged as conditions that are affecting the development of school-aged children and adolescents requiring a comprehensive, in depth review and due diligence in applying appropriate intervention strategies and finding solutions.^{1,2} Credible sources estimate the number of children with disabilities, ages 0 to 18 years, between 93 million and 150 million.³ Additional data obtained from the American Community Survey (2010), which sampled 53.9 million children in the United States, ages 5 to 17, concluded that approximately 2.8 million reported having a disability.⁴ Of significant concern is that children with disabilities comprise some of the most marginalized and excluded groups.⁵ Evidence reveals that these children exhibit a multitude of associated illnesses and multidimensional symptoms and disabilities and experience poorer levels of health than the general population.^{6,7,8,9,10} Motor skill deficits, mainly in coordination, such as hand to eye, is one of the characteristics or symptoms of an intellectual disability.^{5,6} Therefore, exercise therapy, with coordinative elements as well as special approaches to education, is a necessary action to achieve optimal health outcomes; and, to influence the development of the affected children in the best possible way.¹¹ Hence, the aim of this study was to examine the physiological, symptom specific and cognitive effects of a multi-modular Drums Alive Kids Beats® Intervention in children with diverse abilities.

Methods

Of all the children with diverse abilities, those with mental disabilities, aged 13.9 ± 2.7 years of age, were divided into two separate intervention groups and either attended the conventional school physical education lessons (PEG); or, participated in additional Drums Alive® Kids Beats Intervention classes (DG) twice a week. To give perspective, before and after the assessments for the 7-week intervention program were conducted, the performance was measured using the German Motor Skill Test (DMT). Furthermore, the children's behavior and competencies were assessed by means of two questionnaires, the HKI and the VFE, as well as the Developmental Behavior Checklist (DBC), which monitors daily behavioral patterns.

Results

Results showed significant improvements of the DG in aerobic performance ($p=0.11$), coordination ($p=0.038$) & strength (0.015). Regarding the children's monitored behavior (DBC), the DG also showed significant improvements ($p=0.007$) compared to the PEG. No significant changes were found in the competencies within each group and when measured against other groups.

Conclusions

The findings of this study revealed that a sportive multi-modular drumming exercise program that combines endurance, strength training and highly coordinative movements, with emotional elements in an enriched environment, had significant effects on motor skill performance and behavior in children with intellectual disabilities. Therefore, conclusive evidence suggests that this type of intervention can be an additional useful therapeutic tool for children with diverse abilities and/or intellectual disabilities. Furthermore, the Drums Alive® Kids Beats Intervention also seemed to arouse more enthusiasm among children, which, in turn, could lead to better compliance regarding physical activity; however, this should be further investigated to provide additional evidence to validate this type of intervention strategy. Merriam-Webster defines special needs (a.k.a. diverse ability) as "any various difficulty (such as a physical, emotional, behavioural, or learning disability or impairment) that causes an individual to require additional or specialized services or accommodations (such as in education or recreation)."

1. Introduction

Although the statistical data used in this study was obtained from research conducted in the United States in 2010, additional data provided by Statistisches Bundesamt, in 2013, indicated that there are 7.5 Million people in Germany with disabilities, which 11 percent were identified as those who were experiencing intellectual disabilities with a limited range of motor capability (Lehmkuhle, 2007; Van der Schoot, 1990). Due to the independent study being conducted at Chemnitz University in Germany, and to ensure the consistency of data resources, children with diverse abilities living in Germany were selected as participants for this research. The experiment included an intervention group and a control group that, by design, participated in regular school sports activities. However, the intervention group also performed the Drums Alive® Kids Beats Intervention protocols twice a week for a period of seven weeks. In a pre- and post-evaluation, the motoric ability of the children were measured against the Deutsche Motorik Test (DMT); and, the behavior of the participants were evaluated according to the Heidelberger Kompetenzinventar (HKI), the Questionnaire of Behavioural deficiencies (VFI) and the daily observations by the teachers (DBC).

To ensure common understanding, this research defined Sportive Drumming as an "aerobically centric, cerebrally focused, multi-modular, polyrhythmic musical expression of communication." The protocols require the use of various drumming exercises and an enriched environment to improve motor skills and overall health with the goal of creating a positive influence on concentration, learning, memory, cognitive functioning, academic performance, and social-emotional development. Additionally, modeling was defined as a system in which specific movement patterns are practiced or imposed regularly as a way of

improving, restoring, or stimulating muscular coordination, especially in brain damaged or disabled persons; and, patterning is a method of treatment or act of establishing a system or pattern of stimuli that will evoke a new set of responses. These processes have demonstrated positive results in retraining people with diverse abilities, specifically those who have suffered a brain injury or a birth related defect that disrupts normal sensory-motor activities. An additional goal of this research was to determine if preconceived boundaries have limited fitness program protocols and educational opportunities for those with diverse abilities.

As a backdrop for this research, Amnon Gimpel, M.D., psychiatrist and neurologist, suggested that first, a multi-disciplinary (a.k.a. multi-modular) approach will not only contribute to a happier, more confident child, but also build a more flexible, sophisticated brain that allows for enhanced social skills and memory development.¹³ Secondly, Dr. Gimpel reported that mental and physical brain exercise make permanent changes by raising concentrations of neurotransmitters that the synapses use for a more focused person.¹⁴ Multi-disciplinary methods involve drawing appropriately from multiple disciplines to redefine problems outside normal boundaries and reach solutions based on a new understanding of complex situations. One widely used application of this approach is in diverse ability populations and health care environments, where people are often looked after by a multi-disciplinary team that aims to address their complex clinical, physical and educational needs.

As a supporting backdrop to this study, Marian Diamond, University of California at Berkeley, B.A. (1948), M.A. (1949), Ph.D. (1953), University of Oslo, Norway, Certificate of Courses (1948), added her insight, with significant documentation, about the importance of enriched environments and its key role in fostering an enhanced ability to educate. She stated that before 1960, the brain was considered by scientists to be immutable, subject only to genetic control. In the early sixties, however, investigators were seriously speculating that environmental influences might be capable of altering brain structure. By 1964, two research laboratories proved that the morphology and chemistry, or physiology of the brain could be experientially altered (Bennett et al. 1964, Hubel and Wiesel 1965). Since then, the capacity of the brain to respond to environmental input, specifically “enrichment,” has become an accepted fact among neuroscientists, and educators.

This research accepts and endorses the premise that the brain is an extremely plastic organ, the structure of which is “exquisitely sensitive to experience and remarkably responsive to its interactions with the environment.”¹⁸ This plasticity lies in its unique ability to change in response to experience and alter its structure and even generate new neurons¹⁹ when a particular function of the brain is incapable of being completed due to a defect, injury, or learning disability or, if stimulated in a certain way that encourages growth due to excitation. Further evidence suggests that the brain has the ability to expand or contract from the impact of external influences, such as exercise and other stimulating experiences.^{20,21,22,23} In order to capitalize on these capabilities and maximize the benefits of a program, specifically for the diverse ability population, more than just convenient data indicates that a multi-modular (a.k.a. multi-discipline) approach has been extremely beneficial when used as the foundation of an effective program that promotes physical, mental and emotional well-being. This stimulation, in the form of movement and sensory experiences during the early developing years, is necessary to achieve the precision of the mature brain.^{14,15,16,17,18,19,20,21,22,23}

Sufficient data exists that suggests an increase in exercise promotes improvements in a child's physical health, intellectual functioning, awareness, behaviour, emotions, and personality (Lang et al., 2010).²⁵ With respect to children with diverse abilities, a recent review of students performing a physical activity and having Autism Spectrum Disorder concluded that there were positive effects in behaviour, academics, physical fitness, and an increased desire to exercise.²⁵ In 2013, the team of Pontifex, Saliba, Raine, Piccietti, Hillman conducted a study on children who have been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD),²⁶ and participated in bouts of moderately intensive aerobic exercise comprising twenty minutes of treadmill activity or twenty minutes of seated reading. The participants wore an electrode cap to monitor brain function while performing tasked instructions. The children were assessed using the Wide Range Achievement Test (WRAT) after participants' heart rate dropped down to a normal rate. The electrode cap showed more activity throughout the entire brain for the post exercise group; however, the post reading group only experienced activity in the rear part of the brain. Simply put, response accuracy was much higher in the children who exercised and all supporting research indicated that the quality of life can be improved from exercise with those who have limitations or diverse abilities; however, adaptive applications of exercise methodology and venues must be evaluated and deemed appropriate to provide the proper techniques, procedures and environment.

