The Short-term Effects of Music Therapy on Anxiety in Autistic Children

Erin Azbell, Teresa Laking

Faculty Sponsor: Betty De Boer, Department of Psychology

ABSTRACT

This study investigated the effects of rhythmic entrainment, a type of music therapy, on levels of anxiety in children with autism. Anxiety levels were monitored via frequencies of behaviors previously identified as anxiety-related by the residential facility serving the participants. Four participants were randomly assigned to either the treatment or control condition of a single-subject design. Treatment participants listenened to rhythmic entrainment music for 16 20-minute sessions over the course of four weeks. During this time, all participants continued their normal treatment plans provided by the facility. Behavioral frequency data were recorded before, during and after entrainment sessions and analyzed using descriptive statistics. Both treatment participants showed a decrease from baseline anxiety-related behavior frequencies during the treatment period, although this may have been a continuation of improvement due to facility-implemented treatment plans. Informal observations of immediate benefits merit additional investigation.

INTRODUCTION

Autistic individuals live in a different world than the rest of us. The input they receive from their environment—everything from sounds and tactile sensations, to more complex stimuli like speech and facial expressions—does not affect them in normal ways because they do not experience it or process it in normal ways. The prevalence of autism is on the rise; an estimate of 1 in every 2,500 births was considered accurate during the 1970's, but today's literature agrees on a rate of 1 in every 500 (Kabot, Masi & Segal, 2003).

Research on autism is plentiful, but its causes and progress are still poorly understood. The Diagnostic and Statistical Manual, 4th Edition (Text Revision) (DSM-IV-TR), the preeminent diagnostic guide to mental disorders, lists autism as one of several pervasive developmental disorders characterized by: impaired reciprocal social interaction; absent, odd, or severely delayed language skill and a restricted repertoire of interests and activities which are often repetitive (American Psychiatric Association, 1994). Research supports the theory that a dysfunction present in the growing central nervous system causes disordered development, which in turn leads to the many social and behavioral characteristics of autism (Waterhouse, Fein & Modahl, 1996). However, there is little agreement on the origin or nature of this causative dysfunction, or the roles genetics and environmental factors might play. Therefore, the ensuing sequence of neurological events and their relation to behavioral symptoms is largely unknown (Kusch & Petermann, 1995).

Autism and Anxiety

Autism has been linked with anxiety in a variety of studies. Wilcox, et al., (2003) reported a greater prevalence of anxiety disorders and obsessive compulsive disorders in families with an autistic person than families with either no autistic person or families in which a family member suffers from a different pervasive personality disorder. Tani, et al, (2004) found sleep disturbances in individuals with Asperger's syndrome, another disorder on the autistic spectrum, to be related solely to anxiety. Some researchers hypothesize that the high level of general anxiety experienced by autistic individuals is related to idiosyncratic responses to their environment. Information and sensory processing in individuals with autism tend to be inconsistent in addition to being abnormal, often creating intense confusion and anxiety (Berger, 2002). Problems with social functioning and communication create another source of anxiety—namely, other people—that is unavoidable in daily living. The attempt to understand speech or interpret a facial expression can be enough to produce an anxious state for many autistic children (Bellini, 2004). Persons with autism also often have difficulty controlling their emotions, so a minor trigger can easily lead to a major behavioral episode (Rose, 2004). Although treating anxiety is never simple, it is particularly difficult with autistic children due to the complex and seemingly inherent nature of their anxiety.

Treatment of Autism

The common goal of all autism treatments is to maximize the individual's independence in every area of life. This goal may be achieved by improving communication skills, reducing maladaptive behaviors or increasing adaptive ones (Freeman, 1997). However, before any learning or shaping of behaviors can take place, the child must be receptive to instruction (Cicero, 2002; Isawa, 2002). Anxiety is a major disruptor of daily activities for many children with autism and increases many interfering behaviors. Anxiety in social situations can decrease both the likelihood of communication and the ability to be instructed (Bellini, 2004). In addition, constant anxiety may also give the child a sense that he or she has no control over his or her emotions, decreasing well-being. Therefore, anxiety reduction is a crucial component of any autism treatment program. Because social interactions are often a source of anxiety for autistic individuals, treating their anxiety would be more effective if it could be done without direct social interaction; music therapy may provide such a technique.

