

The Effects of String Playing on the Attentiveness, Classroom Behavioral Performance, and
Musical Achievement of Third-Grade Students with ADHD

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Approval Sheet

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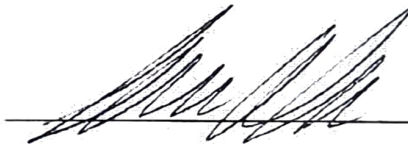
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Date:

5/13/23

Dedication

Dedicated to my mother, Dr. Dorothy A. Frenz. She has influenced my life in countless ways and is why I am pursuing this degree. I miss you more than words can say. Until we meet again, my loving angel!

Acknowledgments

This project would not have been possible without the support of many people. Many thanks to my adviser, Dr. Loida Pineda, who read my numerous revisions and helped clarify the confusion. A big thank you to my wonderful loving husband, my 3 beautiful sons, my father, and numerous friends who endured this long process with me, always offering support and love.

Abstract

This study aimed to investigate the effects of classroom string playing on the Attentiveness, Classroom Behavioral Performance, and Musical Achievement of children with ADHD in third grade. Three research questions were used to observe the Inattentiveness, Classroom Behavioral Performance, and Musical Achievement of third-grade students in orchestra class with ADHD. Three instruments were used. Two were taken from the Vanderbilt ADHD Diagnostic Teacher Rating Scale, focusing on Inattention and Classroom Behavioral performance. The third instrument was the researcher-developed Musical Achievement rubric to weekly assess the learning of 4 beginner-level string-playing criteria, namely, Rhythm Accuracy, Intonation, Posture, and Bow Hold. All data that was observed and recorded was anonymous.

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Problem Statement and Review of Related Literature

Many children throughout the world have ADHD (attention deficit hyperactivity disorder). According to the CDC, ADHD is one of childhood's most common neurodevelopmental disorders (Centers For Disease Control and Prevention, 2022). It is usually first diagnosed in childhood and often lasts into adulthood. The World Health Organization characterizes ADHD as persistent inattention and hyperactivity-impulsivity negatively impacting academic, occupational, or social functioning (Mental disorders, 2022). While the National Institute of Health claims that children with ADHD have inattention issues with or without hyperactivity and impulsivity problems. Overall, children with ADHD have trouble paying attention, controlling impulsive behaviors (may act without thinking about the result), and being overly active. The estimated number of children ages 2 to 17 who have ever been diagnosed with ADHD surpasses 6 million, based on data from the year 2016 to 2019. Most of these children are enrolled in public or private schools (some might be homeschooled), needing the support and help of regular and special classroom teachers (art, music, physical education) to become active members of their classrooms. Therefore, teachers must be prepared to understand the challenges of students with ADHD and to be able to teach the whole classroom (Frantz, 2020). Specialized teaching styles and techniques may be required to help children with ADHD, and music interventions may offer unique benefits for these students.

Research indicates that different types of interventions in the classroom successfully help students with behavioral problems, such as impulsivity, hyperactivity, and inattention. For example, having a classroom management plan will help teachers with students of all needs. One behavioral intervention that had positive results in the classroom is “behavioral self-monitoring of attention and performance.” This self-monitoring system allows all the children in

a classroom to grade their daily performance (Harris et al., 2005). In this study by Harris et al., six students were studied, some neurotypical and some with ADHD. When asked to self-monitor themselves in attention and performance, the students with ADHD responded with more focus for the day.

Medications, physical activity, and social interactions with other children can also positively help behavioral issues (Medication for Behavioral Problems in Children, 2022). A study by NYU Langone found that children taking medications for ADHD, including Adderall and Ritalin, had benefits on behavioral problems. These drugs offer relief for disruptive behavior conditions, such as oppositional defiant disorder (ODD) and conduct disorder (CD) (Medication for Behavioral Problems in Children, 2022). NYU suggests using these medications and behavioral therapy to help ADHD students' symptoms. However, research shows that musical interventions have proved to have unique benefits for this population.

Music aids in language development, starting from an early age. All over the world, songs are sung to babies to help them learn their native languages. In a study by Brandt et al. (Anthony Brandt, 2012), music and language development were researched. They found it would only be possible to speak with the ability to hear music. Based on this research, musical interventions might be key to improve language skills in people with ADHD. A study of children and adults with ADHD showed that people affected by ADHD have trouble moving to the beat of rhythmic sounds in both perceptual and sensorimotor tasks (Puyjayrinet, 2017). Rhythm plays a role in the organizational prosody and phonology of the language, and children with literacy difficulties have demonstrated poor rhythmic perception (Kjersti Lundetræ, 2018). But beat-based timing and beat tracking – activated through musical experiences - can engage the neural networks in these children (Puyjayrinet, 2017). Neural sharing is vital for explaining transfer

effects between music and language (Isabelle Peretz, 2015) and there is compelling evidence that music and language processing have a neural overlap (Kjersti Lundetræ, 2018). Thus, having a neural overlap aids music in helping language development.

Listening to music has proven beneficial for all students. Most students find listening to music in the classroom a rewarding experience. They enjoy silent reading and writing essays when calming music is played. Music listening also helps students tune out distractions and focus better on the task (Barile, n.d.). Donald Shetler, Ed.D., of the Eastman School of Music, found that by listening to just 20 minutes of classical music daily, children had improved speech and language skills, a stronger memory, and more excellent brain organization (Habermeier, 2022). When listening to music, the brain releases dopamine which can lead to a happier mood. Listening to music also lowers cortisol levels in the body. Higher cortisol levels cause stress in the body, which may impact behavior (CHAPPEL, n.d.). It may be that these benefits from music listening experiences might alleviate behavioral issues of students with ADHD.

Music listening effectively promotes attentiveness and focus in people with ADHD (Drake, 2021). In a study, children with ADHD listened to 30 minutes of interactive music and 30 minutes of interactive video game interventions (Drake, 2021). The interactive music did help improve attention management, while the video game intervention did not. The video game interventions overstimulated the children, while the interactive music helped their ability to focus. Instrumental music with no lyrics is believed to not distract the individual with ADHD (Nguyen, 2014). Research also suggests that listening to classical music or binaural beats (an illusion created by the brain when you simultaneously listen to two tones with slightly different frequencies) can help manage ADHD symptoms of inattentiveness (Contributors, 2021).

Children and adults with ADHD seem to have improved their focus and impulsivity and achieved a calmer demeanor when listening to classical music.

Listening to classical music can result in natural dopamine stimulation, reducing the dose or need for ADHD medication (John, 2018). Music is an auditory stimulus for the brain, and listening to music stimulates the dopamine “reward system,” which is linked to improving cognitive functions such as attention and work production (Nguyen, 2014). Children with ADHD require more stimuli to focus, and background music may provide a practical stimulus for the production and release of dopamine (John, 2018). Dopamine, the substance to which well-being and positivity are attributed, is increased by in-depth engagement in musical activities. When dopamine levels increase in students with ADHD, stress levels decrease. Listening to classical music dominant in consonance sounds can also help improve children’s health; however, in children with ADHD, it has been shown to improve it significantly (Nguyen, 2014). Patti Catalano, a neurologic music therapist at Music Works Northwest (Rodgers, 2022), found that brain MRIs can show how music lights up the left and right lobes, meaning activation. Music therapy aims to build up those activated brain muscles over time to help overall function (Rodgers, 2022). Extensive research has been done on how music increases the brain’s dopamine levels in patients with Parkinson’s, Autism, and Tourette’s, but not on patients with ADHD, particularly children.

