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The analysis and treatment of problem behavior evoked by auditory stimulation

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Abstract

The current study aimed to identify specific stimuli associated with music that served as an establishing operation (EO) for the problem behavior of a 6 year old child with a diagnosis of autism. Assessment results demonstrated that specific EOs for problem behavior evoked by auditory stimulation could be identified. A differential negative reinforcement procedure was implemented for specific conditions that evoked problem behavior. Using a changing criterion and a differential negative reinforcement of other behavior, exposure to specific stimuli associated with music was gradually increased, and resulted in reductions in problem behavior to near zero levels.

Keywords: autism, auditory stimulus assessment, establishing operations, differential negative reinforcement of other behavior, music

The Analysis and Treatment of Problem Behavior Evoked by Auditory Stimulation

For several decades, the non-experimental literature has recognized various auditory anomalies have been recognized as affecting a substantial proportion of children and adults with developmental disabilities (Grandin & Scariano, 1986; Hayes & Gordon, 1977). In fact, it has been suggested that as many as 40% of children having a diagnosis of autism show evidence of auditory hypersensitivity (Rimland & Edelson, 1995). However, there are very few studies in the behavioral literature that have investigated the potential effects of auditory stimulation on the development and maintenance of problem behavior in this important population for applied behavior analysis.

Although much research has focused on the identification of the reinforcement contingencies that maintain problem behaviors in autism (e.g., Carr & Newsom, 1985; Mace, Browder, & Lin, 1987), recent studies have shown growing interest in the antecedent conditions associated with behavior disorders. Some studies have documented the aversive properties of noise by demonstrating that an audible tone, delivered contingent upon the occurrence of problem behavior, can function as punishment for that behavior (Ellingson, Miltenberger, Stricker, Garlinghouse, Roberts, & Galensky, 2000). O'Reilly, Lacey, and Lancioni (2000) examined the influence of background noise on levels of problem behavior, and pain, for a child with Williams syndrome. A systematic examination of the influence of hypersensitivity to noise on operant responding under functional analysis conditions, showed that background noise was associated with increases in escape maintained problem behavior. Specifically, three functional analysis conditions (play, attention, and demand) were presented under three different contexts (no noise, noise, and noise plus earplugs), which were designed to examine the influence of noise on task

performance. The results of this study showed that background noise seemed to influence responding, under functional analysis conditions, by increasing the aversiveness of the task demands.

Similarly, McCord, Iwata, Galensky, Ellingson, and Thomson (2001) provided a method for the evaluation of the aversive properties of noise resulting in problem behavior, and treatment procedures for such behaviors. McCord et al. (2001) found idiosyncratic influences of auditory stimulation, among two participants, that served as establishing operations (EOs) for problem behavior. Differential reinforcement of other behavior (DRO) was implemented, with an arbitrary reinforcer (potato chip) as part of a multi-component procedure, to decrease escape-maintained self-injury during exposure to ascending decibel levels of auditory stimulation. Although this strategy was successful in this particular case, there may be situations in which arbitrarily selected reinforcers will not compete with the maintaining negative reinforcement contingencies, and, thus, such situations may require the use of these contingencies (i.e., escape) to effectively reduce problem behavior. The demonstration of an additional effective procedure to reduce problem behaviors is one aim of the current study.

The EO (Michael, 1982; 1993) is a fundamental relation among antecedent events, behavior, and consequences, which alters both the reinforcing effectiveness of specific consequences, and the momentary probability of occurrence for behaviors that have previously produced those consequences. Thus, in the presence of stimuli that are discriminative for a specific response-consequence relationship, the probability of the occurrence of that response may be altered by EOs that increase, or decrease, the reinforcing effectiveness of that consequence. Numerous studies in the literature on applied behavior analysis have shown that the EO can alter the effects of

contingencies, especially those that maintain problem behavior. According to Michael (2004), it is more accurate to conceptualize 'motivational' variables as 'establishing', or 'abolishing' operations, and their evocative effect as either an increase, or decrease, in the momentary frequency of the relevant kind of behavior.