Music Therapy with Autistic Clients

Music therapy has been proven to be effective in treating anxiety in many populations. A Chinese study showed that listening to calming music for just half an hour before an operation decreased both anxious feelings and physiological effects of anxiety (Yung et al, 2003). Another study showed that healthy adults can lower concentrations of stress hormones in their blood for as much as six weeks post-treatment with guided imagery and music therapy (McKinney et al, 1997). Numerous studies have documented the physiological effects of music on the brain. Music therapy—as opposed to pharmacological treatments of anxiety—is non-invasive, has no physical side effects, and can be implemented or discontinued without fear of interaction with other ongoing treatments. A meta-analysis of music therapies used to treat autism found that all music therapy had some type of positive impact on autistic symptoms (Whipple, 2004). Additionally, Heaton, et al (1999) found that individuals with autism can perceive emotion in music as well as individuals without autism, despite the difficulties they have processing and controlling emotion in their daily lives.

One technique that has shown promise is rhythmic entrainment. This phrase refers to the ability to affect certain biological rhythms with a rhythmic auditory stimulus (e.g. music). Several studies have found that certain motor activities and some types of brain waves are capable of being influenced this way (Safranek, Koshland, & Raymond, 1982; Thaut, McIntosh, Prassas, & Rice, 1992; Thaut, 2003). It is, therefore, theoretically possible to influence brain activity which may affect anxiety levels with rhythmic music. A case study found rhythmic entrainment to be effective in reducing anxiety-related disruptive behaviors of an autistic 11 year-old (Orr, Myles & Carlson, 1998). Rhythmic entrainment has the advantage of being simple to implement. Unlike other music therapy techniques, the facilitator needs no special knowledge of music or training in counseling. Also, it involves no direct interaction between the therapist and the client. Given the promise of this type of music therapy, we chose to examine the effect of rhythmic entrainment sessions on the frequency of anxiety-related behaviors in several children with autism.

METHOD

Participants and Setting

Four residents of a facility located in La Crosse, Wisconsin, ages 9-12, were chosen to participate in this study, two serving as controls for environmental effects and two serving as the treatment group. The facility provides residential care, specializing in treating children and young adults with developmental disorders. Studies of a small number of similar children, "single subject designs", are standard in the study of autism (e.g. Bellon, Ogletree, & Harn, 2000; Odom, Brown, & Frey, 2003; Yang, Huang, & Schaller, 2003). The participants, ages 9-12 at the time of the study, all have a primary diagnosis of autism and had lived at the facility for at least one year at the time of the study. All participants have significant difficulties communicating verbally; two are completely non-verbal and two exhibit minimal communicative speech. Please see Table 1 for a more detailed summary of participant characteristics.

Behavior frequency data for each resident are collected on a continuous basis as part of normal operations at this facility. Faculty use criteria specific to individual residents when collecting behavioral data. The unique behaviors exhibited by each resident when they are experiencing anxiety have been previously identified and defined by faculty at the facility. Anxiety-related behaviors for each participant included self-injurious behavior (SIB) and agitated disruptive behavior (AGDIS). Please see Table 2 for a listing of individualized definitions of behaviors monitored during this study. Facility faculty have also documented informally observed signs of a relaxed mood for individual residents. This type of behavioral information is included in the material given to new faculty,

in the hopes of helping to establish therapeutic rapport. For example, treatment participant 1 will kneel while rocking her torso back and forth in a rhythmic manner and smiling or giggling softly. Similarly, treatment participant 2 will arrange seating materials (e.g. carpet squares, bean bags, blankets) in a heap and use a stereotypic "nesting" motion to get comfortable. Informed consent was obtained from the parents of all participants and permission to conduct the study was also given by the facility's human rights committee before any data were collected.

