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Review

Searching for music's potential: A critical examination of research on music therapy with individuals with autism

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Abstract

The authors conducted a literature review on music therapy for individuals with autism because of the frequent use of music therapy for those with autism and recent research on the musical abilities of this population. To accomplish this narrative review, articles were searched from relevant databases, reference lists from articles, and book chapters to provide a thorough critique of past research, which was categorized according to the area of symptomology the therapy intended to treat (social, communicative, behavioral). Music therapists and researchers have carried out mostly case studies and a surprisingly limited number of empirical investigations. Although these reports provide limited empirical support of the therapy with this population, they have utilized a wide array of creative techniques and varying types of music therapy worthy of discussion. The qualities of necessary future empirical investigations are explored.

Keywords: Autism; Music therapy; Musical ability

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Contents

Many parents of children with autism report the effective use of music therapy (MT) with their children. Special schools for children with autism often have sessions with music therapists as part of the normal curriculum. In a postal survey study of the use and recommendation of MT for children with autism in Germany, researchers found that 56% of child psychiatrists and 14.5% of pediatricians recommended MT for the treatment of autism. Also, 25.1% of pediatricians considered MT useful for those with autism. These percentages are particularly impressive given the lack of empirical research support for MT (Evers, 1992).

The relatively high acceptance of such therapy with this population has coincided with several empirical investigations showing that individuals with autism may exhibit musicality (Applebaum, Egel, Koegel, & Imhoff, 1979; Bonnel et al., 2003; Foxton et al., 2003; Heaton, 2003, 2004; Heaton, Hermelin, & Pring, 1998, 2001; Mottron, Peretz, & Menard, 2000). Although it was originally thought that this superiority might reflect the contribution of a subset of people with savant skills, subsequent research has demonstrated unusually good pitch perception even in musically naïve people with autism. Indeed, some have suggested that musical ability is a fundamental component of autism (Hoelzley, 1993), and that ''astonishing musical ability is found in these children quite frequently'' (Rimland, 1964, p. 12).

1. Method

Given the acceptance and use of MT for individuals with autism, and the interest in their modes of processing music, it is important to review the scientific literature on the use of MT with this population to highlight the strengths and weaknesses of the field. Since the literature in the field is often in the form of the narrative case study (the pros and cons of which are later discussed), the form of this literature review is also deliberately narrative in nature so as to include the details necessary to evaluate and understand the therapy used. Although theoretical books with illustrative examples of MT for children with autism have

been published (see Alvin & Warwick, 1991; Berger, 2002), this paper is the first thorough narrative literature review of the field. Wigram (2002) presented a narrative account of several studies on MT and autism, but the author wrote that the literature review was not exhaustive. Whipple (2004) presented a meta-analysis of music used in intervention with children with autism, but the author included several studies where music was used in the broadest sense during therapy and not necessarily in the form of MT. The author also drew heavily from unpublished manuscripts and did not provide a narrative account of the studies. Also of note in this field is a recent Cochrane review on music therapy for those with autism (Gold, Wigram & Elefant, 2006).

Current MT research could inform not only future MT studies, but also investigations of musical and sound processing abilities of those with autism. This MT research may not be readily accessible to autism researchers. We hope to improve this situation by comprehensively reviewing the literature in this field. In searching for studies, we aimed to include all published studies on MT for individuals with autism. We located these articles using computer databases such as PsychINFO and Medline, reference lists from relevant articles, and books. Since MT is distinct from music education, studies that tended to focus on music education more than therapy were not included (see Wager, 2000) as well as studies that focused primarily on another form of therapy while using music (see Brownell, 2002). Auditory integration training, however, a controversial therapy where altered music is systematically used for intervention, is included in the present literature review even though some consider it more of a ''sound'' therapy than a form of ''music'' therapy. A more thorough reasoning for inclusion is discussed later.