Music, as a type of auditory stimulation, has been examined in terms of its potential effects as an EO for problem behavior in some children with developmental disabilities (Iwata, Pace, Dorsey, Zarcone, Vollmer, Smith et. al., 1994; Smith, Iwata, Goh, & Shore, 1995). However, few studies have identified specific variables associated with music that may serve as potential EOs for problem behavior. Buckley and Newchok (2006) demonstrated that identification of specific stimuli (type of playback source) associated with music can be essential when selecting a treatment for the reduction of problem behavior evoked by music. Buckley and Newchok (2006) demonstrated the effective use of a differential negative reinforcement procedure (DNRO) to reduce problem behavior influenced by music to near zero levels in a child with pervasive developmental disorder. Specifically, the participant was exposed to taped music for short intervals that were gradually increased across sessions. The absence of disruption during the interval resulted in termination of music for 30 s (escape from an aversive situation). This study was the first to effectively treat problem behavior evoked by music based on the identification of a specific EO (i.e., the specific type of playback source).

The current study provides an extension to research by examining the influence of specific stimuli associated with music that produce an evocative increasing effect on problem behavior. The study also investigates the effective use of a DNRO procedure to reduce problem behavior evoked by music, based on the identification of specific EOs.

Method

Participant

The participant was a 6:1 year old boy. At the age of 2 years and 3 months, he received a dual diagnosis of Autistic Spectrum Disorder and a Learning Disability by a registered clinical psychologist. He attended a school using applied behavior analysis as treatment for children with autism five days per week, for six hours per day. It was reported by parents and staff that the participant emitted problem behaviors, such as feet stomping, aggravated delayed echolalia and covering his ears when exposed to various selections of music for approximately 18 months prior to the beginning of the study. Occurrences of the behavior were observed both at school and at home.

Setting and Apparatus

An Apple ipod and speakers, and a Sony portable compact disc player, were used to play the selections of music in the various conditions. An individual was randomly selected from a panel of 5 singers to facilitate each of the A Cappella conditions. A digital timer with a ‘beeper’ was used to time each of the intervals. An assessment of the participant’s favourite items and activities was conducted using a reinforcer assessment checklist (McClean, 2005). This assessment involved a questionnaire referring to 120 items and activities that might function as reinforcers for an individual. A rating scale of 1-5 ranging from ‘not at all’ to ‘very much’ was used across twelve categories. The questionnaire was completed by two instructors familiar with the participant. Each item rated 3 or more was used to construct an inventory of reinforcers for the participant. All relevant musical stimuli for each of

the categories were sourced from the school's music library, his home, or 'itunes' (internet music store).

All sessions (assessments, baseline, and treatment) lasted for 5 minutes, and were conducted 3 to 6 times daily in a room in the school.

Experimental Design

A changing criterion design, with pre and post baseline measures, was used to investigate responding under different conditions involving varying the playback source and category of music.

Response Measurement and Interobserver Agreement

Disruptive behavior consisted of the following responses: Ear covering: defined as any simultaneous contact of both hands with any part of the participant's ears; Aggravated delayed echolalia: defined as any vocalizations uttered above conversation level with negative intonation; Finger spelling: any instance of finger movements with raised arm, making no contact with any other solid objects; Stamping feet: any instance of forceful contact with the floor using the sole of either foot to make a noise.

A 10-s partial-interval recording system was used to record all problem behaviors. Interobserver agreement was recorded on an interval-by interval basis for all four responses during 32% of sessions distributed throughout the study. Agreement was calculated by dividing the number of intervals in which observers agreed on the presence or absence of target behavior (agreements) by the number of agreements plus disagreements and multiplying the result by 100%. Mean agreement on problem behavior was 97% and ranged from 91% to 100%.

Baseline and Auditory Stimuli Assessment

An auditory assessment was conducted, prior to treatment, to determine the influence of variables associated with the music that were suspected to influence problem behavior. During each assessment session, the participant had free access to various preferred items, which were determined via a reinforcer assessment completed by both the participant's parents and school staff.

The participant was exposed to music from one of four categories (Disney, pop, television theme songs, and classical). These music categories were played through three different playback sources (a portable compact disc player, ipod and speakers, or A Cappella). Conditions were presented in a randomized sequence (12 conditions in total, see Table 1).