Table 1. Participant characteristics

Participant	Gender, Age	Years at facility	Communication ability	General level of functioning
Treatment 1	female, 9	3.25	< 3 years[a]	1.5 – 5.0 years[d]
Treatment 2	male, 12	1.33	< 3 years[a]	2.0 – 6.3 years[d]
Control 1	male, 12	2.25	< 3 years[b]	pre-kindergarten – grade 4.5[e]
Control 2	male, 11	7.08	< 2 years[c]	1.6 – 5.0 years[d]

[a] AAMR Adaptive Behavior Scale, 2nd ed.
[b] Expressive One-word Picture Vocabulary Test
[c] Non-speech Test for Expressive Language
[d] Brigance Diagnostic Inventory of Development (revised)
[e] Brigance Comprehensive Inventory of Basic Skills

Table 2. Personalized behavior criteria

Participant	SIB	AGDIS
Treatment 1	bite wrist, head bang, hit self in head	loud vocalizations, climb on objects, crying, run around room
Treatment 2	head bang, hit self in head, hit arms against objects	yelling
Control 1	head bang, excessive licking of lips, biting lips	screaming
Control 2	head bang, bite arm, bite foot, hit self in head	screaming, crying

Materials and Data

As mentioned above, behavioral data is collected as a part of daily operations at this facility. Each resident has his or her own personalized data sheet which lists his or her specific target behaviors as well as the criteria to identify each behavior. This data is then stored by the facility and used to evaluate the effectiveness of treatment programs. We used this behavioral history in two ways. First, baseline behavior rates for all participants were obtained by analyzing the behavior frequency data collected by facility faculty over the past year (September 2004 through September 2005). Second, we obtained behavior rates both during and after the treatment period using this same method. In addition, the researchers monitored participants' behavior during each entrainment session. This allowed observation of changes in the participants' behavior frequencies, not only during entrainment sessions, but during the entirety of their waking hours. It should be noted that a single behavior is defined as any continuous exhibition of the defined action with no cessations over one minute in length. In other words, a resident must display the behavior, cease the behavior for at least one minute, and start displaying the behavior again before two behaviors would be recorded.

The rhythmic entrainment stimulus was provided by a CD recording of *Calming Rhythms 3* (Strong, 2005).

Design and Procedure

The study consisted of an introductory phase and a proactive phase. The introductory phase took place between September 26 and October 7, 2005. During the introductory phase, the specialized music was played for the participants as they were allowed to play in the facility's "sensory room". This room had modifications like textured carpeting on the walls, an underwater mural which glowed under black light, and a choice of dim lighting or black light illumination. It contained one partial wall and a wooden platform which created two mostly separated sitting areas. Two beanbag chairs, a video rocker and some carpet squares were available for the participants to sit on. The participants were allowed to move freely between the two areas of the room and allowed to adjust the seating options and the lighting to their liking. The participants were verbally prompted to "stay and listen to the music" or encouraged to sit with visual gestures but not barred from leaving the area so as not to provoke anxiety. The music

was played for 20 minutes per session for a total of eight sessions over the course of two weeks. The goal of this phase was to have participants associate the music with calm, relaxed feelings. Signs of relaxation which had previously been informally observed by facility faculty were noted in both treatment participants during this phase (refer to "*Participants and Settings*" for description).

The proactive phase took place between October 11 and October 27, 2005 and also consisted of eight 20-minute sessions. The participants listened to the specialized music during the first activity of the school day, a time that was noted to be a stressful transition period for most residents. This activity took place in the facility's "creative arts room" and was directed by the facility's creative arts teacher. Several toys were available to the participants after their completion of the art activity. This room was well-lit and contained one long table at which about five children could be seated comfortably. The participants, along with the other members of the class, were encouraged to attend to and participate in the activity in a manner consistent with their individual abilities. The goal of this phase was to reduce the anxiety caused by transition and routine requests before it escalated to the point where the participant was exhibiting anxiety-level behaviors. Both treatment participants attended to either the activity or the toys for a normal amount of time and did not seem anxious or distressed.

In both the introductory and proactive phases, the researchers observed treatment participant behavior during the entrainment sessions themselves and facility faculty continued recording behavior frequencies for all participants as per normal operations. We collected behavioral frequencies for both the control and the treatment group for the entirety of the treatment period. Due to the small sample size used in this study, analysis of our data was based primarily upon descriptive statistics. It is unlikely that inferential statistics would be of any added benefit.

