The Assessment and Treatment of Precursor Behavior

Evoked by Aversive Noise in a Residential Setting

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Abstract

Previous research has demonstrated both an effective methodology of assessment and treatment of problem behavior evoked by aversive noises. The current study extended previous research by conducting both the assessment and treatment of precursor behavior evoked by a peer’s noises within a residential setting. During the first phase, a modified functional analysis (McCord, Iwata, Galensky, Elligson, & Thomson, 2001) was conducted for three participants with autism. Precursor behavior occurred during only the escape from noise condition of the functional analysis suggesting that all three individual’s tantrum behavior was evoked by a specific peer’s noises and maintained by escape from these noises. An intervention consisting of extinction combined with stimulus fading, during which the duration of the aversive noise was systematically increased, was then implemented. Near zero levels of precursor behavior in the presence of the loud noise was observed across all three participants during the final three 10 minute sessions.

Keywords: Establishing operations, noise, stimulus fading
The Assessment and Treatment of Precursor Behavior Evoked by Aversive Noise within a Residential Setting

An establishing operation (EO) is a motivating operation that establishes (increases) the effectiveness of some stimulus as a reinforcer (Cooper, Heron, & Heward, 2007). Michael (2000) was the first to consider the clinical implications of establishing operations and suggest refinements to the concept. Michael discussed the following four points: three steps in the development of EO terminology, his early neglect of its possible relevance to applied behavior analysis, the importance of functional analysis methodology for increasing awareness of EO issues, and three comprehensive reviews that clarify the role of EOs in applied work. Michael also stated that further examination of the role of EOs is necessary in future research.

Since the publication of Michael’s work on EOs (1982, 1993, and 2000), researchers have focused on the ways that EOs can potentially alter the effects of contingencies that maintain problem behavior. In one recent example, O’Reilly et al. (2006), conducted a preliminary examination of the evocative effects of the establishing operation on problem behavior maintained by positive reinforcement. Two individuals diagnosed with autism, both of whom lived in a residential facility, participated in the study. The study was conducted in three phases: functional analysis, presession access versus no access to the reinforcer, and presession access versus no-access extinction. For both participants, all three phases were conducted in a multielement format. The functional analysis conditions were based on procedures by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Within the functional
analysis phase, tangible items (participant 1) and attention (participant 2) were identified as the consequences maintaining problem behavior. In the presession condition, which compared access to no access to the reinforcer, participants were provided either free access to tangible items or attention 10-15 minutes prior to the start of the session, or no access to tangible items or attention for 15-30 minutes prior to the start of the session. Problem behavior occurred at higher rates when access to tangible items and attention were restricted as compared to the access condition. The presession access versus no-access extinction condition was identical to the previous phase except that there were no consequences for the occurrence of problem behaviors during the session. Within this phase, problem behavior occurred at higher rates for both participants during extinction sessions when participants did not have prior access to reinforcers. The results of this study indicated that isolating and manipulating putative EOs may be helpful in clarifying operant functions when functional analysis results are unclear or when problem behavior appears to be multiply controlled.

In the field of applied behavior analysis, there has been considerable research suggesting several different kinds of EOs that might evoke problem behavior. EOs that have received considerable attention include: deprivation from positive reinforcers, aversive task demands, and physical conditions that can cause discomfort or decrease tolerance to environmental situations. However, one potential EO that would benefit from further examination is the effects of noise as an establishing operation. This research is important because it has been suggested that more than
40% of those on the autism spectrum exhibit auditory hypersensitivity (Rimland & Edelson, 1995).

O’Reilly (1997) conducted a functional analysis of episodic self-injury correlated with recurrent otitis media paired with background noise. The purpose of the study was to examine potential analogue techniques to assess the function of episodic SIB and the relationship between the presence of SIB and otitis media. One participant, who was diagnosed with moderate developmental disabilities and Williams syndrome, participated in the study. Six conditions were conducted in a multielement format that assessed the relationship between SIB and the presence of otitis media. The six conditions were: social attention, escape from demands, play, alone, radio on, and escape high sensory. The participant exhibited zero rates of self-injury in the absence of otis media; however, when otis media was present, the functional analysis showed undifferentiated results. The participant exhibited low rates of responding during the alone condition, which suggested that self-injury might be maintained by escape from noise. When the radio was on with otis media present, the participant exhibited high rates of self-injury. Similar results were also shown within the escape high sensory condition with otis media present. These results indicated that SIB occurred at high rates when loud noise was introduced to the environment and that SIB also may have served a sensory escape function when otitis media was present. The results of the study indicate that noise may play the role of an EO for some individuals’ problem behavior and should be considered when
conducting a functional analysis and that otitis media may have served as an EO related to escape from ambient noise.