--- Insert Table 1 about here ---

All musical stimuli were played just above conversation level. All music was tested at the same volume, so that any observed differences in behavior could be attributed to the category of music, or playback source, rather than to its intensity. In addition, a control condition was conducted in which the participant had free access to preferred materials in the absence of musical stimuli.

At the beginning of each five minute music session, the instructor said: "I have some really cool music for you to listen to". The instructor then turned on the music, diverted all attention from the participant, and offered no further verbalizations. Music was terminated for 30 s contingent on the occurrence of problem behavior.

Differential Negative Reinforcement of Other Behavior (DNRO)

On entering the room, the instructor said: “I’m going to play some really cool music. If you can sit quietly with your hands down until you hear the beep, I will turn it off”. The experimenter then set a digital timer to the current DNRO interval and simultaneously started the music (random selection from the auditory conditions). Music was terminated for 30 s contingent on the absence of disruption. Disruption resulted in resetting the timer along with a brief explanation (e.g., ‘let’s try again with your hands down’). The music remained on during this time. DNRO intervals increased contingent on two consecutive sessions in which disruption occurred in no more than 5 intervals. The progression of DNRO intervals was 5s, 7s, 10s, 15 s, 20 s, 30 s, 1 minute and 2 minutes.

Return to Baseline

A return to baseline phase was conducted immediately following the DNRO condition. The same 5 playback sources were implemented as the initial baseline condition, and the procedures used were identical to that of the auditory stimuli assessment.

Results

Baseline and Auditory Stimuli Assessment

--- Insert Figure 1 about here ---

Figure 1 shows occurrences of disruption, expressed as number of intervals within one minute sessions, across each of the three play-back sources, and four music categories. The A Cappella play-back source, produced the highest number of intervals with disruption, such disruption occurring during three of the four musical categories (Disney, pop, TV theme songs). No disruptions were emitted during the

classical music category under the A Cappella condition. For all other play-back sources, disruption was high for the category of TV theme tunes only. During the control condition (free-play) there was no more than one interval with disruption across all of the music categories.

--- Insert Table 2 about here ---

The data from the Auditory Stimuli Assessment (Figure 1) indicated the conditions required for baseline and treatment sessions (See Table 2). The baseline procedure was identical to that used during the auditory stimuli assessment.

Differential Negative Reinforcement of Other Behavior (DNRO)

--- Insert Figure 2 about here ---

Figure 2 illustrates the number of intervals with disruption when the DNRO procedure was applied across each of the five conditions. During all conditions problem behavior decreased from high levels, in the first treatment session of 5 second interval exposure, to zero intervals of problem behavior, during the final two treatment sessions of 1 and 2 minutes. No incidents of problem behavior were recorded for each of the conditions following treatment session 6.

Comparison of Baseline and Return to Baseline Conditions

--- Insert Figure 3 about here ---

---Insert Table 3 about here ---

Table 3 shows mean level of disruption during the pre-baseline, and post-baseline, assessments for each of the conditions selected for treatment. Mean percentage of disruption across all conditions during pre-baseline was 73.2%. Figure 3 shows the number of intervals with disruption during pre-baseline and post-baseline

phases for each of the five conditions selected for treatment. Following the introduction of the DNRO procedure, the number of 10s intervals with disruption decreased across all conditions. For two of the five conditions (A Cappella Disney, and A Cappella pop) no incidences of disruption were recorded for all five minutes. In summary, the mean percentage of intervals with disruption across all conditions in the post-baseline assessment was 0.24% compared to 73.2% prior to treatment.