RESULTS

Baseline Behavior Frequencies

Figures 1 and 2 show the frequencies of all four participants' anxiety-related behavior for the period from September, 2004 through September, 2005. Each point represents the respective participant's mean weekly frequency for that month (i.e. the total number of behaviors during the month divided by the number of weeks in that month). These data were averaged to obtain a baseline weekly frequency for each participant. This baseline frequency was then compared to the mean weekly frequency of behaviors for each participant during the treatment period.

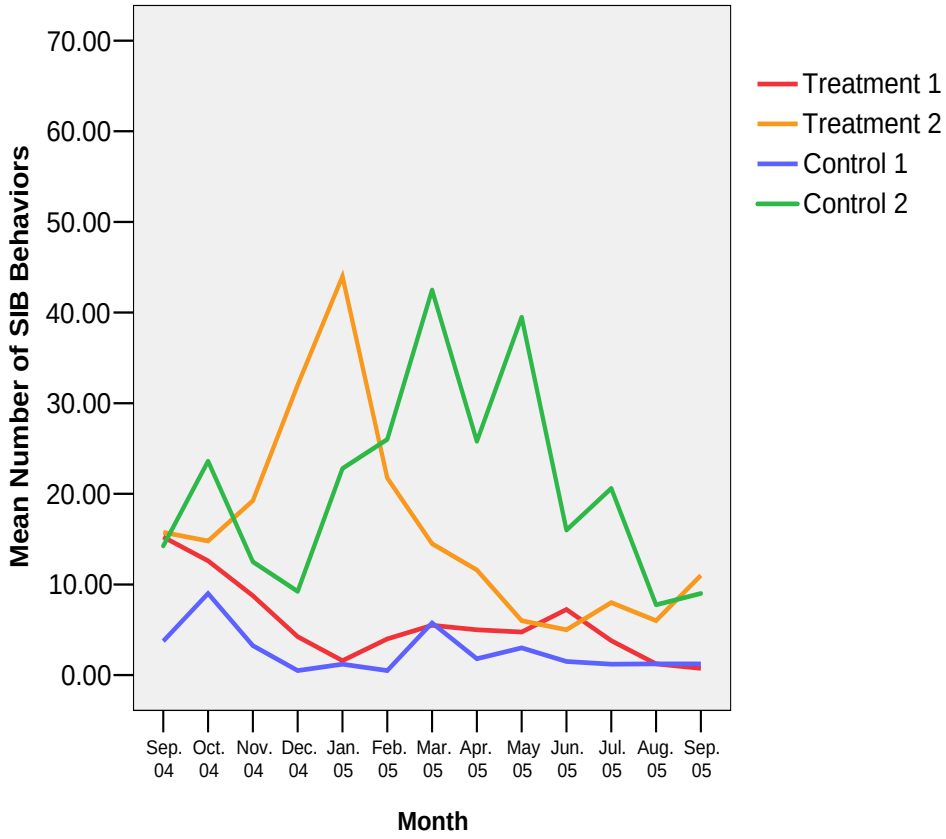

Figure 1. Mean number of SIB behaviors for each child during 13 months prior to treatment.

