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A Comparison of Positive and Negative Reinforcement to Decrease Disruptive Behavior During Medical Demands

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A Comparison of Positive and Negative Reinforcement to Decrease Disruptive Behavior During Medical Demands

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Abstract

Medical demand tolerance is imperative for improving and maintaining physical health, but a disproportionate number of intellectually disabled individuals do not readily cooperate with medical procedure demands. Research suggests that although function-based treatments can be effective, in some contexts nonfunctional interventions can also produce therapeutic results (Briggs et al., 2019; Carter, 2010; Dowdy et al., 2018; Gardner et al., 2009; Lalli et al., 1999; Piazza et al., 1997). The purpose of this study was to compare the treatment effects of using functional and nonfunctional reinforcement to decrease escape-maintained medical demand noncooperation with intellectually disabled children. A reversal design embedded within a multielement design was used to compare the rate of disruption between the negative reinforcement and positive reinforcement conditions. The results indicated that the delivery of preferred edibles contingent on demand tolerance produced a substantial decrease in disruption. Escape from demands contingent on tolerance produced a less significant change as compared to the positive reinforcement condition. These results demonstrated that contingent positive reinforcement to nonpainful medical demands was more effective at suppressing disruptive behavior as compared to contingent negative reinforcement. The results from this study can inform future treatments for different medical procedures.

Keywords: medical demand tolerance, reinforcement comparison, nonfunctional reinforcement

A Comparison of Positive and Negative Reinforcement to Increase Medical Demand Tolerance

Medical demand cooperation encompasses multiple topographies such as taking medications as prescribed, following instructions from a medical provider, and tolerating both routine and novel procedures (Allen & Kupzyk, 2016). Sustaining physical health and identifying potential issues before they develop requires a multitude of complex skills that some intellectually disabled people might not have in their repertoire. Approximately one-third of intellectually disabled individuals engage in some form of medical noncooperation (Gillis et al., 2009). Noncooperation can include emotional responses, elopement, aggression towards the medical provider, self-injurious behavior, or property destruction (Allen & Kupzyk, 2016).

The terms ‘compliance’ and ‘noncompliance’ are used frequently throughout studies with intellectually disabled people pertaining to medical treatment cooperation (Allen & Kupzyk, 2016; Cavalari et al., 2013; Davit et al., 2011; Gillis et al., 2009; Wolff & Symons, 2012). Intellectually disabled individuals, who as children have compounded levels of vulnerability, are four times more likely to be emotionally, physically, and sexually abused as compared to their neurotypical peers (Kendall-Tackett et al., 2005). There are many risk factors involved, one of which is having experienced behavioral, educational, and medical interventions from a young age that can affect their understanding of personal boundaries and autonomy (Palusci et al., 2015). Teaching acceptance of various medical procedures is important since some medical procedures are essential for maintaining the child’s health, but shifting the word choice from ‘compliance’ to terms such as ‘tolerance’, ‘acceptance’, and ‘cooperation’ emphasizes more individual autonomy and assent. Thus, for the remainder of this paper, these terms will be used.

Given the prevalence of medical noncooperation and the importance of physical health, it is critical to implement the least intrusive and most effective treatments to increase medical demand tolerance. Current non-behavioral alternatives for moderate to severe noncooperation include varied levels of physical and chemical restraint (Romer, 2009), both of which are highly restrictive and can result in distress and negative feelings for the patient (Wong & Chien, 2005).

There is substantial behavior analytic literature on the reduction of problem behavior during routine medical exams that encapsulate a variety of different treatments (e.g., Cavalari et al., 2013; Davit et al., 2011; Shabani & Fisher, 2006; Wolff & Symons, 2012). The most common methods include stimulus fading combined with differential reinforcement of either approach responses or the absence of the problem behavior (Shabani & Fisher, 2006), reinforcement for cooperation with high probability requests to establish behavioral momentum (Riviere et al., 2011), and using functional reinforcers for cooperation (Allen & Wallace, 2013). These studies covertly or directly rely on the assumed function of escape and do not include any empirical assessment for confirmation.