Another study conducted by O’Reilly, Lacey, and Lancioni (2000) assessed the influence of background noise on escape-maintained problem behavior and pain behavior. Specifically, this study examined how hyperacusis (intolerance for ordinary sound levels) influenced the rate of problem behavior under functional analysis assessment conditions. One individual, who was diagnosed with Williams syndrome and who functioned within the moderate range of intellectual disability, participated in the study. Problem behavior during a series of three functional analysis conditions, play, attention, and demand, was examined. During each of these assessment conditions, levels of problem behavior were observed in the presence of no noise, noise, and noise plus earplugs. The participant exhibited zero rates of problem behavior when no noise was present across all three functional analysis conditions. Within the play and attention conditions paired with noise, the participant exhibited very low rates of problem behavior. However, during the escape from demand paired with noise condition, the participant exhibited high rates of problem behavior. The results indicated that background noise influenced responding under functional analysis conditions by increasing the aversive characteristics of the task demands. The results also support previous research suggesting that an individual’s potential hypersensitivity to sound should be considered when conducting a functional analysis of problem behavior.
Both the O’Reilly (1997) and O’Reilly and Lacey, Lancioni (2000) assessed noise as an EO for the challenging behaviors of individuals with Williams syndrome. Unfortunately, neither of these studies provided treatment data. McCord, Iwata, Galensky, Ellingson, and Thomson (2001), however, offer this data. In this study, noise was examined as an EO for two individuals with developmental disabilities. The four phases included within this study were an initial noise assessment (phase one), a modified functional analysis (phase two), a preference assessment (phase 3), and a treatment evaluation (phase four). In the first phase, 7 participants were assessed who direct care staff referred to the study because they exhibited auditory hypersensitivity. However, during the noise assessment, only 2 out of the 7 participants exhibited challenging behaviors in the presence of certain noises (e.g., a peer’s noise and a telephone ringing). In the second phase of their study, the authors implemented a modified functional analysis that included three conditions. In the play condition, participants engaged with leisure materials and interacted with a staff member. In the no interaction condition, participants engaged with leisure materials and a staff member did not interact with them. During both the play and no interaction conditions, the aversive noise was not present. The noise condition was similar to the play condition; however, the aversive noise was presented and, if participants exhibited challenging behavior, the noise was terminated for 30 seconds. The results from the functional analysis demonstrated that noise was an EO for problem behavior and was maintained by negative reinforcement (escape) from aversive noise.
Based on these results, an extinction plus fading procedure was implemented for both of the individuals. Treatment sessions for both participants began with aversive noises presented at 50 dB. The noise was then increased by 2 dB following three consecutive sessions with zero rates of challenging behavior. If participants continued to exhibit challenging behavior at a given noise level, participants were moved back to the previous level and the criterion for increasing the volume was doubled. For one participant, a differential reinforcement of other behavior procedure (DRO) was also implemented since she was unable to meet the end of treatment criterion with stimulus fading alone. During DRO sessions, the participant was given an edible for exhibiting appropriate behaviors while tolerating the aversive noise. The results extended previous research on noise and EO for challenging behavior by demonstrating a significant decrease in problem behavior following the implementation extinction plus fading procedure.

Because it can be difficult to terminate aversive noises within naturalistic environments, McCord et al. (2001) used extinction plus stimulus fading as their treatment intervention. This procedure has not been extensively investigated, however, Pace, Iwata, Cowdery, Andree, and McIntyre (1993) did examine stimulus (instructional) fading during the extinction of self-injurious escape behavior. The purpose of the Pace et al. (1993) study was to examine the benefits of combining antecedent and consequent approaches to the treatment of self-injurious escape behavior through the use of stimulus fading combined with escape extinction. The study also examined the effects of fading tasks based on frequency rather than fading
task difficulty. Three individuals with severe to moderate mental retardation who exhibited several topographies of SIB participated in this study, which was conducted at a residential facility. Three different conditions were conducted including baseline (which was similar to the escape condition of the functional analysis), extinction (all occurrences of the behavior were ignored), and extinction plus fading (all occurrences of SIB were ignored and the amount to tasks presented each session was varied). Each participant in the study exhibited higher rates of SIB within the instructional (demand) condition that also contained a brief time out from the task contingent on self-injury. During the treatment condition, SIB was placed on extinction and demands were eliminated and then gradually faded back in. Results indicated that the fading of instructional frequency accelerate the effects of extinction in all three participants. For each participant, a large and immediate reduction in SIB was only observed in the extinction plus stimulus fading condition.