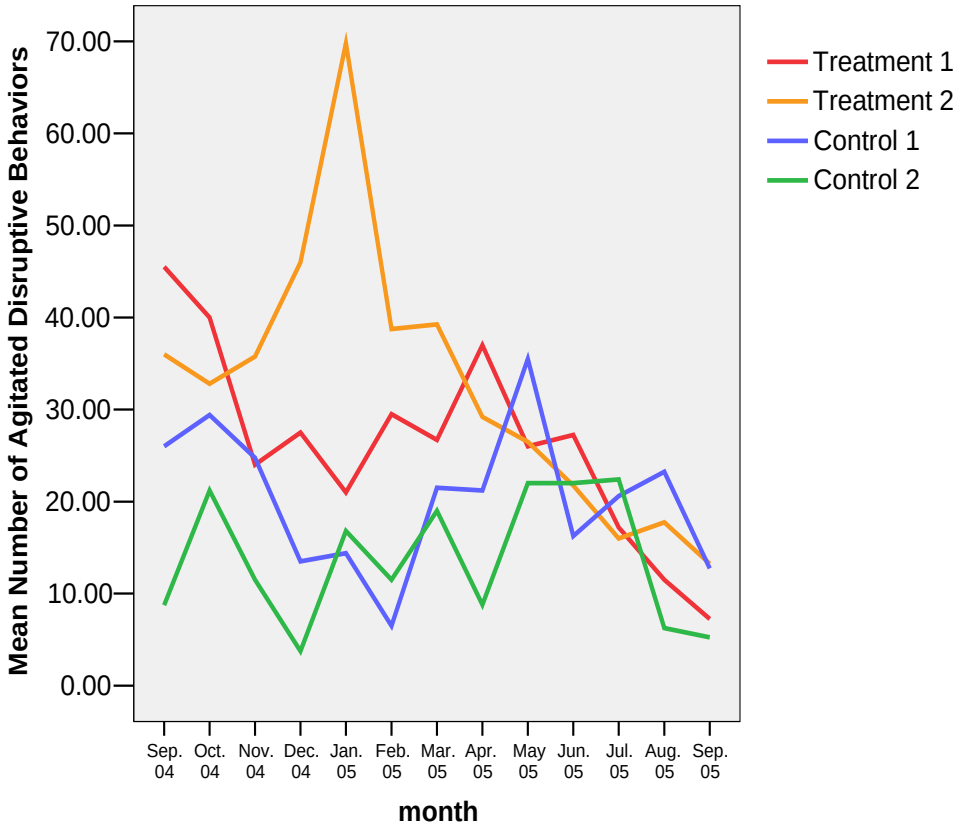

Figure 2. Mean number of agitated disruptive behaviors for each child during 13 months prior to treatment.

Mean Weekly Frequencies and Weekly Behavior Totals

Both participants in the treatment group showed a general decrease in both anxiety-related behaviors during the treatment period (see Table 3). The mean weekly frequencies of SIB and AGDIS were below their respective baseline frequencies for both participants. In addition, treatment participant 1 had weekly SIB totals which were below the baseline frequency during the entire treatment period and AGDIS totals below the baseline frequency during all but the last week of treatment (see middle panel, Figure 3). Similarly, treatment participant 2 had weekly SIB totals which were below the baseline frequency during all but the second week of treatment and AGDIS totals below the baseline frequency during the entire treatment period (see middle panel, Figure 4).

Our control participants showed less homogenous results. Control participant 1 showed no clear trend in either behavior, whereas control participant 2 showed a decrease in SIB accompanied by an increase in AGDIS (see Table 3). Control participant 1 had weekly totals lower than the baseline frequency for each behavior during two of the four weeks corresponding to the treatment period. SIB totals were lower than the baseline during the third and fourth week of the treatment period while AGDIS totals were lower than the baseline during the second and fourth week (see middle panel, Figure 5). Control participant 2 had SIB totals lower than the baseline during all weeks corresponding to the treatment period but had AGDIS totals higher than the baseline during all but the second week of the treatment period (see middle panel, Figure 6).

Table 3. Mean weekly frequency of anxiety-related behaviors

Participant	SIB			AGDIS		
	Baseline	Treatment	Change	Baseline	Treatment	Change
Treatment 1	5.75	1.4	-76%	26.2	18.6	-29%
Treatment 2	16.1	7.2	-55%	32.5	19.0	-42%
Control 1	2.6	2.6	0%	20.4	22.2	+8%
Control 2	20.7	9.6	-54%	7.0	10.4	+33%