The advent of the functional analysis (Iwata et al., 1982/1994) gave way to an increase in function-based treatments. The functional analysis informs the intervention by identifying the variables maintaining the behavior. The treatment then weakens the relationship between the target behavior and the consequence that is maintaining it while strengthening the relationship between the maintaining consequence and a new adaptive behavior. Although research has demonstrated that function-based interventions can successfully, quickly, and ethically decrease target behaviors, there is also evidence function-based treatments are not always the most effective. Numerous studies have indicated that positive reinforcement delivered contingently for cooperation can decrease escape-maintained problem behavior while also increasing cooperation without the use of functional extinction (Briggs et al., 2019; Carter, 2010; Dowdy et al., 2018; Gardner et al., 2009; Lalli et al., 1999). It is important to note that all of the aforementioned studies except Dowdy et al. (2018) have utilized a functional analysis prior to treatment to ensure that the noncooperative behavior that was hypothesized to be maintained by escape had empirical confirmation.

There is a wealth of research on what influences an individual's choice between positive reinforcement and negative reinforcement. Gardner et al. (2009) evaluated the response rate between positive reinforcement in the form of attention and negative reinforcement in the form of escape for two neurotypical children whose problem behavior was maintained by escape. Piazza et al. (1997) compared choice between a break from a nonpreferred task to tangible items, attention, or both. Lalli et al. (1999), Carter (2010), and Slocum & Vollmer (2015) compared task cooperation with contingent tangibles and contingent escape. Although the topography of the reinforcement differed between studies, all results indicated the nonfunctional positive reinforcement better suppressed the problem behavior as compared to the functional negative reinforcement (Carter, 2010; Gardner et al., 2009, Kodak et al., 2007; Lalli et al., 1999; Piazza et al., 1997; Slocum & Vollmer, 2015). The results of these studies all indicate that function-based interventions for escape-maintained behavior might not always be the best or only choice.

A reinforcer's quality, frequency, and magnitude all contribute to the individual's choice between positive reinforcement and negative reinforcement (Kodak et al., 2007). Kodak et al. (2007) examined which variables affected concurrently available choices between escape from demands and access to a food item. As high and low preference food, toys, and tasks were manipulated, the data indicated that regardless of the reinforcement schedule, four of the five participants chose highly preferred food over a break. However, when the quality of the food was manipulated, the motivation for the four participants shifted to prefer the negative reinforcement in the form of a break from tasks. Briggs et al. (2019) altered multiple dimensions of reinforcement within a differential reinforcement of alternative behavior (DRA) without an extinction procedure. Increased preference for the edible resulted in an increase in cooperation for two subjects and an increase in both preference and magnitude resulted in increased cooperation for the other two subjects. These results suggest that the quality and magnitude of the preferred food must compete with the aversiveness of the demand in order to increase the chance of the individual choosing the positive reinforcement over the negative reinforcement.

In a medical context, these studies can help inform treatment for escape-maintained problem behavior. Utilizing nonfunctional edible reinforcement not only has significant empirical support for suppressing disruptive behavior but also may decrease the duration that the practitioner has to spend with the patient. According to the American Academy of Pediatrics, a typical pediatric checkup lasts between 11 and 20 min (Halfon et al., 2011). Considering the variability in the noncooperative topographies across individuals, it is difficult to determine an average duration across all patients who engage in any form of escape-maintained disruption. However, it is reasonable to hypothesize that an increase in noncooperation would produce an increase in procedure duration. This compounds barriers for the client to access necessary healthcare, as medical providers typically have a strict schedule to adhere to and may not be able to fully examine a noncooperative patient due to time restrictions. Edible reinforcement can be easily dispensed and quickly consumed during a medical procedure, which could be preferable to other tangible topographies that might inadvertently provide momentary delay from the demand during their usage.

