

Auditory Stimulus for Children With High Functioning Autism: Towards Reducing Developmental Disorders and Inattentive Attitudes

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Abstract: Preliminary findings in several works have described that children with high functioning autism frequently show hypersensitivity to auditory stimulus. We seek the answer by using auditory stimulus interventions in our time series research. Interventions were assigned alternately to weekly 30 minutes learning session each for musical auditory stimulus followed by musical songs auditory stimulus for 8 weeks without washout period. The aim is to detect trends such as reductions in developmental disorders and inattentive attitudes among participants. Targeted variables for developmental disorders are responsiveness in language, social, cognitive, and emotion. Cognitive and emotion responsiveness are included as a new variables which has not been reviewed by any of the authors referred to. The participants are 5 boys (mean age 12.2 years) with a primary diagnosis of HFA and students of special education programme for children with autism conducted by The National Autism Society of Malaysia (NASOM). The result shows that musical songs auditory stimulus is more beneficial to children with high functioning autism in reducing their developmental disorders with the highest responsiveness both in language and cognitive variables. The same stimulus is also regarded as the more valid intervention in measuring the participants' attentive attitudes by showing a 43 percent reduction with a ratio of 1 in musical auditory stimulus equal to 2 in musical song auditory stimulus. Nevertheless, both interventions cannot reduce the autistic aloneness, a deficit in the social skill of children with high functioning autism. A possible beneficial future study on the effect of musical songs auditory stimulus in children with Rett syndrome is strongly suggested.

Key words: musical auditory stimulus, musical songs auditory stimulus, high functioning autism, developmental disorders, inattentive attitudes.

INTRODUCTION

High functioning autism (shortened to HFA) is a made-up term that has become more and more commonly used. They are just descriptive terms to help parents and teachers better understand a child's status on the autism spectrum. The autism spectrum describes a set of developmental delays and disorders which affects communication, social, motor skills and, to a greater or lesser degree, avoidant behaviours. HFA is a tricky term, because it can be hard to distinguish a person with HFA from a person with Asperger syndrome. The official distinction is that people with HFA had or have speech delays, while people with Asperger Syndrome have normal speech development (Rudy, 2011).

Approximately twenty to thirty percent individuals with autism are of normal intelligence with a full scale IQ 70 or above, possess some language and communicative abilities and are considered high functioning (Fombonne, 2005, 2006; Speirs *et al.*, 2011). High functioning autism participants appear to possess automatic lexical access processes. However, the nature of the input processing on which their lexical access is based differs from that of the typically developing and Asperger's disorder groups (Speirs *et al.*, 2011). Adams *et al.*, (2001) mentioned that children with HFA are challenged by autism's core deficits but with variations. They may have a great vocabulary and can talk, but they can't truly share experiences through give-and-take conversation. They tend to interrupt and, oblivious to what others were chatting about, dominate the conversation by talking non-stop about the one topic that interests them. Unable to intuitively learn the social skills that come as second nature to neurotypical children, they struggle to socialize with peers. The slightest change in routine results in extreme anxiety that is not alleviated by IQ or verbal ability.

Learning in autism is characterized both by spontaneous, sometimes exceptional mastering of complex material and apparent resistance to learning in conventional ways. Learning that appears to be implicit seems to be important in children with autism, but their implicit learning may not map directly onto non-autistics' implicit learning or governed by the same constraints (Dawson, *et al.*, 2008). Preliminary findings from clinical

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studies show potential for interactive and individualized music strategies to enhance areas such as communication and socialization in children with autism (Allgood, 2005). Deficits in the social skills of children with autism were first described by Kanner in 1943, who referred to this lack of skills as 'autistic aloneness'. Researchers also argue that children with autism have significant difficulty developing age-appropriate social skills that involve one or several different aspects of social behaviour. Therefore, they tend to engage in various social avoidance behaviours (Koegel *et al.*, 1987). The American Music Therapy Association (1999) had suggested the use of music for this group by stating that one intervention that has been used to increase the social skills in individual with autism is music therapy. Music therapy can be used to address physical, emotional, cognitive, and social needs of individuals of all ages. Previous researches involving the use of music on children with autism are of interest to researchers. One such research was conducted by Allen *et al.*, (2009). The researchers used a semi-structured interview for 12 high-functioning adults on the autism spectrum in order to examine the nature of their personal experiences of music. The analysis showed that most participants exploit music for a wide range of purposes in the cognitive, emotional and social domains. However, the autism spectrum disorder (shortened to ASD) group's descriptions of mood states reflected a greater reliance on internally focused (arousal) rather than externally focused (emotive) language, when compared with studies of typically developing individuals. Recent research that uses music as a tool for the study was carried out by Finnigan and Starr (2010). The study sought to determine the effects of using music and non-music interventions on the social responsive and avoidant behaviours of a preschool child with autism. A single-subject alternating treatment design was used in which two interventions were presented in a similar fashion except for the addition of music during the music condition. Results indicated that the music intervention was more effective than the non-music intervention in increasing social responsive behaviours. No avoidant behaviours were observed during the music condition. It is suggested that the music condition was more motivating for the participant than the non-music condition, resulting in more social responsive behaviours.