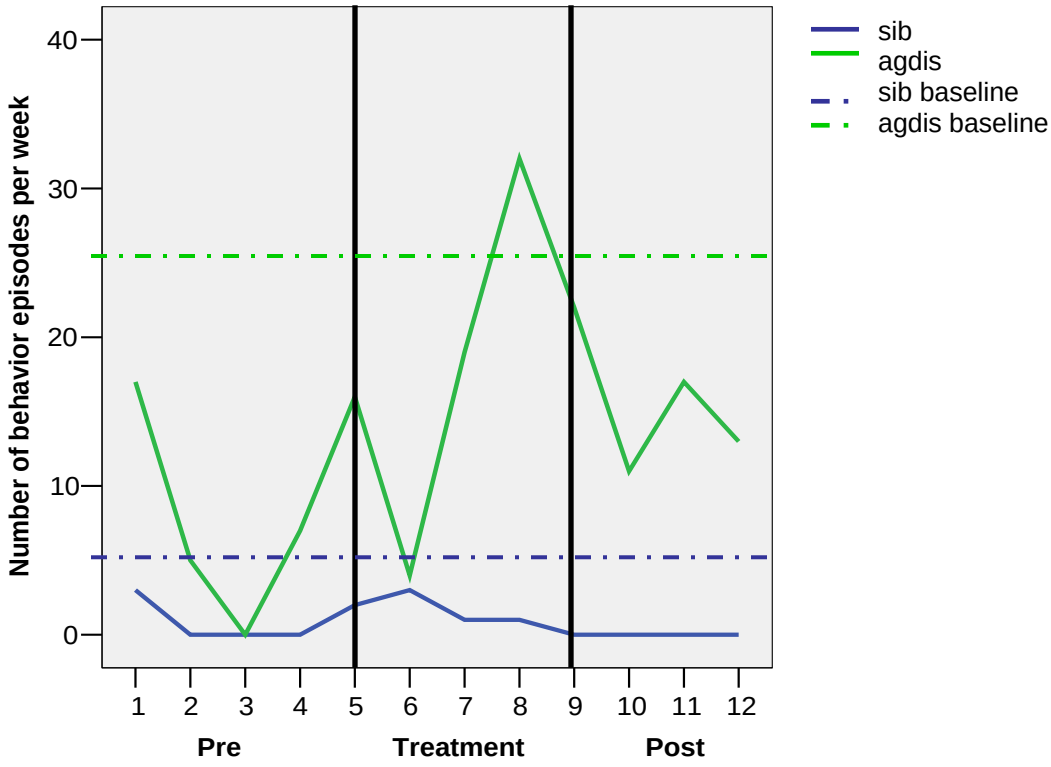

Figure 3. Weekly behavior totals for treatment participant 1 during, before and after treatment.

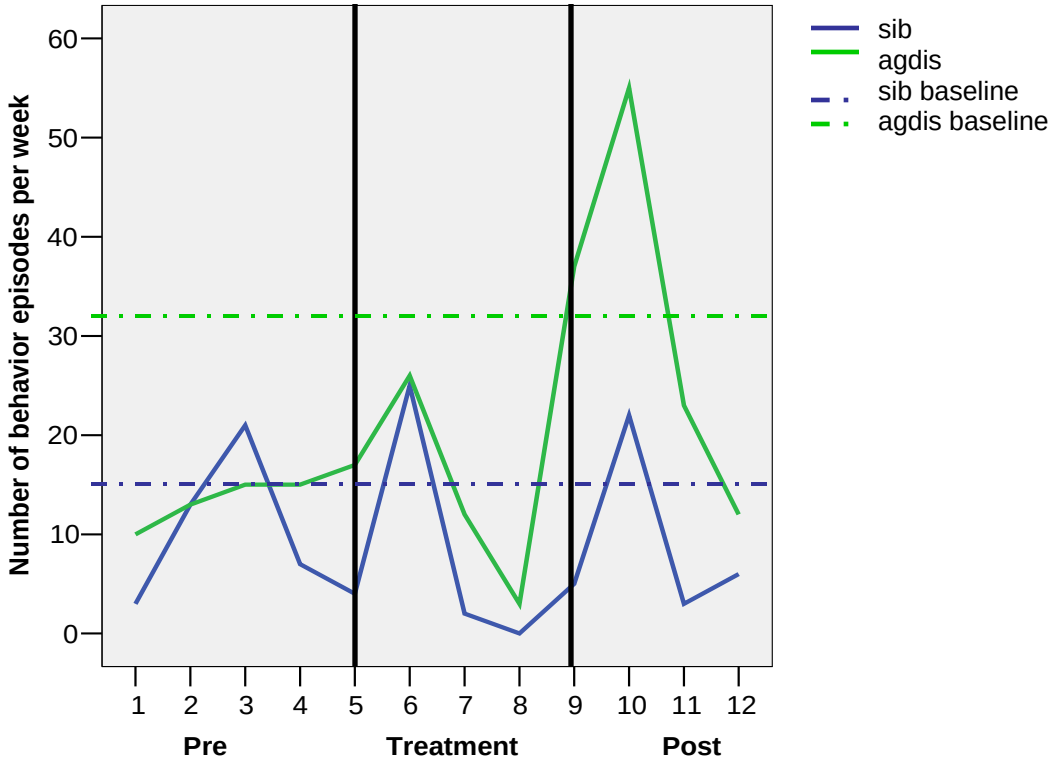

Figure 4. Weekly behavior totals for treatment participant 2 during, before and after treatment.