2. Methods and Materials

2.1 Subjects

The aim of this study was to examine the effects of a multi-modular Drums Alive® Kids Beats intervention on physical performance, behavior, cognitive, social and practical competencies. The participants, who were recruited from a special school for children with intellectual disabilities in Marienberg, Germany, showed developmental delays in multiple areas and/or intellectual disabilities. Data from 15 children aged 13.9 ± 2.7 years, 4 females and 11 males, have been analyzed. All pupils have been diagnosed with mental retardation, behavioural challenges and different intellectual disabilities, such as autism spectrum disorder. Table 1 shows the descriptive characteristics of all subjects and also within the 2 groups (Intervention group (IG); Comparison group (CG)). Written informed consent was received from the legal guardians of all subjects prior to their participation in the study.

Table 1: Descriptive characteristics of the subjects

Groups		Age in years	Weight in Kg	Height in cm	BMI
IG (Drums Alive)	Mean value	14.2	55.8	161	20.6
	SD	3.1	19.9	16	3.9
	N	10	10	10	10
CG (PE)	Mean value	13.4	47.9	157	19.1
	SD	1.7	15.3	10	4.7
	N	5	5	5	5
All subjects	Mean value	13.9	53.2	160	20.1
	SD	2.7	18.4	14	4.1
	N	15	15	15	15

*IG (Intervention Group), CG (Comparison Group),
PE (Physical exercise), BMI (body weight/height²) units are Kg/m²*

2.2 Behavior and Competency Outcome Measures

Trained assessors, parents and schoolteachers assessed the participants within two days before and after the intervention as well as during the intervention phase.

The Heidelberg Competency Inventory (HKI)

The HKI was used to assess the cognitive, social and practical competencies of the children before and after the interventions. The items had been completed by the parents of all participants. Data analyses included the separate evaluation of the three areas of competence (cognitive, social and practical) as well as the overall competency. Therefore, the median values have been determined because some of the items had not been processed, whereby comparisons by using the mean value didn't seem to be useful.

Behavior Questionnaire for Developmental Disabilities (VFL-L)

The VFL-L was used to evaluate the effects on the children's behavior and emotions. The questionnaire consisted of 94 items and was completed by the school teachers before and directly after the intervention. Thereby, it has been made sure that the same teacher assessed the same child. For data analyses the sum of each of the five subscales as well as the total sum score were determined.

The Developmental Behavior Checklist (DBC-M)

The DBC is an instrument to monitor children's behavior during the intervention phase. Five individual behavior patterns were identified for each child and have been monitored by the teachers on a daily basis. Each behavior pattern was assessed on a scale from 0=no problem to 2=very difficult today (see table 2). At the end of each week, a sum of each behavior pattern was calculated, allowing the researchers to assess the behavioral development during the time of intervention.

Table 2: Valuation Key (e.g. Aggressive Behavior)

No of points	Aggressive Behavior
0	...no problem today
1	...somewhat difficult today (moderate)
2	...very difficult today

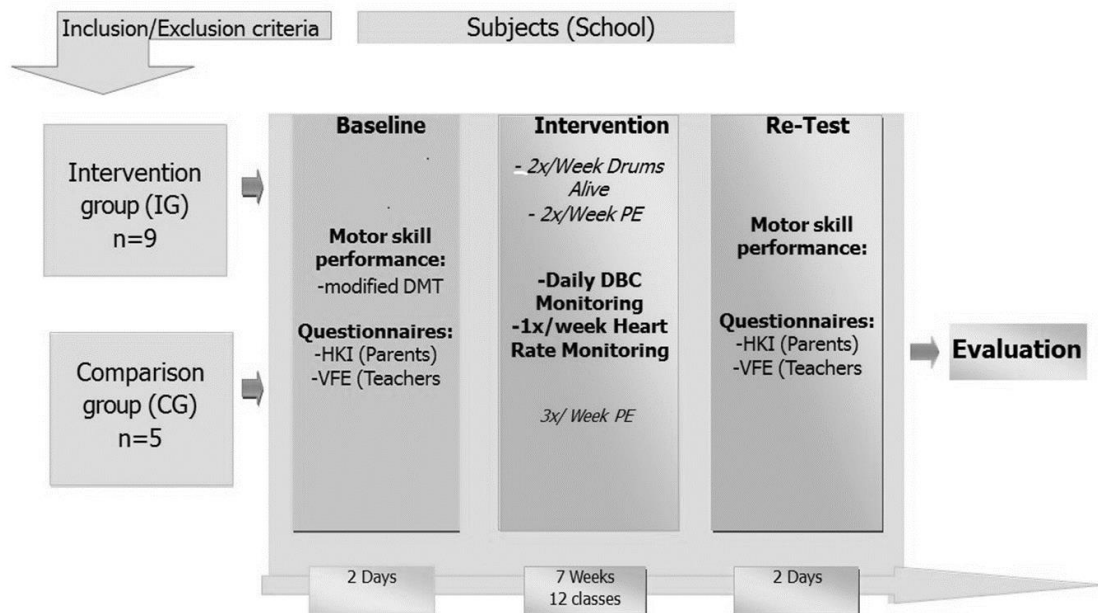
2.3 Motor Skills Outcome Measures

To assess the effects on the participant's motor skills, the German Motor Skill Test (DMT) was used. The standardized test battery consisted of 8 exercises (20m Sprint, Sit Up's, Standing long jump, Forward bend, Jumping side-to-side, Balancing backwards, Press ups, 6 min-run to assess how far various dimensions of physical performance. For the present study, the press-ups have been replaced by medicine ball shots because it would have been too difficult for most of the children to perform those. This exercise has been used in other research studies and standardised test batteries and is therefore a reliable test to assess the upper limb performance. (ELBATRAWY 2008; KATS-K 2001).



The test was carried out in the school's gymnasium and both groups (IC and CG) were tested separately on two different days. Before starting with the actual test tasks, the children performed a guided general warm up. Subsequently, the whole group completed the 20m-Sprint. After a short break all the other tasks except for the 6m-run were performed on individual stations (see picture above). The children were given instructions for each task, followed by a practice trial. Most tasks were performed twice with a recovery break in-between. At the end, all children performed the 6-minute-run together. One child of the intervention group could not attend the post-test because of illness. Hence, the data has not been included in the evaluation of the DMT.

