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Functional Analysis of Ear Plugging and Treatment Analysis of Noise Dampening Headphones

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FUNCTIONAL ANALYSIS OF EAR PLUGGING AND TREATMENT ANALYSIS OF NOISE DAMPENING HEADPHONES

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A DISSERTATION

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An Abstract of the Dissertation Presented
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This current study presents a single case comprehensive functional behavioral assessment of ear plugging behavior that began with the application of traditional functional analysis technology and followed the function based treatment recommendations through a systematic treatment analysis. Results of the functional analysis indicated that the behavior was maintained by automatic positive reinforcement (i.e. ear plugging behaviors produced a reinforcing sensory consequence). These data were in contrast to prior clinical impressions that the individual's ear plugging behaviors were maintained by automatic negative reinforcement (i.e. ear plugging served to block aversive auditory stimuli). To test hypothesis that headphones were functionally equivalent with ear plugging, a treatment analysis phase was conducted. The treatment analysis included an alternating treatments design, to assess the relative effectiveness of contingent access to headphones, contingent access to an activity (i.e. video), and noncontingent access to headphones for increasing task performance and decreasing ear plugging. The results of the treatment analysis supported the use of headphones as a reinforcer for increasing task performance and decreasing ear plugging behaviors. The

results were then replicated in the natural setting using a multiple baseline assessment across three functional activities in the student's educational environment. The implications of the current study had lasting impact on the student's behavioral programing in the educational setting and dramatically changed the way that the educational team conceptualized the use of headphones as an intervention.

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your support from the beginning!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

There is a complex interaction that occurs between individuals and their environments, one that behavior analysts attempt to understand through the application of scientifically validated principles of human behavior. The idea that behavior occurs in a manner that is lawful and predictable remains one of the primary underlying assumptions of behavior analysis (Baer, Wolf, & Risley, 1968). Behavior analysts also understand that behavior occurs as a result of a complex interaction of individual and environmental variables that require scientific consideration and application in experimental research. Carr (1977) discussed how differential sources of environmental stimuli motivate occurrences of self-injurious behavior. He described five hypotheses maintaining self-injury, including operant learning of social positive reinforcement, escape/avoidance of an aversive or negative reinforcement, sensory stimulation, self-injury as the product of "aberrant physiological processes" ("organic hypothesis"), and self-injury as the individual's attempt to establish ego boundaries or reduce guilt (Psychodynamic Theory). Weeks and Gaylord-Ross (1981) demonstrated that the occurrence of interfering behaviors was differentially related to environmental conditions, specifically differences in task difficulty. The seminal article by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) continued to further develop the idea that behaviors were differentially related to ecological setting events (i.e. antecedents) and consequences (i.e. reinforcement), ultimately providing the foundational methodology for measuring functional relationships. This conceptual shift in the field of behavior analysis allowed clinicians to more effectively treat interfering behaviors by moving away from topography-based to function-based interventions, which yield better treatment outcomes for individuals.

The method outlined by Iwata et al. (1982/94) provided a conceptual framework for understanding the basic principles of reinforcement and their relationship to occurrences of behavior. In their examination of self-injury, Iwata et al. created three analogue conditions including play/alone, demand, and social attention. This analysis resulted in the identification of the following functional categories of reinforcement: positive reinforcement (i.e. access to a socially mediated reinforcer such as attention, tangible, or activity), socially mediated negative reinforcement (i.e., escape or avoidance from an aversive stimuli), and automatic reinforcement (i.e., sensory consequence). Iwata et al.'s (1982/94) methodology has been extended in applied research to allow analysts to gather information regarding relevant discriminative stimuli and motivating operations, as well as identify contingencies maintaining behavior through experimental manipulation of the reinforcing consequences (Hanley, Iwata, & McCord, 2003). Due to its rigor and prescriptive relationship for treatment compared to results obtained by indirect or direct descriptive assessments, experimental analyses are now the preferred method of behavioral assessment. The selection of treatments is guided by the differential results of the experimental analyses, ultimately leading to better treatment outcomes (Fisher, Piazza, & Roane, 2011). The two primary forms of experimental analysis are functional analysis (Iwata et al., 1982/94), which is the direct assessment intended to measure response-reinforcer relationships, and structural analysis (Carr & Durand, 1985, Fisher et al., 2011), which is the direct experimental manipulation of antecedent conditions.

Recent research has presented a multitude of clinical variations and applications of experimental analysis of problem behaviors in a variety of applied settings, demonstrating its enduring appropriateness for use in behavioral assessment. For example, Mueller, Nkosi, and Hine (2011), presented a summary of 90 functional analyses in the public school setting. In their review, Mueller et al. (2011) demonstrated that experimental procedures can and should be used in public school settings to better identify relevant discriminative stimuli, motivating operations, and reinforcers, without the confounds typically associated with traditional descriptive assessment procedures most commonly conducted in school settings. New developments in idiosyncratic and trial-based analyses have been presented in the research for accurately and efficiently identifying functional relationships of behaviors in clinical and school settings (Carr, Yarbrough, & Langdon, 1997; Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011).

