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Using Differential Reinforcement to Reduce Diurnal Bruxism

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by

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DEDICATION

I would like to dedicate this manuscript to my family who has not only encouraged me to pursue higher education, but have also made many sacrifices so that this could be possible.

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ABSTRACT

The field of Applied Behavior Analysis is often used to intervene in dangerous or harmful behaviors to the benefit of service recipients. Many children engage in diurnal bruxism which can cause damage to their teeth, gums, and jaws. Tooth gnashing, which is a movement of the jaw that results in high impact between the lower and upper teeth, is a specific and damaging behavior which is included under the label of diurnal bruxism. This study examined the impact of using differential reinforcement of alternative behaviors to decrease the percentage of words spoken while gnashing teeth to reduce the long-term damage caused by this behavior. Opportunities to use vocal verbal behavior were contrived by asking the participant to tact pictures during Discrete Trial Training (DTT) sessions. This study provides evidence that differential reinforcement may be an effective method for reducing tooth gnashing behavior while tacting which generalized to other settings but not other types of verbal behaviors, such as manding. Tooth gnashing also decreased in frequency during client singing and self stimulatory behaviors.

INTRODUCTION

Bruxism is a behavior that over time can cause irreversible damage to an individual's oral structures if left untreated. Bruxism can include the clenching, grinding, or gnashing of one's teeth (Lang et al., 2009) which can occur in different ways. Bruxism can occur in a manner that is audible or inaudible, and nocturnally or diurnally. Nocturnal bruxism occurs in the night while an individual sleeps. Diurnal bruxism occurs during waking hours, meaning that diurnal bruxism is more likely to be successfully treated using behavioral interventions since the individual is awake during the time that treatment would occur. The effects of bruxism can include damage to an individual's teeth, gums, and oral and facial structures, which can result in pain associated with teeth being worn down, headaches, or pain in the face (Lang et al., 2009). The field of Applied Behavior Analysis (ABA) employs the use of many different interventions to address behavioral excesses or deficits for the benefit of service recipients (Cooper et al., 2020).

Due to the damage and pain that diurnal bruxism can cause, it is an important behavior to target using behavioral interventions. Despite the lifelong damage associated with it, the treatment of diurnal bruxism using behavioral interventions includes only a limited body of research. Some of the interventions that have been used in the past have used functional analyses to first address the function of bruxism before treating it. In one study, the function of diurnal bruxism was found to be automatic reinforcement (Armstrong & McAdam, 2014). This study used vocal and physical prompts to reduce bruxism as it occurred. Another study that used functional analysis to identify the function of bruxism, found that bruxism was maintained by both attention and escape functions (Lang et al., 2013). During this study, the participant was

taught alternative responses which included using vocal verbal approximations toward therapists' names to gain attention appropriately. In addition, Bebko and Lennox (1988) used different intensities of prompting to reduce bruxism during the day. In these instances, physical and verbal cues not to engage in bruxism were successful in reducing the amount of bruxism that occurred with multiple individuals. Barnoy et al. (2009) expanded upon Bebko and Lennox (1988) by analyzing the effectiveness of verbal, physical, and combined cues to reduce this same behavior. Barnoy et al. (2009) showed that the frequency of bruxism decreased more drastically when a cue was given that included both vocal and physical prompting than when a vocal cue was given alone in the absence of other prompting methods.

Each of the aforementioned studies were conducted with individuals diagnosed with autism or other developmental disabilities. The current study aims to build upon prior research by combining the use of differential reinforcement which was used by Lang et al. (2013) and a prompting hierarchy to reduce the frequency at which diurnal bruxism occurs. Tooth gnashing will be the specific behavior that is addressed as a subcategory of diurnal bruxism. The purpose of this study is to use prompting and differential reinforcement to reduce diurnal bruxism.

