Percussion and Distance Learning: Improving Attention-to-Task in Children with Autism

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Running title: Percussion and Distance Learning

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Abstract

Objective

Utilize live video teleconferencing (VTC) to remotely train percussion instrument techniques to occupational therapists (OTs) for use in the treatment of children with Autism to increase attention-to-task.

Method

a. The participants totaled eighteen OTs (nine in the test group and nine in the control group). Participant proficiency scores, post-test proficiency mean test scores, and descriptive statistics were computed and stratified on demographic variables to identify intervening variables. The mean score difference between groups was tested for statistical significance using a t-test.
b. OTs utilized the percussion instrument techniques with children with Autism and measured attention-to-task pre/post intervention.

Results

a. All of the OTs successfully completed training.
b. Student attention-to-task increased an average of 90.3 seconds with a median of 74.15 seconds (an average percentage change of 189.1%).

Conclusion:

a. Educating OTs in percussion instrument techniques from a distance using VTC is possible.
b. Percussion interventions can improve attention-to-task in children with Autism.

Key words: Attention-to-task, Autism, distance learning, percussion, technology.

Introduction

Saint Francis University's (SFU) Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) collaborated with Camco Physical and Occupational Therapy, LLC, a provider of contract rehabilitation services in Western Pennsylvania, and SFU Fine Arts and Occupational Therapy Departments to train rural occupational therapists (OTs) how to use percussion instruments in the therapy of children with Autism. Through a technology gateway, OTs simultaneously participated in live exercises with a percussion instructor in order to become trained facilitators. Following the training, the OTs applied these techniques with children with Autism in public schools across the Commonwealth of Pennsylvania. Specifically, OTs were asked to utilize the percussion instrument techniques and measure their impact on attention-to-task behaviors of the students.

Autism is a complex neurobiological disorder that typically lasts throughout a person's lifetime and is part of a group of conditions known as Autism Spectrum Disorders (ASD). According to Autism Speaks, a leading science and advocacy organization, it is estimated that 1 in 110 children in the United States (US) is diagnosed with Autism (Autism Speaks, 2010). Government statistics also suggest the prevalence rate of Autism is increasing 10 to 17 percent annually (Rayburn, 2010). Autism does not discriminate; it occurs in all racial, ethnic, and social groups and is four times more likely to strike boys than girls. It can impair a person's ability to communicate and relate to others. On their website, Autism Today states that the condition is associated with rigid routines and repetitive behaviors, such as obsessively arranging objects or following very specific routines, and symptoms can range from very mild to quite severe (Autism Today, 2010).

As a result of the dramatic increases in the incidences of this group of conditions, the

Autism treatment field is rapidly evolving, and there is need for expanded and improved treatment options. In this regard, OTs continually strive to find ways in which they can assist their clients on the Autism spectrum to communicate and control their environments for the purposes of improving their quality of life. In response to these needs, CERMUSA initiated a research project that trained OTs via video teleconferencing (VTC) in percussion instrument techniques and then measured the effectiveness of applying these techniques on attention-to-task behaviors in children with Autism.

The reason rhythm is such a powerful tool for treating these conditions is that it permeates the entire brain. The human response to rhythm has been studied for centuries and, according to Dolle, rhythm is documented to have a far more influential effect upon us than previously believed (Dolle, 2006). Michael Winkleman of Arizona State University notes that, "drumming synchronizes the frontal and lower areas of the brain, integrating nonverbal information from lower brain structures into the frontal cortex, producing feelings of insight, understanding, integration, certainty, conviction, and truth, which surpass ordinary understandings and tend to persist long after the experience, often providing foundational insights for religious and cultural traditions" (Winkleman, 2000).

According to Michael Drake, a nationally recognized writer, rhythmist, and shamanist, "the ability to access unconscious information through symbols and imagery facilitates psychological integration and a reintegration of self" (Drake, 2009). Drake further emphasizes the homeopathic effects of percussion, stating that "The sound of drumming generates dynamic neuronal connections in all parts of the brain even where there is significant damage or impairment such as in traumatic brain injury, stroke, Parkinson's disease, Alzheimer Disease, and Attention Deficit Disorder" (Drake, 2009). Dr. Barry Quinn, a clinical psychologist

specializing in neuro-biofeedback for stress management, indicates that drumming for brief periods can actually change brain wave patterns, dramatically reducing stress. For over eight years, Dr. Quinn has been researching how a variety of techniques affects brain waves. He calls the results of 30-40 minutes of drumming on the highest stress clients, "by far the most amazing results I've encountered thus far in my research" (Friedman, 2000). Until drumming was included, no other technique used in Dr. Quinn's neuro-biofeedback therapy research had been able to bring a significant return of the Alpha relaxation brain wave in any client. Alpha (8-12 hertz or cycles per second) is a mental relaxation state missing in nearly 40% of the population. Dr. Quinn demonstrated that even a brief drumming session could double alpha brain wave activities, dramatically reducing stress (Friedman).