Similarly, Zarcone, et al. (1993) also examined the therapeutic effects of extinction with and without instructional fading on SIB maintained by negative reinforcement (escape). Three women diagnosed with profound mental retardation and histories of SIB were included in this study which took place at a residential facility. The treatment evaluation phase included a baseline similar to the demand condition of the functional analysis. Each participant was then exposed to escape extinction (all SIB was ignored) which was followed by escape extinction plus instructional fading (all occurrences of SIB were ignored and the frequency of instructional trials were faded in over time). For all three participants, extinction
alone reduced SIB to the end of treatment criterion faster than the extinction plus fading procedures. However, for two out of the three subjects, there was an initial increase in SIB in the frequency of SIB at the onset of treatment with extinction (an extinction burst) that was not seen within the extinction plus fading procedure. The results of this study indicated that extinction alone was an effective treatment for SIB, although it was associated with an initial burst of responding at the onset of treatment. Within the stimulus fading condition, no initial burst of responding was observed when used in combination with extinction. These results also demonstrated that each of the three subjects’ SIB decreased rapidly at the outset of treatment when utilizing the stimulus plus extinction treatment package.

Zarcone, Iwata, Smith, Mazaleski, and Lerman (1994) examined the reemergence and extinction of self-injurious escape behavior during stimulus (instructional) fading. The purpose of the study was to determine if a decrease in the rate of instructional trials, when used as the only intervention, would produce a large initial decrease in escape-maintained SIB. The treatment phase included a baseline condition (which was similar to the demand condition within the functional analysis), instructional fading (initially eliminating all task demands and then slowly fading them back in over time), and extinction (suspension of the fading procedure and implementation of SIB no longer producing escape from demands). These phases were conducted in a multiple baseline across subjects design. For each of the participants, instructional fading (without an extinction component) eliminated SIB initially; however, these results were not maintained. All three participants required
multiple exposures to extinction over the 150 treatment sessions in order to meet the end of treatment criteria set by the authors. The results of this study indicated that instructional fading was an effective treatment method for reducing self-injurious escape behavior. These results also demonstrated a rapid elimination of SIB within all three participants once the frequency of instructions was reduced even though SIB still produced termination of the instructional trial. However, each of the participants required an extended course of treatment and needed to undergo 3-5 exposures to extinction in order to maintain low levels of SIB. These results indicated that rapid initial reductions in SIB are possible by simply reducing the frequency of task demands; however, extinction still may be a necessary component for this type of treatment package in order to maintain low levels of SIB maintained by negative reinforcement.

The purpose of the present research is to extend the findings on noise as an EO for problem behaviors. The research attempted to replicate both the functional analysis and treatment analysis demonstrated by McCord et al. (2001). In addition, the current research extended previous studies by, a) conducting functional analyses and treatment assessments on precursor behavior, b) conducting the functional assessment and intervention within the residential setting, and c) conducting stimulus fading with the duration of the aversive stimulus.
General Method

Participants and Setting

Three males, ages 12-18 years old, were selected to be participants in this study. All three participants were diagnosed with autism; they attended school and lived in the residential program at Melmark New England. Each of the participants had a history of maladaptive behaviors including SIB (Alan and Aaron only) and aggression. All of the participants also have a history of noise sensitivity. Each of the participants had deficits in expressive, receptive, and pragmatic language. Alan and Aaron were verbal, but had a limited vocabulary. John was non-verbal and utilized gestures and pointing as his main form of communication. During this study, John was currently being trained to use Picture Exchange Communication (PECs).

Both the functional analysis and treatment sessions were conducted in the residential setting where the participant lived with eight other peers (6 other males and 2 females). The residence was a two floor house with five bedrooms, two living rooms, four bathrooms, a kitchen, and a dining room area. The functional assessment conditions were conducted in both living rooms and the student’s bedroom. Each of the living rooms was equipped with a television, various games and toys, couches, and end tables. The students’ bedrooms all contained a desk, at least one dresser, and at least one bed. Treatment sessions were conducted in one of the living rooms at the residence. A standard compact disc (CD) player was used in both the assessment and treatment sessions. Direct care staff reported that a specific peer’s sounds evoked each participant’s precursors. These peer noises were then recorded and played
during sessions on a standard compact disc. The CD player’s volume was turned up all the way and kept constant throughout all sessions. The CD player was positioned 15 feet away from the participant in all sessions.