METHOD

Participant and Setting

The participant for this study was a 9-year-old boy diagnosed with autism spectrum disorder named Rufus. Rufus had been participating in ABA therapy for 7 years and used vocal verbal language to communicate prior to the beginning of the study. Rufus had a history of bruxism which had caused his teeth to be significantly worn down and cracks to form in his teeth. He additionally engaged in long durations of vocal and motor stereotypy, usually in the form of singing songs and stomping or hitting his chest to the beat of his singing. Rufus engaged in tooth gnashing behavior paired with humming, where the tooth gnashing occurred to the beat of his humming. The behavior of tooth gnashing had generalized so that it occurred when he used vocal verbal language in the form of tacting, manding, and echoics as well as during vocal stereotypy. The study took place in his home during his typical ABA sessions. Sessions for this study were conducted either on the floor in his living room or at the dining room table, which were alternated between randomly.

The participant chosen for this study had a history of engaging in nocturnal bruxism and diurnal bruxism in the form of tooth grinding. This had resulted in severe damage to his teeth and his teeth had been worn down significantly. This damage most significantly impacted his baby teeth, and this behavior had occurred less with his adult teeth. About two months prior to the start of the study, the participant had a cold and began engaging in tooth gnashing behavior paired with vocal stereotypy, namely while he would hum. After he recovered from this sickness, he continued to engage in tooth gnashing, which also occurred while he would use vocal verbal

behavior as well. This suggested that the behavior might be maintained by automatic reinforcement because it was paired with stereotypy.

Materials

Materials used for this study included laminated pictures of different objects and people. The objects included three different pictures of books, three different pictures of balls, two different pictures of boys swinging on a swing set, a picture of a boy eating, a picture of Rufus' mother, and a picture of his father. The pictures used for this study were stock images obtained from a search engine or were obtained from his parents. In addition to the picture cards, preferred edible items were used such as a lollipop, pasta shells with tomato sauce, vegetables, and rice bowls. A table which measured approximately 3-ft by 4-ft was used as well as two dining chairs. An iPad and apple pencil were used to record data.

Data Collection

Data were collected on tooth gnashing behavior which was defined as forcefully striking the top and bottom teeth together while simultaneously using vocal verbal language such that the impact between the teeth was loud enough to be heard from approximately 3-ft away. Rufus was presented with fifty picture cards during each session and was prompted to tact the object, verb, or person represented in the picture. When Rufus correctly tacted the picture that was presented to him, data were collected on whether that tact was emitted with or without the presence of tooth gnashing. If Rufus incorrectly tacted a picture, he was presented with the initial prompt and card again and data were collected when he correctly tacted the card.

Interobserver Agreement and Treatment Integrity

For the duration of this study, Rufus was receiving direct services from only one Registered Behavior Technician (RBT) and there were no other professionals in the company

who were able to collect interobserver agreement (IOA) data. Due to this limitation, IOA was not collected. Treatment integrity data was also not collected due to these staffing limitations. If others were available to collect IOA data, both the RBT and the second independent observer would have collected data on tooth gnashing behavior during at least 33% of sessions. IOA would have been collected on whether tooth gnashing did or did not occur for each of the fifty trials in each dually observed session. The number of agreements about whether tooth gnashing behavior did or did not occur would be divided by the total number of trials within the session and multiplied by 100 to receive a percentage. Treatment integrity data would have been collected by breaking up each step necessary for conducting the intervention, and training others to conduct the intervention. These steps would have been compiled into a task analysis. Data would have been recorded on whether those who participated in the study trained or conducted the intervention correctly. Direct observation would have been used to record whether each step included in the task analysis was completed correctly. The number of correctly completed steps for either the intervention or training would have been divided by the total number of steps included in that task analysis and would have been multiplied by 100 to receive a percentage.

Experimental Design

This study employed an AB design and the use of Discrete Trial Training (DTT) sessions to contrive opportunities for Rufus to speak and engage in tooth gnashing. The AB design was used to evaluate the effectiveness of using differential reinforcement as an intervention for reducing tooth gnashing behavior.