Children with ADHD can significantly benefit from listening to classical music while working on classwork and homework. In a study on the effects of classical music listening on attentiveness, fifty children with ADHD and fifty neurotypical students (not displaying or characterized by autistic or other neurologically atypical patterns of thought or behavior) were observed in a classroom while listening (ADHD students) and not listening (neurotypical

students) to classical music (Mittag, 2020). The children were between the ages of 8 and 9 years. The composers and compositions used for this study were Mozart and Beethoven: Piano Concerto No. 23 (Mozart), Fur Elise (Beethoven), Salzburg Symphony No. 1 – Divertimento in D major (Mozart), Moonlight Sonata (I) (Beethoven), and Salzburg Symphony No. 3 Divertimento in major (Mozart). The students with ADHD performed better while listening to classical music. They could focus on their “classwork” better than the neurotypical students, while the neurotypical students performed better with no music listening.

The Radiological Society of North America has found that listening to music increases brain fiber connections in children with ADHD. When brain fibers are increased, brain development and long-term memory have increased functions (Rampton, 2022). Listening to music or singing songs to patients with dementia or Alzheimer’s unlocks musical memory in their brains. Music can reduce stress and anxiety in patients with memory diseases (Jonathan Graff-Radford, 2021). This implies that students might achieve the behavior control needed to focus by reducing stress and anxiety. More research needs to be done on the outcomes of classical music and brain development with students that have ADHD (John, 2018).

Music-based therapy can decrease the need for doses of medication for ADHD symptoms (Rodgers, 2022). Classical music has been proven to be a calming force for those with ADHD (Johnson, 2021). Johnson found that classical music positively affected children’s impulsivity (Johnson, 2021). In a study on the current mood in adults with ADHD, listening to Mozart decreased negative mood in both the healthy control and ADHD groups (Zimmermann, 2019). It also aids focus and impulse control (Zimmermann, 2019). The negative moods of adults in this study were feelings of depression, tiredness, and overall melancholy.

Beyond mere listening, music-making experiences can benefit ADHD students in both private and group lessons. Private lessons can build confidence, focus, and structure. Chamber music can help develop socialization skills that many ADHD students lack (Mittag, 2020). Playing an instrument, regardless of the performer's level (beginner/professional) or educational setting, helps to stimulate the neural networks in the brain (Habermeyer, 2021). Various studies have shown that when children with ADHD or learning disabilities learn an instrument, attention, concentration, impulse control, social functioning, self-esteem, self-expression, motivation, and memory improve (Habermeyer, 2021). Habermeyer suggests having ADHD students start private music lessons between the ages of five – seven. Many instruments are considered ADHD-friendly, such as the string bass, woodwinds, and percussive instruments because children can move while playing them. Moving to music helps children with coordination and becomes a fun way to release hyperactive energy (Bailey, 2020). More research needs to be done to determine how children with ADHD are helped with focus by taking music lessons (Habermeyer, 2021).

For students with ADHD, participating in music groups increases cooperation, discipline, and responsibility. One study investigated whether orchestral music training reduces impulse behaviors in Italian children with no learning disabilities, ages 8-10 (Fassano, 2019). One hundred thirteen children participated in the study survey. Fifty-five children attended a 3-month orchestral training program; the other fifty-eight had no musical training. This study found promising results: children in the group with orchestral training had significantly improved focus control (Fassano, 2019). To the extent of my investigation, there are no studies on the effects of orchestral music training on children with ADHD.

Even though the benefits of listening to classical music on ADHD students' attentiveness limitations have been investigated, to the extent of my explorations, the benefits of orchestral

music playing on the attentiveness of children with ADHD have not been researched.

Additionally, the effects of string playing on classroom behavioral performance and musical achievement of students with ADHD have not been investigated. Finally, there is no research on the effects of string playing on students with ADHD in the third grade.

Research Questions

- 1) What are the effects of string playing on the attentiveness of students with ADHD?
- 2) What are the effects of string playing on the classroom behavioral performance of students with ADHD?
- 3) What are the effects of string playing on musical achievement of students with ADHD?

Definitions

Attentiveness: the state of being awake, alert, and actively paying attention to a stimulus.

Classroom Behavioral Performance: the evaluation of successful participation in a group class setting in terms of classroom etiquette, collaboration, and ability to accomplish tasks.

Musical Achievement: the learning and understanding of musical skills for beginner string playing.

Methodology

This study used a quasi-experimental, mixed-methods design (quantitative and qualitative) with pre-and post-test and no control group.

For this study, I researched 10 third-grade students (4 boys and 6 girls) in an elementary orchestra class in Putnam County, New York. All participants had a diagnosis of ADHD and were

part of a fully inclusive music class of 20 students in total. All students were brand new beginner music students, only learning stringed instruments in school and not taking private lessons during this study. For this study, each student chose the particular string instrument they wanted to perform (violin, viola, cello, or bass). One student chose the cello, two chose the viola, and seven chose the violin. No one picked the bass. The classroom was a traditional music room, with the students sitting in a U-shape—only one student per music stand. A seating chart with a number system was used to identify the students with coded names for anonymous data collection. Data collection was facilitated by the teacher, and the researcher collected data while protecting the participant’s identities.

Three separate instruments were used to measure Inattention, Classroom Behavioral Performance, and Musical Achievement for this study. The first two instruments were taken from the Vanderbilt ADHD Diagnostic Teacher Rating Scale (Wolraich et al., 1998), and the third instrument was researcher developed.

The Vanderbilt scale assesses four behavioral constructs: inattention (items 1-9), hyperactivity/impulsivity (items 10-18), oppositional defiant and conduct disorders (items 19-28), and anxiety or depression symptoms (items 29-35); and two performance constructs: academic performance (3 items) and classroom behavioral performance (5 items). Since I was only measuring Inattentiveness and Classroom Behavior for this study, and since the Vanderbilt scale assumes that these variables are mutually exclusive, only the “Inattention” and “Classroom Behavioral Performance” scales were used. The Inattention scale (from 0 *never* to 3 *very often*) and the Classroom Behavioral Performance scale (from 1 *problematic* to 5 *above average*) were used for pre and post-test and a weekly assessment.

The third instrument scale used was the researcher-developed Musical Achievement rubric used to test assess the learning of 4 beginner-level string-playing criteria, namely, Rhythm Accuracy, Intonation, Posture, and Bow Hold, on a scale from 1 *poor* to 5 *excellent*. Participants were assessed on Musical Achievement at pre-test, weekly after that, and at post-test. Additionally, I collected any relevant data about participants' behaviors observed for the duration of the treatment through a personal journal.

The treatment consisted of a 5-week group-based strings class on “Twinkle, Twinkle Little Star,” taught by the school music teacher (not the researcher). The classroom teacher structured her teaching based on Bloom’s taxonomy (Armstrong, 2010), which consisted in listening, remembering the melody, understanding the central theme, applying the variations, playing the theme and variations on their instruments, evaluating themselves, and analyzing their performance.

During week 1, Jan. 3-6, the basics of string playing were taught. During this first day, much of the 40-minute lesson was spent on classroom rules, instrument care, proper posture, and bow hold. The teacher played the main melody of “Twinkle Twinkle,” but no actual playing on the students’ instruments occurred. The rest of the first week involved a daily review of proper posture and bow holds on the stringed instruments. The children learned how to clap and use body percussion to feel the rhythms of Twinkle Twinkle, the main melody and the themes of pepperoni pizza (Ti-Ti-Ti-Ti-Ta-Ta) and pepperoni pepperoni (Ti-Ti-Ti-Ti Ti-Ti-Ti-Ti). The teacher played these rhythms on the D and A strings.