Controlled studies investigating whether music therapy is effective in reducing the social, behavioural and communicative difficulties of children with ASD by Edgerton, 1994; Buday, 1995; Brownell, 2002; Kim *et al.*, 2008, 2009; and Katagiri, 2009 have been reviewed by Kinloch (2011). The review concluded that there was good evidence that music therapy has beneficial effects, in comparison with a no-treatment control. There was also evidence that a variety of music therapy approaches might be useful. However, when music therapy was compared with other conditions that attempted to control for factors such as providing attention, or information, the evidence was more mixed. Kim *et al.*, (2008, 2009) looked at interactive music therapy and emotional, motivational and interpersonal responsiveness (such as smiling in response to another, or seeking to initiate shared activities); Brownell (2002) looked at social stories set to music and specific target behaviours; Buday (1995) investigated music impacting upon the ability to imitate signs and words; Edgerton (1994) analysed whether improvisational music therapy improved communicative behaviours; Katagiri (2009) looked at background music, singing songs, and the understanding of facial emotions difference between teaching with music versus teaching with rhythm only. The results from Katagiri (2009) may suggest that a broad variety of music therapy approaches may be useful, as this study found that singing had similar effects to background music in understanding of facial emotions among children with autism.

A possible beneficial relationship between song and children with autism has been highlighted for many years. Kanner (1943), one of the first people to study autism, identified an unusually well developed ability to retain and sing many songs in this population. Children with autism preferred the sung version rather than the spoken version of songs (Blackstock, 1978) and a musical auditory stimulus over a visual stimulus (Kolko *et al.*, 1980). Interestingly, this is in contrast to evidence that children with ASD frequently show hypersensitivity to other auditory stimuli (Sinha *et al.*, 2004; Newschaffer *et al.*, 2007; Baron-Cohen *et al.*, 2009). Clinical reports and pre-experimental studies suggest that songs may be an effective intervention for children with autistic spectrum disorder. Starr and Zenker (1998) used an original song, "Line up," to decrease a child's anxiety and aggression due to change and enable him to wait more easily in the classroom. Then came a study conducted by Kern *et al.*, (2007). This study evaluated the effects of individually composed songs on the independent behaviors of two young children with autism during the morning greeting/entry routine into their inclusive classrooms. A music therapist composed a song for each child related to the steps of the morning greeting routine and taught the children's teachers to sing the songs during the routine. The effects were evaluated using a single subject withdrawal design. The results indicate that the songs, with modifications for one child, assisted the children in entering the classroom, greeting the teacher and/or peers and engaging in play. For one child, the number of peers who greeted him was also measured, and increased when the song was used. Recent study with the same purpose has been carried out by Katagiri (2009). The purpose of this study was to examine the effect of background music and song texts to teach emotional understanding to children with autism. Participants were 12 students (mean age 11.5 years) with a primary diagnosis of autism who were attending schools in Japan. Each participant was taught four emotions to decode and encode: happiness, sadness, anger, and fear by the counterbalanced treatment-order. Participants were given a pretest and a posttest and received 8 individual sessions between these tests. The results indicated that all participants improved significantly in their

understanding of the four selected emotions. Background music was significantly more effective than the other three conditions in improving participants' emotional understanding. The findings suggest that background music can be an effective tool to increase emotional understanding in children with autism, which is crucial to their social interactions.

The researchers used two different types of auditory stimulus, namely musical auditory stimulus and musical songs auditory stimulus on language, social, cognitive, emotion responsiveness, and, to a greater or lesser degree, inattentive attitudes of five special education programme children with HFA by using an alternating interventions during their learning sessions. Language and social responsiveness fit the category of developmental delays whereas cognitive and emotion responsiveness are included as a new variables in this study which has not been reviewed by any of the authors referred to. Specifically, it was hypothesized that children with HFA would be more responsive and showed several attentive attitudes in musical songs auditory stimulus compared to music auditory stimulus or equal. The aim of the current study then was to determine whether developmental disorders and inattentive attitudes of children with high functioning autism can be reduced by the use of auditory stimulus.