Discussion

Noise sensitivity is a widespread issue in the area of developmental disability (Rimland & Edelson, 1995), and the findings of the current research are a potentially important contribution to the limited behavioral literature on auditory stimulation. A number of articles, as well as some preliminary data from functional analyses, have suggested that noise, and certain musical stimuli, may serve as an establishing operation for evoking problem behavior in individuals with developmental disabilities (e.g., Iwata et al., 1994; O'Reilly et al., 2000). The results from the current investigation demonstrated that specific EOs for problem behavior evoked by auditory stimulation could be identified (category & playback source). In this case, the participant showed differential sensitivity to music from the 'TV Theme Songs' category, irrespective of playback source. Data from the assessment also indicated that the 'A Cappella' condition initiated more intervals of disruptive behavior than any other playback source. Such a procedure could be adopted for other participants with developmental disabilities, who may well show hypersensitivity to auditory stimulation. Following this assessment, differential negative reinforcement of other behavior (DNRO) was used to reduce problem behavior to near zero levels, in each of the selected conditions. This study shows the importance of identifying specific establishing operations to provide best treatment for problem behaivors evoked by

auditory stimulation. In addition, the use of a DNRO procedure to reduce problem behavior demonstrates the role of negative reinforcement in increasing tolerance of stimuli that have become aversive for individuals.

These results extend the research conducted by McCord et al. (2001) by showing that EOs for problem behavior evoked by auditory stimulation can be highly idiosyncratic. The current research also lends support to the findings recently put forward by Buckley and Newchok (2006) by emphasizing the importance of rigorous assessment in identifying potential EOs before designing or implementing treatment strategies for problem behavior evoked by music, or any other type of auditory stimulation.

Future research should explore alternative approaches to intervention. Alternative forms of treatment (e.g. teaching one to walk away from sources of aversive auditory stimulation) could have been considered for the participant in this study. In addition, when circumstances allow the termination of music, the strengthening of a communicative response presents as an attractive alternative to the intervention used in the present investigation. However, treating individuals with developmental disabilities to tolerate multiple forms of auditory stimulation is important because this may act as a form of desensitization to auditory sounds that occur readily in the natural environment. The extent to which treatment effects can be generalized to other members of an auditory stimulus class warrants further investigation.

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Figure Captions

Figure 1.

Number of 10s intervals with disruption during each playback source and four music categories.

Figure 2.

Percentage of intervals with disruption during DNRO treatment analysis for each playback source and music category.

Figure 3.

The number of 10s intervals with disruption during pre and post-baseline for each playback source and music category.

Figure 1.