The first week of learning the bow hold was hard for most students to grasp, so the teacher had the class use pizzicato to feel and play the rhythms on the D and A strings. The teacher did not give out sheet music to the class. She instead had the students listen and play by

ear, which helped them understand the music better when they heard it. The teacher played the pepperoni pizza variation (Ti-Ti-Ti-Ti-Ta-Ta) on her violin to reinforce ear training. The students would then pick up their instruments, bow, and try echoing the rhythm on the open strings. The teacher used solfege and the Suzuki method to help the students understand the rhythms.

During week 2, Jan.9-13, the teacher put finger tapes on all the instruments. The children learned how to play first finger B on the A string. Then, the teacher would play the beginning melody of “Twinkle Twinkle” with the new note B, and the children would try to echo and find the pitch. The class brought home their Chromebooks and instruments for practice. The teacher had uploaded videos for the students to listen to and play along to, helping with their at-home practice. The Chromebooks and the teacher demonstrating on her instrument were great visual reminders for students with ADHD.

Week 3, Jan. 17-20, was a big turning point. The teacher showed the students how to place their fingers on the other tapes on the D-string. The class could play G, F#, and E. She played a game with the class to see who could match her pitches. This game encouraged hands-on learning, another excellent teaching strategy for students with ADHD. To help keep the class organized and focused, the teacher encouraged hands-on learning by allowing the students not only to play and try the instruments but also by allowing them to be the teacher and help the class learn the body percussion rhythms.

Week 4, Jan. 23-27, the students were able to play “Twinkle Twinkle” and the variations by ear. The teacher played a background track on the Smartboard of the Suzuki piano accompaniment to “Twinkle Twinkle,” She led the class in a play-along with the students lined up in 2 rows (row 1 and row 2). By having rows, the teacher was able to play the first line of

Twinkle Twinkle, then row 1 played the second line of the song, and row 2 played the third line of the song. After the third line was played by row 2, the entire class and the teacher played the final line of the song.

This study took place over five weeks, from January 3rd- February 3rd, 2023, during the regular daily schedule of orchestra class (40 minutes long). The researcher attended classes daily and used weekly assessments to obtain measurements of students' levels of Inattention, Classroom Behavioral Performance, and Musical Achievement. On the first day of the study, to get a baseline, pre-tests were filled by the researcher and the classroom teacher using the instruments discussed above to assess students' level of Inattention, Classroom Behavioral Performance, and Musical Achievement. Additionally, the teacher and researcher filled out the same three instruments at the end of each week (week 1- week 4).

During the treatment month, the classroom teacher taught the song to students through listening, remembering the melody, understanding the central theme, applying the variations, playing the theme and variations on their instruments, evaluating themselves, and analyzing their performance, which, as stated above, follows the structure of Bloom's taxonomy (Armstrong, 2010). I, the researcher, was only an observer taking notes on the teaching strategies used by the classroom teacher.

At the end of the four weeks of treatment, the post-tests were administered, collecting data again about the participants from the classroom teacher and myself, the researcher.

Results and Discussions

Data collected was analyzed and interpreted through quantitative methods. For the quantitative data, descriptive statistics were obtained, and t-tests were run to evaluate treatment

effects, significance, and effect size. Common themes and categories were identified for the qualitative analysis of the teacher's teaching strategies.

To analyze quantitative data, scores from the Inattention, Classroom Behavioral Performance, and Musical Achievement scales filled by both the teacher and the researcher were statistically combined. For easy identification, the combined data of the teacher and researcher was named "Observers."

For the first research question - What are the effects of string playing on the Inattentiveness of students with ADHD; descriptive statistics for Inattentiveness at Pre-Test revealed a mean of 2.66 on a scale from 0 (*never*) to 3 (*very often*), showing that participants were inattentive very often. Descriptive statistics at week 3 revealed a mean of 1.73 on a scale from 0 (*never*) to 3 (*very often*), which indicated participants as being inattentive less often. Descriptive statistics for the post-test revealed a mean of 1.47 on a scale from 0 (*never*) to 3 (*very often*), showing participants as being inattentive less often, with a small decrease in comparison to week 3. The complete descriptive statistics for each week are shown below in Table 1.

Descriptive Statistics- Table 1

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre_Observers_Inatt	10	2.17	3.00	2.6611	.30815
Week3_Observers_Inatt	10	1.11	3.00	1.7389	.56173
Post_Observers_Inatt	10	.67	3.00	1.4778	.72776
Valid N (listwise)	10				

Histograms were also obtained to see the ratings of these participants with ADHD. The charts below show the distribution of Inattentiveness at pre-test, week 3, and post-test. While data scores were normally distributed at the pre-test (Table 2), skewed data was observed at weeks 3 (Table 3) and post-test (Table 4). Skewness in the last two histograms were due to a single outlier in the extreme right (Tables 3 and 4).

Table 2

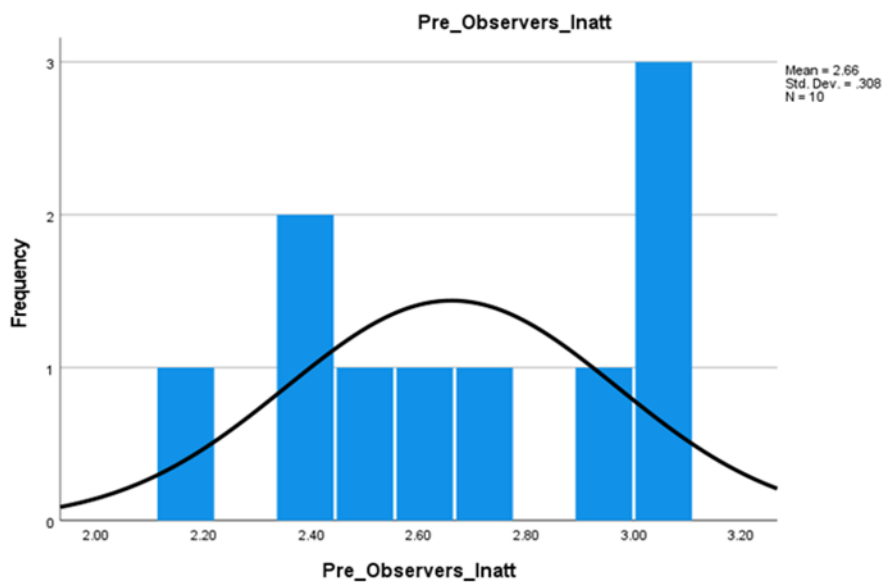


Table 3

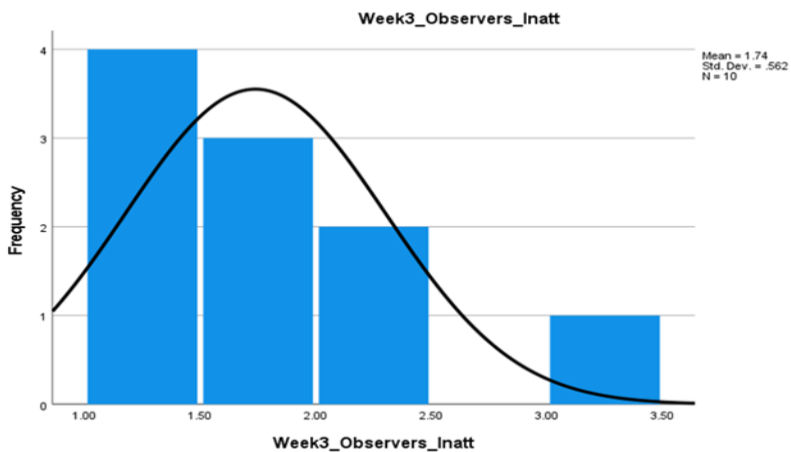
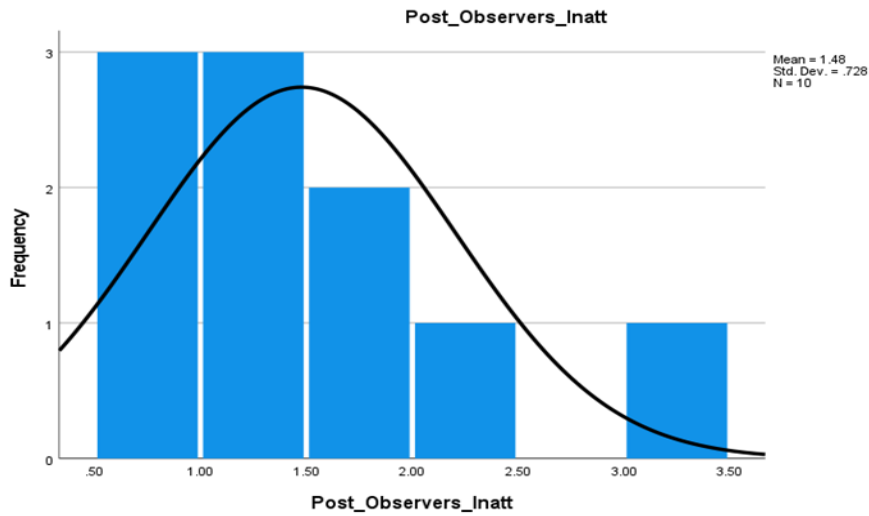