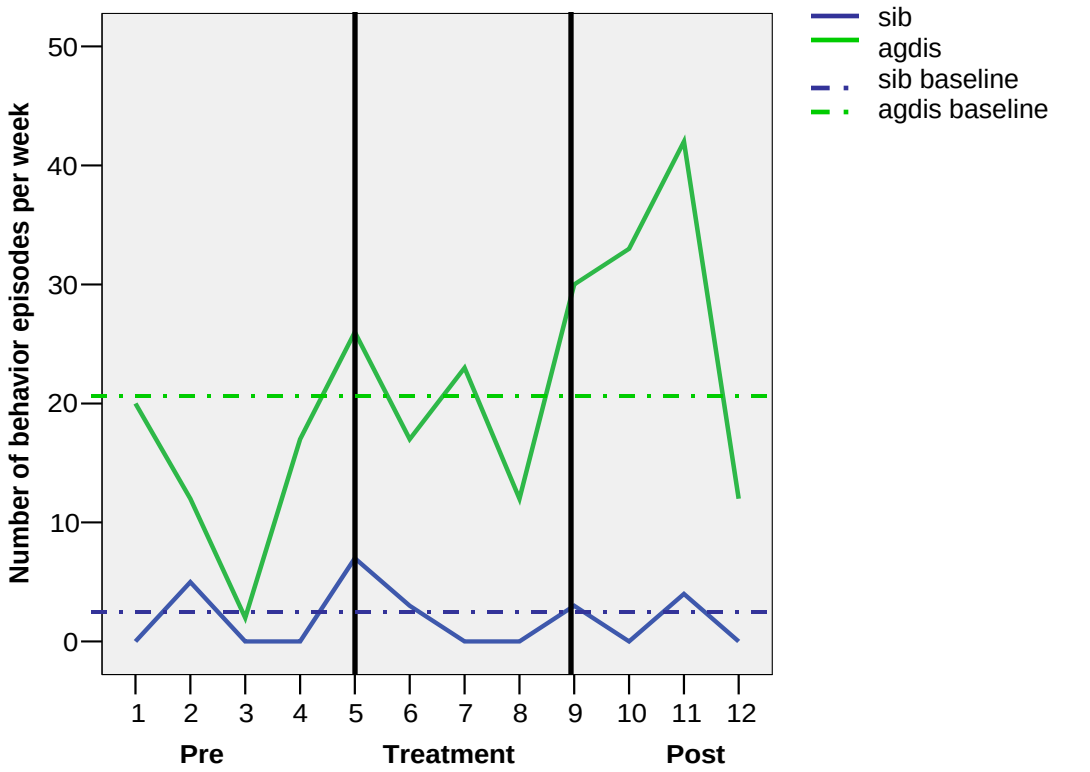

Figure 5. Weekly behavior totals for control participant 1 during, before and after period corresponding to treatment.