The most important aspect in experimental analysis of behavior is accurate interpretation of the results. Carr (1994) suggested that the analytic tools of functional analysis must be extended beyond the primary categories identified to maintain behavior by Iwata et al. (1982/1994), to address the more complex clinical problems that occur in the applied setting, such that the three primary categories of reinforcement, positive, negative, and automatic, require further analysis and differentiation. While a great deal of research has been conducted around the occurrence of automatic reinforcement, very little applied research has looked at the differentiation of automatic positive and automatic negative reinforcement. For many individuals, aversive stimulation, which can include physically painful or uncomfortable stimuli, can function as an establishing operation (Michael, 1982) that makes introceptive escape from the aversive stimuli more reinforcing. Therefore, behavior that occurs to terminate or attenuate the aversive stimuli without social mediation can then be identified as automatic negative reinforcement (Rapp & Vollmer, 2005).

While many researchers have acknowledged that some forms of problem behavior are related to biological or sensory reinforcers in the framework of functional analysis, this almost always refers to automatic positive reinforcement in the form of sensory induction/stimulation (Carr, 1994; Piazza, Adelinis, Hanley, Goh, & Delia, 2000). Numerous functional analysis designs include an alone condition that occurs in an austere environment with the hypothesis that behaviors occurring within such "non-stimulating settings" are reinforced by the personal production of stimulation (i.e., visual, auditory, tactile, etc.). In fact the term automatic reinforcement, most often identified when the results of functional analyses are undifferentiated or highest in the alone condition, simply means automatic positive reinforcement to most analysts. The prescribed treatments for undifferentiated responding or findings of automatic reinforcement generally involve sensory extinction (i.e., response blocking, restraint, or protective equipment; Fisher, Piazza, & Roane, 2011) or access to matched or non-matched stimulus reinforcers either contingent (i.e., differential reinforcement of an alternative behavior) or not contingent (i.e., noncontingent reinforcement) on behavior (Steege, Wacker, Berg, Cigrand, & Cooper, 1989; Piazza, et al., 2000; Rapp, 2006). However, these treatments rely on the assumption that disruptive behavior is evoked by deprivation of stimulation, and that by creating treatment contingencies in which alternative sensory stimulation is used to differentially reinforce competing behaviors or provided noncontingently to abolish the motivation of behavior (i.e., NCR) one can decrease the future occurrence of the problem behavior.

This current study demonstrates the importance of applying functional assessment procedures and pairing those procedures with an analysis of function based treatments both in the analogue and applied setting. Without the application of functional assessment procedures, clinicians may develop false hypotheses regarding the function of interfering behaviors, based on topography or even diagnosis. For example, a prevailing hypothesis for individuals with autism spectrum disorder (ASD) is that they are sensitive to sound (i.e., auditory hypersensitivity) and find certain noises aversive (Stiegler & Davis, 2010; Lucker, 2013). Currently, the Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition (American Psychiatric Association, 2013), includes "adverse response to specific sounds or textures" in the diagnostic criteria for autism spectrum disorder. Based on this understanding of ASD, clinicians often recommend noise dampening headphones as a standard treatment to help those individuals reduce their aversive experience of the world around them. This hypothesis suggests that headphones serve as an antecedent modification that reduces the likelihood that an individual will engage in a behavior (i.e., ear plugging, agitation, opposition, etc.) to reduce or escape their aversive experience in noisy environments. This hypothesis may be wrong, however unless a functional assessment of the behavior is completed, the clinician may continue to recommend the wrong treatment (i.e., headphones).

The use of noise dampening headphones as a standard treatment for individuals with ASD is problematic for a number of important reasons. These headphones can be stigmatizing for the individual wearing them in the community. Headphones that block noise, generally manufactured for sportsman and hunters to block the noise of guns, can be brightly colored and large, which likely draw unwelcome attention in the community. Large headphones also serve as a stimulus that signals that a student is unavailable for social interaction or appropriate social communication to community members, decreasing the likelihood that they will be asked to generalize communication skills in other settings. The noise blocking effects of the headphones may also block the direct verbal instruction that is important in systematic teaching of skills to individuals with expressive and receptive language skill deficits. Another important consideration is that headphones are often delivered contingent on problem behavior; for example a student becomes agitated or disruptive and the therapist provides the headphones based on the assumption that the headphones will reduce or abolish the aversive auditory environmental stimuli. For these reasons, it is important that clinical staff consider the use of the intervention prior to recommending headphones as an antecedent modification alone and conduct a functional analysis of the target behavior prior to making the recommendation.

This current study presents a case example illustrating the significance of functional assessment and treatment analysis when addressing false hypotheses and topography-based treatment recommendations. The individual who participated in this study had a long history with using noise dampening headphones primarily to block ear plugging behavior. His educational team had long hypothesized that ear plugging behavior was maintained by automatic negative reinforcement. Specifically it was believed that he found noise in his environment aversive and manually blocked his experience of this aversive environmental stimulus. This individual was chosen for participation in a replication of Tang, Kennedy, Keppekin, and Caruso’s (2002) study of a functional analysis of ear plugging behavior maintained by introceptive reduction of an aversive auditory stimulus (i.e., automatic negative reinforcement) based on the team’s hypothesis regarding the function of his interfering behaviors. As the results of this analysis described below demonstrate, this turned out to be a false hypothesis and led to an interesting analysis of treatment options in a manner that reconceptualized the individual, his behavior, and the use of a sensory/topography-based intervention.