Table 4



To assess the effects of the treatment on participants, nonparametric *t-tests* compared results from pre-test to week 3, from week 3 to post-test, and from pre- to post-test. Week 3 was used as a point of comparison because it was a midpoint in the treatment, and thus, it was considered as a good point in time to “track” any effects of the treatment.

First, the *t-test* result from pre-test to week 3 was statistically significant ($p = .008$), revealing a strong effect of the treatment.

Table 5

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_Inatt and Week3_Observers_Inatt equals 0.	Related-Samples Wilcoxon Signed Rank Test	.008	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Looking at a comparison from week 3 to post-test, the nonparametric *t-test* showed a non-significant result.

Table 6

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Week3_Observers_Inatt and Post_Observers_Inatt equals 0.	Related-Samples Wilcoxon Signed Rank Test	.233	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

And, as expected, the pre- to post-test *t-test* resulted in a strong statistically significant effect.

Table 7

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_Inatt and Post_Observers_Inatt equals 0.	Related-Samples Wilcoxon Signed Rank Test	.008	Reject the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

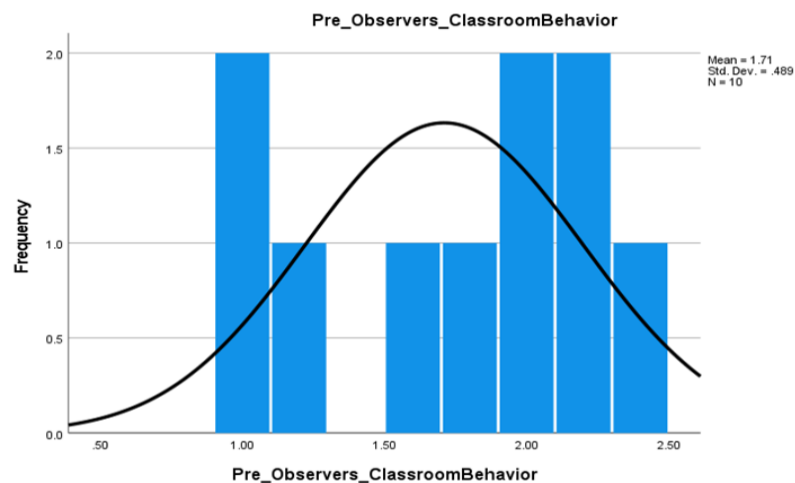
For the second research question: What are the effects of string playing on the Classroom Behavioral Performance of students with ADHD, descriptive statistics were obtained. At pre-test, a mean of 1.71 on a scale from 1 (*poor*) to 5 (*excellent*), showed poor classroom behavior. At week-3, an increased mean of 3.84 on a scale from 1 (*poor*) to 5 (*excellent*), showed very good classroom behavior. Finally, at post-test, a mean of 4.4 on a scale from 1 (*poor*) to 5 (*excellent*), showed the highest ratings for Classroom Behavioral Performance. The complete descriptive statistics for each week are shown in Table 8.

Descriptive Statistics - Table 8

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre_Observers_ClassroomBehavior	10	1.00	2.30	1.7100	.48865
Week3_Observers_ClassroomBehavior	10	1.40	4.80	3.8400	1.02762
Post_Observers_ClassroomBehavior	10	2.20	5.00	4.4400	.84222
Valid N (listwise)	10				

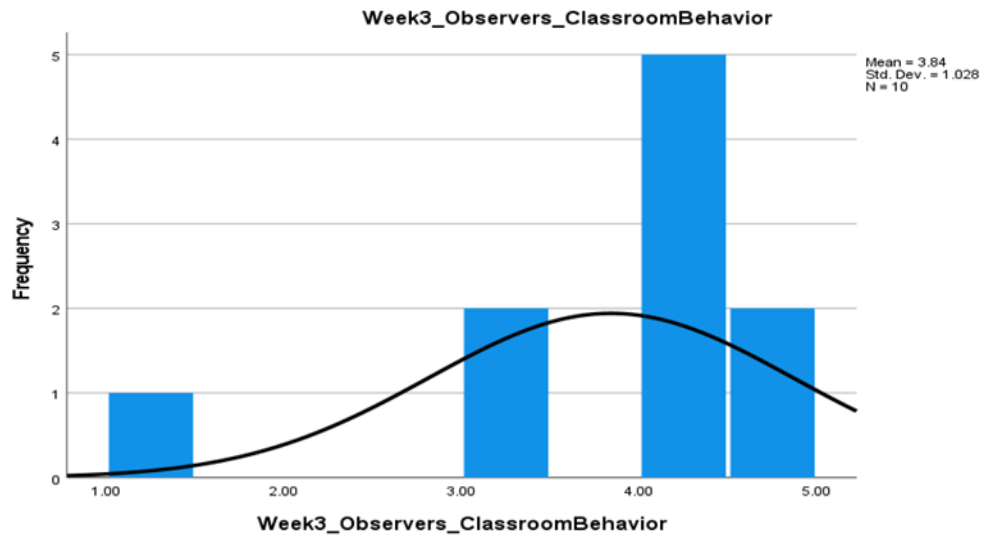
Histograms were also obtained to more clearly see the ratings of the Observers (teacher and researcher) on participants' Classroom Behavioral Performance. The charts below show the distribution of Classroom Behavioral Performance characterized by pre-test, week 3, and post-test scores. While the histogram at pre-test showed a normal distribution (Table 9), those at week 3 (Table 10) and post-test (Table 11) were not.

Table 9



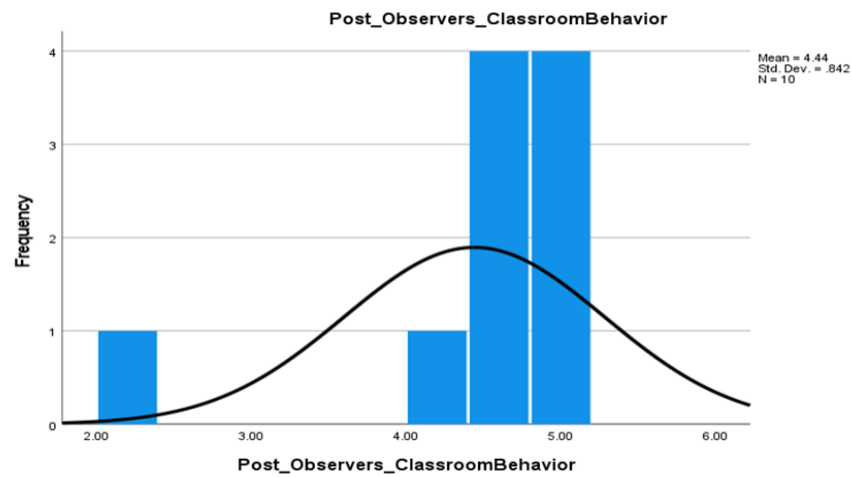
At week 3, a low bell shape indicated a very spread range of responses with one participant as an outlier on the far left, revealing overall the high variance of classroom behavior performance amongst participants after 2 weeks of treatment (see Table 10 below).