2. Music therapy

In 1950, MT became a formalized area of research, study, and practice (Dileo, 2000; Peters, 2000; Van de Wall, 1946). In *Music Therapy: An Introduction*, Peters (2000) writes:

> ... music therapy may be defined as a planned, goal-directed process of interaction and intervention, based on assessment and evaluation of individual clients' specific needs, strengths, weaknesses, in which music or music-based experiences (e.g., singing, playing musical instruments, moving or listening to music, creating or discussing songs and music) are specifically prescribed... to influence positive changes in an individual's condition, skills, thoughts, feelings and behaviors (Peters, p. 2).

During the therapy, a client's increased musical abilities are usually by-products of treatment and are not direct goals. There are five types of MT. In practice, however, a music therapist may use a variety of types of therapy or a specific form that does not neatly fit into one of these categories. *Receptive* MT involves listening to live or recorded music that may elicit certain reactions or emotions in the client. *Compositional* MT involves the creation of original music by the client. *Improvisational* MT involves the therapist guiding the client to creating music spontaneously (Dileo, 2000; Peters, 2000). *Recreative* MT requires the client to learn how to play an instrument and then rehearse and perform a piece. *Activity* MT involves structured musical games set up by the therapist for the client (Dileo, 2000). The effectiveness of the therapy is mostly based on anecdotal evidence. There are very few

data demonstrating its efficacy. A critique of MT research pointed out the need for scientific testing of MT to design studies other than case reports, anecdotal accounts, and small group studies (Marwick, 1996).

3. Music therapy in the treatment of autism: current research

Despite immense creativity in the design of MT reports that have shown the effects of MT on the behaviors, socializations, and communication of those with autism, there are several consistent flaws in the research that will become apparent as the literature is reviewed. These studies and case reports are grouped into categories based on the area or areas of symptoms of autism that the therapy aims to target and are summarized in Table 1.

3.1. MT in the treatment of the social abnormalities of autism

Wimpory, Chadwick, and Nash (1995) used musical interaction therapy to increase the social participation, reciprocal interactions, and eye contact between one 3-year-old child and her mother. She participated in 20-min sessions of musical interaction therapy two times each week in her home for 7 months. To help the child anticipate the actions of her mother, the mother's motions were synchronized with the therapist's playing on the harp. The mother also imitated the actions of the child during the sessions. The researchers monitored the child's development of social skills outside of the sessions by videotaping semi-structured settings in the home six times over a 4-month baseline, seven times during 7 months of MT, and, after an additional 5 months of MT, a follow-up 20 months later.

Data were analyzed using a binomial test by establishing the significance of data during therapy when compared to the developmentally projected baseline data. The researchers reported some changes in social interactions, including a decrease in the amount of time it took the child to acknowledge the mother and an increase in eye contact and initiations of involvement with the mother. As stated in the paper, the researchers were unable to conclude how much increased socialization was due to MT and how much was due to the child's maturation during the course of the 2 years between study and follow-up (Wimpory et al., 1995).

Starr and Zenker (1998) used keyboard sharing during MT sessions to help increase the socialization of a 5-year-old male with autism. Their supposition was that the child would allow more human contact through the use of a shared instrument. At the start of sessions, the child would only allow 2 min of shared keyboard use with the therapist. After three MT sessions, the child played with the therapist on the keyboard for up to 9 min when the therapist played his favorite song. Researchers also reported that eye contact increased during the sessions. As they noted, the researchers failed to analyze these socializations outside of therapy sessions. They also failed to use any statistical analyses to evaluate the child's progress. The researchers only used two songs during therapy and noted that the child enjoyed the second song more and showed improved socializations during it. It would have been helpful if they had examined other songs to see if the single song that had a positive effect was an anomaly.