**Response Measurement and Reliability**

Both functional analysis and treatment sessions were conducted at random times between 3pm and 10pm. Sessions were conducted 3-5 times per day, 4-6 days a week. All three participants had a history of exhibiting aggression to staff and peers. Alan and Aaron also had a history of exhibiting potentially tissue damaging SIB. Each participant’s precursor behavior was defined on an individual basis based on a descriptive assessment checklist. On the checklist, staff members identified the antecedent behaviors that each individual displayed immediately prior to engaging in challenging behavior occasioned by aversive peer noise. For John, precursor behavior was operationally defined as anytime he covered one or both ears with at least one hand or sticks his fingers into ears for at least 3 seconds and can also be paired with non-contextual loud vocals for at least 3 seconds. For Aaron, precursor behavior was defined as anytime he covered one or both ears with at least one hand, stuck his fingers into ears, or pressed his ears into shoulders for at least 3 seconds. These behaviors could also have been paired with non-contextual loud vocals for at least 3 seconds. Finally, for Alan, precursor was defined as anytime he covered or folded (taking the top part of the ear and holding it to the side of his head) one or both ears with at least one hand for at least 3 seconds. This behavior might also been paired with crying/whining (with or without tears) for at least 3 seconds. Non-
examples included cupping his hand to his cheek or cupping his ears. Precursor behavior was recorded using a 10-s partial interval measure and summarized as percentage of intervals with precursor behavior. If the student engaged in precursor at any time during the 10-second interval, the interval was marked with a yes. If the student did not engage in precursor during the interval, the interval was marked as no. The dependent variable was the percentage of intervals during which precursor behavior occurred. The percent of intervals were calculated at the end of each session by dividing the number of intervals that included the target behavior by the total number of intervals and multiplied by 100.

Interobserver Agreement (IOA) was conducted for 67% (range, 56-78%) of all functional assessment conditions and 77% (range, 75-78%) of treatment sessions across participants. Within each IOA session, staff members collected data on the target behavior simultaneously and independently of one another. Staff members that participated in these sessions had previous experience with the student, recording data, and participating in IOA sessions at the residence. Prior to each session, each staff member was given the operational definition of the target behavior and the partial time interval recording sheet. They were also given the instructions for recording on the 10-second partial time interval at that time. Each of the staff members then sat across the room from one another while recording data and was equipped with a MotivAider timer to signal the end of the interval. Agreement scores were calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplied by 100.
Mean interobserver agreement were 99.3% (range, 98-100%) for each of the functional analysis conditions and a mean 98.4% (range, 90-100%) for treatment sessions as averaged across participants.

Procedural checklists were written for all conditions. During the noise condition of the functional analysis, data were collected on whether or not the noise was terminated upon the occurrence of each participant’s target behavior and whether or not the noise continued to be delayed 30 seconds while the participant was engaging in precursor behavior. During all functional analysis conditions and treatment sessions, data were collected on staff interaction with the participants and whether or not precursor behavior was verbally ignored. Within the treatment sessions, individuals were scored on the duration the noise was played prior to the end of the session and if they continued to play the noise for 10 additional seconds if individuals engaged in precursor behavior during the last interval of the session. Procedural integrity data was collected across 60% (range, 55-75%) of all sessions across participants. Procedural integrity was a mean 100% for all functional analysis conditions, as well as treatment sessions.

**Phase 1: Preference Assessments**

**Procedure.** Prior to implementing the functional analyses with each participant, a paired-stimulus preference assessment (Fisher, et al., 1992) was conducted that included six leisure items. Prior to the assessment, each participant sampled one item at a time for 30 seconds. During each assessment trial, the therapist presented a pair of items to the participant, instructed the participant to pick one of the items, and then
allowed the participant to engage with the selected item for 30-seconds. If the
participants attempted to select both items, they were blocked and reminded to only
pick one item prior to the items being represented. If the participants did not select an
item within 10 seconds, both items were removed and the next trail began.
Preference assessment trials continued until all items had been paired together two
times. Highly preferred leisure items (selected during at least 80% of trials) were
included during all three functional assessment conditions as well as treatment
sessions.