Escape extinction (the discontinuation of negative reinforcement) has historically demonstrated efficacy in decreasing escape-maintained behavior (Iwata et al., 1990). However, unwanted side effects such as extinction-induced behavioral variability and countertherapeutic increases in the behavior can occur at the outset of the treatment (Lerman et al., 1999). During checkups and medical procedures, it can be significantly more unsafe to implement escape extinction around potentially dangerous medical instruments. Additionally, escape extinction is a more effortful intervention that requires training and fidelity measures for the caregiver and practitioner. It is reasonable to project that incorrect implementation of escape extinction (e.g., overly restrictive holds, improper restraint of limbs, unnecessary utilization of extinction) can lead to physical and behavioral harm. Even if consistently implemented correctly, the procedure requires for continual presentation of aversive stimuli which can pair the environment and medical practitioner as a conditioned punisher. Further disruptive escape and avoidance behavior may be evoked in similar environments and with similar implementors. Finally, research suggests that the social acceptability of extinction has a low rating across consumers of behavior analytic services (Owen et al., 2021).

Nonmedical studies have demonstrated efficacy in increasing demand cooperation and decreasing problem behavior without escape extinction (Athens & Vollmer, 2010; Briggs et al., 2019; Carter, 2010; Gardner et al., 2009, Lalli et al., 1999). In a medical context, Dowdy et al. (2018) successfully increased hygiene routine tolerance without the use of escape extinction while using nonfunctional positive reinforcement in the form of edibles. With the substantial empirical evidence and consideration of the patient and provider's safety, the omission of escape extinction may be beneficial for escape-maintained problem behavior during medical procedures.

Slocum and Vollmer (2015) extended the previous research of Lalli et al. (1999) and Carter (2010) by replacing their reversal designs with a reversal design embedded within a multielement design to better control for carryover effects. The results demonstrated a decrease in target problem behavior for all of the five participants in the contingent positive reinforcement condition while the contingent negative reinforcement condition was effective for only two of the five subjects. This study will replicate the methodology of Slocum and Vollmer (2015) in the context of escape-maintained medical demand noncooperation to compare the efficacy of negative reinforcement and positive reinforcement with intellectually disabled children.

Method

Participants, Settings, and Materials

The participant, Kris, was referred by his behavior analyst due to his caregiver's report of disruption during medical procedures. Kris was 8 years old and diagnosed with autism spectrum disorder. Kris did not reliably engage in expressive communication but would infrequently use the word "no". The study was located at the ABA clinic that Kris attended for 30 hours a week. The sessions were run in an upstairs room that Kris had never been exposed to and was decorated to appear similar to a doctor's office. Materials included a stethoscope, automatic blood pressure cuff, gloves, medical table paper, and medical scrubs.

Response Definitions and Measurement

A reversal design embedded within a multielement design was used. A nonpainful procedure was chosen to minimize the influences of respondent conditioning due to pain. The dependent variable was disruptive behavior. Disruptive behavior was defined as any instance of interference to the completion of the procedure which included self-injury, aggression, flopping, turning away, pushing, or pulling the experimenter or medical materials. Self-injury was defined as any forceful contact between the body and an object or between two body parts. Aggression was defined as any instance of hitting, punching, pinching, kicking, or biting the experimenter or therapist. Flopping was defined as any instance of dropping to the floor from a sitting or standing position. Termination criteria was defined as any instance of disruptive behavior that could reasonably result in injury to Kris or a clear withdrawal of assent (e.g., stating "no").

Kris' therapists were informed on the purpose and method of the research and asked to collect data on Kris' responses. The experimenter and therapists measured the percentage of disruptive behavior as the number of demands not cooperated with divided by the total number of demands presented per session. The experimenter obtained mean-count-per-interval interobserver agreement (IOA) with Kris' therapists who collected data independently for 100% of the total sessions. The smaller recorded response numbers were divided by the larger number and multiplied by 100 to determine the IOA percentage. Agreement across all sessions was 100%.