CHAPTER 2: METHOD

Participant

The participant for this study was a student at a middle and secondary day treatment school that operates on the principles of applied behavior analysis. His educational team identified him for participation because he engaged in high rates of a specific stereotypic behavior (i.e., ear plugging). The team suspected that this participant engaged in ear plugging behaviors for automatic negative reinforcement associated within noisy environments (i.e., ear plugging behaviors thought to be maintained by the reduction of aversive auditory stimulation). The participant, Matthew, was 15 years old and had been diagnosed with autism spectrum disorder at an early age. He had been a student at the day treatment school since kindergarten. While Matthew did engage in verbal communication, he also engaged in high rates of non-functional echolalic behaviors, with a history of escalation to agitation and other disruptive behaviors. Behavior analytic interviews conducted with his educational team indicated that Matthew had a long history of ear plugging behavior that increased in frequency when he was not wearing his headphones. His team reported increased ear plugging in noisy environments without the headphones, as well as increased agitation and tantrum behaviors in noisy settings.

Analogue Functional Analysis Procedures

The first phase of this study was a replication of the Tang et al. (2002) study. The analogue functional analysis sessions were all conducted in a therapy room located outside of the student's classroom, which contained only a table and chairs. Data collection and inter-observer agreement were obtained using a closed-circuit audio-video monitoring system located in an adjacent office. An analogue functional analysis of ear plugging behavior was conducted in a manner that replicated Tang et al. (2002), which also utilized the method described by Iwata et al. (1982/94). The eight conditions analyzed included demand, attention, alone, free play, alone plus noise, demand plus noise, attention plus noise, and free play plus noise, which were arranged in a multi-element design. Each of the sessions lasted 5 minutes and conditions were presented in a counter-balanced manner.

The noise conditions were conducted using audio-taped recordings of the student's own "noisy" educational setting (i.e., his classroom, community room, etc.). The recordings were played continuously at 80 dB in the analogue therapy room during the plus noise sessions. At no point during the session did the therapist stop the recordings. Therefore, the escape or automatic negative reinforcement from the noise came from the student's own behaviors (ear plugging) and was not socially moderated by the therapist. At no point during the sessions did the therapist attempt to block ear plugging behavior, but rather followed the methodology of Iwata et al. (1982/94) by providing the corresponding reinforcement for the experimental condition.

All of the sessions were monitored so that an observer could record ear plugging behavior as the dependent variable using 6-second (6-s) partial interval recording. An independent observer also recorded ear plugging behavior during 57% of sessions using 6-s partial interval recording with a mean agreement of occurrence of 98% (range, 88% to 100%). Results are graphically displayed in Figure 1, which shows the occurrence of ear plugging behaviors in each of the eight experimental conditions. Given the results of the initial 30 sessions of the functional analysis, the experimenters restricted the final sessions of the analysis to the alone plus noise and alone conditions.

Vocal Stereotypy

During the initial 30 sessions of the functional analysis, vocal stereotypy was observed but not systematically recorded. Vocal stereotypy was defined as delayed echolalia and scripting dialogue from movies (e.g., repeatedly saying, “I can’t memorize” from Charlie Brown’s Christmas). Vocal stereotypy was recorded using 6-s partial interval recording procedures during the final four sessions of the functional analysis. See Figure 2 for occurrence data for both vocal stereotypy and ear plugging during those four sessions.

Reinforcer Preference Assessment

Based on interviews with staff and parents, videos (i.e., specific movies) were identified as a potential activity reinforcer. When offered, there was 100% correspondence between acceptance of the video player and watching behavior for up to 15 minutes on each occasion. Also, during free operant conditions, Matthew was observed both independently wearing headphones and at times manding for headphones. Thus, headphones were identified as a potential reinforcer.

Treatment Analysis

After completion of the functional analysis, which supported an alternative hypothesis of ear plugging behavior (i.e., automatic positive reinforcement versus hypothesized automatic negative reinforcement), Matthew’s educational team, including his parents, met to discuss treatment options for both reducing the occurrence of ear plugging behavior and increasing task performance during instructional programming. The team agreed to analyze the relative effectiveness of the following three treatments: noncontingent headphones, contingent headphones, and contingent videos. The three treatments were compared using an alternating treatments design during a functional activity (i.e.,. sorting items by color). During baseline sessions, the participant was not allowed access to the noise dampening headphones and at no point during the treatment sessions did the therapist physically block the occurrence of ear plugging behavior. The dependent variables included the occurrence of ear plugging behavior recorded with a 6-s partial interval recording procedure and task performance with a permanent product frequency count of items sorted at the end the 5-minute session.