Trained observers collected data on each participant’s selection during each
trial. An independent observer collected data on a minimum of 30% of trials across
preference assessments. Interobserver agreement was calculated by comparing each
observer’s recorded numbers on a trial by trial basis. Agreement scores were 100%
across all preference assessments.

**Results.** The results from each participant’s preference assessments are displayed in
Table 1. High preferred items were those selected by each participant in at least 80%
of trials. For Alan, the two highly preferred items were a rubber ball (80%) and Elmo
microphone (90%). John’s two highly preferred items were beads (100%) and a
spinning light (80%). Finally, Aaron’s showed a high preference for art supplies
(100%) and Mr. Potato Head (90%).
Phase 2: Functional Analysis

Procedure. Prior to each functional assessment, descriptive data were collected on each student’s precursor behaviors and also on the peer noises occurred prior to the participant exhibiting these precursor behaviors. Peer noises that resulted in each participant exhibiting challenging behaviors in at least 4 out of 5 descriptive assessments were selected as the noises for the escape condition of that participant’s functional analysis. Each participant was then exposed to three conditions arranged in a multielement design (Iwata, Dorsey, Bauman, and Richman [1982/1994]). The three conditions used in this experiment replicated the three conditions used by McCord et al. (2001). Each session lasted for 10 minutes and occurred in a semi-random manner so that no two sessions of the same condition were run back to back. Highly preferred leisure materials were selected for each participant based on the preference assessment phase data; and were presented during all three of the conditions. The noise condition was based on the informal staff interviews and observations. During these sessions, a CD, which was remained at a constant volume, was played that contained several different vocalizations from a peer who lived in the residence with the participant. Contingent upon the occurrence of precursor behavior, the CD was stopped for 30 seconds. If the participant continued to engage in precursor behaviors, the CD remained stopped for an additional 30 seconds until the participant had met 30 seconds calm criteria. In the play condition, a staff member worked with the selected participant and would deliver continuous social interaction throughout the session. If precursor behavior occurred during the
control condition, all instances were ignored and the participant was redirected back to the selected leisure items. Finally, in the no interaction condition, a staff member was present, but did not interact with the participant at any time during the session. Any occurrence of precursor behavior was ignored during these sessions. The noise and play sessions were conducted in the two different living rooms of the residence and the no interaction sessions were conducted in the participant’s bedroom. The CD containing vocalizations from the participant’s peer was not played during the play and no interaction conditions.

**Results.** During the functional analysis sessions, all three participants engaged in little or no problem behavior during the control conditions; however, they did engage in moderate levels of precursor behavior during the noise condition. The results from Alan’s functional analysis are displayed in Figure 1. Alan engaged in little or no precursor behavior during the play and no interaction conditions. During both control conditions, precursor behavior ranged from 3-13.3% of intervals. Within the noise condition, Alan engaged in moderate levels of precursor behavior which ranged from 30-35% of intervals. The results from John’s functional analysis are displayed in Figure 2. John engaged in zero rates of precursor behavior during the play and no interaction conditions. In the noise condition, John engaged in moderate levels of precursor behavior which ranged from 40-45% of intervals. Finally, the results of Aaron’s functional analysis are displayed in Figure 3. Aaron engaged in precursor behavior for 0-5% of intervals during the play and no interaction conditions. Like the
other two participants, Aaron engaged in moderate levels of precursor behavior during the noise condition ranging from 25-47% of intervals.

**Phase 3: Treatment Evaluation**

*Baseline.* The participants’ rate of responding during the noise condition of their functional analysis served as baseline for precursor behavior during treatment analysis. The clear differentiation between the functional assessment conditions suggested that for all participants noise was an establishing operation for precursor behavior that was maintained by escape from another peer’s vocalizations (negative reinforcement).