CERMUSA chose to pursue this avenue of study based upon documented research and clinical outcomes of the positive effects of percussion on a variety of clinical, psychological, and social disorders. Various studies have demonstrated that therapy which incorporates music can improve communication skills, imitation ability, and even social inclusion for children with Autism. These studies include works by Ronna Kaplan, MA, MT-BC of The Cleveland Music School Settlement; Nicole Allgood, MSEd, MT-BC, Director of the Autism Center of Excellence, Giant Steps Illinois, Incorporate; and Varvara Pasiali, M.M.E., MT-BC, University of Kansas (Allgood, 2005; Kaplan and Steele, 2005; Pasiali, 2002). Also, therapy in the form of percussion has shown promise as a method of intervention for persons with neurological disorders, such as traumatic brain injury, stroke, and Parkinson Disease (Dolle, 2006). According to the Institute for Music and Neurologic Function, music affects our neurological, psychological, and physical functioning in such areas as learning, language processing, emotional expression, memory, and physiological/motor responses. Also, therapy in the form of

musical interventions has repeatedly been shown to improve the communication skills for children with Autism (The Language of Music: Working with Children on the Autism Spectrum, 2010). For instance, the Rochester Center for Autism in Rochester, Minnesota, uses drums, tambourines, bells, egg shakers, and other instruments to promote social interaction, vocal responses, self-awareness, and fun (Rochester Center for Autism, 2010). In addition, the Drums and Disabilities (DAD) program, the nation's largest non-profit community outreach organization helping children fight Autism with music, launched the National DAD Drum Therapy Tour and Mobile Drum Therapy Center. The Mobile Center features drumpad and snare drum stations; its goal is to help parents and professionals raise and teach special needs children. This program has helped children with disabilities to develop and expand retention, coordination, self-esteem, and physical and cognitive functioning (DAD, 2010). Organizations such as The Rhythmic Arts Program (TRAP) employ drums and percussion to teach and enhance basic life skills such as maintaining focus, using memory, taking turns, developing leadership, using numbers, using prepositional concepts, following instructions, and modeling. Issues of spatial awareness, fine and gross motor skills, and speech are also addressed (The Rhythmic Arts Project, 2008). A number of private and foundation-based entities are also performing research into the value of percussion and music intervention. Many of these research findings confirm positive links between music, education, scholastic achievement, and social adaptability, especially among at-risk and special needs children (Portowitz and Klein, 2007).

To effectively utilize percussion as a therapeutic intervention requires appropriately trained facilitators to deliver the therapy and evaluate the clinical outcomes. Unfortunately, trained facilitators are in short supply, and if available, they may be located hours away from the practitioners and/or individuals requiring their services. As in any clinical intervention, high-

priority challenges and high-impact solutions must be ascertained. To aide in determining these factors, CERMUSA staff met with OTs to outline the proposed project and to conduct a formal needs assessment. As part of the planning process for the study, CERMUSA staff attended the 2007 National Autism Conference held at Pennsylvania State University. At the conference, CERMUSA staff participated in informal and impromptu discussions with parents, practitioners, and educators to talk about their needs and the needs of their children as they related to clinical interventions, family dynamics, and, in particular, their receptiveness to the use of percussion as an intervention. In addition, an extensive literature search was conducted prior to the implementation of the study to:

- Clarify the directions for the research
- Identify gaps in knowledge
- Identify other researchers with similar interests
- Identify what approaches would be taken in research design and methodology
- Reveal existing knowledge on the subject matter

An additional factor in the success of the project was the recruitment of James Donovan as the percussion instructor and content developer. Mr. Donovan is an award winning musician, teacher, motivator and founding member of the multi-platinum band Rusted Root from 1990-2005. He was recently voted "Facilitator of the Year" by the readers of Drum! magazine. In addition to being a full time instructor at Saint Francis University, Donovan also regularly offers workshops in the US and Europe focused on using the power of rhythm, drumming and the voice to assist in personal growth, wellness, and creating community in a variety of academic, corporate, and specialty venues. He is the author of the soon-to-be-released inspirational book

"Serving the Groove" and is featured columnist in Drum! Magazine. As a member of the group, Mr. Donovan has appeared on national TV and the music of Rusted Root has been featured on numerous television shows and in major motion picture films. As a solo artist and teacher, Donovan has released 6 highly acclaimed solo CD's as well as several popular instructional drumming audio and video products. He received his BA in music from the University of Pittsburgh where he had the opportunity to study African Music with noted scholar Kwabena Nketia from Ghana. Currently, he is serves as the director of the SFU World Drumming Ensemble.

Based upon the outcomes of these efforts, the decision was made to move forward with the study. It was also decided that the study would be conducted in phases due to the availability of the participants and the instructor, recommendations from the biostatistician related to data collection and analysis, and allotment of funding.

Project Plan

In 2009, CERMUSA staff experimented with telecommunications technologies to overcome the difficulties of time, distance, and geography to deliver instruction in percussion instrument techniques, utilizing a point-to-point application. The efficacy of using this method of delivery was assessed. Sustainable technologies, including IP-based (h.323) VTC and established networks, were deployed to contain costs and increase the likelihood of a successful project. Audio, video, and networking components selected from commercial off-the-shelf devices were also used.