Figure 1: Schematic Study Design



2.4 Interventions

The subjects were assigned by the schoolteachers to either the intervention group (IG) or the comparison group (CG). The IG conducted two Drums Alive® (Kids Beat sessions) and additionally two conventional physical exercise (PE) classes per week, over the duration of seven weeks. The CG performed three PE-classes a week only.

The PE classes were carried out by the schoolteachers and included the regular key areas of the current curriculum, which were running, jumping and throwing at the time of the intervention.

Drums Alive® Kids Beats combines cognitive experiences with simple dynamic movements and drumming on a fitness (stability) ball. Rhythm exploration is also a strong component of the program. The intervention, which consisted of a warm up, main phase and cool down also included strength based, tam-oriented and relaxing exercises. Therefore, the Drums Alive® Kids Beats intervention adopted a holistic approach, based on the children's needs.



2.5 Statistical Analyses

For all participants, descriptive statistics were performed.

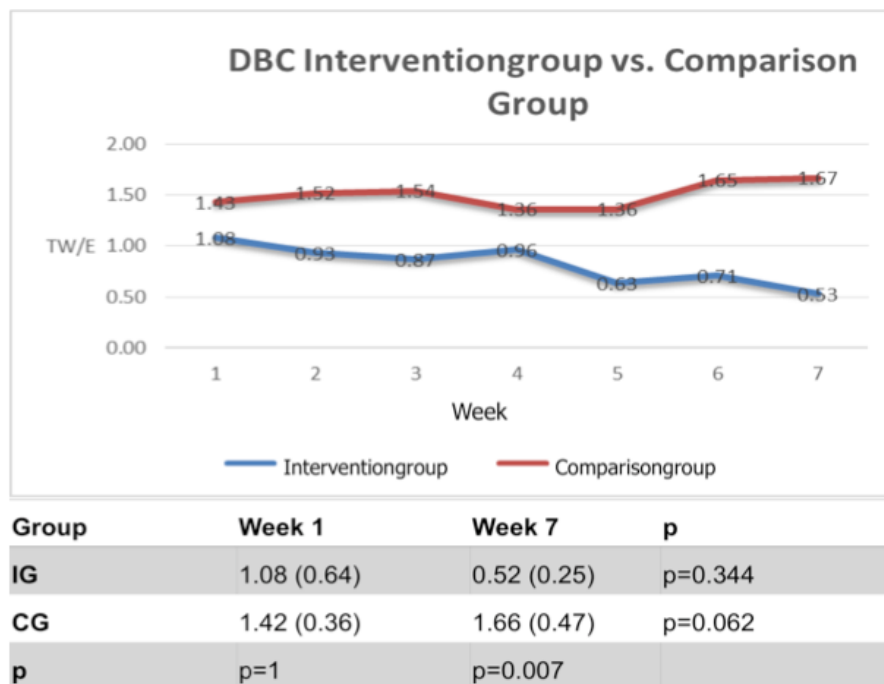
The DMT as well as the Behavior Questionnaire for Developmental Disabilities was analysed by using either the t-Test for dependent samples or the Wilcoxon-Test, with a 95% confidence interval. Regarding the Heidelberg Competency Inventory (HKI) the median values of each competency as well as the total competency were determined and assessed for differences by using the sign test, which was also used for the Developmental Behavior Checklist (DBC). For the DBC, determining a daily value per characteristic, which was calculated from the relation of the weekly sum, the number of monitored days and the number of assessed behaviour patterns, was used to evaluate the daily behaviour.

3. Results

3.1 Developmental Behavior Checklist (DBC)

Figure 2 shows the results of the DBC over the intervention time, including mean values as well as the standard deviation in brackets and p-values. The intervention group showed a non-significant improvement in the individual behaviour patterns, whereas the comparison group performed a slight decline over time. At the end of the intervention in week 7, the difference between the two groups has been significant ($p=0.007$).

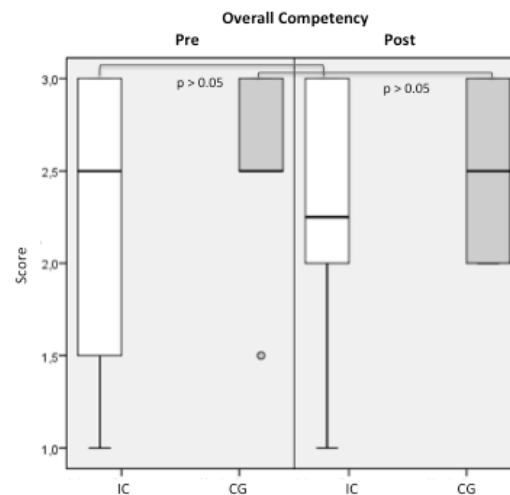
Figure 2: Results of the Developmental Behavior Checklist (Mean values, standard deviation and p-values)



3.2 The Heidelberg Competency Inventory (HKI)

The following figure represents the results of the overall competency pre to post test in both groups in the form of boxplots. There have been no significant changes regarding the overall competency, neither in the intervention group nor in the control group. The separate evaluation of the three areas of competence (social, cognitive & practical competence) didn't show any significant changes either. All values remained mainly unaffected by the intervention.

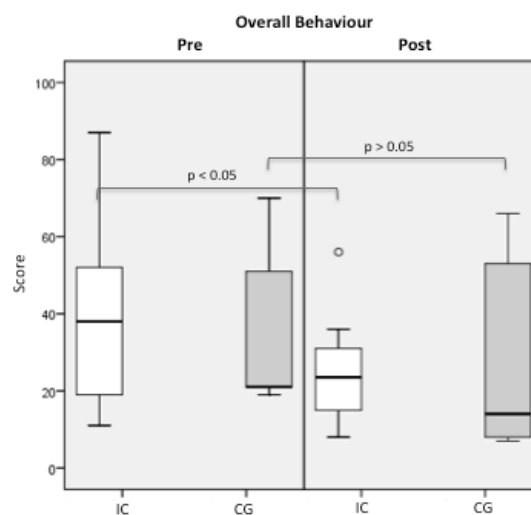
Figure 3: Comparison of the Overall competency score pre- and post-intervention in both groups