*Extinction plus fading.* Treatment sessions were identical to the noise condition conducted in the functional analysis with a few exceptions. Precursor behavior was placed on extinction. In other words, whenever participants exhibited precursor behaviors, they were ignored and redirected back to the leisure items available and the CD continued to play until the end of the session. The amount of time that each participant was required to listen to the CD of peer’s noises was determined on an individual basis. By analyzing the raw data from the functional assessment, each participant’s the latency of response to noise was calculated; that is, the amount of time from the onset of the noise to the start of precursor behavior. The session began when the therapist pressed play on the CD; session time was increased by 10 or 30 seconds when the participant exhibited precursor behavior at or below 80% of the mean baseline for three consecutive sessions. For Alan and Aaron, the duration of noise was increased if precursor behaviors were exhibited at or below 7%
of intervals. For John, the duration of noise was increased if precursor behaviors were exhibited at or below 9% of intervals. Once a participant’s data stabilized at 8 minutes with noise, sessions were increased by 1 minute. Criterion to decrease the amount of time the participant was required to listen to the peer’s noises as 3 consecutive sessions of precursor behaviors exhibited above 80% of the mean baseline. At the end of the session, each participant received a 2-5 minute break prior to the start of the next session. If a participant engaged in precursor behavior at the end of the session, the noise was not terminated until the participant did not exhibit precursor behavior for 10 seconds.

Experimental Design. A multiple baseline design across subjects with an embedded changing criterion design within participant was used to evaluate the effects of extinction plus stimulus fading.

Results. The results for all three participants are displayed in a multiple baseline format in Figure 4. Alan exhibited precursor behavior during a mean 32.3% of intervals during baseline. During baseline sessions, Alan began exhibited precursor behaviors 20 seconds after the start of the session. Based on the information from the raw data, Alan’s first treatment session began at 10 seconds. Alan continued to exhibit precursor behaviors during these intervals and only met fading criteria after 11 sessions at 10 seconds. After six sessions, Alan met fading criteria to move up to 1 minute and 10 seconds. However, at this point, he exhibited precursor behavior in 14% of three consecutive intervals and was moved back to 40 seconds. Alan then exhibited zero rates of precursor behavior for the next three
consecutive sessions at 40 seconds. Due to Alan’s difficulty at the beginning of treatment sessions, a decision was made to only fade Alan by 10 seconds until some stability was reached. When being faded 10 seconds at a time, Alan successfully met fading criteria with zero rates of precursor behaviors during sessions lasting 40 seconds through 2 minutes. Once Alan successfully faded to 2 minutes, Alan’s fading intervals were increased to 30 seconds. For the remainder of the sessions, Alan consistently met the moving up criteria after three sessions. At the end of treatment, Alan exhibited near zero rates of behavior and was successfully faded to 10 minutes.

John’s results were a different in that he was able to meet fading criteria faster than Alan. John exhibited precursor behavior during a mean 42.2% of intervals during baseline. During baseline sessions, John began exhibited precursor behaviors around 50 seconds after the start of the session. Based on the information from the raw data, John’s first treatment session began at 30 seconds. John exhibited zero rates of precursor behavior and was faded up to 1 minute and 30 seconds. John then exhibited precursor behavior in 11% of intervals and met fading criteria after 5 sessions. John consistently met the fading criteria and was faded up after every three sessions. John continued to exhibit near zero rates of precursor behavior and successfully faded up to 10 minutes.

Aaron’s response pattern was similar to that show by Alan. Aaron exhibited precursor behavior during a mean 35.4% of intervals during baseline. During baseline sessions, Aaron began exhibited precursor behavior around 50 seconds after
the start of the session. Based on the information from the raw data, Aaron’s first treatment session began at 30 seconds. Initially during treatment sessions, Aaron exhibited zero rates of precursor behavior and was faded up to 40 seconds. However, once Aaron reached 50 seconds he exhibited precursor behaviors during 80% of intervals. Aaron finally met criteria to fade to 1 minute after 8 sessions. Aaron had another increase in responding during sessions at 1 minute and 20 seconds. However, Aaron then exhibited zero rates of behaviors and was faded up to 1 minute and 30 seconds after only 4 sessions. After this increase in responding, Aaron consistently met criteria to move up after only three sessions. Aaron then exhibited near zero rates of precursor behavior during the remaining sessions and successfully faded up to 10 minutes.

Discussion

Results from several studies suggest that noise evokes problem behavior in individuals with developmental disabilities (e.g., Mc Cord, et al., 2001; O’Reilly, Lacey, and Lancioni, 2000). This is not surprising because noise can have several potentially aversive characteristics. Our results are consistent with previous research demonstrating the aversive characteristics of noise. In fact, all three participants exhibited moderate levels of responding during the escape condition of the functional analysis and low to zero rates of responding during the two control conditions. These results indicate that aversive peer noises are an EO for precursor behavior and that precursor behavior was maintained by negative reinforcement (escape) from aversive peer noise. An analysis of this data allowed the author to develop a systematic
intervention that increased all participants’ tolerance to specific peer noises within a residence. Noise tolerance was developed in structured session and this tolerance appeared to generalize into the natural environment of the residence.