Procedure

Prior to the pairwise functional analysis and treatment comparison, possible edible reinforcers were determined by using a multiple-stimulus-without-replacement (MSWO) preference assessment (DeLeon & Iwata, 1996). Kris' highly preferred foods were identified as sour cream and onion chips, cookies, and small pieces of chocolate. An informal preference assessment was conducted with the three highest preferred edibles each day that a session occurred.

Pairwise Functional Analysis

Demand. The experimenter, Kris, and Kris' therapist entered the session room together. The experimenter instructed Kris to sit on the examination table, moved within 20 cm of Kris, presented the blood pressure cuff[1], gave the statement "I am going to take your blood pressure", and then placed the instrument on Kris' arm for 20 s. If any disruptive behavior occurred, the experimenter removed the instrument and stepped 1 m away from Kris for 30 s. The demand was presented again after the elapsed 30 s. Demands continued to be presented until all 5 trials were completed or 5 min had elapsed. If acceptance of the medical demand occurred, the next demand trial was issued until all 5 trials were completed or 5 min had elapsed.

Control. The experimenter, Kris, and Kris' therapist entered the session room together. Physical and verbal attention were given on a 30 s fixed-time interval for 5 min. Moderately preferred toys were provided, and no demands were placed. There were no

[1] The choice to use a blood pressure procedure was informed by Kris' caregiver report as the most aversive instrument.

programmed consequences for target behavior.

Treatment Comparison

The two treatments were compared using an ABAB reversal design embedded within a multielement design. Each session consisted of 5 trials and lasted a maximum of 5 min. Different colored medical scrubs and examination table locations correlated to each condition to facilitate discrimination.

Baseline. The first baseline phase was collected from the demand condition of the pairwise functional analysis. The second set of baseline phase was conducted in the same format as the pairwise functional analysis demand condition.

Positive reinforcement. The positive reinforcement condition was the same as the pairwise functional analysis demand condition except that Kris was delivered the edible of his choice contingent upon tolerance of each discrete demand on a fixed-ratio 1 schedule. The next trial was presented regardless of if Kris had consumed the edible to ensure escape was not inadvertently provided. Disruptive behavior continued to produce 30 s of escape from demands.

Negative reinforcement. The negative reinforcement condition was the same as the pairwise functional analysis demand condition except a 30-s break from demands was given contingent upon tolerance. Disruptive behavior continued to produce 30 s of escape from demands.

Results

The pairwise functional analysis results are shown in Figure 1. The clear differentiation between the demand and control condition indicated that Kris' disruptive behavior was likely maintained by social negative reinforcement in the form of escape from demands.

Intervention results for Kris are shown in Figure 2. The percentage of disruption during baseline had a countertherapeutic trend and was at a moderately high level. The first treatment comparison phase showed a decrease in disruption in both the positive reinforcement and negative reinforcement conditions. However, the positive reinforcement condition resulted in less disruption relative to the negative reinforcement condition. Experimental control was demonstrated in the reversal to baseline as the percentage of disruption increased in level and trend similar to the first baseline phase. When the intervention comparison was implemented again, both reinforcement conditions produced a decrease in disruption. The positive reinforcement condition had an average of 16% disruption across both treatment phases whereas the negative reinforcement condition had an average of 37% disruption. As compared to the baseline average, the positive reinforcement contingency and negative reinforcement contingency resulted in a 45% and 24% decrease in disruption, respectively.

Discussion

The delivery of preferred edibles contingent on tolerance of a nonpainful blood pressure procedure produced a substantial decrease in disruption for Kris. Contingent escape from demands demonstrated a decrease as well but was less substantial as compared to the positive reinforcement condition. These results suggest that contingent positive reinforcement to nonpainful medical demands was more effective at suppressing disruptive behavior as compared to contingent negative reinforcement without the use of escape extinction. It is important to note that because the negative reinforcement consequences were in the same response class (the same reinforcer was provided both for noncooperation and cooperation), there was less effective competition between the two contingencies which may have resulted in a higher percentage of disruption in the negative reinforcement condition.