Procedures

Baseline

Each session was broken into fifty trials which each included the presentation of one picture card, any necessary prompts, and reinforcement. For each trial, Rufus was presented a randomly selected picture card and was given a prompt. These prompts were delivered in the form of questions which included, “what is this,” “what is he doing,” or, “who is this?” Each of the cards included in this study were pictures of objects, verbs, or people that he could independently tact. If Rufus incorrectly tacted the picture, he was re-presented with the initial prompt and card until he responded correctly. He typically only needed one extra prompt, but would correctly tact the card with no more than three additional prompts. When Rufus correctly tacted the picture card, brief verbal praise was delivered using phrases such as “nice job,” or “good work Rufus!” A new card was then presented with the aforementioned verbal prompts. When all fifty cards were presented, Rufus was offered a break and was able to leave the work area. Maladaptive behavior was blocked or ignored.

Differential Reinforcement of Alternative Behaviors

During the intervention, differential reinforcement was used to decrease the frequency of tooth gnashing behavior during DTT. Each session included fifty trials of DTT as was described in the baseline condition. For each trial, Rufus was presented with a picture card and was prompted to tact the card in the same manner as they were presented during baseline. If Rufus incorrectly tacted the card, he was prompted again as he was in baseline. When Rufus correctly tacted the picture, if he responded in the absence of tooth gnashing, he was given brief verbal praise paired with either a 5-s break or a bite of food before moving on to the next trial. The researcher randomly alternated between delivering the 5-s break and bite of food when reinforcement was delivered. If he tacted the card correctly but engaged in tooth gnashing, he was prompted to respond without tooth gnashing using least-to-most prompting. These prompts

included a verbal prompt in the form of the RBT saying “try again.” If he still responded with tooth gnashing, an additional prompt was given using the phrase, “no chomping,” or, “keep your teeth still.” If he continued to respond with tooth gnashing, a model prompt was used by modeling the tact without tooth gnashing and then a light touch to the cheeks if necessary. Once he responded without tooth gnashing, he was given brief verbal praise and the next card was presented. Maladaptive behavior was blocked or ignored.

RESULTS

The results of this study show that differential reinforcement was an effective intervention to reduce tooth gnashing behavior during DTT. During baseline, Rufus engaged in tooth gnashing behavior for an average of 80% of trials with a counter therapeutic trend (See Figure 1). When differential reinforcement was introduced tooth gnashing decreased so that it occurred on an average of 24% of trials. This showed a significant decrease in tooth gnashing behavior. Toward the end of the intervention phase, tooth gnashing behavior decreased to 0% of trials.

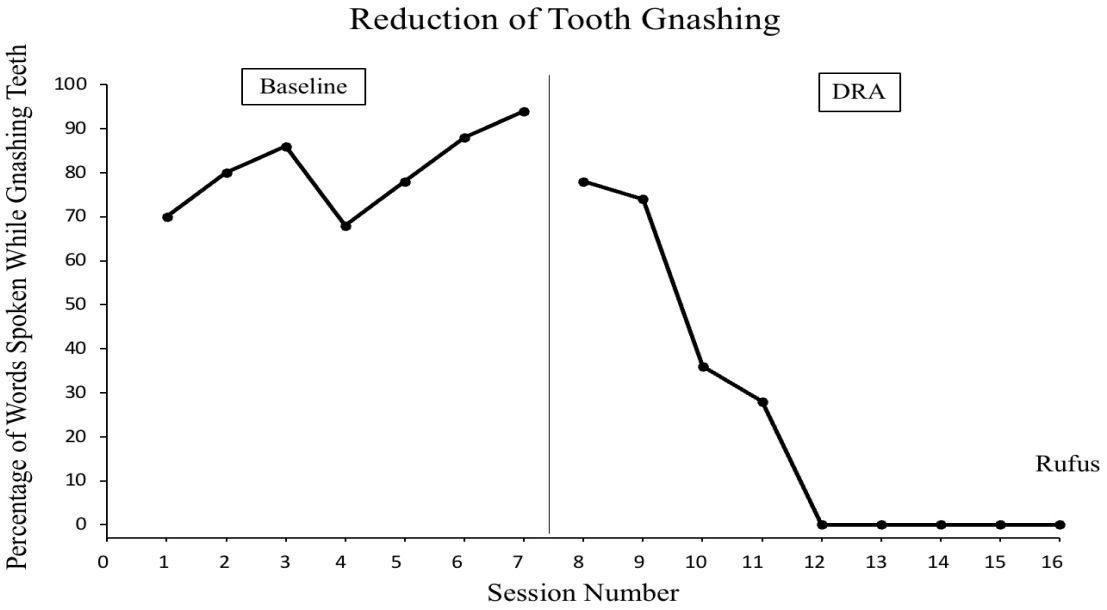

Figure 1

The percentage of occurrences of tooth gnashing behavior during DTT sessions is represented in this graph. Each data point represents one session, and each session included fifty DTT trials.