Subsequent to these experiments, Mr. Donovan provided percussion training to a distant group of nine OTs via live interactive VTC and to another group of nine onsite OTs in a traditional classroom environment. Through this comparison, the feasibility of remotely

extending a percussion instructor based at SFU via live interactive VTC to the distant group of OTs was measured. Using this technology, the distant OTs were able to simultaneously participate in live percussion exercises with the instructor in order to become percussion facilitators. The principal goal of this comparison was to ensure that VTC-based training in the use of percussion instruments was comparable to training delivered via in-class instructions. This factor was measured by comparing participants' outcomes in a test group that received the instructions over VTC from a distance and a control group that received the instructions via a standard face-to-face educational modality. As indicated in **Figure 1,** the research plan proved that percussion techniques learned using VTC were comparable to those learned using a standard classroom presentation.

The training portion of the research studied the effectiveness of the method of delivering the training and not the training content. Unlike other educational sessions delivered over VTC, the delivery of music instruction posed unique challenges. A number of technology issues were identified, most notably, latency; due to the time required to "encode" and transmit video and audio from one location to another, participants experienced some level of lag time. Latency of some level is endemic in ALL forms of electronic communications. For example, two people speaking on cellular telephones do not notice the slight lag time between transmission and reception of speech when they are not in close proximity of each other. This lag is noticed, however, when two people are speaking to each other on cellular telephones within the same room; they can hear each other's conversation acoustically within the room before they can hear it on the cellular device, indicating that some kind of delay is taking place. This delay is more pronounced (i.e. longer) in VTC communications due to the heavier processing requirements at both ends of the communication. Because the latency is longer for VTC than simple voice

communications, it was difficult for individuals to play "in time" with each other at remote sites. Mr. Donovan countered this issue by using a "call and response," methodology; rather than have students play along with him, they would simply repeat the rhythms he demonstrated, thereby effectively conquering the latency problem.

The results from the training identified the salient features of this paradigm: hands-on experience, instructor supervision, on-sight and distant testing, and video debriefing. The study was then expanded by deploying various drum-emulation software programs in conjunction with desktop sharing software, such as Virtual Network Computing; this approach enabled the drumming facilitator to remotely train OTs with a PC and high-speed Internet connection in "electronic" percussion instrument techniques. CERMUSA staff evaluated the tying of external electronic drum pads and augmentative devices (such as alternative computer keyboards) to computer workstations to enhance the experience of in-room percussion instruction. Prior to implementation of these devices, CERMUSA staff tested and evaluated this technology to ensure that a quality drumming education session was possible. Tests were conducted in the following areas:

- Audio quality
- Latency/lag affect on collaborative playing
- Web conference connections

Data Analysis results from the training of the OTs are displayed in **Figure 1.**

Encouraged by the findings of other researchers and the success of the first phase of this study, CERMUSA embarked on the next phase. In 2010, OTs who participated in the Phase I training classes (both onsite and at a distance), utilized the percussion instrument techniques learned to attempt to increase attention-to-task behavior of their students with Autism. Study

subjects were school-age children with Autism being treated by the OTs who had participated in the percussion training. The students' baseline attention-to-task was measured prior to initiation of the percussion interventions. The OTs first explained the importance of paying attention and completing work to the students. Then they began deploying percussion interventions, while systematically observing the students' behaviors to determine whether the students were attending-to-task more frequently, with greater consistency, and for longer periods of time. Attention-to-task was measured with digital stop watches and the results were compared and contrasted against student baseline data. The stop watch was started when the child oriented to the task at hand, and if the child oriented away from the task, the stop watch was stopped. The study was outcome-based and the subjects, all with an ASD diagnosis, acted as their own control. Data analysis results from this phase of the study are displayed below.

Demographic Information

In 2010, there were 41 individuals in the study. Three of the participants were female (7.32%) and 38 (92.68%) were male. **Figure 2** depicts these proportions.

- Tally for Discrete Variables: Gender
    - Gender Count Percent
        - Female 3 (7.32%)
        - Male 38 (92.68%)
        - N = 41

Table 1 shows the number of participants in the study ranged from age 2 to age 17. The mean age of study participants was 8.375 years with a median age of 8 years. The grade level of

the participants varied from pre-kindergarten to 8th grade as illustrated by **Table 2. Table 3** illustrates the various diagnoses of the study participants.

Attention-to-task percent change - For each participant in the study, an initial measure of attention-to-task in seconds was recorded. Attention-to-task was also measured during each therapy session. The percentage change from the baseline measure was then calculated for each session. **Figure 3** shows the average percentage change in attention-to-task from the baseline by session. For example, 40 of the 41 study participants had a session '1'. Of those, the average percentage change in attention to task was 126.1% of the baseline percentage. Further, a series of one-sample t-tests showed these changes to be statistically significant.

There were students in the study with four different conditions (Asperger's, Autism Spectrum Disorder, Mental Retardation with Autism, and Pervasive Developmental Disorder) and each realized an average percentage increase in attention-to-task as compared to the baseline value. **Figure 4** depicts the average percentage increase by session. There were students in the study varying in grade-level from pre-kindergarten to 8th grade and each realized an average percentage increase in attention-to-task as compared to the baseline value. **Figure 5** depicts the average percentage increase by session.