Table 1
Characteristics of studies on music therapy with individuals with autism

Author	Study		Participants		Therapy (type)	Outcome (area of symptomology addressed)
	Year	Design	*n*	Age		
Bettison	1996	Experimental, control groups	80	3–17	Auditory integration training	Social, behavioral, communicative
Edelson et al.	1999	Pair matched experimental, control groups	19	4–39	Auditory integration training	Social, behavioral, communicative
Edgerton	1994	Within subjects, ABA	11	6–9	Improvisational	Communicative
Gillberg & Wheeler	1997	Pre- and post-treatment within subjects	9	3–16	Auditory integration training	Social, behavioral, communicative
Griggs-Drane et al.	1997	Case study	1	Adolescent	Receptive, improvisational, activity	Behavioral
Hoelzley	1993	Case study	1	6	Activity, melodic intonation therapy	Communicative
Hollander & Juhrs	1974	Experimental group	30	4–16	Activity, improvisational, group	Social, behavioral, communicative
Keats	1995	Case study	1	40	Improvisational	Social, communicative
Mahlberg	1973	Case study	1	7	Improvisational, activity	Social, behavioral, communicative
Miller & Toca	1979	Case study	1	3	Adapted melodic intonation therapy	Communicative
Mudford et al.	2000	Crossover	16	5.75–3.92	Auditory integration training	Social, behavioral, communicative
Orr et al.	1998	Case study	1	11	Rhythmic entrainment	Behavioral
Ricketts	1976	Case studies	2	4, 9	Improvisational	Social, behavioral, communicative
Rimland & Edelson	1994	Experimental, control groups[a]	445	4–41	Auditory integration training	Social, behavioral, communicative
Rimland & Edelson	1995	Experimental, control groups	17	4–21	Auditory integration training	Social, behavioral, communicative
Saperston	1973	Case study	1	8	Musical synchronization	Social, communicative
Starr & Zenker	1998	Case studies	3	4–6	Improvisational, activity, musical synchronization, behavioral	Social, behavioral, communicative
Wimpory et al.	1995	Case study	1	3	Musical interaction therapy	Social
Wimpory & Nash	1999	Case study	1	[b]	Musical interaction therapy, musical synchronization	Social, communicative
Zollweg et al.	1997	Experimental, control groups	30[c]	7–24	Auditory integration training	Social, behavioral, communicative

[a] Control group from 1995 study with 9 participants used since all 445 participants in this study were in an experimental group, using various AIT devices and different filtering conditions.
[b] Not reported.
[c] Only 9 of the 30 participants in this study had a diagnosis of autism. The other 21 were had a diagnosis of "cognitive impairment."

3.2. MT in the treatment of the behavioral abnormalities of autism

Starr and Zenker (1998) also presented the case report of a 6-year-old boy with autism who was verbal and high functioning, but exhibited major problems with changes to his routine and waiting in line. The therapist intended to decrease the child's anxiety and aggression due to change by enabling him to wait more easily in the classroom. Starr and Zenker used an original song, ''Line up,'' to help the child understand the need to wait before leaving the classroom. The therapist used visual cue cards, showing the various steps of waiting, to show the child what he was expected to do during each part of the song. He listened to the song on the way to school in addition to during MT sessions. During therapy sessions, his anxiety and aggression associated with waiting decreased, as assessed by the therapist on a subjective scale. As stated in the study, the researchers should have analyzed the child's behaviors outside of therapy to see if the child's improvement generalized.

Griggs-Drane and Wheeler (1997) had a blind, female adolescent with autism listen to various musical theatre, children's, rock, folk, country, and originally composed songs; sing along to music; and play instruments to lessen her self-destructive behaviors. Researchers used the music with functional assessment charts to document which types of music were most effective. A decrease in destructive behaviors was noted during the sessions, but was not statistically analyzed outside of or during sessions.

Orr, Myles, and Carlson (1998) used rhythmic entrainment to lessen headjerking and screaming in an 11-year-old girl with autism. Entrainment was defined by the researchers as ''us[ing] music to aid in relaxation by introducing externally produced rhythms that are specifically designed to re-entrain the body to its natural rhythmic patterns'' (Orr et al., p. 163). Therapists used music at 50–60 beats/min to increase alpha waves, those responsible for relaxation. Researchers analyzed 30 days of data utilizing an ABAB design, with alternating baseline and musical intervention periods. Researchers analyzed the child's headjerks and screaming during the first 20 min of class during both conditions. The average number of screams and headjerks on days with therapy was lower than that of baseline days.

As with preceding work with one participant, the generalizability of the work of Orr et al. (1998) is questionable. It is also unfortunate that researchers only recorded the participant's behaviors during the set 20 min period each day and failed to use statistical measures to analyze these results. Since the participant often exhibited a wide frequency of headjerks and screams during the specified time period, it would have been helpful if the researchers had surveyed the frequency of these occurrences outside of the set period of time.