Method:

The participants are 5 boys (mean age 12.2 years) with a primary diagnosis of HFA and students of special education programme conducted by National Autism Society of Malaysia (NASOM), a society that was formed in 1986 by a group of parents and professionals with the aim of delivering lifelong service to the community of persons suffering from autism. NASOM also operates a One Stop Centre that provides screening assessment, psychology services, speech therapy and occupational therapy all under one roof. Autism diagnosis was done by health care provider, generally paediatric psychologist and Childhood Autism Rating Scale (CARS). Using standardized assessment tools, they met criteria for Axis 1, Autism Spectrum Disorders specified in the *DSM-IV-TR* 4th edition (American Psychiatric Association, 2000). All children have a full scale IQ (FSIQ) above 70 and have sufficient language to complete the task. They displayed adequate attention to music and motor or vocal imitation abilities and no mental retardation.

By using a time series research design in which a single population group of defined size is studied, interventions are assigned alternately to weekly 30 minutes learning session each for musical auditory stimulus followed by musical songs auditory stimulus for 8 weeks without washout period. Each activity was completed within 30 minutes of learning session. The target variables were language, social, cognitive, emotion responsiveness and inattentive attitudes. The inattentive attitudes were defined as the following: a) screaming; b) not responding; c) Harassing peer; d) Biting object; e) swinging leg; f) moving away; g) rubbing eye; h) supporting the chin; and i) placing head on desk. Single-group time series design was used. Teaching in the classroom was conducted by two paediatric psychologists by turns. The researchers acted as observers and recorded the study variables using a checklist at the end of week eight. All observed responsiveness and attitudes variables were scored by using frequency count. The attentive finding from both types of stimulus was analyzed by utilizing the dependent sample t-test.

Two music versions and the two musical songs were used as instruments for this study. At the beginning of the week, the observation was made on the result by the first musical auditory stimulus which was assigned alternately with the first musical song auditory stimulus in the HFA learning session. Each session took 30 minutes. Researchers also provided several answer sheets containing pictures of animals, fruits and names in bold letters. Crayons were also provided for coloring pictures. In the second week, the second musical auditory stimulus was used in the same setting and then followed by the second musical song auditory stimulus on the following day. The music versions were actually derived from the instrumental music originally composed for the two songs entitled, 'Happy Fruits' and 'Happy Animals'. The songs were obtained from karaoke video compact disk entitled 'Songs for Autistic' by Jessica Ong (2010). An original checklist, the Checklist of Responses Acts Score Sheet (CRASS) was constructed by the researchers as there was no standardized test that evaluated developmental delays responsiveness for HFA either in musical or musical songs auditory stimulus.

Data Analysis:

The following is a frequency list of HFA positive responsiveness taken from the checklist entry at the end of week eight for musical auditory stimulus (MAS) and musical songs auditory stimulus (MSAS).

Based on the research data, it is clearly showed that the highest frequency directed to the language responsiveness (19 counts or 40%). The second highest frequency is cognitive responsiveness (11 counts or 23%). Emotion responsiveness is higher than social responsiveness by 1%, i.e 9 counts or 19% whereas social responsiveness is listed at the bottom with 8 counts or 19%.

Table 1: HFA positive responsiveness for musical auditory stimulus (MAS) and musical songs auditory stimulus (MSAS).

Type/Total	Positive Responsiveness	MAS	MSAS
Language Responsiveness			
	<i>Spell one syllable</i>	3	3
	<i>Spell all words</i>	2	2
	<i>Able to complete sentences</i>	2	5
	<i>Able to sing lyrics</i>	1	5
	<i>Willing to talk with others</i>	0	4
Total		8	19
Social Responsiveness			
	<i>Obeying teacher's instruction</i>	0	5
	<i>No walking aimlessly</i>	0	1
	<i>Polite</i>	0	1
	<i>Participate actively</i>	0	1
Total		0	8
Cognitive Responsiveness			
	<i>Focus</i>	0	1
	<i>Thinking before answering question</i>	0	5
	<i>Thinking before giving response</i>	0	5
Total		0	11
Emotion Responsiveness			
	<i>Smiling</i>	1	4
	<i>Less sensitive</i>	0	4
	<i>Crying while listening to music</i>	0	1
Total		1	9

Table 2: A comparison of HFA inattentive attitudes with musical auditory stimulus and musical songs auditory stimulus.