Attention-to-task (Average Change over All Sessions) - As expected and for various reasons, each participant's performance in the study was not always consistent. There were participants who had realized a significant increase in attention-to-task in one session and then fell below their baseline in the very next session. Therefore, given the diagnoses of the participants and the structure of the study, each participant's attention-to-task measured by sessions was averaged to yield a mean change from baseline. The results of this analysis showed that participants in the study realized a statistically significant average increase of 90.3 ($p < 0.01$)

seconds, with a median of 74.15 seconds. This is an average percentage improvement of 189.1% in attention-to-task.

Attention-to-task (Raw Change from Baseline) - For each participant in the study, an initial measure of attention-to-task in seconds was recorded. Attention-to-task was also measured during each therapy session. The change from the baseline measure was then calculated for each session. **Figure 6** shows the average change in attention-to-task from the baseline in seconds by session. For example, 40 of the 41 study participants had a session '1'. Of those, the average change in attention-to-task was an increase of 45.9 seconds from their baseline value. Further, a series of one-sample t-tests showed these changes to be statistically significant.

Conclusion

For this study CERMUSA utilized an existing technological infrastructure to overcome the lack of access to percussion training and information in rural and medically underserved areas. Comparisons made between the test group of OTs who received the training from a distance and the control group of OTs who received training via a traditional modality clearly indicates the success of the distance training. OTs were effectively trained in percussion in both groups, concluding that educating OTs in percussion instrument techniques from a distance using a 'technology gateway' is feasible and effective.

The percussion instrument techniques learned were then tested in a clinical trial to measure attention-to-task results on school-age children with ASD. Even more significant from a research perspective are the results from this phase of the study. The overall result for all participants was an impressive positive average percentage increase of 189.1% in attention-to-task.

The research study indicates that the use of percussion instruments may improve attention-to-tasks for children with Autism. This indication would lead one to conclude that percussion, when used as a clinical intervention, positively impacts the length of time a client with Autism will sustain attention-to-task, and that therapists are justified in giving consideration to use of this intervention.

In addition to individuals with Autism, documented findings support that percussion instrument techniques work well with people diagnosed with stroke, traumatic brain injury, mental illness, Alzheimer disease, and other dementias (The Rhythmic Arts Project: drums and therapy working hand in hand, 2008; and Gilbertson, 2008). CERMUSA plans to expand this project and include an initiative to provide mental healthcare practitioners and families of children with developmental, neurological, emotional, and/or mental health disorders with the opportunity to participate in percussion training and interventions delivered via a technology gateway. The goals of the next phase of the study are to offer percussion training that can be used to:

- Assist parents and professionals raise, treat, and teach children with special needs
- Develop and expand retention, coordination, self-esteem, and physical and cognitive functioning
- Provide opportunities for enjoyment, laughter, play, and fun (Lund, 2009).

Acknowledgements

The authors wish to acknowledge statistician Dr. John Miko for analyzing the data collected in this study, Ms. Lori McClellan, Health Research Communications Specialist, for her assistance with designing the figures in this submission, and the SFU Fine Arts and Occupational Therapy Departments for their assistance. In addition, the authors gratefully acknowledge Mr. Jay B. Roberts, Dr. Ashok Bapat, and Ms. Barbara R. Demuth, CERMUSA's Director, Chief Scientist, and Assistant Director for Telemedicine respectively, for their support and guidance. Finally, the authors would like to recognize the following OTs and occupational therapy assistants (OTAs) who generously donated their valuable time and without whom we could not have implemented this study.

- Barbara Walkovich, OTR/L, CEO
- Ann Aiken, OTR/L
- Mary Beth Baish-Westin, OTR/L
- Sherie Calka, OTR/L
- Jennifer Conrad, OTR/L
- Stephanie Despot, OTR/L
- Amy Elgin, OTR/L
- Diana Frantz, COTA
- Sondra Kissell, COTA
- Terri Kohler, OTR/L
- Jill Lehman, OTR/L
- Michele Link, COTA

- Jennifer Mahute, OTD/OTR/L
- Greta Rabatin, OTR/L
- Jeanne Svec, COTA
- Linda Wallace, COTA

Disclosures:

This project is supported by Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) in Loretto, Pennsylvania, and funded by the U.S. Army Medical Research and Materiel Command (USAMRMC) Telemedicine and Advanced Technology Research Center (TATRC), Fort Detrick, Maryland – Contract Number W81XWH-10-2-0107.