3.3. MT in the treatment of the communicative abnormalities of autism

Miller and Toca (1979) used melodic intonation therapy with a 3-year-old, nonverbal male with autism. In melodic intonation therapy, therapists use simple melodic fragments to intone short phrases and sentences. As they sing to clients, the therapist taps the rhythm of the words on the client's body. The goal of therapy is to intone speech so that the clients' understanding of spoken language increases and to guide the clients to intone their own

words and phrases. Therapists expect the intoned utterances to lead to nonintoned speech. Sessions started out by teaching the client manual signs combined with tones. The therapist taught him to imitate the signs. The child then began speaking words in and outside of therapy sessions. After 35 sessions, he started to combine words and could respond to intoned questions or statements. After the study, he continued with intoned therapy sessions on a daily basis. He could produce up to four words together in an intoned fashion to make sentences and began to understand and respond to nonintoned questions. While the results of this study were very encouraging for the one participant, the researchers failed to include a quantitative analysis of the changes in the child's communication.

Hoelzley (1993) hypothesized that novel sounds, those in a register different than that of speech, like those of a brass instrument, would bring about communicative increases in children with autism. The author hypothesized that sounds outside the realm of those that the child usually encounters would break down the resistance to communication to elicit positive, imitative responses. Hoelzley provided a case study of one 6-year-old female with autism who mimicked the trombone with low, grunting noises. During sessions with the therapist on a trombone, the girl's grunts led to speech-like vocalizations on pitch after the therapist continually sang sentences using the melodic fragments played on the trombone. The client eventually sang words. A year later, the child could speak the phrases that she had sung. Hoelzley, however, failed to acknowledge the possibility of the natural development of the child's speech during this period of time, not influenced by therapy.

Edgerton (1994) conducted a study using one-on-one improvisational MT with eleven children with mild to severe autism, ranging in age from 6 to 9. The clients participated in therapy for a half-an-hour each week for 10 weeks. This comprehensive study analyzed communicative improvements inside and outside of therapy with the communicative responses/acts score sheet (CRASS). During sessions, the therapist utilized the piano, snare drum, and cymbal to create nonverbal improvisational communication between the child and music therapist. CRASS scores were taken for each child during a 10-min interval randomly selected, through time interval sampling, prior to each therapy session. After the study, speech therapists, parents, and teachers rated the communicative, social/emotional, and musical behaviors of the children on the behavior change survey. The general scheme of therapy consisted of intervention followed by one session of withdrawal and then intervention. During intervention, the therapist played improvised music to the child, and the child would play back based on the approach of creative MT (see Nordoff, 1972; Nordoff & Robbins, 1964, 1968, 1977). During the withdrawal session, the therapist played and sang composed music. The CRASS scores of all eleven children consistently rose during intervention, fell during withdrawal, and rose again during intervention. All individual scores on the CRASS were higher after the last session than after the first session. Using a Wilcoxon matched-pairs signed ranks test, the researchers showed that the scores of the last session were significantly higher than those of the first. The behavior change survey indicated "no change" to a "slight change" in each of the children.

The Edgerton study is unique in its number of participants and "objective methods of control, observation, and data reporting" (Edgerton, 1994, p. 51). Many music therapists would argue that since MT is individually tailored to a client, the case study is the ideal way to measure success. This empirical investigation shows that such studies can effectively take place in the field without diminishing the individual nature of the therapy.

Starr and Zenker (1998) used MT with a child with autism to try to increase his language skills and appropriate use of first person pronouns because he exhibited echolalia and pronoun confusion. He participated in six to eight one-on-one, 30 min MT sessions each week. The therapist used activity MT to create a musical game entitled, ''Beat that drum.'' The therapist spoke to the child using pronouns properly and rewarded the child with the drum each time he imitated the therapist and used pronouns correctly. With this behavioral therapy, the child used the ''I'' pronoun more frequently and used longer sentences, but the researchers failed to assess the participant's performance outside of therapy.