During the pairwise functional analysis and first treatment phase, Kris only engaged in mildly disruptive behavior including pushing the blood pressure cuff off his arm and attempting to get off the examination table. During the reversal to baseline in session 17, Kris was observed to engage in aggression towards the experimenter for the first time. The topography included pinching, open hand hitting, mouthing, and kicking. The magnitude was not significant enough to cause tissue damage, but it was included as procedurally disruptive as the action could reasonably cause a medical professional to stop the procedure regardless of if pain was inflicted. During session 28, Kris was first observed to engage in self injury and withdraw his assent by explicitly stating “no”. In conjunction with one instance of high magnitude aggression towards the experimenter and one instance of self-injury (hand to head), the experimenter decided to end the sessions for the day. The emergence of Kris’ dangerous disruptive behavior exclusively in the negative reinforcement condition provides additional support to the social significance of safety maintenance through the use of positive reinforcement contingencies. The magnitude and topography of the disruptive behavior observed in the positive reinforcement condition was never dangerous (e.g., pushing the sleeve off, getting up out of the chair).

The topography of Kris' responding in each condition further supports the omission of escape extinction and provides multiple implications for medical professionals. As escape extinction has multiple potentially dangerous side effects (Slocum & Vollmer, 2015), the use of nonfunctional contingent positive reinforcement without escape extinction can offer a safer treatment option for both the patient and provider. When dangerous behavior is already part of the disruptive topography, escape extinction poses the risk of increasing its likelihood, duration, magnitude, and frequency (Lerman et al., 1999). If the patient is stronger, larger, or has health conditions that prevent safe procedural execution, escape extinction may not be an option.

Contingent positive reinforcement is a simple procedure that has been supported by extensive research to decrease escape-maintained disruptive behavior. The simplicity and efficacy of delivering contingent edibles across other instructional environments (Carter, 2010; Gardner et al., 2009, Kodak et al., 2007; Lalli et al., 1999; Piazza et al., 1997; Slocum & Vollmer, 2015) along with the data collected from Kris gives confidence to the validity in a medical setting. The choice to utilize the delivery of preferred food items as opposed to preferred tangible items avoided both adverse responses from the individual due to the removal of the preferred item when the allotted exposure period elapsed and inadvertent escape that could be provided while the individual engaged with the tangible. Further, a small container of preferred foods is easily transportable and in situations where the preferred edible is difficult to consume, a token system (Hackenberg, 2009) can be used to bridge the delay. Concerns regarding the possibility of satiation as well as health concerns (if the preferred food is calorically substantial) can be minimized by systematically thinning the reinforcement schedule.

The immediate reduction in disruption seen in both conditions for Kris has promising implications for practitioners both in the behavior analytic and medical field. By providing a quickly consumable food item contingent on demand tolerance, the duration of the medical procedure can plausibly be decreased which in turn can lead to an increase in healthcare access. This is further benefitted by edibles typically being faster to consume than tangibles or escape. Medical professionals are typically on a strict schedule and cannot extend appointment durations in excess to accommodate frequent breaks. In conjunction with the data that demonstrate a bias for positive reinforcement contingencies over negative reinforcement contingencies, the ease of implementation may also result in caregiver and medical practitioner preference for the use of contingent edibles. If the use of edible reinforcement is a more preferred procedure by medical professionals, the social acceptability and simplicity of the intervention can contribute to higher fidelity of implementation (Carroll et al., 2007).

The location of the study was the most prominent limitation; Kris' caregivers were unable to transport him to the researcher's preferred location that had been decorated to be a more medical-adjacent environment. Due to Covid-19, conducting sessions within a medical facility was not an option, so the sessions were conducted at the ABA clinic he attended. Although the sessions were run in an upstairs room to which he had never been exposed, the fundamental structure of the building may not have been similar enough to a doctor's office to have sufficient stimulus control and could potentially have suppressed some responding. Because disruptive behavior was observed in both the pairwise functional analysis and treatment comparison, the impact of the setting on Kris' behavior was likely minimal. It is important to note, however, that these results may not be wholly representative of Kris' typical responding at a traditional medical office. The location may suggest a generalization limitation as well, as the suppression of Kris' disruption may not maintain in other environments.