3.3 Behavior Questionnaire for Developmental Disabilities (VFL-L)

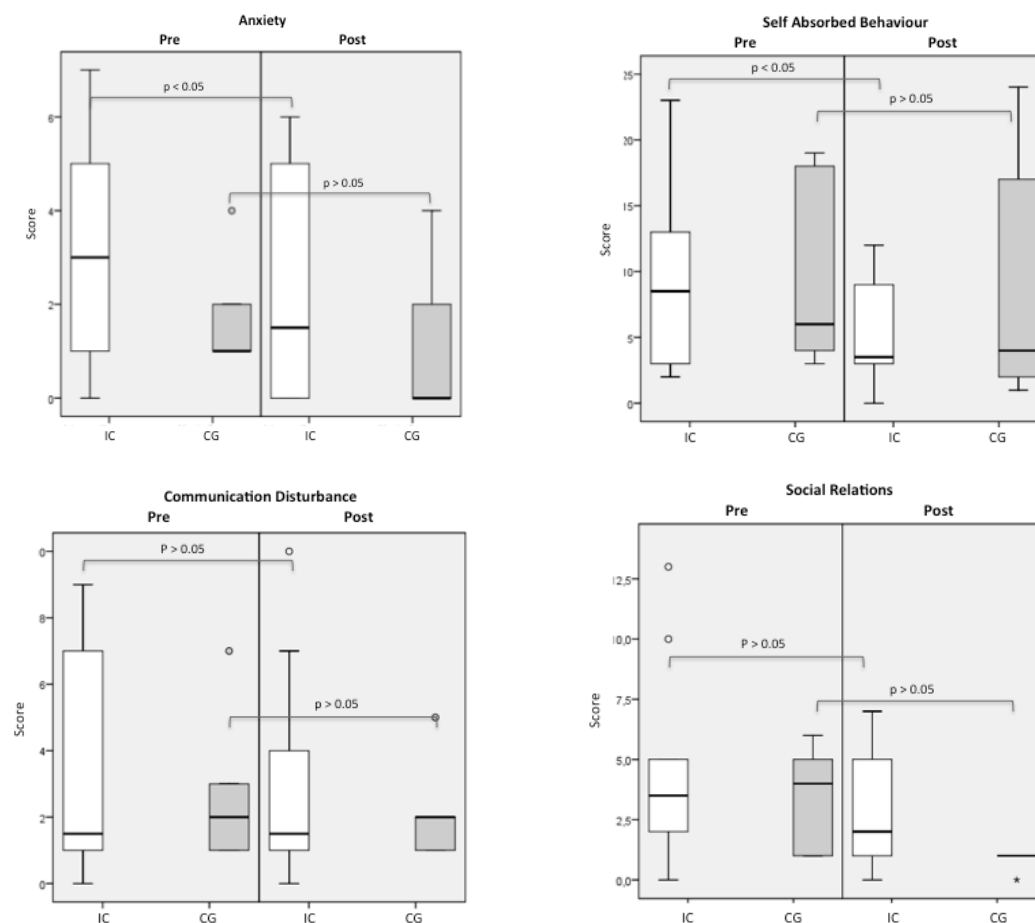
Figure 4 shows the total behaviour scores for both groups pre- to post- intervention. There has been a significant improvement ($p=0.08$) in the intervention group (IG) compared to the comparison group ($p=0.345$). The differences between the groups have been non-significant.

Figure 4: Comparison of the total behaviour score pre-to post-intervention in both groups



The figure below represents the results of the subcategories of the VFE-L. The intervention group showed significant changes in the categories "Anxiety" ($p=0.016$), "Disruptive behaviour" ($p=0.036$) and "Self-Absorbed Behaviour" ($p=0.01$). There were no significant changes in any category in the comparison group and no significant differences between the groups.

Figure 5: Comparison of the subcategory scores pre- to post-intervention in both groups



3.4 German Motor Skill Test (DMT)

The following table shows the results of the motor skill test with the mean values as well as the standard deviation in brackets, the p-values pre to post test and between the groups. There have been significant improvements in the intervention group in five of the eight performed tasks, whereas the comparison group doesn't show any significant differences after the intervention.

Table 3: Results of the DMT with mean values, standard deviation shown in brackets

Medicine ball shot	Distance (m) Pre	Distance (m) Post	P-value
IG	4.9 (1.79)	4.8 (1.52)	p=0.583
CG	3.5 (1.43)	3.36 (1.24)	p=0.431
<i>P-value</i>	p=0.162	p=0.098	
Sit ups	(No. Of Sit ups) Pre	(No. Of Sit ups) Post	
IG	18.11 (7.06)	22 (6.08)	p=0.015
CG	17 (2.82)	19 (4.47)	p=0.176
<i>P-value</i>	p=0.947	p=0.348	
Standing long jump	Distance (m) Pre	Distance (m) Post	
IG	1.46 (0.46)	1.52 (0.42)	p=0.032
CG	1.22 (0.34)	1.24 (0.28)	p=0.728
<i>P-value</i>	p=0.325	p=0.220	
6-minute-Run	Distance (m) Pre	Distance (m) Post	
IG	1008 (189.48)	1079.56 (184.71)	p=0.11
CG	1021.20 (97.45)	971.80 (137.20)	p=0.500
<i>P-value</i>	p=0.888	p=0.279	

Table 3: Results of the German Motor Skill Test (Mean values, standard deviation and p-values)

20-m Sprint	Time(Sec.) Pre	Time(Sec.) Post	P-value
IG	4.28 (0.81)	4.15 (0.61)	p=0.491
CG	4.3 (0.7)	4.3 (0.79)	p=1.00
<i>P-value</i>	p=0.98	p=0.711	
Balancing backwards	(No. of Steps) Pre	(No. of Steps) Post	
IG	24.22 (10.75)	29.67 (10.42)	p=0.045
CG	24.4 (11.63)	28.2 (9.09)	p=0.135
<i>P-value</i>	p=0.977	p=0.797	
Jumping side to side	(No. of Jumps) Pre	(No. Of Jumps) Post	
IG	23.77 (9.23)	27.16 (11.65)	p=0.038
CG	18.9 (4.6)	19.8 (5.39)	p=0.221
<i>P-value</i>	p=0.295	p=0.212	
Forward bend	(cm) Pre	(cm) Post	
IG	-1.58 (6.36)	-1.83 (5.87)	p=0.633
CG	-20.2 (3.4)	-19.7 (6.51)	p=0.686
<i>P-value</i>	p=0.003	p=0.004	

Discussion

In spite of the recent availability of research regarding exercise in children, the effects of physical activity are less understood in children with disabilities. There is a diversity of disabling conditions which provides a challenge in generalizing information gathered on a population of children (or even research on other disabilities) and applying it to a specific child or group of children. A broad spectrum of abilities and limitations exists within the category “disability” that precludes a standardized, experimentally-based examination; therefore, careful consideration should be taken to guard against the extrapolation of adult to children's data when applied to children with disabilities; and, any attempt to investigate the effect of exercise must evaluate the effect of the disability on normal physical and psychosocial growth and development. However, as complex as it may be to gather substantive data and demonstrate a congruency of applicability to all situations, it is plausible to form a valid position on the positive effects that exercise has on children with diverse abilities.

For example, in children with “mental retardation,” a study was performed to assess their quality of life before and after an exercise program (Ilhan, Kirimoglu, Filazoglu- Cokluk, 2013).²⁷ A total of 145 children, 88 with diverse abilities, participated in a ten-week special education program. The other 57 children were in the control group who did not complete any physical activity. The exercise group would warm up, perform a series of functional exercises, then played a sport. The Pediatric Quality of Life Inventory (PedsQL) was used to collect data on the quality of life for both groups. Both groups’ scores on the pretest were similar and showed that post-exercise program scores increased in all areas of the survey (Ilhan, Kirimoglu, Filazoglu- Cokluk, 2013).²⁷ Johnson (2009) reviewed youth with developmental disabilities and the benefits of exercise on that population.²⁸ Many types of disabilities and physical activities were evaluated. Water aquatics showed an improvement in bodily function. Horseback riding and therapeutic riding showed improvement in muscle symmetry, gross motor skills, and functionality in the home and surrounding environment (Johnson, 2009). A study using downhill skiing on children with cerebral palsy showed improvements in gross motor skills (Johnson, 2009). Group exercise programs were also reviewed and demonstrated a general improvement in cardiovascular function, strength, gait speed, mobility, improved perception, and high levels of satisfaction. (Johnson, 2009). Of note, children with Down Syndrome found a decrease in heart rate and blood pressure during stress testing. An additional study performed on girls with Rett Syndrome showed a significant difference in heart rate, 21 functional skills, in walking and motor functioning (Johnson, 2009). This study fully embraced the research and valid conclusions of the two studies above (Ilhan, Kirimoglu, Filazoglu- Cokluk, (2013); Johnson (2009) regarding the positive effects of exercise on physical improvement in children with diverse abilities. However, these studies confined their research to a one dimensional activity, or a single discipline and did not address the various other advantages gained from drumming and multi-modular exercise and its positive influence on concentration, learning, memory, cognitive function, academic performance, and social-emotional development.