3.4. MT in the treatment of the social and communicative abnormalities of autism

Saperston (1973) conducted a study of an 8-year-old male with autism, who participated in half-an-hour improvisational MT sessions three times a week. The therapist accompanied the child's individual movements with different gestures on the piano. For example, music ceased when the client stopped moving, and the therapist played a low G when the client stepped with his left foot and a high G when the client stepped with his right foot, or a tone cluster when the child stomped. As the client became increasingly aware of his ability to influence the music played, the client began to smile at and make eye contact with the therapist. Session length increased from 7 to 30 min of activity, and the client began to sit next to the music therapist at the start of a session. The client also greatly increased his amount of eye contact and began to vocalize frequently. He also generalized the ability to interact with people outside of therapy sessions. Unfortunately, Saperston failed to substantiate many of his results by not quantifying and statistically analyzing the client's increased socialization and communication even though the data collection in the study could have made this possible.

Keats (1995) described 18 months of MT sessions conducted with a nonverbal, 40-year-old male with autism, severe hearing impairment, and limited vision. The participant used finger spelling to communicate. The therapist set up four music-making stations, each with percussive instruments and different mallets, to use rhythm as a nonverbal means of communication. Station one, ''Hello,'' consisted of an alto xylophone, melodic cowbells, a triangle, a conga drum, and temple blocks. The sessions started here with a musical conversation between client and therapist that usually increased in rhythmic complexity. Most improvisations were based on the pentatonic scale. Station two, ''How are you today?,'' utilized the drums, a cowbell, and a cymbal to encourage socialization. Their playing was a full body experience that depicted the client's emotions with dynamics and accents. Station three, ''What's new,'' consisted of a basic drum set that the therapist taught the client to play. Station four, ''Let's jam,'' involved a concert size marimba with a gong and cymbal and enabled the client to express his creativity and imagination. Keats stated that the client enjoyed himself as he and the therapist took turns soloing through improvisation. This study unfortunately lacked an analysis of the client outside of therapy sessions and any quantification of the client's socializations and communication.

Wimpory and Nash (1999) used the previously mentioned musical interaction therapy to increase the communication and socialization of a girl with autism. For 4 months, researchers videotaped the mother and daughter's interactions to establish a baseline. For 7 months after the baseline, the child underwent MT twice a week at home to increase the

child's interactions with her mother. Therapy involved lap play, play routines, and songs to increase tactile interactions between mother and daughter. The therapist provided music to accompany the interactions between mother and child and to help the child to anticipate the mother's actions. During therapy, the child and mother exhibited increased eye contact, communication, pretend play, and socialization. The client also increased her pretend play and the frequency of initiating pretend play with her mother. Researchers claimed that the therapy also had an effect on the relationship between mother and child outside of therapy by increasing their communication and socialization. After 7 months of monitored therapy, therapy continued for another 5 months in an unmonitored fashion. A 20-month follow-up, a rare and necessary inclusion in this field, revealed that many of the positive effects of the musical interaction therapy remained.

3.5. MT in the treatment of the social, behavioral, and communicative abnormalities of autism

Mahlberg (1973) created a daily MT plan for a 7-year-old boy with autism who was prone to tantrums, did not pay attention to noises, had significant speech deficits, displayed social avoidance, pinched himself, and was hyperactive. The therapist used a tambourine to create a rhythmic pattern with speech to teach nonverbal communication, used clapping with and without music and imitation in songs to increase his attention span, and had the child march and dance in tempo with music to lessen maladaptive behaviors. The therapist used songs to help the child gain greater awareness of his body. The child eventually learned some words and exhibited increases in socialization by sitting on the therapist's lap during sessions and beginning to relate to the therapist.

This study is a first attempt at using MT to treat a large range of symptoms of autism. This study lacks a methodical means of evaluating the client's performance and has biased outcome measures that relied solely on the therapist's observations. The study also lacked proper follow-up and any observations outside of therapy sessions.