The results from this study not only replicated previous findings by McCord, et al. (2001), but they also extended findings on noise as an EO into another applied setting. All functional analysis and treatment sessions were conducted at the residence where each of the three participants lived. By conducting all sessions at the residence, students were already in the environment where they would come into contact with their peer’s noises. This setting may have helped each student generalize their tolerance to their peer’s noises faster than if they were in an analogue setting. A five question social validity survey was conducted that assessed whether the participant’s precursor behavior occurred the presence of aversive peer noises, tolerance was an important skill to have within the residence, and if participants were able to tolerate noises subsequent to completion of the study. Ten staff members who work at least 8 hours a day with the participants at their residence were asked to rate whether they strongly agreed (5), agreed (4), neutral (3), disagreed (2), or strongly disagreed (1) with each question. The results from the social validity survey are displayed in Table 2. For all three participants, all staff members strongly agreed (range, 4.8-5) that tolerance was an important skill within the residence and this skill was also important in situations where escape from aversive noises was not always available. Also for all three participants, staff members agreed (range, 3.4-4.8) that they covered their ears prior to engaging in challenging behavior in the presence of
aversive peer noises. Finally, staff members also agreed (range, 3.8–4.9) that all three participants have been able to better tolerate peer noises over the past month.

The present study also extends previous research by examining the reduction in precursor behavior instead of challenging behavior. In many cases, severe problem behaviors such as SIB or aggression are unethical to examine within a functional analysis due to the severity of their potential damage to the participant or people conducting the study. Within these cases, it may be unethical to evoke such severe problem behavior in order to determine its function and develop a function-based treatment. However, by examining precursor behaviors that are in the same response class as the more severe challenging behaviors, one is still able to develop a function-based treatment (Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008). All three participants in this study engaged in precursor behavior prior to engaging in maladaptive behaviors such as SIB or aggression. Results from the functional analysis indicated that these precursor behaviors were maintained by negative reinforcement (escape) for all three participants. By implementing an intervention that included extinction plus stimulus fading, all three participants demonstrated that they could tolerate peer noises for 10 minutes. Also, by examining precursor behaviors, the side effects of extinction (e.g., an extinction burst) were not as evident. However, one potential limitation to this study was that data was not taken on challenging behavior (e.g., SIB or aggression), so the relation between precursor and target problem behavior remains unclear.
Finally, this study extends previous research on extinction plus stimulus fading. Firstly, the duration of noise was systematically faded versus fading the level of the noise (McCord el. al., 2001). Since it is difficult to control the level of noise within a residential setting, the author decided that fading the duration of noise would be more realistic. Secondly, although a very effective function-based treatment, extinction can have several negative side effects. Some side effects of extinction include an increase in the frequency of the target response (extinction burst) and an increase in aggression. In previous studies, extinction plus fading has minimized the side effects of extinction and also accelerated the effects of extinction (e.g., Zarcone, et. al., 1993). The current study demonstrated that extinction plus stimulus fading was an effective treatment for all three participants. By the end of the study, all three participants tolerated specific peer noises for 10 minutes. Because all of these individuals lived within the same residence, tolerance is an important skill to have as appropriate methods of escape (e.g., functional communication to leave the area) are not always available.

Although the study was relatively successful in reducing precursor behavior for all three participants, it has some limitations that should be noted. First, recorded peer noises were utilized throughout the study. Over time, participants may have habituated to these recordings since they never changed. In the natural environment, peer noises can be significantly different on a day to day basis. These peer noises could have different volumes and inflections that were not accounted for on the recordings. Another potential limitation is that there are un-programmed noises in the
residence. In the residence, up to 16 people (9 students and 7 staff members) could have been present at anytime during the study. Since the residence was a very busy place, there have been a considerable amount of un-programmed noises that might have interfered with treatment sessions. For example, peers could also have been on the same floor as the participants and could have exhibited loud vocalizations at the same time as the recording was played. Potentially, this could have made the peer noises appear even louder. An additional limitation to this study is that all of the fading steps may not have been necessary. A general criticism of fading procedures is that a possible prolonged exposure to aversive stimuli may increase challenging behavior in response to these frequent exposures. A probe could have been utilized for all three participants rather than repeated exposures through the different fading steps. Another potential limitation to this study is that there was no replacement behavior trained that would allow the participants to appropriately escape from noisy conditions. However, as mentioned previously, it is important for individuals living in a communal to tolerate a degree of noise since escaping from the noise is not always possible.