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Figure 1

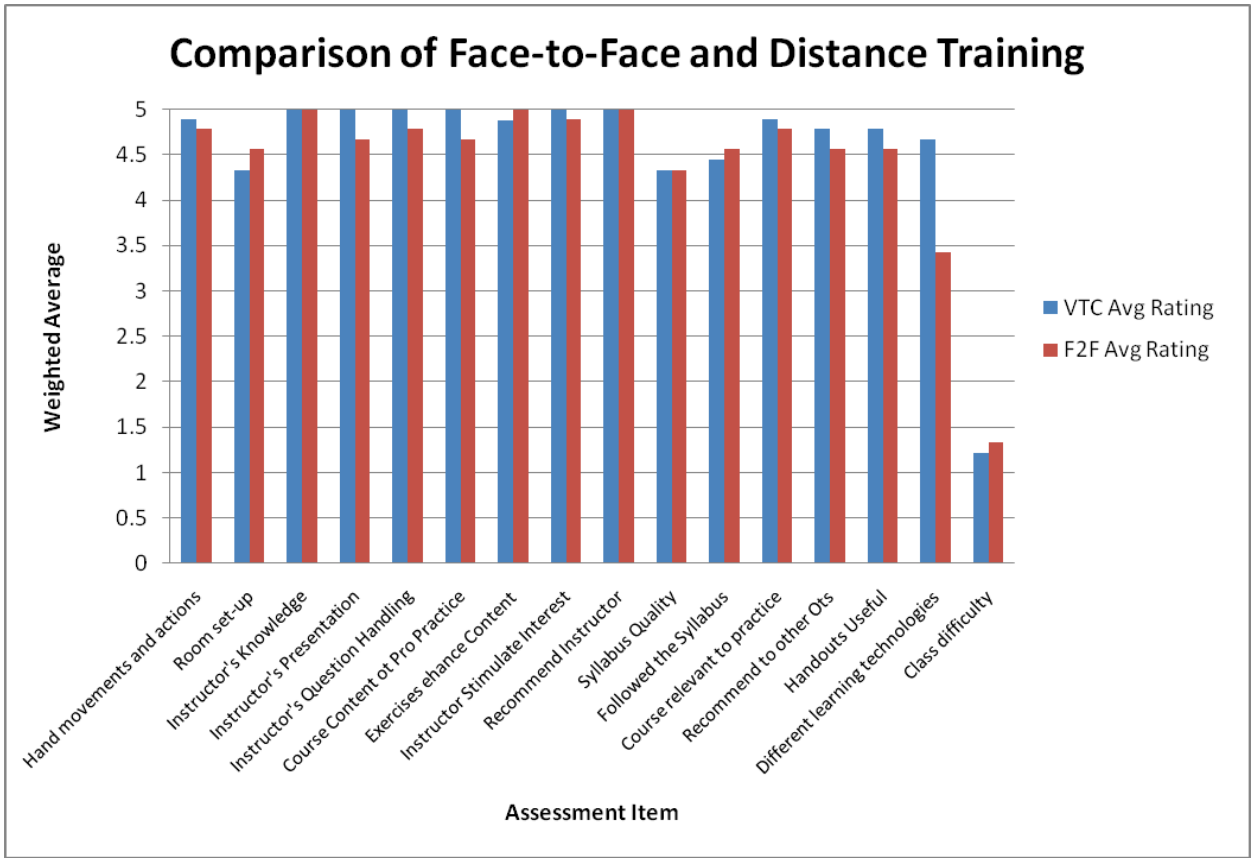

Comparison of Face-to-Face and Distance Training
Weighted Average
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Hand movements and actions
Room set-up
Instructor's Knowledge
Instructor's Presentation
Instructor's Question Handling
Course Content ot Pro Practice
Exercises ehance Content
Instructor Stimulate Interest
Recommend Instructor
Syllabus Quality
Followed the Syllabus
Course relevant to practice
Recommend to other Ots
Handouts Useful
Different learning technologies
Class difficulty
Assessment Item
VTC Avg Rating
F2F Avg Rating