Hollander and Juhrs (1974) conducted a study using the Orff–Schulwerk treatment method to increase social, communicative, and behavioral symptoms of autism in thirty 4–16-year-olds with autism. Based on humanistic therapy, the Orff–Schulwerk method uses music set to the tempi of body movements and speech to elicit responses in children with autism. To express themselves, the children used instruments, including percussive types. Therapists also used the instruments and sign language to develop language skills during the therapy sessions three times each week. To bring about behavioral changes, the therapists taught the children rhythmic motions to replace their ritualistic ones. The children also played with instruments to improve fine motor coordination. To increase social skills, the children interacted with and imitated one another in groups of four to six. As these relationships developed and imitations increased, the children's awareness of other maladaptive behaviors increased, and rates of these behaviors then decreased in all children.

Like the Mahlberg (1973) study, the Hollander and Juhrs study attempted to address a wide range of symptoms of the child with autism yet did not fully implement adequate controls. For one, the study simply states observations of the results of therapy and failed to calculate the statistics associated with this presumed progress of the children due to the

therapy. The study also does not address the children's progress outside of the classroom or contain a follow-up.

Ricketts (1976) used improvisational MT with two boys with autism whom he described in case reports. The first was a 4-year-old who exhibited ritualistic behaviors by constantly arranging objects. Although he could produce high pitched sounds, he exhibited neither functional speech nor eye contact. After 3.5 years of improvisational MT, the child started making eye contact, speaking with a vocabulary of 50 words, responding to simple sentences, and playing games. The second boy described was 9 years old and had perfect pitch and excellent musical abilities. He spoke with short sentences and exhibited maladaptive behaviors. After 6 years of improvisational MT, although his behaviors remained "bizarre," he reached a high enough level of function to go to a music conservatory where he played violin and piano and composed music (Ricketts, p. 587). In these two suggestive and brief cases studies, Ricketts failed to describe the details of and devices used during the improvisational MT sessions.

Ironically, auditory integration training (AIT) is the most empirically researched area of MT for those with autism and is also the most controversial due to the claim by Stelhi (1991 as cited in Rimland & Edelson, 1995) that her daughter with autism experienced dramatic emotional and cognitive improvements after just 10 h of AIT. Of the six published empirical investigations on AIT for those with autism, all summarized in Table 1, Rimland and Edelson (1994, 1995) and Edelson et al. (1999) reported the potential benefits of AIT, and Bettison (1996), Gillberg, Johansson, Steffenburg, and Berlin (1997), Zollweg, Palm, and Vance (1997),[3] and Mudford et al. (2000) failed to find positive effects from AIT. This review critiques the most recent investigations of both sides of this controversial therapy.

Edelson et al. (1999) produced an empirical study of the effects of AIT on people with autism. Comprised of twenty half-an-hour sessions, AIT involves the listening to machine "modulated" music on headphones by participants. The researchers describe "modulation" as using

> wide band filters to attenuate the volume of a specific frequency range. The onset and duration of the modulated stimulus is determined randomly by the AIT device. At one moment, the volume of the frequencies between 20 Hz and 1000 Hz may be attenuated; at another moment, the volume of the frequencies at 1000 Hz and higher may be attenuated. An analogy would be rapidly switching the output of a hi-fi stereo between treble and bass at random intervals. The attenuated sounds vary in duration from 0.250 to 2 s (Edelson et al., p. 73).

Attenuation eliminates certain frequencies that may be particularly troubling to those with autism. AIT was once used exclusively for people with autism with sound sensitivity, and previous studies showed effectiveness in this area (Rimland & Edelson, 1994). Other studies showed that AIT might also increase the language comprehension and cause behavioral changes in individuals with autism (Rimland & Edelson, 1995). One leading theory of how AIT works is that modulated music catches people's attention better than conventional music due to the constant changes in frequency of the altered music. This

[3] Only 9 of the 30 participants in this study had a diagnosis of autism. The other 21 were had a diagnosis of "cognitive impairment."

process inspires greater attentiveness to the music. The claim of the therapy is that this attentiveness may generalize to one's environment and lessen maladaptive behaviors.