During the two treatment sessions that required Matthew to earn access to either headphones or his video player, the team used a token board on a fixed ratio schedule of one token for every five items sorted and five tokens for 2-minutes of access to the item or activity. During the 2-minutes of access, the sessions were paused for data collection and resumed when the student was given the verbal prompt to sort (i.e., "Matthew, please sort"). During baseline and treatment sessions, the therapist sat at the table with Matthew in the analogue treatment room, which was the same room used during the functional analysis. Matthew was provided a verbal prompt to begin sorting at the start of the 5-minute sessions and then the therapist did not prompt him to the task again for the duration of the session. During the treatment sessions that utilized the token board (i.e., access to headphones or video player), the therapist prompted Matthew to read the rules of the token board ("For five balls I get one token. When I get five tokens I earn _____.") prior to the start of each session, including coming back from each 2-minute reinforcement phase. Tokens were delivered during the sessions without verbal praise, and when the 5 tokens were earned, the therapist would tell Matthew "You earned all of your tokens. You get ______".

Results of the treatment analysis are depicted in Figure 3. An independent observer also recorded ear plugging behavior during 55% of sessions using 6-s partial interval recording with a mean agreement of occurrence of 95% (range, 58% to 100%). The independent observer also recorded the frequency of items sorted at the end of the sessions during 55% of the sessions with a mean agreement of frequency of 100% (range, 98% to 100%).

Treatment Analysis in the Natural Setting

The results of the treatment analysis demonstrated that both contingent headphones and contingent video were equally effective in reducing ear plugging behavior and increasing task performance. During this final phase of the study, the team used a multiple baseline/probe across tasks design to demonstrate the effectiveness of contingent access to reinforcement at increasing task performance within the context of Matthew's natural educational setting (e.g., lunchroom and community room with peers and staff present). Three activities were chosen based on Matthew's current repertoire of functional daily living skills as activities that could be targeted to increase fluency (i.e., speed and accuracy) rather than teaching a new skill. The three activities were sorting silverware into a drawer organizer, filing small letter cards into alphabetical folders, and loading dishes into the dishwasher. The dependent variable measured during baseline and treatment were the number of items correctly sorted/filed/loaded per minute, reported as rate per minute. During baseline and treatment sessions, Matthew was provided a specific verbal prompt to "go ahead and (sort, file, or load)" at the start of each session, including coming back from the 2-minute reinforcement phase. Matthew was not provided with any other prompting to the task for the duration of the session.

During baseline sessions, Matthew did not have access to his headphones. Once treatment started, Matthew was then offered a choice of access to his headphones for 2 minutes or access to a video on his DVD player for 2 minutes. The percentage of opportunities Matthew chose headphones versus video player were recorded and will be reported in the results section. The tokens were delivered on the same schedule of reinforcement as in the treatment analysis and were paired with verbal praise (i.e. "nice job earning your tokens"). Matthew was also reminded of the rules of his token board ("earn five tokens and then you get ____") at the start of each session and returning to session from the earned reinforcer.

Figure 4 depicts the results of the effects of the treatment analysis in the natural setting. To assess maintenance effects, a 4-week probe was conducted at the end of the treatment analysis in the natural setting. The independent observer also recorded the frequency of items sorted at the end of the sessions during 38% of the sessions with a mean agreement of frequency of 99% (range: 94% to 100%). Table 1 depicts data recorded for ear plugging behavior during baseline and treatment sessions, reported as average occurrence per session, recorded using 6-s partial interval recording procedures.

CHAPTER 3: RESULTS

Figure 1 depicts the results of Matthew's functional analysis of ear plugging behavior across the eight experimental conditions.