Figure 2

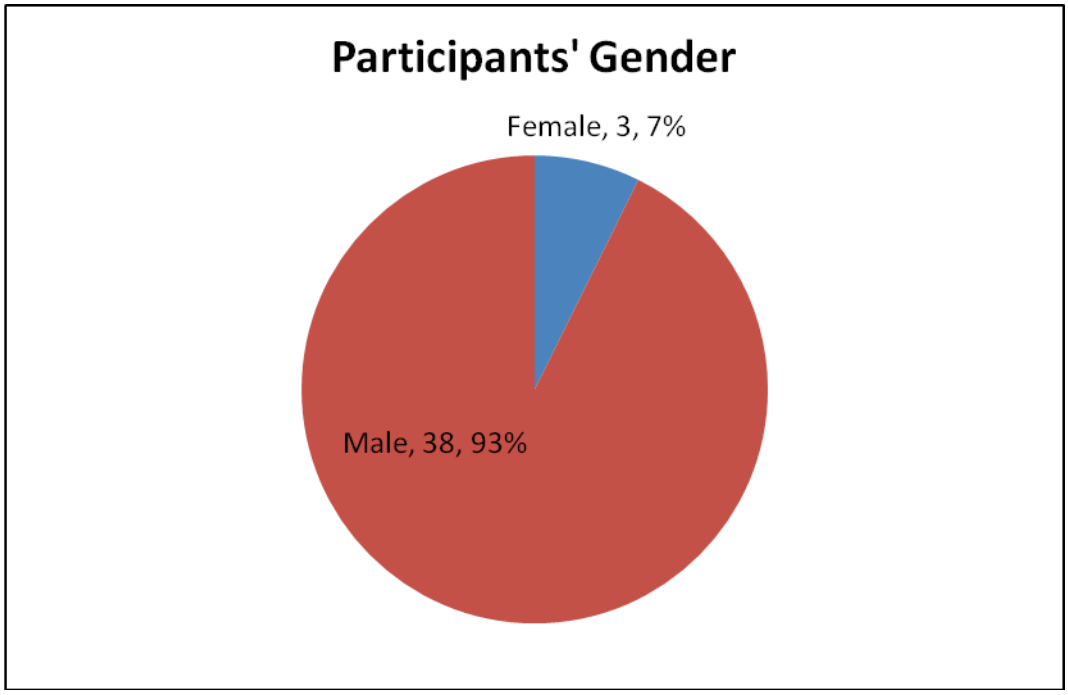


Table 1

Age	Frequency	Relative Frequency
2	1	2.44%
3	1	2.44%
5	5	12.19%
6	3	7.32%
7	8	19.51%
8	5	12.19%
9	5	12.19%
10	3	7.32%
11	4	9.76%
13	2	4.88%
14	3	7.32%
17	1	2.44%
Total	41	100.0%

Table 2

Grade Level	Frequency	Relative Frequency
Pre-Kindergarten	3	8.11%
Kindergarten	8	21.62%
1	7	18.92%
2	1	2.70%
3	4	10.81%
4	5	13.51%
5	4	10.81%
6	1	2.70%
7	1	2.70%
8	3	8.11%
Total:	37	100.0%

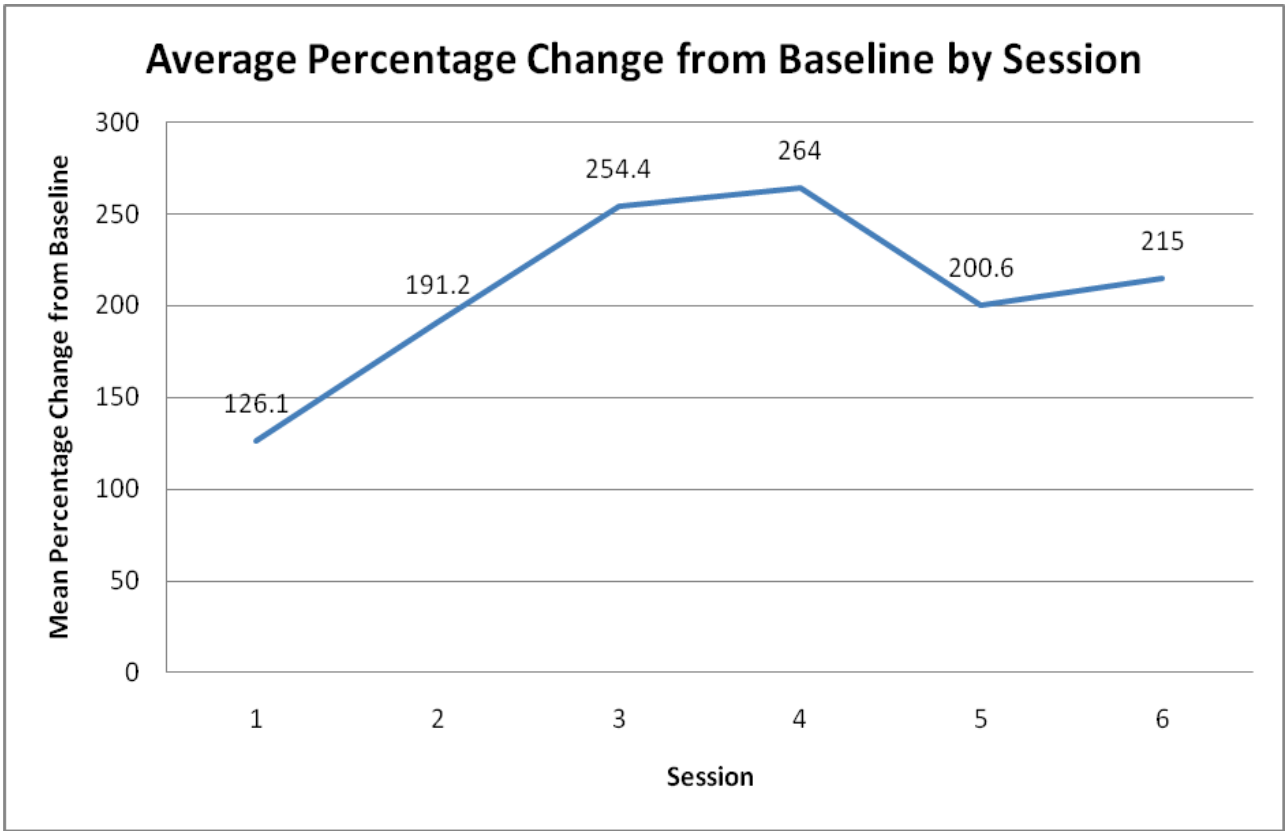
Note: Four (4) participants did not report grade level

Table 3

Diagnosis	Frequency	Relative Frequency
Aspergers	5	12.82%
Autism Spectrum	29	74.36%
MR with Autism	1	2.56%
PDD	4	10.26%
Total	39	100.0%