According to a ground-breaking controlled study conducted in 2000 by researchers at the Mind-Body Wellness Center in Meadville, Pennsylvania, and the Loma Linda University School of Medicine in Loma Linda, California, the benefits from drumming aren’t just psychosocial; but, have been proven to boost the immune system’s ability to defend the body against foreign intrusion; and, in a positive way, alters a response to multiple stressors.⁴⁰ Additional research conducted by Dr. Ping Ho et al. has shown that participation in group drumming is a

“recreational music-making activity that builds social-emotional assets consistent with a positive youth development approach.”³⁰ From the simple drum circle consisting of a few participants to the more complex drumming experience using multiple percussion instruments, group drumming has been shown to encourage empowerment, unify groups, and exceed group synergistic expectations. A group drumming experience is led by a facilitator whose role is to maximize a sense of community through rhythmic dialogue. It is inclusive, non-verbal, universal, and does not require previous experience for participation. Furthermore, group drumming is culturally relevant; and, is an integral part of diverse cultures, and supports the value of collectivism shared by non-European-based cultures.

Homo sapiens are the only species that can follow complex rhythmic patterns that afford synchronized group behaviors, such as singing, drumming, and dancing.³³ In addition, they are also the only species which form cooperative alliances between groups that extend beyond consanguineal ties.³⁴ One way to form and strengthen these social bonds may be through music, specifically the kind of temporal and affective entrainment that music evokes from infancy.³⁵ In turn, these musical entrainment-based bonds may be the basis for Homo Sapiens’ uniquely flexible sociality.³⁶ If this is the case, then our evolutionary understanding of music is not simply reducible to the capacity for entrainment; but, rather music is the arena in which this and other capacities participate in determining evolutionary fitness. Music stimulates the brain’s reward centers and as a result releases certain levels of dopamine, a neurotransmitter, which mediates pleasure and is released during pleasurable situations and stimulates one to seek out those pleasurable activities.¹⁵

Recent discoveries by neuroscientists from Columbia University have led to a term called, “anticipatory pleasure,” which is the “synchronizing of music and movement through dance to activate the brain’s sensory and motor circuits resulting in a “pleasure double play.”²⁹ Although this term seems relatively easy to understand, John Krakauer, a neurologist at Columbia University, in his article, “Why do we like to dance—And Move to the Beat?,” states that “scientists aren’t sure why we like movement so much, but there’s certainly a lot of anecdotal evidence to suggest we get a pretty big kick out of it. Maybe synchronizing music, which many studies have shown is pleasing to both the ear and brain, and movement—in essence, dance—may constitute the pleasure double play.”²⁹ Dance may also be seen as an enriched environment. Examining cells involved in neuron survival, specifically cerebellar glia of rats, Anderson et al (1994) showed that synaptogenesis following motor-skill learning was associated with glial hypertrophy which was not the case of angiogenesis following exercise alone.³¹ Interestingly, additional research performed by Thalia Wheatly, Associate Professor of Psychological and Brain Sciences, Dartmouth Social Intelligence Laboratory, Center for Social Brain Sciences Cognitive Science, Psychological and Brain Science, also revealed that “universal emotions such as anger, sadness and happiness are expressed virtually the same in both music and movement across most cultures.”³⁹ Thus, the applicability of dance and music crosses all spectrums of learning, emotion, pleasure, sadness, enlightenment, enrichment and overall wellness.

Research conducted by Catriona Morrison, MA from the University of Glasgow and a Ph.D., University of York, suggests that “music impacts our motor and emotional functions and is a powerful cue for storing and retrieving data.”³⁷ Thus, our brain has the ability to associate an event to a certain influence and many times music is that stimulus. Those influences are converted to memories and stored in dormancy until retrieved by a repeat of the stimuli that

produced that particular association in the first place. An example would be an event that occurred during the playing of a certain song; and, each time that particular song would be heard thereafter, the brain would be subjected to that specific stimuli and, in turn, retrieve the emotion from that association.

Dr. Nina Kraus, Ph.D., Northwestern University, scientist, inventor, and amateur musician, studied the biology of auditory learning and strongly suggests that there is a relationship between neural response consistency and the ability to keep a beat.³⁸ In addition, she demonstrated that there is a link between the ability to maintain a rhythm and/or beat-synchronization and a significant improvement in reading and language skills to include neural encoding in speech development.³⁸ These results suggested that physical fitness can counter the effects of aging in prefrontal and temporal areas, while motor activity is more likely to boost visual-motor coordination and visual-spatial integration (parietal areas) as well as motor response automatization, thus reducing the inhibitory cost supported by prefrontal areas.³²

Previous to the study conducted at Chemnitz University using the Drums Alive® Kids Beats intervention program, very little had been documented on any sportive drumming program and the effects it has on motor skills and behavior in children with diverse abilities. The testing was conducted under strict protocols using the following to validate the research: a Behavior Questionnaire for Developmental Disabilities (VFL-L), the Developmental Behavior Checklist (DBC-M), interventions, statistical analyses, the Heidelberg Competency Inventory (HKI), a comparison of the subcategory scores pre- to post-intervention in both groups, and the German Motor Skill Test. The Drums Alive® Kids Beats program, which is the original and researched based brain and body drumming fitness and wellness program that has been implemented around the world since 2001, endorses Dr Gimpel's theory and applies a multi-disciplinary approach (dance, movement, music, rhythm, modeling and patterning) to build a more flexible and sophisticated brain and improve social skills and memory development. The protocol includes musical sportive drumming intervention methodology using oversized exercise (a.k.a. stability balls), drumsticks and incorporated movement through dance elements and strength training. In addition, by providing inspiring music and an enriched environment, the experience adds an emotional element resulting not only in evidence-based improvements in all aspects of health and wellness; but, also allows the researched populations to literally drum out their emotions and aggressions. The objective is to create a learning environment without a competitive atmosphere, teach simple, culturally based choreography and rhythms, promote creative experimentation and self-expression, ensure various healthy possibilities by providing safe but effective physical exercise, encourage participation regardless of ability, and provide orientation for the participants by offering structures and rituals.

Drums Alive® Kids Beats Programming and Sportive Drumming for Research

When addressing diverse abilities and the required variances in protocols, it is essential to recognize that everyone is unique and should not be labeled against the bell curve. Research and practical application of sportive drumming, specifically through the Drums Alive Kids Beats program that was independently selected as the intervention strategy by Chemnitz University, established evidence based data that provides the construct to understand and apply appropriate strategies with respect to full spectrum inclusion of all abilities. It

addresses the patterns and offers a wide variety of coping skills and exercises for those who demonstrate patterns of anxiety and anger which may lead to tantrums, distracting and counterproductive obsessions or complete shutdown. Kids Beats is an all-inclusive, multi-sensory program that provides a comprehensive approach to accommodate individual physiological, emotional and cognitive needs that support learning within the diverse ability population. It uses sportive drumming as a useful tool to help gain a healthy, happy and productive perspective through a “No Limitation,” culturally based, brain and body fitness program that fosters creativity and builds self-esteem integrating kinesthetic awareness, neuro-muscular connections, cardiovascular conditioning, flexibility, strength and wellness activities in an enriched environment.