Auditory stimulus	Screaming	Not responding	Harrassing peer	Biting object	Swinging leg	Moving away	Eye rub	Support the chin	Placing head	Total
Musical	1	1	0	5	2	4	4	6	7	30
Musical songs	0	2	0	1	1	3	3	4	3	17

Eye rub; Rubbing eye; Placing head: Placing head on desk

At the end of eighth week using musical auditory stimulus in the classroom, it was observed that the most inattentive attitude displayed by children with HFA was placing the head on the desk, with 7 counts. The second most frequent was supporting the chin (6 counts), Listed the third was biting object (5 counts). This was followed by moving away and rubbing the eyes (respectively with 4 counts), and swinging leg (2 counts). Screaming and not responding occurred only once respectively. No harassing peer behavior was observed. The behavior observed was 30 counts in total. HFA Inattentive attitude was found to decrease during the musical songs auditory stimulus learning sessions. The most frequent was supporting the chin, with 4 counts; while moving away, rubbing eye, and placing head on the desk, with 3 counts each. The observed attitude of not responding occurred twice but biting object and swinging leg happened only once. No screaming and harassing peer attitude were found. The total behavior observed were 17, a reduction of 43 per cent in HFA inattentive attitude. This data was supported by evidence from HFA attentive attitude recorded during musical songs auditory stimulus learning session compared with the musical auditory stimulus. Details of these data are as follows:

Data A: Evidence HFA Attentive Attitude

Attentive Attitude	MAS	MSAS
1. Doing light physical work out	5	4
2. Obeying teachers' instructions	2	2
3. Listening to songs	0	1
4. Respond to teaching	2	3
5. Pointing to fruit while citing lyrics	0	5
6. More focus	2	2
7. Singing along with teachers/friends	1	3
8. Interested in doing answer sheet exercise	4	5
9. Answering questions	1	2
10. Clapping hands	0	1
11. Holding the tool given by teacher	0	2
12. Requesting to re-play the songs	0	1
13. Read lyrics	0	4
14. Help teacher to distribute tools	0	1
15. Searching for the sound of music	1	0
16. Can guess the animal sounds	2	0
17. Can guess the animal picture	1	0
18. Able to read syllables and sentences that are taught	1	0
19. Controlled behaviour	1	2
20. Calmer	1	0

21. Colouring pictures of animals	1	0
22. Can match pictures with the correct syllables	1	0
23. Communicate with teachers	1	0
24. Help teachers turning on songs	1	0
25. Smiling	1	1
26. Make action in accordance with animal sounds	1	0
Total	30	39

From the above mentioned, it is seen that with MSAS, children with HFA obtained an advantage 9 counts, or 39 counts in total, while MAS gained 30 counts. However, there are ten attentive attitudes in MAS data which are not presented in MSAS data. Still, generally, it is not definite to say that MSAS is better for children with HFA compared with MAS. Having said this, arbitrary assumptions should not be made. Validation of data with the right statistical procedure must be carried out in order to avoid 'blindness' of observers as mentioned earlier by Kinloch (2011). Therefore, researchers decided to use statistical analysis of dependent samples t-test to compare the mean of both groups and then test the research hypothesis that has been built at the beginning of this research.

The test is set to two-tailed at 0.05 level of significance with 4 degree of freedom at t-2.132 critical value. The statistic value for MAS is t-4.106 while MSAS is t-10.546. Both values exceed the critical value of t-2.132. The statistical tests are found to be significant. However, the statistical value, t-10.546 is higher than that of MAS, which is t-4.106. The null hypothesis which stated that the population means for MAS and MSAS attentive attitudes are gained equally can be rejected. Therefore, the researchers conclude that MSAS is a better stimulus than MAS for children with HFA.

Discussion:

In this section, researchers used HFA acronym to refer to children with high functioning autism. According to Rudy (2011), people with HFA had or have speech delays. This is found to be true by researchers even though HFA possess some language and communicative abilities and appear to possess automatic lexical access processes as described earlier by Fombonne (2005, 2006); and (Speirs *et al.*, 2011). At the end of the eighth week of this study, it is found that with musical auditory stimulus, none of the five HFA was willing to talk with others. Only one was able to sing lyrics although the subtitle track is displayed on the whiteboard along with the musical rhythm. Highlights of Kolko *et al.*, (1980) on their previous study mentioned that children with autism preferred the musical auditory stimulus over a visual stimulus can be considered to explain the reasons HFA are not interested in subtitles displayed on the whiteboard in front of them. With musical songs auditory stimulus, only one HFA is unwilling to talk with others whilst all of them were able to sing lyrics. It seems clear that HFA will take some time to express words through speech. Therefore, individuals dealing with HFA must be patient with their whims. HFA are challenged by autism's core deficits but with variations. They may have a great vocabulary and can talk, but they cannot truly share experiences through give-and-take conversation as mentioned by Adam *et al.*, (2001). It is also found that HFA apparently resisted learning in conventional ways. Implicit learning appeared to be important to HFA as noted by Dawson, *et al.*, (2008). Both interventions produced similar counts for items 'spell one-syllable' and 'spell all words'. In addition, MSAS is seen to have advantage over MAS because all HFA are able to complete sentences and able to sing lyrics.