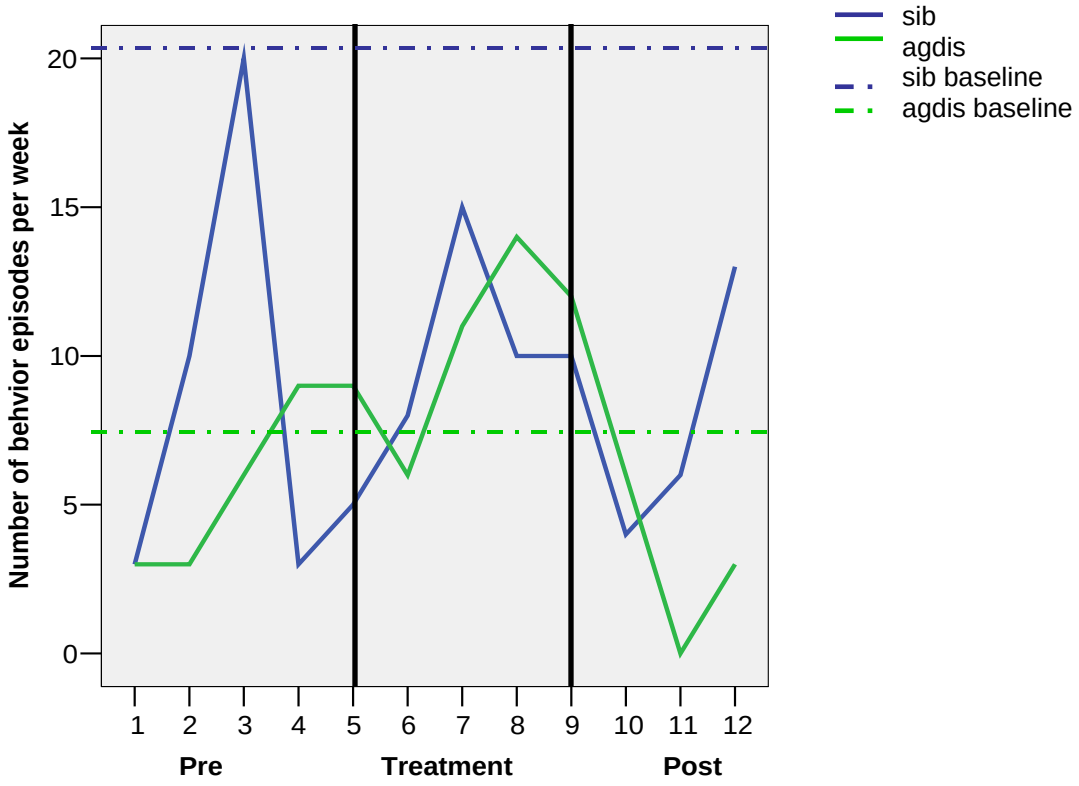

Figure 6. Weekly behavior totals for control participant 2 during, before and after period corresponding to treatment.

Variability of Behavior Frequencies

Range size of the treatment period was compared to that of the four weeks immediately prior to treatment (pre) and the four weeks immediately following treatment (post) for all four participants. Range sizes were calculated by subtracting the minimum weekly total for a period from the maximum weekly total of that same period. No clear trend emerged, as can be seen in Table 4 and Figures 3-6.

Table 4. Range size of weekly totals of anxiety-related behavior

Participant	SIB			AGDIS		
	Pre	Treatment	Post	Pre	Treatment	Post
Treatment 1	4	3	0	13	29	12
Treatment 2	19	26	20	6	24	44
Control 1	6	8	5	19	15	31
Control 2	18	11	10	7	9	13

DISCUSSION

The results of this study indicate rhythmic entrainment may reduce levels of anxiety in some autistic children. Evidence is stronger for immediate rather than lasting effects. We observed signs of relaxation which had previously been informally observed by facility faculty during several of the introductory phase entrainment sessions. In addition, both treatment participants attended well to familiar daily activities during the proactive phase entrainment sessions. However, our two measures of lasting effects—mean weekly frequencies and size of range of weekly totals—provided conflicting evidence. A general decrease from the mean weekly frequency of the past year occurred without a concurrent decrease in variability represented by smaller range sizes. Because our control participants also showed some decrease in mean weekly frequencies—albeit not to the same degree—it is difficult to say how much of our treatment participants' decrease in this measure was due to environmental factors. It should also be noted that all four participants showed a general downward trend in behavior frequency during the baseline period (see Figures 1 and 2). This is most likely an effect of the treatment programs provided by the facility which continued during the treatment period of this study. Therefore, our finding of decreased weekly frequencies without a change in range size may be the result of a continuation of this previous trend rather than a lasting effect of entrainment sessions. Nonetheless, observations of immediate benefits merit additional investigation.

Due to the ease of implementation and evidence of immediate effects, rhythmic entrainment may be an ideal supplement to treatment in residential facilities which are often under-staffed and under-funded. As past and present employees of a facility of this type, the authors can testify that successful activities are almost always those which require little or no special equipment and work within existing programs. Playing a CD satisfies both of these conditions. Rhythmic entrainment would most likely be best utilized as one of a wide array of options for daily anxiety-relief offered to the child with autism.

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