Table 10



At the post-test, although most participants rated high in their classroom behavior, one participant still rated very low in this variable, as seen in the histogram below.

Table 11



Results of the Observers (teacher's and researcher's data were compared using nonparametric *t-tests*. Significant results were found for all comparisons, from the pre-test to week 3, from week 3 to post-test, and from pre- to post-test (See Tables 12 to 14).

Table 12

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_ClassroomBehavior and Week3_Observers_ClassroomBehavior equals 0.	Related-Samples Wilcoxon Signed Rank Test	.005	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Table 13

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Week3_Observers_ClassroomBehavior and Post_Observers_ClassroomBehavior equals 0.	Related-Samples Wilcoxon Signed Rank Test	.007	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Table 14

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_ClassroomBehavior and Post_Observers_ClassroomBehavior equals 0.	Related-Samples Wilcoxon Signed Rank Test	.005	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Descriptive statistics were also obtained for the third research question: What are the effects of string playing on Musical Achievement of students with ADHD. The pre-test revealed a mean of 1.36 on a scale from 1 (*poor*) to 5 (*excellent*), showing poor musical achievement. At

week 3, a mean of 3.42 on a scale from 1 (*poor*) to 5 (*excellent*) indicated medium levels in musical achievement. Finally, at post-test, students' musical achievement had a mean of 4.62 on a scale from 1 (*poor*) to 5 (*excellent*), showing high ratings in musical achievement. The complete descriptive statistics for each week are shown in Table 16.

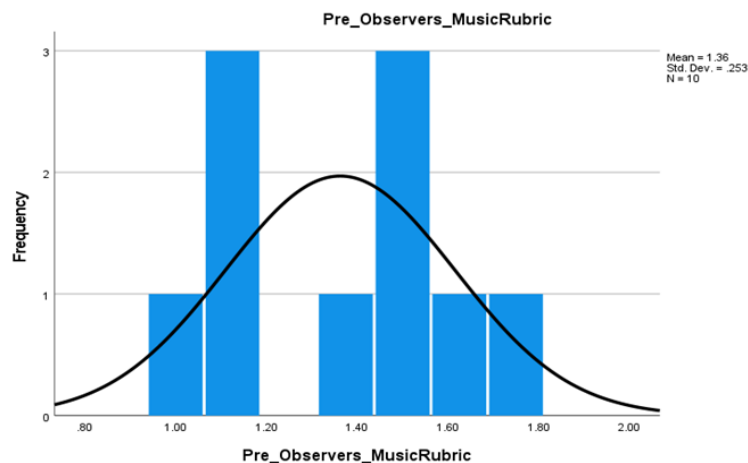
Descriptive Statistics - Table 15

	N	Minimum	Maximum	Mean	Std. Deviation
Pre_Observers_MusicRubric	10	1.00	1.75	1.3625	.25311
Week3_Observers_MusicRubric	10	1.25	4.13	3.4250	.92646
Post_Observers_MusicRubric	10	3.00	5.00	4.6250	.67956
Valid N (listwise)	10				

Histograms were also obtained to more clearly see the frequency of responses amongst these students with ADHD. The charts below show the distribution of the Musical Achievement Rubric characterized by pre-test, week 3, and post-test scores.

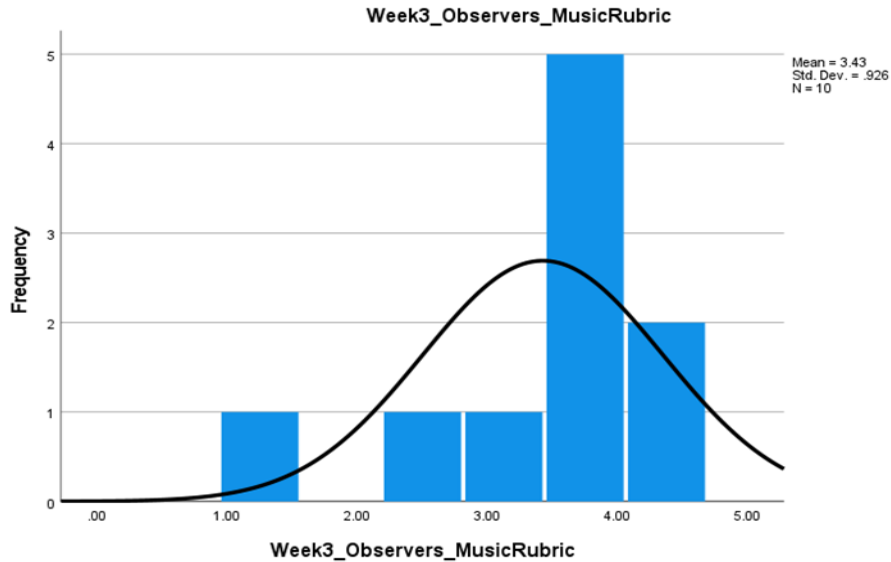
A normal distribution of scores was identified at the pre-test.

Table 16



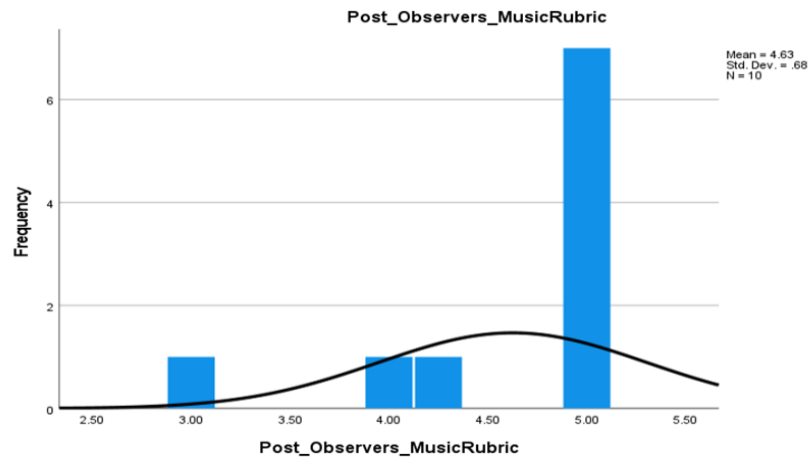
At week 3, data from the Musical Achievement Rubric showed an overall normal distribution with only one participant on the low side of the histogram.

Table 17



Interestingly, high variability was observed at the post-test with most students scoring very high (between 4 descriptor and 5 descriptor) and one participant scoring at a mid-point (3 descriptor).

Table 18



A nonparametric *t-test* was used to compare the teacher's and researcher's data.

Statistically significant results were found for comparisons from pre-test to week 3, week 3 to post-test, and pre- to post-test (Tables 19 to 21).

***t-test* Table -19**

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_MusicRubric and Week3_Observers_MusicRubric equals 0.	Related-Samples Wilcoxon Signed Rank Test	.005	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Table 20

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Week3_Observers_MusicRubric and Post_Observers_MusicRubric equals 0.	Related-Samples Wilcoxon Signed Rank Test	.005	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Table 21

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Pre_Observers_MusicRubric and Post_Observers_MusicRubric equals 0.	Related-Samples Wilcoxon Signed Rank Test	.005	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Discussions

Regarding the first research question, What are the effects of string playing on the Inattentiveness of students with ADHD, the nonparametric t-tests from pre-test to week 3, and pre- to post-test all showed significant results with a strong effect size. This means that the treatment, that is, the string class, more than likely caused a statistically significant improvement in students' inattentiveness.