Future research should focus on including a replacement behavior such as functional communication training (FCT) or providing differential reinforcement of alternative behaviors (DRA). If they develop an initial level of tolerance to peer noises, participants would be able to endure specific peer noises until escape became available. Once escape was available, participants would be able to use an FCT response (e.g., “I need a walk, please.”) in order to momentarily escape the noisy
environment and therefore challenging behaviors would be avoided. Future research should also focus on generalization and maintenance of treatment effects within the residence and the school setting. In this study, participants were only exposed to one specific peer’s noises. However, there might be several peers within the residence that typically evoke challenging behaviors within these individuals. Perhaps also using extinction plus stimulus fading with other peer noises might also be beneficial. It should be noted that generalization of noise tolerance to other settings was not tested, nor was the behavior trained in more than one setting. It is possible that peer noises in other settings such as the school also evoked challenging behavior and, if so, tolerance of the behavior in that setting should also be addressed.
References

Upper Saddle River, NJ: Pearson Education Inc.

Fisher, W., Piazza, C.C., Bowman, L.G., Hagopian, L.P., Owens, J.C., & Slevin, I.


Functional analysis and treatment of problem behavior evoked by noise.
*Journal of Applied Behavior Analysis, 34,* 447-462.


### Tables

<table>
<thead>
<tr>
<th>Participant</th>
<th>High P1</th>
<th>High P2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>John</strong></td>
<td>Beads</td>
<td>Spin light</td>
</tr>
<tr>
<td><strong>Alan</strong></td>
<td>Rubber ball</td>
<td>Elmo microphone</td>
</tr>
<tr>
<td><strong>Aaron</strong></td>
<td>Drawing materials</td>
<td>Mr. Potato Head</td>
</tr>
</tbody>
</table>

*Table 1:* The two highly preferred items from each participant’s paired-stimulus preference assessment. Both items were selected within at least 80% of trials for all three participants.
<table>
<thead>
<tr>
<th>Question</th>
<th>Average for Alan</th>
<th>Average for John</th>
<th>Average for Aaron</th>
</tr>
</thead>
<tbody>
<tr>
<td>When a peer exhibits loud vocalizations, student covers his ears prior to engaging in SIB or AGG.</td>
<td>3.4</td>
<td>3.4</td>
<td>4.8</td>
</tr>
<tr>
<td>It is important for student to tolerate peer noises.</td>
<td>4.8</td>
<td>5</td>
<td>4.9</td>
</tr>
<tr>
<td>Although student has an FCT response (e.g., go walk or leaving the area), it’s important for him to tolerate noises when leaving the area is unavailable.</td>
<td>4.9</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Over the past month, student has been able to better tolerate peer noises.</td>
<td>4.9</td>
<td>3.8</td>
<td>4</td>
</tr>
<tr>
<td>Tolerance is an important skill to have within the residence.</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2: The average responses to questions from the social validity survey given to 10 direct care staff that work with all three participants within this study. The scale was ranked at (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, (5) strongly agree.
Figure Captions

Figure 1: The functional analysis of Alan’s precursor behavior in the presence and absence of a specific peer’s noises. The percent of intervals containing precursor behavior is on the ordinate and the session numbers are on the abscissa.

Figure 2: The functional analysis of John’s precursor behavior in the presence and absence of a specific peer’s noises. The percent of intervals containing precursor behavior is on the ordinate and the session numbers are on the abscissa.

Figure 3: The functional analysis of Aaron’s precursor behavior in the presence and absence of a specific peer’s noises. The percent of intervals containing precursor behavior is on the ordinate and the session numbers are on the abscissa.

Figure 4: The baseline and intervention phases of Alan, John, and Aaron’s precursor behavior evoked by noise. The percent of intervals containing precursor behavior is on the ordinate and the session numbers are on the abscissa. The duration of noise during the treatment sessions (in minutes) is located on the secondary ordinate. The closed diamonds are the percent of intervals containing precursor behavior and the open triangles are the duration of noise in minutes.
**Figure 1:** The functional analysis of Alan’s precursor behavior in the presence and absence of a specific peer’s noises. The percent of intervals containing precursor behavior is on the ordinate and the session numbers are on the abscissa.
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