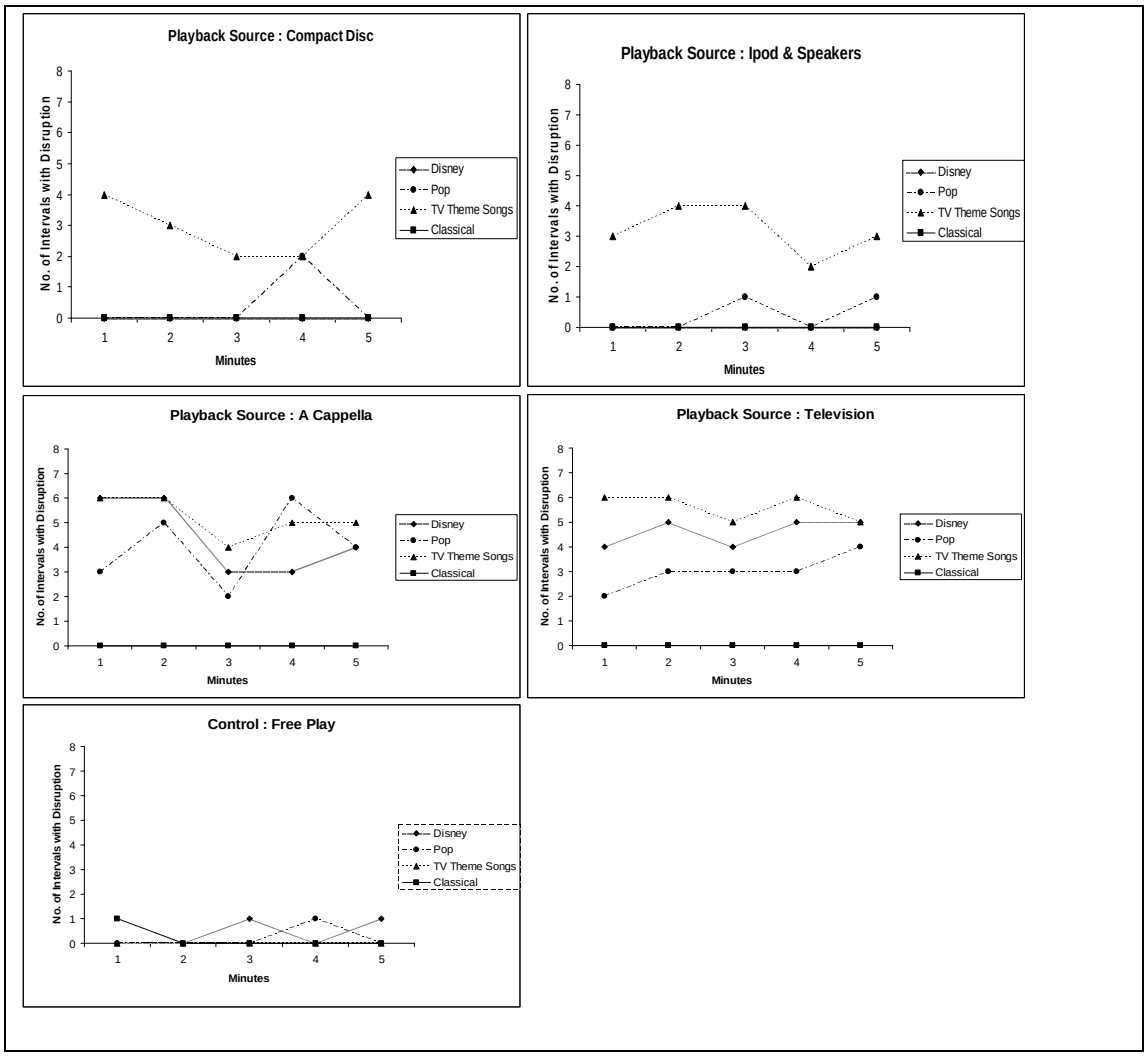
Playback Source : Compact Disc
No. of Intervals with Disruption
Minutes
Disney
Pop
TV Theme Songs
Classical
Playback Source : Ipod & Speakers
No. of Intervals with Disruption
Minutes
Disney
Pop
TV Theme Songs
Classical
Playback Source : A Cappella
No. of Intervals with Disruption
Minutes
Disney
Pop
TV Theme Songs
Classical
Playback Source : Television
No. of Intervals with Disruption
Minutes
Disney
Pop
TV Theme Songs
Classical
Control : Free Play
No. of Intervals with Disruption
Minutes
Disney
Pop
TV Theme Songs
Classical

Figure 2.