From the pre-test to week 3, great development of students' inattentiveness took place. When the pre-tests were administered, the students entered the music room excitedly and loudly. However, by week 3, the students came into class less rowdy and seemed to enjoy playing stringed instruments. One of the strategies that the teacher used to help keep the class organized and focused was to encourage hands-on learning by allowing the students not only to play and try the instruments but also by allowing them to be the teacher and help the class learn the body percussion rhythms. Although nonsignificant results were obtained from week 3 to post-test, this did not impact the overall powerful effect of the treatment from pre- to post-test. It only means that the greatest improvement happened from pre-test to week 3. Simply put, the children went from being rowdy and loud at the pre-test to listening and understanding how to play "Twinkle Twinkle" at the post-test.

To fully understand participants' improvement in inattentiveness, a discussion of the specific 9 criteria measured by the Inattentiveness Scale (See Appendix A) follows:

First, regarding the criterion "Fails to give attention to details or makes careless mistakes in schoolwork," results show that students that failed to give attention to details or made careless mistakes in schoolwork during weeks 1-2 made fewer mistakes in their schoolwork by week 3 to

post-test. For the first two weeks, most of the ADHD students were careless in how they treated their instruments. They would leave the instruments out of the cases unattended. The teacher made it a point to have a daily review of instrument care. She showed videos of what could happen to these delicate wooden stringed instruments if they were left out unattended. She made a point to show how easily accidents could happen. In fact, in week 2, as the teacher was tuning up a violin, the E string popped and broke. The entire music class witnessed this, and realized how delicate these stringed instruments are, and started to take care of their instruments like “babies.” For the rest of the treatment, from weeks 3 to the post-test, there were no more accidents or careless mistakes regarding instrument care.

Regarding the second criterion in the Inattentiveness Scale, many students had difficulty sustaining attention to tasks or activities during the beginning of the treatment. To help the students focus and learn the theme and variations of “Twinkle Twinkle,” daily rhythmic clapping happened at the beginning of each class. Repetition of rhythms allowed students to not only hear the rhythms but also feel them through clapping and speaking them. By week 3, daily repetition of these rhythms became easier for students to grasp, and the class became more engaged and less distracted. Those that started out the treatment being distracted and not able to stay on task ended the treatment with more attentiveness and positivity.

Those students that did not seem to listen when spoken to directly, the third criterion in the Inattentiveness Scale, made great progress in their listening skills by weeks 3 to post-test. To instill listening skills, the teacher played a game with the class to see who could match her pitches. The children were so focused on trying to match the pitch on their instrument to the teacher’s pitch that this allowed for their heightened ability to listen carefully.

Improved listening skills might have helped students improve their ability to follow through on instructions and to finish schoolwork, which was the fourth criterion assessed in the Inattentiveness Scale. As the treatment progressed, students attained learning goals week by week by listening carefully instructions and following them accordingly; and the awareness of their own learning progress seemed to have reinforced their continued following to instructions, thus enabling their ability to finish tasks. For example, students beamed with pride by week 3 when they became aware of their improvement from not being able to play a note to be able to complete the first line on the main melody. In other words, students realized that following instructions produced results! By the post-test, they could all play the song and variations together, and all students were able to complete the 40-minute classes without complaining about being tired.

Regarding the fifth criterion, “has difficulty organizing tasks and activities,” a strategy that was helpful to students was the use of technology (Chromebooks and the Smartboard). Using the Chromebooks at home for practice and the Smartboard in school, the teacher uploaded fun videos with the different rhythms and play-along of “Twinkle Twinkle.” This was a fun way to reinforce the daily rhythm review and importance of practice. The teacher would give stickers to those that were prepared and remembered to bring their instruments and Chromebook to class. By using a reward system, students wanted to be prepared to get a sticker. By the middle of the treatment, everyone was more organized and remembered to be ready for class.

The sixth criterion, “avoids, dislikes, or is reluctant to engage in tasks that require sustaining mental effort,” was addressed in original ways by the teacher. Instead of just having the class hear the music being played only by the teacher, uploaded videos of the song and variations were used. Additionally, the teacher frequently asked the class to move around the

room. ADHD students often get distracted when a class is one-directional or with sustained mental effort. Having the class get up out of their seats and move around the room, feeling the different rhythmic beats, allowed for whole-body percussion. This allowed for student engagement and excitement to move around the room. In this case, the teacher's use of multiple activities with constant motion allowed for less fidgetiness and more focus.

“Loses things necessary for tasks or activities ” is the seventh criterion. To keep the class prepared, the teacher used a sticker reward system. The class was responsible for bringing in their instrument daily and their Chromebook. The first few days, many students would forget to be prepared and would not receive a sticker in the rewards chart. Feeling left out and disappointed that they were not getting a sticker for the day made the entire class want to be prepared. By weeks 2-3, everyone came to class prepared and excited to see how many stickers were on the chart.

Regarding the eighth criterion, “is easily distracted by extraneous stimuli,” notably, the class as a whole was listening to the teacher and following directions, even when there was a distraction in the room. Upon reflection on the teacher's strategies, the use of hands-on learning, combined with listening and solfege rhythms with body percussion, may have been key in allowing all types of learners (auditory, visual, and kinesthetic) to be fully engaged throughout the class and thus, counteracting all external distractions. By the end of the treatment, the teacher did not need to redirect the class to keep their attention. Thus, these teaching strategies involving different learning modes helped those students with ADHD become more attentive each week.

The ninth criterion, "is forgetful in daily activities," was easily noticeable in the first week. Students would forget how to perform the rhythms, how to hold the instrument and bow, and even come to class without their instruments. By week 2, the teacher's use of the rewards

sticker system, daily review of rhythms, and instrument care, made the class want to be prepared and remember the rhythms.

Regarding the second research question -What are the effects of string playing on the Classroom Behavioral Performance of students with ADHD; the nonparametric t-test showed significant results with a substantial effect size. From the pre-test to week 3, a significant result of $p = .005$ was recorded. From week 3 to the post-test and from the pre-test to the post-test, the nonparametric t-tests showed a significant result of $p = .005$. This may have been a consequence of the class beginning to have a better understanding of the instruments, which caused less frustration and more peer conformity. Also, students were having group discussions and encouraging their classmates from week 3 to the post-test, which means that socialization skills and classroom behavior performance were improved. The U-shape of the classroom allowed for eye contact and group discussions for the class.

To fully understand participants' improvement in classroom behavior, a discussion of the specific 5 criteria measured by the Classroom Behavioral Performance Scale (See Appendix "B") follows:

By the post-test, all aspects of the Classroom Behavioral scale saw significant improvements. First, “relationships with peers” improved towards the second half of the treatment. Peer interaction went from negative during weeks 1 and 2, with many outbursts by distracted classmates, to positive ones by week 3 to post-test. At that point, the class began to encourage each other to match the intonation of notes and enjoyed seeing the progress they made when they could finally play the whole song. This means that patience during the first stages is needed, giving time to students’ absorption of the music experience and to allow music-making and musical learning to improve social interactions.

Second, despite some challenges, students were also able to improve their ability to “follow directions/rules.” During weeks one and two, the students were frustrated by the difficulties in learning proper instrument care, posture, and counting the rhythms. This made it difficult for students to follow the classroom rules and resulted in students out bursting and distracting the class. As soon as one student would call out, the teacher had to redirect the entire class to regain focus in the classroom. However, as consistently shown by the statistical results, by week 3, the class was starting to understand the musical concepts, which made for fewer outbursts, allowing the students to better follow classroom directions and rules.