Autistic aloneness which was first described by Kanner in 1943 clearly cannot be overcome by using MAS in HFA learning sessions if these findings are accounted for. None of the four items in social responsiveness checklist are met by MAS. For MSAS, the item 'Obeying teacher's instruction' can be fulfilled by all HFA, while the results of the remaining three items are not encouraging either because each only gets one count. Previous research involving the use of music on children with HFA by Allen *et al.*, (2009) which showed that most participants exploit music for a wide range of purposes in social domain is contrary to our data. Results from the study done by Finnigan and Starr (2010); and Allgood (2005) are also against these findings. Ultimately, researchers decided to accept Koegel *et al.*, (1987) argument that children with autism have significant difficulty developing age-appropriate social skills that involve one or several different aspects of social behaviour.

Apparently, MAS does not stand for cognitive and emotion responsiveness data with zero score for the earlier and one for the later. MSAS gets the highest score in cognitive responsiveness from the item 'Thinking before answering question' and 'Thinking before giving response'. For emotion responsiveness, MSAS showed HFA most preferred item of 'Smiling' and 'Less sensitive'. Several works by Kim *et al.*, (2008, 2009) also affirmed interpersonal responsiveness such as smiling in response to another, or seeking to initiate shared activities in children with autism. At the beginning of this article, the researchers explained that cognitive and emotion responsiveness are included as a new variables in this study which has not been reviewed by any of the authors referred to. After examining the findings of the study and compare the results between the two stimuli, it can be concluded that both variables work in the MSAS with the highest score for cognitive responsiveness. The work by Wright and his collaborators which has been stated by Hare (2008) suggest that important maturational processes may be involved in global cognitive and age to emotional recognition ability.

Further discussion is about the reduction of HFA inattentive attitudes during their learning sessions. Finnigan and Starr (2010) termed it as avoidant behaviours. Part of their study sought to determine the effects of using music and non-music interventions on the avoidant behaviours of a preschool child with autism. No avoidant behaviours were observed during the music condition. Thus, researchers can use their findings to come to a decision that music does help reducing the inattentive attitude among the HFA. However, according to Kinloch (2011), when music therapy was compared with other conditions that attempted to control for factors such as providing attention, or information, the evidence was more mixed. Conversely, when music and songs are used simultaneously in studies involving HFA, study results are encouraging, as proved by Starr and Zenker (1998; Kern *et al.*, 2007). Returning to our study results, doing light physical work out is the one attentive attitude displayed by all participants during MAS while for MSAS, pointing to the fruit while citing lyrics and interested in doing work book exercise are more prominent. It cannot be denied that the use of MSAS reduces the inattentive attitude of participants more than MAS. For MSAS, 10 variables in the checklist do not get any response from the participants. For MAS, a sum of seven variables scores nil response. This data seems to indicate the use of MAS has produced more responses than MSAS, but if the data are examined in detail, it is clear that the frequency response is greater in MSAS. In order to avoid blindness of observers, a statistical analysis is used for validity and reliability. The test prove to be significant whereby the null hypothesis can be rejected and the researchers conclude that MSAS is a better stimulus than MAS for children with HFA.

Conclusion:

It can be concluded that the use of musical songs auditory stimulus is more beneficial to HFA compared to musical auditory stimulus either in reducing their developmental disorders or inattentive attitudes. Musical auditory stimulus real strength is in motivating the group towards their attentive attitude to do light physical work out at the beginning of the learning sessions. The rest appears dominated by musical songs auditory stimulus with the highest responsiveness both in language and cognitive which represent the developmental disorders. In reducing inattentive attitude among HFA, pointing to the fruit while citing lyrics and interested in answering worksheet exercise respectively scored the highest. Interestingly, this is in contrast to evidence that children with ASD frequently show hypersensitivity to auditory stimulus. Nevertheless, both interventions are found to be incapable of reducing HFA autistic aloneness. This study has certain limitations in the inability to control for confounding factors such as the natural development of an individual. We strongly suggested a possible beneficial future study on the effect of musical songs auditory stimulus in children with Rett syndrome, also referred to as Rett's Disorder, is a condition that is found only in females. It would be interesting to examine the findings from the girls group.

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