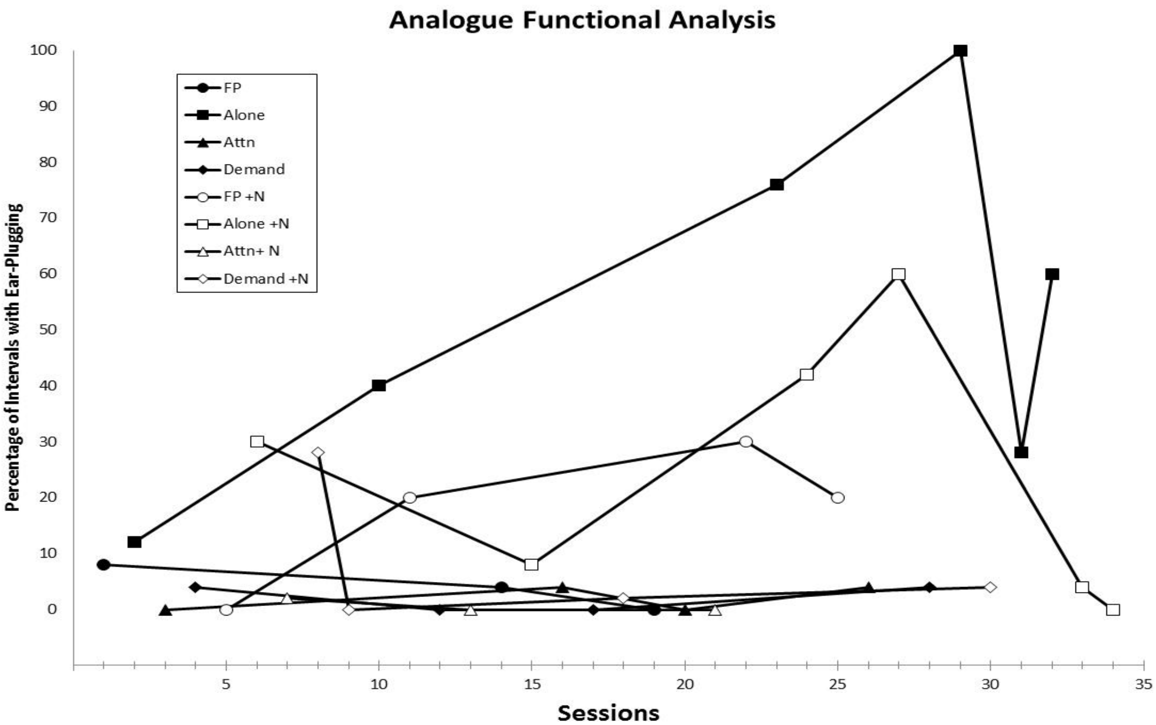

Figure 1. Functional Analysis Results for Matthew

Results of the functional analysis indicate that Matthew's ear plugging was maintained by automatic positive reinforcement, contrary to the team's initial hypothesis regarding the arousal reduction (i.e., escape from an aversive introceptive experience) function of ear plugging. Figure 2 depicts the occurrence data recorded for both vocal stereotypy and ear plugging during the final four sessions of the functional analysis. These data demonstrated high degree of correspondence between ear plugging and vocal stereotypy. Both behaviors occurred at high rates during the alone condition, suggesting an automatic positive reinforcement function for both behaviors.

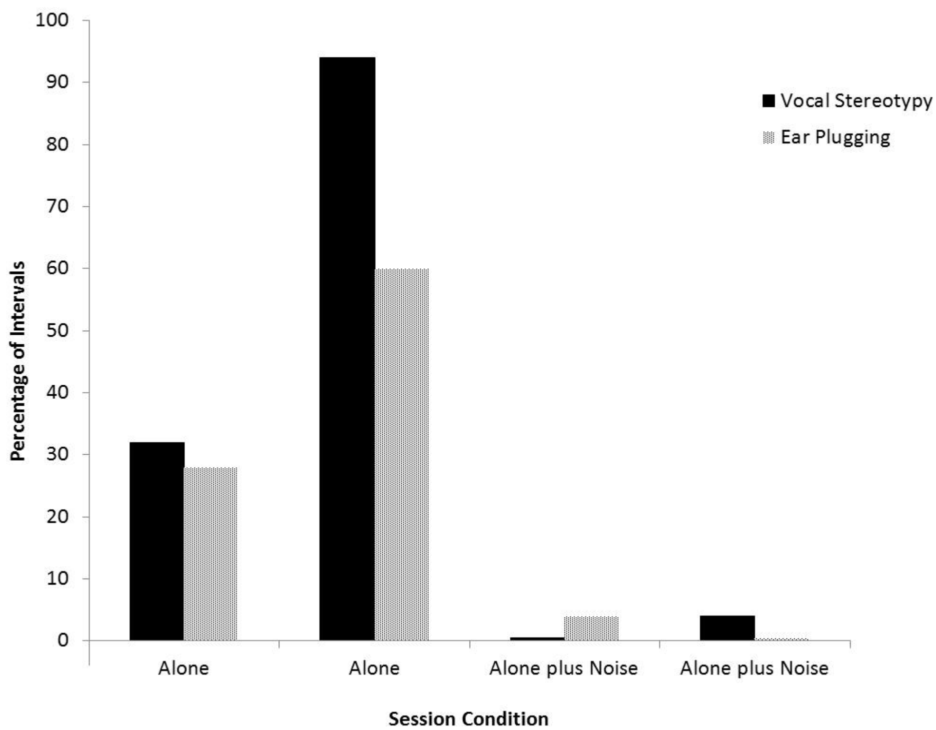

Figure 2. Percent occurrence of vocal stereotypy and ear plugging in the final four sessions of functional analysis

Figure 3 depicts the results of the treatment analysis, which compared the relative effectiveness of three treatments addressing ear plugging and task performance: noncontingent headphones, contingent headphones, and contingent video. The results indicated that compared to baseline, all three treatments were effective at decreasing ear plugging behaviors. Contingent access to headphones or video was similarly effective in increasing task performance, and both produced much higher levels of task performance compared noncontingent headphones. These data suggest that both contingent headphones and contingent videos function as reinforcers for task performance.