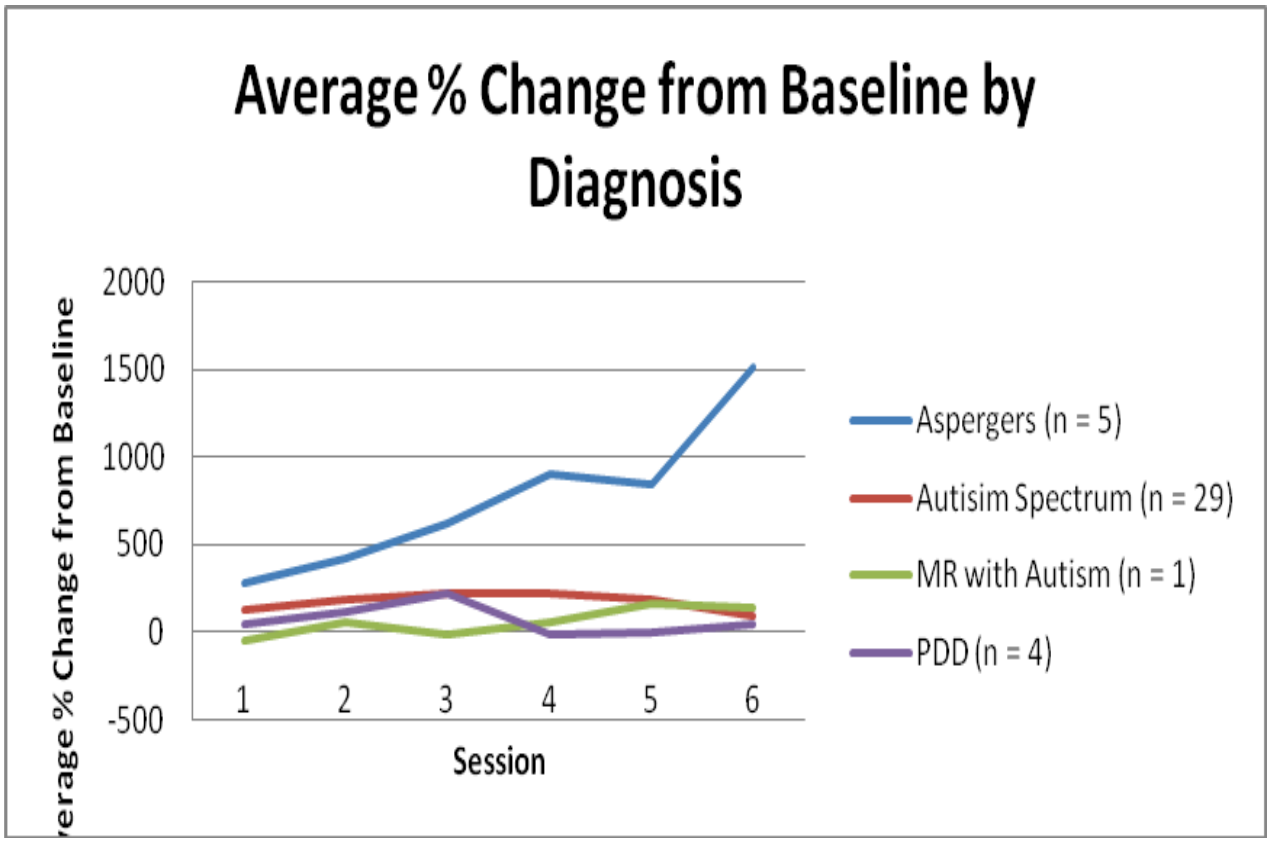
Note: 2 participants did not report a diagnosis

Figure 3



Note: Not all study participants had 6 sessions. The sample size and p value for each session is as follows: Session 1: n = 40, p =0.043; Session 2: n = 38, p = 0.017, Session 3: n = 35, p = 0.11; Session 4: n = 32, p = 0.024, Session 5: n = 27, p = 0.021; Session 6: n = 23, p =0.064.

Figure 4



Note: Because the Aspergers percentage change is so high it somewhat distorts the graph.