To fully understand the utility, power and influence of drumming, Remo Belli, Founder and C.E.O., Remo, Inc, The Essence of Wellness, and arguably one of the world’s expert on drumming, said, “It’s time to stop thinking of the drum as just a musical instrument. Start thinking of it as a unifying tool for every family, a wellness tool for every retiree, and an educational tool for every classroom.” He added the following comment: “The rhythm of life is a symphony and expression of our soul. When we drum our inner voice resounds. Our energy raises, vitality improves and our emotions are exhilarated. Group drumming opens the doors of communication and allows us to speak where words often do not pass. Music, rhythm, and dance enhance self-esteem, ensure a healthy workout, stimulate our minds, boost our creative potential, make us laugh and connect us on many levels.” If there is ever a need to open the door and allow for expanded communication in all its forms, be it drumming, dance, rhythmical expression or movement, it is for those with diverse abilities or other intellectual limitations. This intriguing combination of motor movement, blended with auditory and visual feedback, facilitates greater engagement, encourages learning and enhances brain function. When people are engaged with the world around them, they are more prepared to interact with it, learn from it, and contribute to it. Drums Alive® Kids Beats is a vehicle that stimulates this engagement and can address a variety of needs, such as:

1. Physical Needs - Improvement in Physical fitness, Health and Well-being on multiple levels
2. Cardiovascular endurance, muscular endurance, proprioception, balance, agility, posture, flexibility as well as improvements of fine and gross motors skills
3. Neurological Needs - Promotion of hemispheric divergence through simultaneous activation in multiple regions of the brain. (Sensory Cortex, Auditory Cortex, Hippocampus, Visual Cortex, Cerebellum, Amygdala, Prefrontal Cortex, and Motor Cortex)
4. Cognitive Needs - Improvements in concentration, consistency, and sensory awareness
5. Emotional Needs - Encourages children on the spectrum to control, regulate, and understand their emotions. Provides a healthy way to release stress and aggression as well as provide a non-intimidating way to express one’s emotions
6. Communication Needs - Drumming and movement are a valuable ways to communicate nonverbally and provide an opportunity to listen to others and contribute to the group dynamics and dialog. In a typical “call and response” exercise, children are able to understand the dynamics of conversation, and may be able to

offer their own personal response to a question or statement that was played on the drum rather than trying to give a verbal response

7. Social Needs - Drumming and movement provide a safe environment that helps children interact with others. In addition, it teaches children to listen, pay attention, turn-taking, sharing, and taking cues from one another. Everyone can drum and be part of the team. As a result, improvement in self-control with fewer outbreaks of disruptive behavior is developed
8. Educational Needs - Drumming can reinforce speech, vocalizations, sounds and even help with sentence building. Kinesthetic learning activities that integrate drumming, rhythm and movement can make learning engaging and accessible. This helps activate and stimulate the hippocampus and thalamus which are both important for working memory and learning
9. Self - Actualization Needs - Drumming and movement boost self-esteem and provides an avenue where appreciation and acceptance are fostered. This helps children find peace within themselves and aids with coping skills and promotes a sense of happiness and freedom

Application of the Drums Alive® Kids Beats Program

A safe and successful Drums Alive® Kids Beats program depends on the instructor's ability to apply sound instructional principles and practices as well as understanding the desired learning objectives of this program used to develop the research protocols and subsequent positive results. Additionally, following the American Council of Exercise guidelines will help provide the instructor with a sound foundation of these principles and practices. The Drums Alive® programming suggests paying special attention to the following:

- Safety First! Promote safety on all levels and periodically review general safety rules for teaching a movement program, as well as, following the safety precautions for teaching a Drums Alive Kids Beats® class
- Know your audience, execute proper form, and utilize safe, yet effective, movement and rhythmical skills for all levels of abilities
- Be prepared for medical emergencies (emergency contact numbers, evacuation procedures, overstimulation protocols, CPR, Defib Kit, etc.)
- Use appropriate equipment or equipment modifications and reinforce its proper care and usage (Refer to the Drums Alive® website for information on proper equipment)
 - Recommend approved "Anti – Burst Stability Ball." Size is dependent on the style of class taught (sitting or standing); what type of ball holder is being used; as well as the height of each individual participating.
 - Use good quality drumsticks and check condition each time before use
 - Use modifications to drumsticks if needed (for example, pool noodles, foam insulator tubes, foam grips on end of drumsticks or any creative use of a safe striking device
 - Use a solid ball holder to maintain a good foundation and avoid tipping during workout (bucket, step riser, basket, etc...)
- Provide an enriched environment that is conducive for learning, self-expression; and, a breakout room to desensitize and soothe, if needed
- Use appropriate music and be mindful of the volume and tempo during the execution of the instruction

- Some students may be sensitive to loud music; so, recommend a volume level between 85 dBA – 90 dBA
- You may need to use music with slower tempo or slow the tempo of the music (using pitch control)
- Adagio (slow and stately--literally, "at ease"--tempo is 66 – 76 bpm)
- Allegro tempo (fast, quickly, and bright—tempo is 120 – 168 bpm)
- Modify the drumming or movement patterns (e.g. instead of drumming on every beat, drum once on every two beats)
- Songs or Music over 100 bpm need to be monitored carefully and adapted or modified based upon capability
- Be prepared and teach used suggested Kids Beats “Class Design” and execute good class delivery and sound teaching skills, including audio, visual and technique cues
- USE KIND WORDS with everyone—this applies to students, assistants, and teachers
- Remind everyone to use “GENTLE HANDS AND FEET” (e.g. “keep hands and feet to yourselves,” state this rule in a way that is age and comprehension appropriate for your audience)
- Remind everyone (students and their assistants) to LISTEN AND FOLLOW DIRECTIONS
- Provide time for WATER BREAKS or REST AND RELAXATION BREAKS
- HAVE FUN!

Drums Alive® Kids Beats Class Design

The Drums Alive® Kids Beats class design can vary according to the demographics of your class and students’ capabilities. Below is a preferred structure to implement in a class comprised of diverse ability students:

- Greeting and Welcome
- Warm up Activities
 - Fine and Gross Motor Skills
 - Drop & Catch, Throw & Catch, Flip & Catch
 - Listen & Learn Cognitive Skills
 - Follow the leader – Call Answer Activities
 - Brain Beats – Cognitive applications
 - Working Memory
 - Speech Patterning
- Functional Academics and Functional Living Skills
- Musical Interpretation
 - Activate the Anticipatory Pleasure Response
- Health and Fitness Exercises
 - A Combination of Drumming & Movement Skills
- Teambuilding Skills and Games
- Creativity and Expression
 - Creating Your Own Moves, Groves and Fun!
- Hand Clapping Games
- Mindfulness, Cool Down and Relaxation
- Gather, Review and Goodbye

Inclusion Strategies

Working with individuals who require adaptations is a challenging but very rewarding experience. Drumming is an activity that most will be able to enjoy regardless of ability. The following are adaptations that will help design a class that provides the opportunity for everyone to participate in a safe and enriched environment. Participants with learning disabilities and/or cognitive delays may need extra instructional tools to assist in learning. The use of visual schedules, Drums Alive® Rhythm Cards, Number Cards, Feeling and Emotion Cards, and any other form of modified instructions to ensure their understanding of the lesson may be helpful and necessary. Some may have physical challenges with the equipment; so, consider making adjustments to the pieces you are using to accommodate for ease of use and adherence to safety rules. Be aware of any allergies to ingredients such as latex, different fabrics, or dyes before handing out equipment. Remember to teach each lesson in layers and monitor the growth in learning to determine how quickly to add additional layers to challenge cognitive skills. In general, many simple and easy modifications can be made to help students enjoy the fun in each lesson, embrace the social interaction and the community of the group; and, still benefit from the physical and cognitive exercises. Positive encouragement and eye contact when speaking is always the best method to keep all students engaged; and, matching “exceptional” students with typical peer models has proven successful in many cases. Inclusion strategies ideas and techniques:

- Use poly spots or masking tape for anchor spots to show where to stand
- Mark directions for movement of routines, choreography, entrance and exit points
- Place masking tape or markers on the ball showing the child where they are to hit the ball
- Place masking tape or markers on the drumsticks to show where to grasp the drumsticks
- Use colored markers or colored wrist bands on hands and feet to mark left and right. Red for right; Lime, Lemon, Lavender for left. (Note: Hair bows work well for this adaptation)
- Use slower, simple and repetitive movements when treading new routines
- Select proper tempo of music for choreography; slow at first then increase pace when able
- When performing specific locomotor skills, allow those with diverse abilities to move according to ability (e.g. jump instead of hop; gallop instead of skip; walk instead of run, etc.)
- Encourage teachers and parents to allow time to practice skills at home or in class for retention
- Consider placing individuals with disabilities closer to the end of parallel lines when doing partner activities for ease of monitoring and assisting if needed
- Use adult or peers as mentors to provide extra verbal or physical cues

Wheelchair or other Limited Mobility or Body Strength Considerations

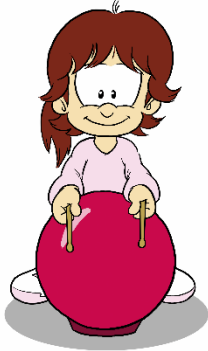
- Allocate time to allow participants with limited mobility/movement issues to try and maneuver while holding their own drumsticks
- If a wheelchair is involved, allow for placement of the drumsticks in the individual's lap while moving; or, roll up a towel and place on lap to keep drumsticks from rolling off
- If other mobility or body strength is involved, allow mentor or helper assist in holding sticks
- Encourage participants to engage in as much of the activities as possible, even if they are not doing the activity exactly as the others; or, allow for substitution of their own controllable movements
- Allow adults or peers (if permitted) to push the participants in wheelchairs if needed
- Allow individuals in wheelchairs to substitute arm movement for leg movements (e.g. "arm pump, clap, clap, clap, instead of stomp, clap, clap, clap")

Students with Visual and Auditory Impairments

- Use brightly colored spot markers on the floor
- Have partner wear brightly colored pinny or shirt
- Place a string under tape on the drumstick to feel where they need to hold the drumstick
- Use auditory cues to help students with visual impairments find their partner or move toward area where they need to go (e.g. bells, beeper)
- Have an adult, mentor or peer verbally cue the student with what to do or where to go
- Keep them close to the front of class to monitor and make sure that instructions are clearly understood
- Note: For children having problems gripping and holding onto the drumsticks, Drums Alive®, through REMO, has an adaptation glove that can be used. Otherwise, loosely tape the drumsticks to their hands with a shortened ace bandage or use a Velcro wrap to secure the drumstick to their hands (ensure you obtain permission from the parents if using these securing techniques)

Drums Alive ® Ability Beats (Kids Beats) Sample Choreography

8x Double Beats (8 counts)



8x Overhead Click (8 counts)

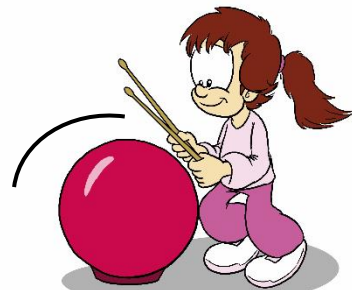


Repeat as often as desired

8x Single Beats (8 counts)



8x Right Side Slide Around the ball (8 counts) Individuals in wheelchairs (Circle drumsticks above the head)

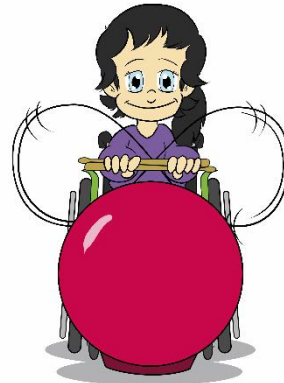


Repeat entire pattern to the left

Rumble as fast as you can (8 counts)



Figure 8 Right & Left (8 counts)



Repeat Rumble on the left side

Repeat Figure 8 Left & Right

8x Floor Beats (8 counts)



8x Overhead Clicks (8 counts)



Repeat Floor Beats and Overhead Clicks as often as desired

More information, routines, music, theory and research can be referenced at www.drums-alive.com For Drums Alive® equipment please contact West Music at www.westmusic.com

Conclusions

For many of the diverse ability population, the disabilities they experience often require special approaches to education or other accommodations.¹¹ To review, a comprehensive, independent study was conducted at Chemnitz University, Germany to evaluate the effects of the Drums Alive Kids Beats sportive drumming exercise program, with its associated multi-modular disciplines (dance, movement, music, rhythm, modeling and patterning) to generate positive effects in motor and cognitive skills, as well as behavior and learning with respect to those with diverse abilities. In this context, drumming, dancing and music have been important and essential forms of communication since mankind evolved; and, evidence strongly suggests that drumming has great acceptance, not only cross-culturally; but, also across social-economic barriers and has the unique ability to encompass everyone regardless of age or ability. As stated throughout this publication, the results and findings provided research based evidence that the Drums Alive® Kids Beats Intervention, with all its methodology, demonstrated that a sportive drumming exercise program that combined endurance, strength training, cognitive exercises and highly coordinative movements, with emotional elements in an enriched environment, provided significant therapeutically proven improvements for a majority of the participants. Results indicated a significant uptick in the disciplines of coordination and endurance within the DMT. The control group showed a mild level of improvement in all the motor abilities and a moderate level in the behavioral disciplines tested. Therefore, exercise therapy, with coordinative elements, such as those applied by the Drums Alive® Kids Beats program, seemed to be an important intervention for these patients and could be used as a versatile medium to introduce a wider population to this type of therapeutic exercise.