DISCUSSION

This study showed significant improvements in reducing tooth gnashing behavior as compared to the baseline condition. The intervention was simple to implement, given that only differential reinforcement and prompting were used to show improvements in decreasing tooth gnashing behavior. It is important to note that speaking in the absence of tooth gnashing behavior was already in the participant's repertoire prior to the start of the intervention but was not used often during DTT sessions. Past studies have addressed tooth gnashing behaviors within the environment that they occurred (Armstrong & McAdam, 2014; Barnoy et al., 2009; Lang et al., 2013) and the results of the interventions did not always generalize to other settings. This study used contrived opportunities to engage in tooth gnashing behavior, but the results may have also generalized to other settings. It was anecdotally observed after the conclusion of the study that the frequency of tooth gnashing behavior was reduced after during DTT in the home, and during the activities that the participant was typically involved in at school. Even when the RBT was not present, tooth gnashing behavior was reported to occur at reduced frequencies in both home and school. Tooth gnashing decreased when the participant tacted items during the duration of the study. It was observed after the conclusion of the study that tooth gnashing continued to occur when the participant manded, specifically when he manded for breaks or for preferred food items. Therefore, tooth gnashing appeared to generalize across settings but not across different behaviors. One limitation to this study is that data was not collected on tooth gnashing behavior across different times of day and settings. The collection of data on tooth gnashing behavior

during various times of day and across settings would have strengthened the findings of this study.

Differential reinforcement is an intervention that is commonly used within the field of ABA, and it does not often require the use of costly reinforcers or extreme time commitments. The accessibility of DRA as an intervention means that it could be incorporated easily into a treatment plan for individuals who engage in diurnal bruxism. Both edible and non-edible reinforcers were used during this study. There was a random alternation between edible reinforcers and 5-s breaks during the intervention phase, which together resulted in a decrease in tooth gnashing during DTT. Although these reinforcers were randomly chosen to be delivered contingent upon tacting without tooth gnashing, the participant seemed to show a strong preference for edible reinforcers. This was evidenced by the participant reaching for the food often when it was being used as a reinforcer. While a functional analyses of tooth gnashing was not conducted, it was hypothesized to be maintained by automatic reinforcement. Therefore, differential reinforcement was likely not a functionally equivalent reinforcer for tooth gnashing. It is possible that food was an equivalent stimulus to tooth gnashing which could have been more reinforcing than tooth gnashing. If that was the case, then it is possible that a higher quality reinforcer was provided contingent upon tacting in the absence of tooth gnashing. It is also possible that food is highly reinforcing to the participant which is why it was a potent reinforcer in reducing tooth gnashing, rather than it being a replacement stimulus.

Limitations to this study include that the function of bruxism for this individual was never formally tested, although it was hypothesized that it was maintained by automatic reinforcement as evidenced by its occurrence being paired typically with other self-stimulatory behaviors such as singing or humming. Past studies have used functional analyses before

implementing an intervention for bruxism, but the intervention reduced tooth gnashing without the use of a formal functional analysis to determine the function of bruxism for this participant. It is not known based on the results of this study whether differential reinforcement alone or prompting alone would have been effective interventions to reduce tooth gnashing. The prompting method was also topographically different from those used in previous studies which used pressure to the chin or jaw. Pressure to the chin or jaw would have been insufficient or inappropriate to reduce tooth gnashing since the participant needed to be able to speak while the physical prompt was given. Instead, a touch to the cheeks was used so that the participant was able to still tact picture cards while the prompt was being administered. An additional limitation of this study was the use of an AB design which does not show experimental control of the intervention. Future studies should continue to evaluate individualized interventions that are effective in reducing bruxism to prevent or decrease damage that can be caused to the mouth when engaging in this behavior.

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