Figure 5

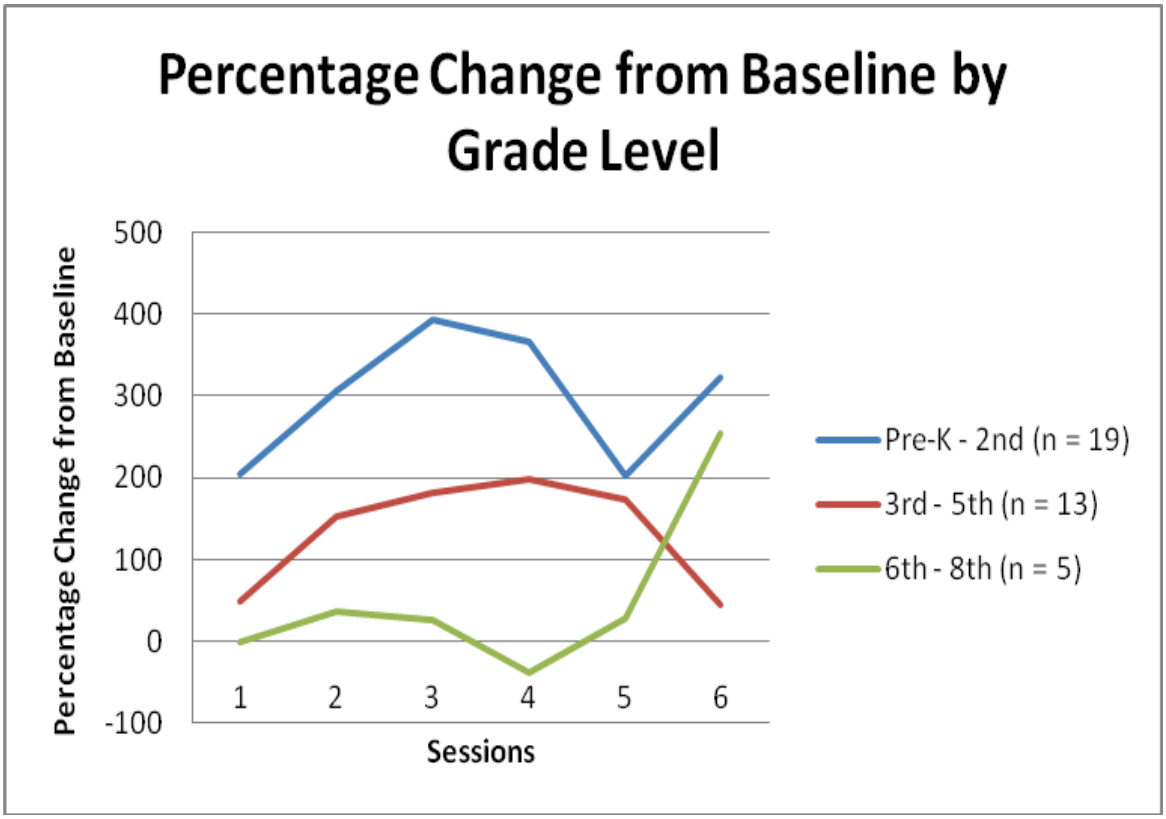
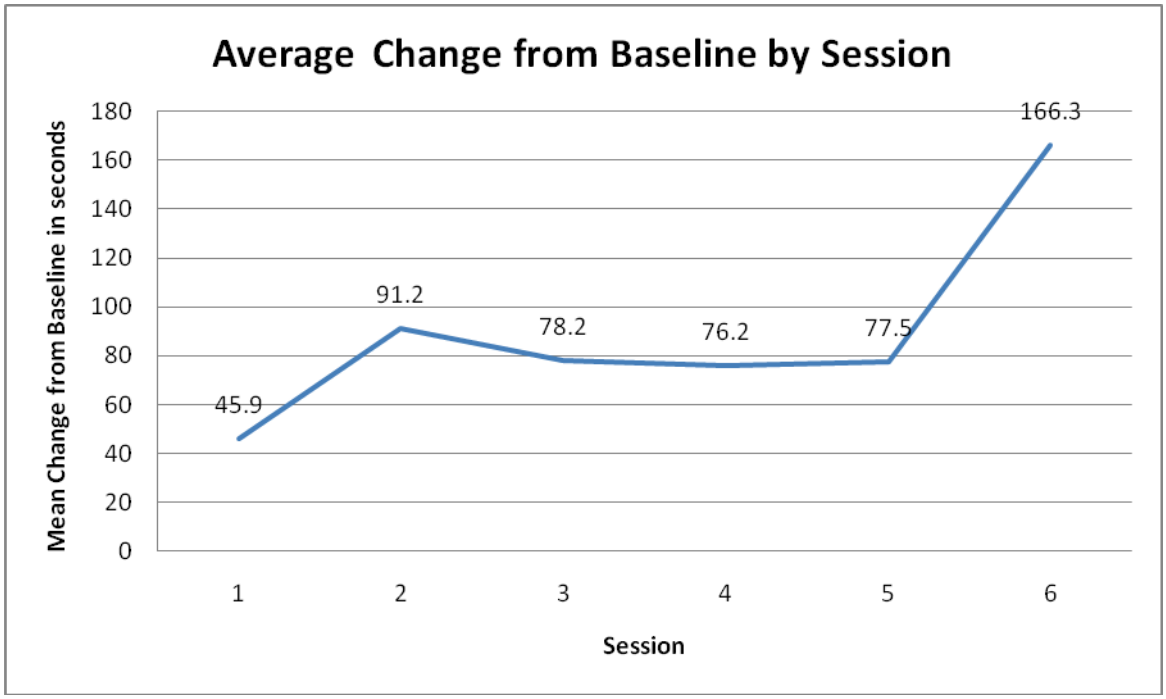

Percentage Change from Baseline by Grade Level
Percentage Change from Baseline
500
400
300
200
100
0
-100
1
2
3
4
5
6
Sessions
Pre-K - 2nd (n = 19)
3rd - 5th (n = 13)
6th - 8th (n = 5)

Figure 6



Note: Not all study participants had 6 sessions. The sample size and p value for each session is as follows: Session 1: n = 40, p =0.126; Session 2: n = 38, p = 0.007, Session 3: n =35, p = 0.006; Session 4: n = 32, p = 0.036, Session 5: n = 27, p = 0.007; Session 6: n = 23, p =0.007.