One strategy that greatly contributed to improve two criteria, “disrupting class” and “assignment completion,” was the use of finger tapes on the instruments. The finger tapes helped the students find the notes faster and easier, which in turn caused less frustration in the classroom. Once the students started to grasp how to place their fingers for string playing, fewer disruptions and calling out happened in the room. More importantly, the use of the finger tapes allowed for lesson completion. Students wanted to find the note and were excited when they could use all the finger tapes on their instruments.

“Organizational skills,” the last criterion on the Classroom Behavior Scale, improved from weeks 1-2 to the post-test. The use of the sticker reward system - mentioned above - made students want to come to class prepared. This may mean that the sticker reward system contributed to improve both, Classroom Behavior and Inattention. By week 3, everyone was remembering to bring their instruments and Chromebooks. As the class became more organized, assignment completion was able to happen more easily.

Regarding the third research question - What are the effects of string playing on Musical Achievement of students with ADHD, the nonparametric t-test showed significant results with a

substantial effect size. From the pre-test to week 3, a significant result of $p = .005$ was recorded. In other words, these students who did not know how to play the stringed instruments before the pre-test made great strides by week 3 to the post-test. Although these results might be assessed as not surprising, they are. Students with ADHD have problems learning, mainly because they lack focus and capacity to process information like students without ADHD do. Thus, these results may indicate that while inattention and classroom behavior improved, these students had a better chance to absorb all teaching and thus, in turn, allowed learning and musical achievement to occur.

To fully understand participants' improvement in musical achievement, a discussion of the specific 4 criteria measured by the Musical Achievement Rubric (See Appendix "C") follows.:

For the first criterion regarding rhythm, the teacher would do a daily repetitive rhythmic review. She would clap, play the rhythms on her violin, and play videos of the rhythms on the Smartboard. She encouraged the class to not just hear the rhythms but to “be” the rhythms. The class would get up and use body percussion to move around the room and feel the rhythms from head to toe. After feeling the rhythms with their bodies, the class would pick up their instruments and bow the rhythm on the open strings. They could feel and hear these important rhythms on their instruments. Repetitive rhythmic clapping and movement allowed these ADHD students to learn the rhythm in a fun way and kept the classroom active instead of just sitting in a chair for the entire class.

Regarding the criterion “Intonation,” it was difficult during the first 2 weeks of treatment. However, several factors contributed to their great improvement. First, through the use of the finger tapes, the students were able to improve their playing in tune. Repetitive listening to

the main melody and variations helped with ear training. Also, listening to the music through videos played in the Chromebooks contributed to students forming a mental image of proper tuning , and aided in ear training. Additionally, as the teacher modeled accurate pitch playing and students echoed the pitches back, students could grasp intonation skills with ease. Last, practicing in school and at home helped participants to develop aural feedback of the right intonation.

“Bow hold” and “posture,” the last two criteria in the Musical Achievement rubric, are difficult to learn, especially for a fidgety overactive ADHD student. By weeks 3 to post-test, these students began to have more stamina and attentiveness and achieved significant improvements in bow hold and posture . The teacher used rubber bow grips that she placed on every child’s bow, to help the students grasp the proper grip. She placed these on during week 2, and it really made a big difference in how the students could hold the bow. For posture, the teacher played a sitting game. She would purposely have the students sit lazily for “bad” posture and then ring a bell to have them sit correctly for the “proper playing” position. The class loved doing this because they found it funny to see all the lazy seating positions versus the one proper playing position.

When asked what they liked about orchestra class, these 3rd graders said it was fun to learn an instrument and felt special because they were in a group! Feeling a part of an orchestra class allowed these ADHD students to have a sense of belonging and pride. ADHD students can benefit from learning stringed instruments. All aspects of “Inattentiveness, Classroom Behavior and Musical Achievement” were greatly improved. An orchestra teacher just needs to think outside the box for these students and add different hands-on teaching strategies that will allow all learners to feel comfortable in strings class. Regarding the first research question, What are

the effects of string playing on the Inattentiveness of students with ADHD, the nonparametric *t*-tests from pre-test to week 3, and pre- to post-test all showed significant results with a strong effect size. This means that the treatment, that is, the string class, more than likely caused a statistically significant improvement in students' inattentiveness.

Summary

This study aimed to investigate the effects of classroom string playing on the Attentiveness, Classroom Behavioral Performance, and Musical Achievement of children with ADHD in third grade. Observation of the teaching strategies used by the orchestra teacher to explore their impact on those three variables on students with ADHD was recorded.

Three research questions were used to observe the Attentiveness, Classroom Behavioral Performance, and Musical Achievement of third-grade students in orchestra class with ADHD.

- 1) What are the effects of string playing on the attentiveness of students with ADHD?
- 2) What are the effects of string playing on the classroom behavioral performance of students with ADHD?
- 3) What are the effects of string playing on musical achievement of students with ADHD?

For this study, 10 third-grade students (4 boys and 6 girls) were observed in an elementary orchestra class in Putnam County, New York. All participants had a diagnosis of ADHD and were part of a fully inclusive music class of 20 students in total. All students were brand new beginner music students, only learning stringed instruments in school and not taking private lessons during this study. For this study, each student chose the string instrument they

wanted to perform (violin, viola, cello, or bass). Students ended up choosing violin, viola, and cello. The classroom was a traditional music room, and all data collected for this experiment was anonymous.

Three instruments were used (see the Appendix section). Two were taken from the Vanderbilt ADHD Diagnostic Teacher Rating Scale (Wolraich et al., 1998). This scale assesses four behavioral constructs: inattention, hyperactivity/impulsivity, oppositional defiant and conduct disorders, and anxiety or depression symptoms; and two performance constructs: academic performance and classroom behavioral performance. Only the “Inattention” and “Classroom Behavioral Performance” scales were used for this study. The Inattention scale (from 0 *never* to 3 *very often*) and the Classroom Behavioral Performance scale (from 1 *problematic* to 5 *above average*) was used for pre and post-test and a weekly assessment.

The third instrument used was the researcher-developed Musical Achievement rubric to weekly assess the learning of 4 beginner-level string-playing criteria, namely, Rhythm Accuracy, Intonation, Posture, and Bow Hold, on a scale from 1 poor to 5 excellent.

This study took place over five weeks, from January 3rd- February 3rd, 2023, during the regular daily schedule of orchestra class (40 minutes long). The researcher attended classes daily and used weekly assessments to obtain measurements of students’ levels of Inattention, Classroom Behavioral Performance, and Musical Achievement. On the first day of the study, to get a baseline, pre-tests were filled by the researcher and the classroom teacher using the instruments discussed above to assess students’ level of Inattention, Classroom Behavioral Performance, and Musical Achievement. Additionally, the teacher and researcher filled out the same three instruments at the end of each week of the treatment (week 1- week 4).

During the treatment month, the classroom teacher taught the song to students through listening, remembering the melody, understanding the central theme, applying the variations, playing the theme and variations on their instruments, evaluating themselves, and analyzing their performance, which, as stated above, follows the structure of Bloom's taxonomy (Armstrong, 2010). I, the researcher, was only an observer taking notes on the teaching strategies used by the classroom teacher. At the end of the last week of treatment the post-test was filled again by the classroom teacher and the researcher.

SPSS was used for statistical analysis and emergent coding to analyze qualitative data; descriptive statistics and frequencies were obtained, and *t-tests* were used to compare both the teacher and the researchers' results. Emergent coding was used to analyze qualitative data.