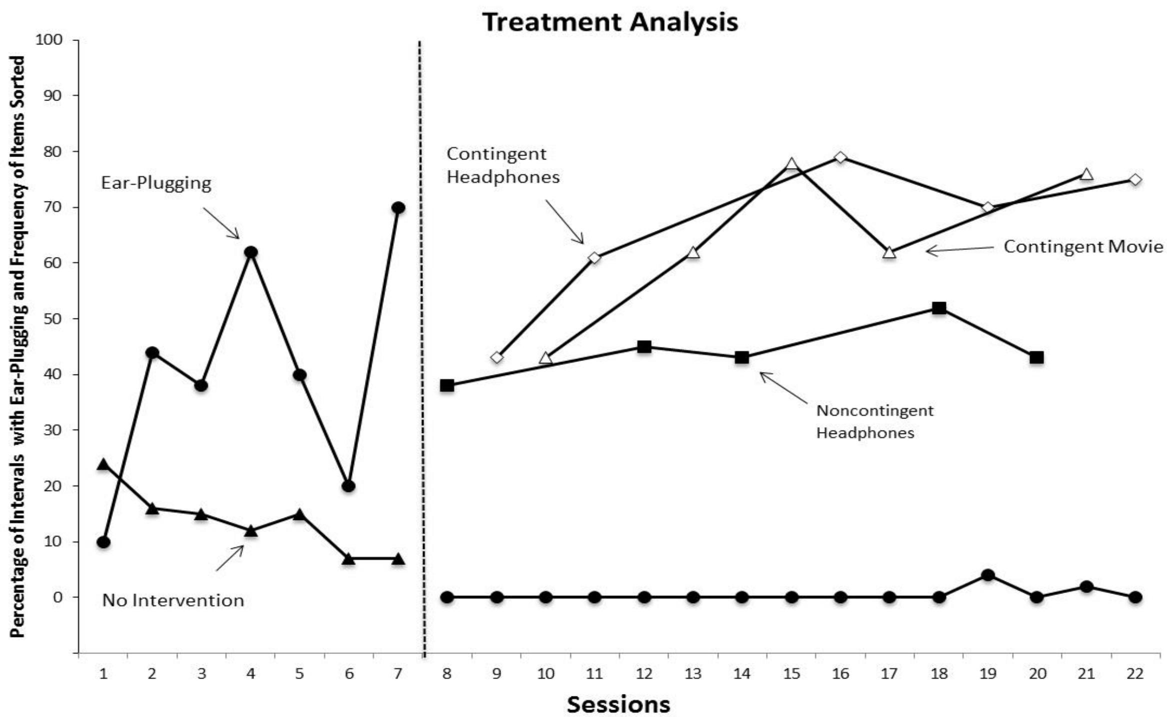

Figure 3. This graph displays the results of the treatment analysis comparing the effects of NCR headphones to DRI using contingent access to headphones or video player

In the final phase of this study, the experimenters analyzed the effects of contingent headphones and contingent videos on task performance in Matthew's natural educational setting. During the treatment analysis, Matthew completed his functional activities in the quiet analogue setting of the therapy room. Therefore, concerns regarding the validity of this treatment with functional skills within the school setting were raised. A treatment analysis was designed to evaluate the reinforcing properties of the headphones in the natural setting around Matthew's school. Figure 4 depicts the results of the treatment analysis in the natural setting, which indicate that the treatment was found effective in the analogue treatment analysis (i.e. contingent access to either headphones or video) and was effective at increasing task performance in the natural setting during a variety of functional and meaningful tasks.