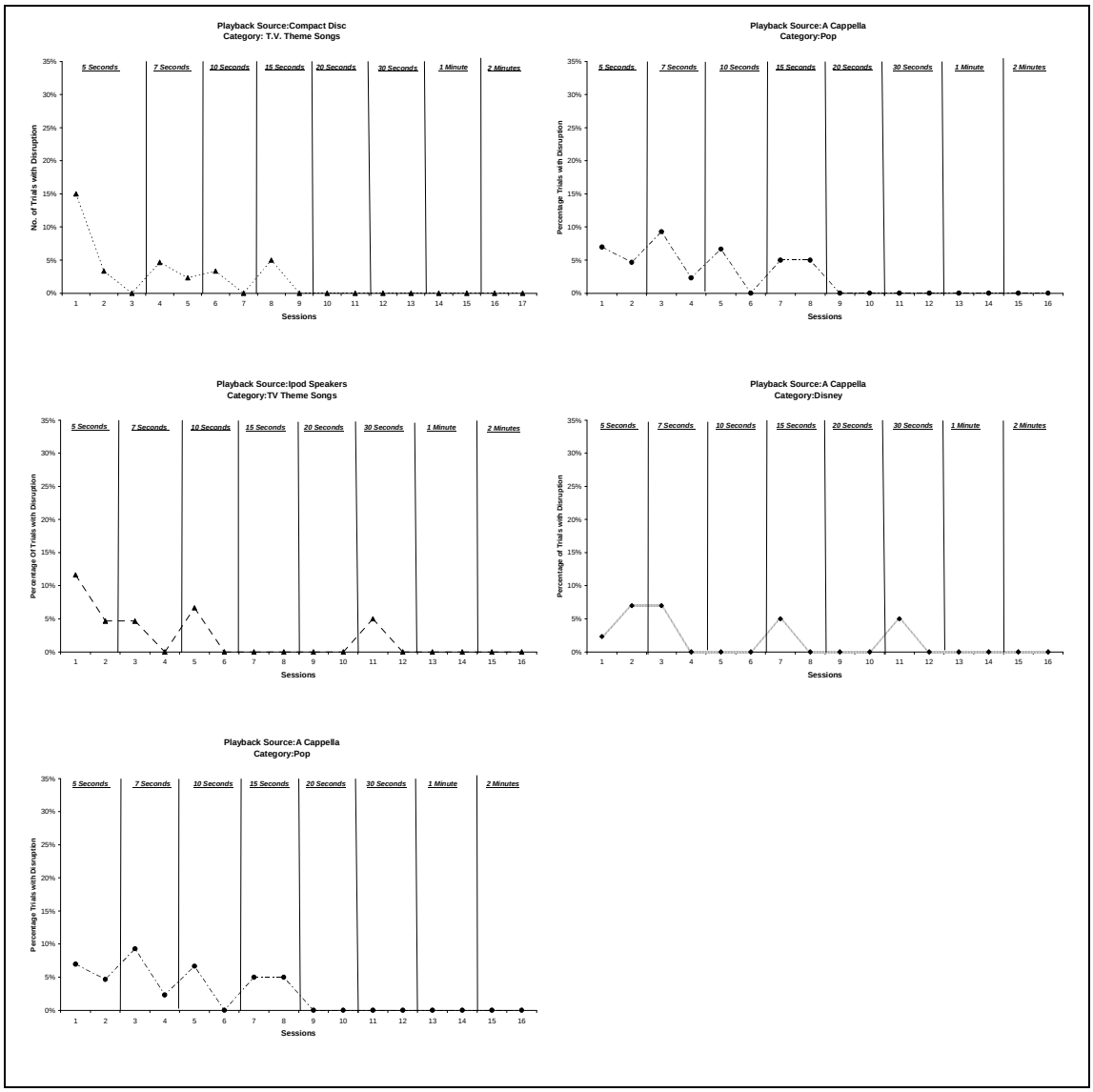
Playback Source:Compact Disc
Category: T.V. Theme Songs
No. of Trials with Disruption
Sessions
Playback Source:A Cappella
Category:Pop
Percentage Trials with Disruption
Sessions
Playback Source:Ipod Speakers
Category:TV Theme Songs
Percentage Of Trials with Disruption
Sessions
Playback Source:A Cappella
Category:Disney
Percentage of Trials with Disruption
Sessions
Playback Source:A Cappella
Category:Pop
Percentage Trials with Disruption
Sessions
5 Seconds
7 Seconds
10 Seconds
15 Seconds
20 Seconds
30 Seconds
1 Minute
2 Minutes

Figure 3.