Data collected was analyzed and interpreted through quantitative analysis. For the quantitative data, descriptive statistics were obtained, and *t-tests* were run to evaluate treatment effects, significance, and effect size. Common themes and categories were identified for qualitatively analyzing the teacher's teaching strategies.

To analyze quantitative data, scores from the Inattention, Classroom Behavioral Performance, and Musical Achievement scales filled by the teacher and the researcher were statistically combined. For easy identification, the combined data of the teacher and researcher was named "Observers."

Regarding the first research question - What are the effects of string playing on the Inattentiveness of students with ADHD; the nonparametric *t-test* showed significant results with a substantial effect size. This means that the treatment, that is, the string class, more than likely

caused an improvement in students' inattentiveness. From the pre-test to week and pre-test to post-test showed significant results with a substantial effect size.

Regarding the second research question -What are the effects of string playing on the Classroom Behavioral Performance of students with ADHD; the nonparametric *t-test* showed significant results with a substantial effect size. This means that the treatment, that is, the string class, more than likely caused an improvement in students' classroom behavior. From the pre-test to week 3, week 3 to post-test, and pre-test to post-test showed significant results with a substantial effect size.

Regarding the third research question - What are the effects of string playing on Musical Achievement of students with ADHD; the nonparametric *t-test* showed significant results with a substantial effect size. This means that the treatment, that is, the string class, more than likely caused an improvement in students' music performance. From the pre-test to week 3, week 3 to post-test, and pre-test to post-test showed significant results with a substantial effect size.

Conclusions

In light of previous research, as cited below, the results of this study have led to the following conclusions. First, inattentiveness and classroom behavior for third-grade students with ADHD are improved after learning a stringed instrument. Attentiveness is being awake, alert, and actively paying attention to a stimulus. Both regular and special classroom teachers (art, music, physical education) must support students with ADHD to become active classroom members. Music listening and music therapy are very beneficial to students with ADHD. After introducing stringed instruments to the 10 ADHD students in 3rd grade, inattentiveness went from very poor and easily distracted during Pre-Test – Week 3 to more attentive and less

distracted from Week 3 – Post-Test. More focus was observed in all students, causing fewer outbursts and more attentiveness in music listening, performance, and classroom behavior. It is then concluded that strings instruction strongly contributed to students staying attentive and engaged throughout this class.

After the significant results of Classroom Behavior Performance were evaluated in this study, it was concluded that strings instruction could be used to see fast improvement in this variable. During week 1 and week 2, many students acted out, causing the music class to become frustrated. Peer relationships were affected negatively when students acted out. By week 3 – week 4, the students understood the stringed instruments' concepts and became more eager to learn. This eagerness led to more class participation and positive peer interactions. Social participation in a group setting can be challenging for students with ADHD. However, after the treatment, students were able to display good socializing skills. When asked what they liked about orchestra class, these 3rd graders said it was fun to learn an instrument and feel special because they were in a group! It may be that excitement and positive emotions aroused by participants' corporate music-making experience were motivating factors to keep them on their best behavior.

Musical Achievement is the learning and understanding of musical skills for beginner string playing. From the Pre-Test to week 2, rhythmic patterns, proper posture, and bow hold were extremely poor. As the weeks progressed, so did the children. Clapping back of musical rhythms became a fun game, with the students learning the different variations of "Twinkle Twinkle" by week 3. The children even enjoyed making the rhythms with their bows on both the open strings and using the finger tapes to make the pitches. Ear training by listening to recordings and the teacher playing the song helped engage the students. By Post-Test, all

students improved musical achievement (rhythms, posture, and bow hold). These findings point at the musical learning that participants achieved throughout the treatment. In other words, they achieved the learning objective set by the teacher for each class. This is extremely relevant because the whole purpose of being attentive and with proper classroom behavior is that learning can take place. Therefore, this study supports the idea that through proper musical instruction in strings, students are able to accomplish lesson-learning objectives.

Another important conclusion from this study is that the lesson design was successful. The statistically significant results for every variable studied reinforce the idea that the treatment, as it was, based on Bloom's Taxonomy, based on one single song, and developed throughout five weeks, had an impactful effect on students' attentiveness, classroom behavior and musical achievement. This means that teachers with students having ADHD diagnosis could plan their instruction emulating the design of the lesson plan used for this study to see similar results.

Recommendations

This study showed positive results in inattentiveness, classroom behavior, and musical performance in students with ADHD in third grade. Learning stringed instruments helped all these aspects of learning, but further qualitative and quantitative research needs to be done. This study was only five weeks long. Perhaps following third-grade students with ADHD for the entire school year will give more detailed information. More quantitative research needs to be done, focusing on the teaching strategies used to help aid in classroom behavior performance. It would be interesting to follow these third graders from this study through the end of elementary school (3rd – 5th grade) to see who is still taking orchestra class and what benefits are observed in their ADHD symptoms after three years of playing music. So, a longitudinal study is recommended.

Significant improvements after the treatment in attentiveness and classroom behavior were exclusively related to the learning of music. Music class can also work with the other subjects. A history lesson or math lesson can have songs that enhance the subject goal. More research needs to be done in the regular classroom after the strings class is over. Do students keep the same levels of attentiveness and classroom behavior after the strings class is over when they go back to their third-grade classroom? Attention and classroom behavior should be positively affected in these subjects with the use of music.

This study revealed that instruction in string music does have the power to help alleviate symptoms of ADHD. Learning a stringed instrument is an excellent non-medicated way to help ADHD students improve attention and classroom behavior. There are no negatives to learning a stringed instrument, only positives.

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Appendix A

Inattentiveness Scale (Mark L. Wolraich, 2013)

Name: _____

Grade: _____ Date of Birth: _____

Teacher: _____ School: _____

Each rating should be considered in the context of what is appropriate for the age of the children you are rating.

Frequency Code: 0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often

1. Fails to give attention to details or makes careless mistakes in schoolwork	0	1	2	3
2. Has difficulty sustaining attention to tasks or activities	0	1	2	3
3. Does not seem to listen when spoken to directly	0	1	2	3
4. Does not follow through on instruction and fails to finish schoolwork (not due to oppositional behavior or failure to understand)	0	1	2	3
5. Has difficulty organizing tasks and activities	0	1	2	3
6. Avoids, dislikes, or is reluctant to engage in tasks that require sustaining mental effort	0	1	2	3
7. Loses things necessary for tasks or activities (school assignments, pencils, or books)	0	1	2	3
8. Is easily distracted by extraneous stimuli	0	1	2	3
9. Is forgetful in daily activities	0	1	2	3

Appendix B

Classroom Behavioral Performance Scale (Mark L. Wolraich, 2013)

1. Relationships with peers	1	2	3	4	5
2. Following directions/rules	1	2	3	4	5
3. Disrupting class	1	2	3	4	5
4. Assignment completion	1	2	3	4	5
5. Organizational skills	1	2	3	4	5

Appendix C

Musical Achievement Rubric (researcher-developed)

Please use this rubric to assess learning of 4 string-playing criteria weekly: **Rhythm Accuracy, Intonation, Posture, and Bow Hold**, on a scale from **1 poor to 5 excellent**.

Please circle your answer.

1. Rhythm Accuracy (Does my rhythm match the teacher's rhythm?)	1	2	3	4	5
2. Intonation (Am I in tune with my peers?)	1	2	3	4	5
3. Posture (Am I holding my instrument and sitting correctly?)	1	2	3	4	5
4. Bow Hold (Am I holding my bow correctly?)	1	2	3	4	5

Vita

Elizabeth Tedesco

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Education

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Musikgarten Family Music for Babies and Toddlers Certification

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Musikgarten Workshops, Greensboro, North Carolina

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Putnam music Center, Mahopac, New York

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Strings Teacher, specializing in violin and viola

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