The Edelson et al. study (1999) used surveys filled out by participants' guardians to assess behaviors that were exhibited by the nineteen participants with autism, ranging in age from 4 to 39 with a mean age of 11.58 years. Clients, seventeen males and two females, were placed in either the placebo or experimental group. The placebo group listened to music on headphones two times a day for 30 min during 10 consecutive days. The experimental group listened to modulated music two times a day for 30 min during 10 consecutive days. Previous studies had shown that the results from AIT were present within 3 months post-therapy (Rimland & Edelson, 1994). Guardians and parents of the individuals with autism in the experiment filled out behavioral surveys regularly after the experiment. At 3 months post-therapy, results on the Aberrant Behavior Checklist, revealed a significant difference between the placebo and experimental groups. There were no differences between groups on the Conner's Rating Scales, which evaluate hyperactivity and social behavior, and the Fisher's Auditory Problems Checklist.

The empirical nature of the Edelson et al. study is unique in the field of MT and autism. The investigators, however, failed to see if the positive effects of the AIT lasted after 3 months. The researchers also did not include details of the music used. Without this information, the placement of this controversial therapy in the area of MT is further complicated. It would be helpful to know the type of music used during AIT, particularly in response to the criticism of those who may argue that AIT is not a form of MT.

Responding to the work of Rimland and Edelson (1994, 1995), Mudford et al. (2000), conducted a similar study that detected no behavioral benefits for individuals with autism after AIT. Sixteen children with autism listened to modified music on headphones for two 30-min sessions two times a day for 10 consecutive business days. Before the withdrawal of five participants from the study, the mean age of the seventeen male and four female participants was 9.42, and all attended special schools. The researchers utilized a within subjects design where all children experienced AIT and baseline conditions, with at least 4 months between them. Seven children started with the AIT condition, and nine children began with baseline, during which participants wore headphones, but did not hear anything through them. Parents, teachers, and the researchers filled out behavioral questionnaires for each child before, during, and after the experimental and control conditions. The parents and teachers used the Aberrant Behavior Checklist and the Nisonger Child Behavior Rating Form Hyperactivity.

Mudford et al. (2000) analyzed 14 months of data and did not replicate Rimland and Edelson's findings (1994, 1995). According to the parent ratings on the Aberrant Behavior Checklist, a significant reduction in maladaptive behaviors took place during baseline. Parental ratings on the Nisonger Child Behavior Rating Form Hyperactivity revealed that scores for poor behaviors were more reduced during baseline than during AIT. Researcher observations of inappropriate behaviors showed that maladaptive behaviors involving the ear actually increased after AIT. Mudford et al. argued that AIT could be dangerous for children and could create false hopes in parents. Mudford et al. also criticized Rimland and Edelson's (1995) design where families had to pay for the treatment and travel and hotel expenses. The parents were thus not blind to treatment type, and the financial demands could have influenced them to view the therapy in a positive light in addition to the

possibility of experimenter expectancy effects (Kazdin, 1998 as cited in Mudford et al.). In the Mudford et al. study, researchers paid all costs for participants, and parents were blind to the order of therapy conditions in which the child participated.

Like the Edelson et al. (1999) study, Mudford et al. (2000) tested multiple participants in an empirical study with a control group. Such characteristics are not often found in research in this area. The researchers failed to elaborate on the musical stimuli used during therapy. Mainstream music therapists often consider AIT a form of ''sound'' therapy, distinctly different from mainstream MT. The writing on AIT, however, reports that music is used in a systematic way for the purpose of intervention. This music, however, is neither defined nor discussed, and it certainly should be. From what the AIT researchers report, however, it does seem logical that AIT be considered a form of MT as it is defined in this literature review. This classification would be greatly strengthened with the identification of the exact music used during therapy. The researchers noted another weakness of the design was the lack of music during the control period. Previous studies (Bettison, 1996; Rimland & Edelson, 1995; Zollweg et al., 1997) used unmodified music for the control condition. The crossover design of the present study, however, did not allow for such music to be played because the Society for Auditory Intervention Techniques advises against the playing of music through headphones after experiencing AIT (Society, 1999 as cited in Mudford et al).

A Cochrane report (Sinha, Silove, Wheeler, & Williams, 2004) summarized the findings of all of the AIT studies mentioned in this review and reported the need for more systematic research in the field to resolve its controversy.