The topography, magnitude, and rate of Kris' responding may have been elevated due to the inorganic number of repeated exposures to the aversive blood pressure procedure. Each day of data collection had a maximum 5 sessions, or 25 trials. Kris' disruption may have been due to operant responding towards other aversive elements in the sessions not directly related to the blood pressure cuff (e.g., the number of repeated presentations, the duration in an unfamiliar location). Regardless, the treatment comparison and subsequent suppression of the disruptive behavior still proves to be effective. Future research would benefit from conducting single trials in each condition instead of 5 per session.

This study could be strengthened in future replications by conducting a standard functional analysis conducted with the most common conditions. Although the pairwise functional analysis demonstrated clear differentiation between the escape and control conditions, it did not account for the other conditions which were omitted due to time and environmental barriers (e.g., attention, no interaction). Because access to edibles was not included in the pairwise functional analysis, it was never fully confirmed that positive reinforcement in the form of access to edibles didn't partially maintain the disruptive behavior. Anecdotally, it was reported that the caregivers had never previously attempted to use food to reinforce cooperation during medical demands.

The next step in future research would be to conduct this comparison across different medical procedures and across more participants. More data is essential to support these emergent findings with more single case studies and with other nonpainful medical procedures. Additionally, as social significance is an integral aspect of applied behavior analysis (Baer et al., 1968), the social acceptability of each treatment should be evaluated across caregivers and medical practitioners. Finally, to simplify the procedure even further, future research would benefit from investigating the efficacy of a token system for edible delivery not only to reduce any potential health related risks involved with the number of edibles consumed, but also to decrease the procedural interruptions of delivering the reinforcement on a more dense schedule.

This study adds to the research of biasing responses towards nonfunctional positive reinforcement contingencies against functional negative reinforcement contingencies and poses opportunities for utilization focused on reducing disruption during medical procedures. By decreasing medical demand disruption, individuals with developmental disabilities have a greater opportunity to avoid more restrictive physical and chemical restraint during nonpainful medical procedures and increase access to effective healthcare.

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Figure 1

Pairwise Functional Analysis Results

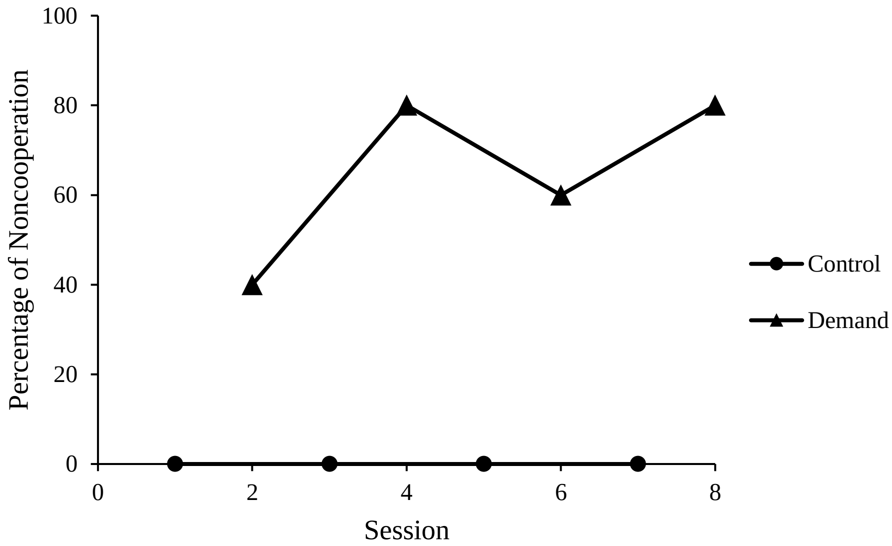

Figure 2

Treatment Comparison Results