References

1. Federal Indecency Forum On Child And Family Statistics. America's Children: Key National Indicators of We-Being, 2007. Washing, DC 2007
2. New Freedom Commission On Mental Health. Achieving the Promise: Transforming Mental Health Care In America. Final Report DHHS Pub No SMA-03-3832. Rockville, MD-2003
3. World Health Organization (2011) World Report On Disability. Geneva: WHO/World Bank, P. 36. [Http://www.who.int/Disabilities/World_Report/2011/En/Index.Html](http://www.who.int/Disabilities/World_Report/2011/En/Index.Html)
4. United States Census Bureau
<http://www.Census.Gov/Library/Publications/2011/Acs/Acsbr10-12.Html>
5. Unicef Factsheet https://www.Unicef.Org/Disabilities/Files/Factsheet_A5__Web_NEW.Pdf
5. Unicef Factsheet https://www.unicef.org/disabilities/files/Factsheet_A5__Web_NEW.pdf
6. Grossman, HJ., (1983) Classification In Mental Retardation, American Association on Mental Deficiency, Washington DC.
7. Van Der Schoot P, Et Al (1990) : Lern Und Geistige Behinderungen, In Forschungsbericht Bewegung, Spiel Und Sport Mit Behinderten Und Von Behinderung Bedrohten. Indikationskatalog Und Methodenmanual, Band 3, Indikationskatalog. Sinnesbehinderungen. Lern- Und Geistige Behinderungen. Psychische Störungen. (Hrsg.) Von Der Bundesminister Für Arbeit Und Sozialordnung. S.890 – 965.
8. Lehmkuhle, T., & Van Der Schoot, & Lehmkuhle, J; Rebel, & Gunther (HRSg.): Bewegung Und Kommunikation. Förderung Von Menschen Mit Geistiger Behinderung Durch Bewegung Und Tanz, Band 5, Münster, Waxmann Verlag Gmbh, 2007, S. 9-21.
9. Krebs, L., (1989) Beratung Bei Geistiger Behinderung. In: Die Rehabilitation, Sonderband 21, Jahrgang 1989, S. 15ff.
10. S.W Hawking, M. Chan, R. B. Zoellick, Summary World Report On Disability, World Health Organization, The World Bank, WHO/NMH/VIP/11.01 © World Health Organization 2011 http://Apps.who.int/Iris/Bitstream/10665/70670/1/WHO_NMH_VIP_11.01_Eng.Pdf
11. Brault, M., (2010) School-Aged Children with Disabilities in U.S. Metropolitan Statistical Areas: Report Number: ACSBR/10-12,
12. STATISTISCHES BUNDESAMT, Hunter: <https://www.destatis.de/DE/Zahlenfakten/Gesellschaftstaats/Gesundheit/Behinderte/Aktuell.Html>, Zugriff Am 11.4.13, 14:01.
13. Gimpel A. M.D. (2007), Brain Exercises To Cure ADHD, Book Surge Publishing, North Charleston, South Carolina – Pg. 127

14. Gimpel A. M.D. (2007), Brain Exercises To Cure ADHD, Book Surge Publishing, North Charleston, South Carolina – Pg. 132-133
15. Diamond, M., & Krech D., & Rosenzweig Mr., The Effects Of An Enriched Environment On The Histology Of The Rat Cerebral Cortex. Journal Of Comparative Neurology. 1964; 123:111–120. [Pubmed]
16. Diamond, M., & Law F., & Rhodes H., & Lindner B., & Rosenzweig Mr., & Krech D., Et Al. (1966) Increases In Cortical Depth And **Glia** Numbers In Rats Subjected To Enriched Environment. Journal of Comparative Neurology. 128:117–126. [Pubmed]
17. Diamond M., & Lindner B., & Johnson R., & Bennett El., & Rosenzweig Mr., (1975) Differences In Occipital Cortical Synapses From Environmentally Enriched, Impoverished, And Standard Colony Rats. Journal of Neuroscience Research. 1:109–119. [Pubmed]
18. Cotman CW., & Berchtold NC., (2002) Exercise: A Behavioural Intervention To Enhance Brain Health And Plasticity. Trends in Neurosciences. 25:295–301. [Pubmed]
19. Ratey, J., MD, Spark (2008) The Revolutionary New Science Of Exercise And The Brain. Little, Brown And Company, New York, Boston, London
20. Markham, J. & Greenough, W., (2004) Experience-Driven Brain Plasticity: Beyond The Synapse. NIH Public Access, Published In Final Edited Form As: Neuron Glia Biology; 1(4): 351–363.
21. Van Praag¹, H., & Kempermann, G., & Gage, F., (2000) Neural Consequences Of Environmental Enrichment. Nature Reviews Neuroscience 1, 191-198
Doi:10.1038/35044558
22. Gabbard, C., Ed.D., & Rodrigues, L., Optimizing Early Brain And Motor Development Through Movement
(Earlychildhoodnews.Com), http://www.Earlychildhoodnews.Com/Earlychildhood/Article_View.aspx?Articleid=360
23. Greenough, W. T., & Black, J. E. (1992). Induction Of Brain Structure By Experience: Substrates For Cognitive Development. In M. Gunnar & C. Nelson (Eds.), Minnesota Symposia On Child Psychology. Vol. 24, Developmental Behavioural Neuroscience (P. 155-200).
24. Nelson, C., (1999), Neural Plasticity and Human Development. Institute Of Child Development and Department Of Pediatrics, University Of Minnesota, Minneapolis, Minnesota. [Http://Journals.Sagepub.Com/Doi/Pdf/10.1111/1467-8721.00010](http://Journals.Sagepub.Com/Doi/Pdf/10.1111/1467-8721.00010)
25. Lang, R., & Koegel, L., & Ashbaugh, K., & Regester, A., & Ence, W., & Smith, W. (2010). Physical Exercise and Individuals with Autism Spectrum Disorder: A Systematic Review. Research in Autism Spectrum Disorder, (4), 565-576.

26. Pontifex, M., & Saliba, B., & Raine, L., & Picchietti, D., & Hillman, C. (2013). Exercise Improves Behavioural, Neurocognitive, and Scholastic Performance In Children With Attention-Deficit/Hyperactivity Disorder. *The Journal of Pediatrics*, 162(3), 543-551.
27. Ilhan, E., & Kirimoglu H., & Filazoglu-Cokluk G., (2013). The Effect of Special Education And Sports Program On The Quality Of Life Of The Children With Mental Retardation. *Nigde University Journal of Physical Education And Sports Science*, 7(1), 1-9.
28. Johnson, C. C. (2009). The Benefits of Physical Activity For Youth With Developmental Disabilities: A Systematic Review. *American Journal Of Health Promotion*, 23(3), 157-167.
29. Krakauer, J., <https://www.Scientificamerican.Com/Article/Experts-Dance/Why-Do-We-Like-To-Dance--And-Move-To-The-Beat?> Columbia University Neurologist
30. Ping Ho, & Jennie C., & Tsao, L., & Bloch., & Lonnie K., & Zeltzer, The Impact Of Group Drumming on Social-Emotional Behavior In Low-Income Children
31. Anderson, B., & Li,X., & Alcantara, A., & Isaacs, K., & Black, J., & Greenough,W., (1994). Glialhypertrophyis Associated With Synaptogenesis Following Motor-Skill Learning, but not with Angiogenesis Following Exercise. *Glia* 11, 73–80
32. Voelcker-Rehage, C., & Godde, B., & Staudinger, U.M., (2010).
33. Brown S., & Jordania J., (2011) Universals in The World's Musics. *Psychol Music*, 10.1177/0305735611425896.
34. Hagen E., & Bryant G., (2003) Music and Dance as A Coalition Signaling System. *Hum Nat* 14(1):21–51.
35. Phillips-Silver J., & Keller P., (2012) Searching For Roots of Entrainment and Joint Action In Early Musical Interactions. *Front Hum Neurosci*, 10.3389/Fnhum.2012.00026.
36. Janata P, Grafton ST (2003), Swinging In The Brain: Shared Neural Substrate for Behaviours Related to Sequencing and Music. *Nat Neurosci* 6(7):682–687.
37. <https://www.pressreader.com/usa/honolulu-star-advertiser/20100222/282681863414012>
38. <http://www.brainvolts.northwestern.edu/slideshows/rhythm/index.php>
39. Wheatley, T., & Kang, O., & Parkinson, C., & Looser, C.E. (2012). From Mind Perception to Mental Connection: Synchrony as a Mechanism for Social Understanding. *Social Psychology and Personality Compass*, 6, 589-606.
40. https://www.researchgate.net/publication/8062381_Recreational_music_making_modulates_the_human_stress_response_A_preliminary_individualized_gene_expression_strategy