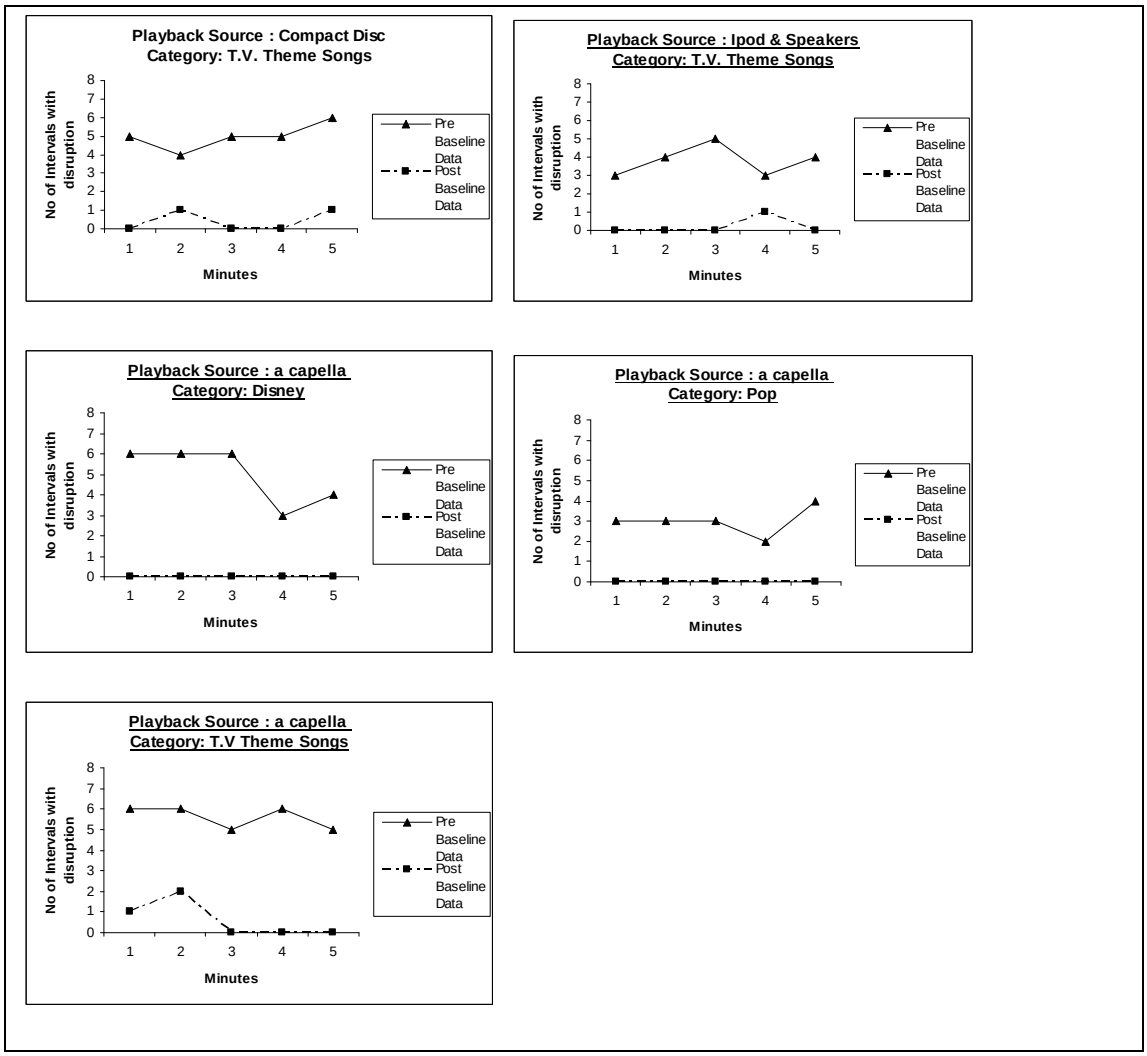
Playback Source : Compact Disc
Category: T.V. Theme Songs
Playback Source : Ipod & Speakers
Category: T.V. Theme Songs
Playback Source : a capella
Category: Disney
Playback Source : a capella
Category: Pop
Playback Source : a capella
Category: T.V Theme Songs
No of Intervals with disruption
Minutes
Pre Baseline Data
Post Baseline Data

Table 1

Summary of auditory assessment conditions including playback source and category of music.

Playback Source: Compact disc player	
Category:	Disney
	Pop
	T.V. theme songs
	Classical
Playback Source: Ipod and speakers	
Category:	Disney
	Pop
	T.V. theme songs
	Classical
Playback Source: A Cappella	
Category:	Disney
	Pop
	T.V. theme songs
	Classical

Table 2

Summary of conditions during baseline and treatment sessions

Playback Source:	**Category:**
Compact Disc Player	T.V. Theme Songs
Ipod and Speakers	T.V. Theme Songs
A Cappella	Disney
A Cappella	Pop
A Cappella	T.V. Theme Songs

Table 3

Mean percentage of 10s intervals with disruption for each condition during pre and post-baseline assessments.

Condition	**Percentage of 10 sec intervals with disruption**	
	Pre-Baseline	Post-Baseline
Compact Disc – T.V. Theme Songs	83%	7%
Ipod & Speakers– T.V. Theme Songs	63%	3%
A Cappella – Disney	77%	0%
A Cappella – Pop	50%	0%
A Cappella – T.V. Theme Songs	93%	10%