4. Discussion

The preceding critique of the current literature shows that MT has been used to address and alter activities in areas where individuals with autism are particularly deficient including behavior; sensory and motor skills; language and communication; interpersonal skills and abilities to express themselves; and self-help and survival skills. Therapists have utilized several different types of MT with their clients with autism including: adapted melodic intonation therapy, AIT, rhythmic entrainment, improvisational MT, musical synchronization, musical interaction therapy, activity MT, and receptive MT.

Music therapists and researchers of MT need to reflect upon past research to improve the consistent flaws in the literature. While the research with more than one client may lack the detail of a case study, it is much more generalizable than a case report that only notes changes in a single participant (Marwick, 1996). Of the work reviewed in this paper, with the exception of the AIT studies, all but two of the pieces of research were case studies, and one of these investigations with more than a single participant contained no formal analyses of the results (Hollander & Juhrs, 1974). Music therapists have argued that only case studies are appropriate since the treatment schedules are individualized for each client, and thus, the same regimen cannot be followed during therapy for several participants in a study. Researchers, however, can account for these subtle differences in therapy in sound empirical designs, which have not yet taken place in this field. Other forms of individualized therapy (cognitive behavioral therapy, for example), have been

empirically researched. It is also important that changes that may occur during therapy are monitored outside of therapy sessions and during follow-ups after formal sessions. Studies also need control groups. Additionally, MT is no different than any other scientific area of research in its need for statistical analyses to test the significance of any improvements of individuals with autism. It was disappointing to see the number of reports on MT and autism that included no statistical analysis, necessary for the MT field to make the claim that its work is advantageous to the population with autism. It is dangerous to assume that MT may not bring about negative side effects. Since individuals with autism often exhibit hyperacusis, it certainly is conceivable that MT could have a negative effect for some as has been argued in Mudford et al. (2000) in reference to AIT. MT must undergo the same scrutiny as other therapies. In the AIT studies, it is imperative that the specific music used is reported. Although all elements of therapy reported in the study are in line with the definition of MT, the reporting of the music used during therapy would be helpful to sharpen this classification of AIT as a form of MT.

In evaluating the performance of the clients, rater bias may play a large role in many of the studies assessed because the clients were not evaluated blindly by a second rater to confirm the reports of the therapists, naturally biased in their assessments. This factor was unfortunately the case with Edgerton (1994), the other non-AIT multiparticipant study in this review. Finally, there is a large void in the literature of studies with comparative outcome designs to see how MT compares to other forms of therapy used to treat those with autism. Although some existing research compares the effects of MT to the absence of therapy, more work of a comparative nature is still needed in this area.

Gold, Voracek, and Wigram (2004) carried out a meta-analysis of eleven empirical investigations of MT for children and adolescents with highly varied psychopathology. Furthermore, conditions treated were extremely varied and included sexual abuse, emotional handicaps, developmental delays, and autism. Other studies in this field were excluded if they did not meet the authors' strict criteria including addressing the effects of music only (not used in a therapeutic fashion) or music education, only having one participant, and using MT with another form of therapy and not clearly stating the effects of the MT alone. Of these eleven studies, only one concerned child with autism (Edgerton, 1994). When the authors analyzed the overall effect size of the studies, the Edgerton study had to be removed because it was an outlier potentially due to its outcome measure by the therapist only. So, unfortunately, the Gold et al. meta-analysis effect size did not include a study on children with autism.

The researchers established that MT exhibited a highly significant, medium to large effect on outcomes. Based on other analyses, the authors suggested that eclectic forms of MT, borrowing from various types and models, are most effective with children with psychopathology. Although the outcome of the meta-analysis is promising, the authors commented on the small number of studies used in this first summary investigation of MT for this population. Like this literature review, Gold et al. also commented on the need for more empirical research of MT with unbiased and controlled paradigms to answer the questions of what types of therapy are most effective to achieve a specific outcome with a client. These future studies and concurrent investigations on the music and sound processing of individuals with autism will hopefully shed light on the effectiveness of MT for individuals with autism.

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