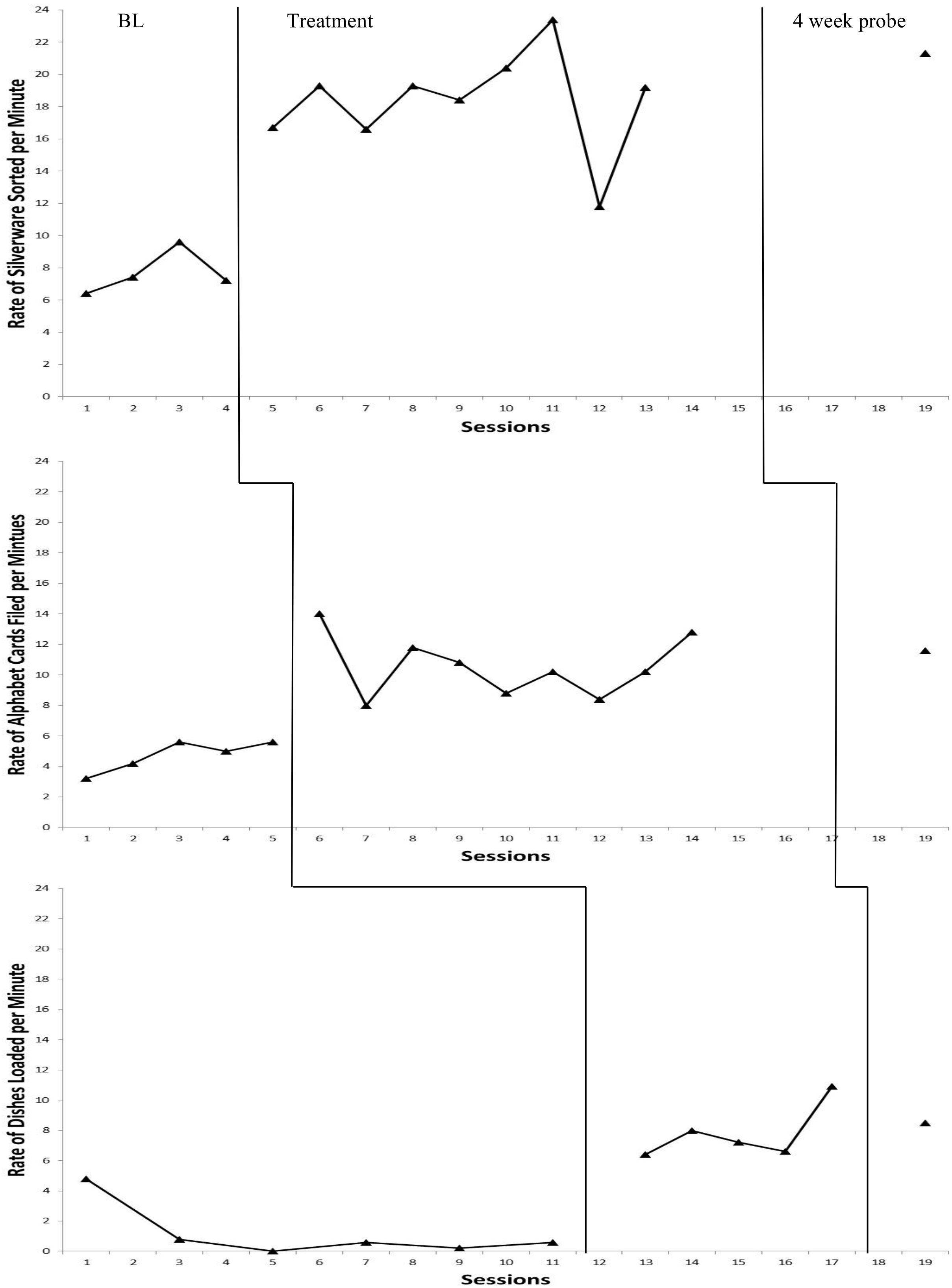

Figure 4. Treatment analysis in the natural setting for Matthew

As illustrated in Figure 4, the results of the treatment in the natural setting were maintained four weeks following the conclusion of the sessions. Data were collected on Matthew's preference for reinforcement (i.e., headphones or video). He chose access to headphones on 30% of all opportunities, while the rest of the time he chose access to the video.

Ear plugging behaviors occurred intermittently and at low levels throughout both baseline and treatment phases. For example, during the 15 baseline sessions, ear plugging occurred during four of those sessions, ranging from 4% to 18% of intervals. These data are consistent with percent occurrences of ear plugging during the functional analysis sessions in which Matthew was engaged in tasks or activities. During the 27 treatment sessions, ear plugging occurred during seven of those sessions, ranging from 2% to 24% of intervals. See Table 1 for average occurrences of ear plugging per session for baseline and treatment sessions across the three functional activities.

Table 1

Average occurrence of ear plugging during baseline and treatment sessions.

Functional Activity	Average occurrence of ear plugging per session in Baseline	Average occurrence of ear plugging per session in Treatment
Silverware	5.5%	3.8%
Filing	4.8%	1%
Dishwasher	1.7%	1%

CHAPTER 4: DISCUSSION

The study described above illustrates a single case design that follows the initial functional analysis through treatment design and generalization of treatment effects in the natural setting. The student participant in the study presented with a common clinical behavior (i.e., ear plugging) associated with his diagnosis (ASD). For many years, his clinical team hypothesized that environmental auditory stimuli were aversive and he engaged in ear plugging to block the aversive stimuli (i.e., automatic negative reinforcement). Based on anecdotal observations, a well-meaning clinician recommended the use of noncontingent access to noise dampening headphones to reduce the occurrence of ear plugging behaviors.

During the functional analysis, the audio samples played in the "plus noise" conditions were drawn from a variety of settings (i.e., busy lunchroom, students engaging in interfering behaviors, small group instruction, etc.) that had been reported during a clinical interview to increase the likelihood of ear plugging behavior. However, this was not demonstrated consistently during the functional analysis, which showed the highest occurrence of Matthew's ear plugging behavior during the alone (without noise) condition. These data supported the hypothesis that Matthew's ear plugging was maintained by automatic positive reinforcement. While vocal stereotypy was not systematically manipulated during the functional analysis, it is noteworthy that co-occurrence data reported in Figure 2 demonstrate high correspondence between the two behaviors. It is also important to note that the two behaviors (i.e., ear plugging and vocal stereotypy) occurred at much higher rates during the austere alone conditions, as described by Betz and Fisher (2011), compared to the alone plus noise conditions. Thus both ear plugging and vocal stereotypy appear to be maintained by automatic positive reinforcement.

The results of the functional analysis changed the way that Matthew's clinical team viewed his ear plugging behavior, as well as the functional relationship of his headphones as an intervention. These data support a hypothesis that ear plugging and the noise dampening headphones are maintained by automatic positive reinforcement; that is, they both modulate the auditory stimulus. This is in contrast to the original automatic negative reinforcement hypothesis, which suggested that ear plugging or noise dampening headphones served to reduce an aversive auditory stimulus. A new research question emerged: could headphones function as reinforcement for task performance and with collateral reductions of ear plugging behaviors during instructional programming? Similar to Steege et al. (1989), the next phase of this study combined the results of the functional analysis of problem behavior, in this case ear plugging, and the results of preference assessment, in this case videos and headphones, to develop an intervention comprised of differential reinforcement of incompatible behavior to reduce ear plugging and to increase task performance. This question was directly addressed by comparing noncontingent access to his headphones, contingent access to a preferred activity (i.e., video), and contingent access to headphones. As illustrated in Figure 3, the contingent headphones and contingent videos were effective at both increasing his performance with the sorting task, as well as suppressing the occurrence of ear plugging during the treatment conditions.

While very few occurrences of ear plugging occurred across the three treatment conditions, Matthew had access to his ears during the two contingent reinforcement conditions, as they were not blocked by the presence of the headphones. Treatment analysis also indicated that contingent reinforcement, video and headphones, was more effective at increasing task performance compared to noncontingent access to his headphones. In fact, headphones were comparable in their reinforcing properties compared to the activity reinforcer. These results have dramatic implications for Matthew's educational programing, however, the question remained whether these treatments would be effective within the natural educational setting during meaningful functional activities.

To address this final research question, a multiple baseline design across functional tasks was used to evaluate the effectiveness of the interventions. As Figure 4 graphically illustrates, contingent access to either headphones or video was effective in the natural setting at increasing task performance and minimizing ear plugging behavior (see Table 1). These gains were also maintained four weeks later as evidenced by probe data collection. Matthew was also allowed to choose which reinforcer he wanted to work for during these activities. Although Matthew's choice behavior was higher towards the video player (i.e., 70%), his choice of headphones at 30% of opportunities further confirms their functional property as a reinforcer.

This study demonstrates the importance of going beyond experimental analyses of problem behavior by incorporating a treatment analysis that validates both the results of the functional analysis and the effectiveness of the recommended interventions. Identifying reinforcers that are strong enough to compete with behaviors maintained by automatic reinforcement can be challenging in applied settings. Students with developmental delay and autism spectrum disorder may therefore engage in high rates of automatically reinforced interfering behaviors, particularly stereotypy, that leave clinicians searching for activities, tangibles, or edibles that can compete with their occurrence. For Matthew, this analysis allowed for identification of a powerful reinforcer that increased task performance and effectively competed with behaviors maintain by automatic positive reinforcement.

The primary limitation of this study was that this was an analysis of a single subject and it would be premature to generalize these results to all individuals on the autism spectrum. It is possible that there are individuals with ASD who are sensitive to auditory stimuli or find certain noises aversive, and may benefit from the use of noise dampening headphones. However, this study is consistent with decades of research demonstrating the value of functional analysis procedures that identify the true functions of behaviors. Based on functional understanding of behaviors, clinicians can then design and implement function-based treatment recommendations with better treatment outcomes. The current study also provides a methodology for assessing automatic negative reinforcement in the functional analysis by using a “plus noise” condition for behaviors that are suspected to be maintained by escape or avoidance of aversive auditory stimuli. A “plus noise” condition can be used to contrast the austere alone (i.e., quiet, sensory deprivation) traditionally used to assess automatic positive reinforcement, in a brief methodology for differentially assessing automatic reinforcement, an area in need of clinical attention.

In general, clinicians should use caution recommending topography-based interventions, such as noise dampening headphones, to address behaviors that have not been analyzed through comprehensive functional behavioral assessments for a number of reasons. While some individuals with the diagnosis of ASD may have sensitivities to certain sounds or environmental stimuli, it may be detrimental to the individual to recommend an intervention without understanding the function of the behavior. For example, headphones as an intervention can be socially stigmatizing for the individual wearing them. Headphones may also function as a stimulus delta (S^{Δ}) for social communication (i.e., signaling that the individual is unavailable for verbal communication). Moreover, the use of reinforcement (i.e., headphones) contingent on the occurrence of disruptive behaviors (i.e., agitation) may be strengthening problem behaviors. For example, headphones provided contingent on problem behaviors (i.e. agitation, disruptive behaviors, etc.) under the assumption that headphones abolish the aversive auditory stimuli in the environment may actually function as a reinforcer, therefore providing reinforcement for problem behavior. However, this level of assessment may not always be practical in applied settings, as this study took many hours of systematic preparation and implementation to complete. Regardless, the information gathered in this assessment will have important implications for Matthew's future programming, and serves as a cautionary tale for clinicians in applied settings recommending sensory interventions without functional assessment.

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Erin Beardsley was born in Buxton, Maine on April 21, 1981. She was raised in Gorham, Maine and graduated from Gorham High School in June of 1999. Erin attended Bates College in Lewiston, Maine and graduated with a Bachelors of Arts in Psychology in May of 2003. In the fall of 2005, Erin entered the Masters in School Psychology program at the University of Southern Maine. After completing her internship at the Margaret Murphy Center for Children, Erin graduated with her Masters of School Psychology and Certificate in Applied Behavior Analysis in May of 2009. Erin continued her employment at the Margaret Murphy Center for Children as a Certified School Psychologist and Nationally Certified School Psychologist (NCSP) and pursued her supervised experience in applied behavior analysis towards accreditation as a Board Certified Behavior Analyst (BCBA), which she received in the fall of 2011.

After completion of the Doctoral Degree in School Psychology, Erin will continue her employment at the Margaret Murphy Center for Children's middle and secondary school program. She will continue to pursue professional competencies in the areas of research design and publication, functional analysis of challenging behaviors, and training and support of staff in the understanding and implementation of the principles of applied behavior analysis. She is a candidate for the Doctoral degree in School Psychology from The University of Southern Maine in August of 2014.