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USE OF ESCAPE AND REWARD IN THE MANAGEMENT OF YOUNG CHILDREN DURING DENTAL TREATMENT

KEITH D. ALLEN

WEST VIRGINIA UNIVERSITY

TREVOR F. STOKES

FLORIDA MENTAL HEALTH INSTITUTE

UNIVERSITY OF SOUTH FLORIDA

A reinforced practice procedure was used to facilitate cooperative behavior in five children, aged 3 to 6 years, during dental treatment. In a multiple baseline design across subjects, the children were rewarded with escape, inexpensive stickers, and praise for cooperative behavior in the presence of the sights, sounds, and some sensations of the dental instruments prior to actual dental treatment. Direct observations of disruptive behavior via a 15-s interval recording system indicated baseline levels as high as 90% were reduced to less than 15% by the final treatment visit. In addition, the procedure was effective in reducing overall heart rate and blood pressure reactivity to dental treatment. All children were rated by the involved dental professionals as more cooperative and relaxed following exposure to reinforced practice.

DESCRIPTORS: children, negative reinforcement, dental visits, cooperation

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The management of disruptive and uncooperative children receiving dental treatment continues to represent a special challenge to dentists. Estimates of the number of children presenting management problems have reached nearly 20% (Ayer & Corah, 1984). This presents a serious recurring problem because the cooperation of a child may significantly affect the successful completion and quality of necessary dental work. In fact, the difficulties and risks that result from attempting to provide dental care to uncontrolled children can be so stressful that some dentists refuse to include children among their patients (Ingersoll, 1982).

Procedures that have been evaluated in reducing the distress of young dental patients include the provision of information (e.g., Siegel & Peterson, 1980), modeling and imitation (e.g., Melamed, Hawes, Heiby, & Glick, 1975; Williams, Hurst, & Stokes, 1983), distraction (e.g., Venham et al., 1981), and contingency management (e.g., Ingersoll, Nash, Blount, & Gamber, 1984; Ingersoll, Nash, & Gamber, 1984; Kohlenberg, Greenberg, Reymore, & Hass, 1972; Melamed et al., 1983). Not surprisingly, contingency management procedures have generally been found to be effective, although Melamed et al. (1983) found that delivery of praise or criticism alone contingent on children's behavior during dental treatment was nonfunctional. Ingersoll and her colleagues (1984), however, found audiotaped stories and videotaped cartoons presented contingent on cooperative behavior to be an effective means of managing mildly disruptive children. In addition, Kohlenberg et al. (1972) found that rewarding mentally retarded youths for closer and closer approximations of tar-

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The disruptive behavior code and scoring criteria, the dental procedure code and scoring criteria, and the Cooperation and Anxiety Rating Scales are available from either author upon request.

Reprint requests may be addressed to either Keith D. Allen, Meyer Children's Rehabilitation Institute, 444 S. 44th St., University of Nebraska Medical Center, Omaha, Nebraska 68131-3795 or Trevor F. Stokes, Florida Mental Health Institute, University of South Florida, 13301 N. 30th St., Tampa, Florida 33612.

geted cooperative behaviors during practice visits effectively reduced the average number of restraints required and increased the percentage of time that the mouth was open.

Lacking in these studies is a functional analysis of the disruptive behavior of children visiting the dentist (Stokes, 1985). The reification of anxiety as the cause of the children's distress has resulted in an acceptance of reductions in distress responses as indicative of reductions in anxiety, with no further attempt to explain anxiety. In addition, functional analyses have been neglected in favor of the application of available behavioral technology until a procedure that works is identified.

A behavior analysis suggests that "anxiety" is a complex of behaviors and that the disruptive behaviors exhibited by children of any age are a function of specific antecedent or consequent stimuli (Nietzel & Bernstein, 1981), not of the anxiety. For example, some of the sensations experienced during restorative treatment (e.g., the pinch of the injection, vibrations from the drill, the tightness of the rubber dam clamp), may be aversive stimuli in the sense that escape from or avoidance of these stimuli may be reinforcing. The sights and sounds associated with these procedures may then become discriminative for disruptive behavior; responding which, in the past, has resulted in the avoidance or termination of contact with these stimuli or similar stimuli. Successful escape, even if only temporary, might maintain these disruptive behaviors. In addition, gaining the attention of the dentist, even if it is negative, might further strengthen disruptive behavior. Recognizing the existing controlling relation between escape and attention and disruptive behavior should be useful in the development and maintenance of more cooperative behavior in children visiting the dentist.

The purpose of this research was to investigate the effectiveness of a contingency management procedure using both positive and negative reinforcement to strengthen cooperative behavior in children during dental treatment. Escape and attention were provided contingent on the demonstration of nondisruptive behaviors during a practice period prior to the actual dental treatment but in the presence of the sights, sounds, and some sensations of each of the dental procedures involved in dental treatment.

METHOD

Subjects and Setting

Children visiting the West Virginia University Pediatric Dental Clinic were screened and examined by clinical instructors and advanced dental students. Children exhibiting excessive levels of disruptive behavior (e.g., kicking, screaming, hitting, noncompliance, etc.) during one or more procedures during dental treatment and who required at least four additional restorative dental visits were referred for participation in the study. Five children, Clark and Heidi (age 3), Mark (age 4), Tammi (age 5), and Judy (age 6), served as subjects. All of the children had previous experience with routine restorative dental treatment. Periodic episodes of vomiting by Judy were considered by her dental student and clinical instructor to be extremely disruptive and potentially dangerous, prompting the referral.

The study was conducted in a clinic room equipped with a dental chair, dental equipment, and decorative posters and mobiles. All dental work was performed by a faculty member and dental assistant.

Dependent Measures

Disruptive behaviors. The occurrence of four categories of disruptive behavior (head and body movements, crying/gagging/moaning, and physical restraint) were observed and scored during 15-s intervals according to a refinement of the Williams et al. (1983) disruptive behavior code. Two graduate students in psychology and two psychology undergraduates were trained on the code until 85% reliability was attained. Primary and reliability observers were present at every session. To ensure the independence of the observations, the observers sat on opposite sides of a large posterboard screen approximately 1 m apart and approximately 1 m from the child and were not permitted to talk with each other or the dentist about procedures. The beginning of the recording period and subsequent recording intervals were signaled by audiotape through earphones to each observer. The two observers began scoring when the dentist was both looking at and touching the mouth of the child and ceased scoring 5 s after the dentist either looked away or stopped touching the child's mouth.

Dental procedures. Six dental procedures were scored according to a refinement of the dental procedure code developed by Williams et al. (1983). These included exploration, water/suction, injection, placement of the rubber dam, drilling, and restorative procedures. The occurrence of a procedure was scored when an instrument was inside or touching the child's mouth at any time during the 15-s interval. These dental procedures were scored simultaneously with the disruptive behaviors and by the same observers.

Rating scales. Two 6-point rating scales were used by the dentist and dental assistant to evaluate the child's cooperation and anxiety during the dental procedures. The child was rated from 1 (extremely cooperative or relaxed) to 6 (extremely uncooperative or anxious). Each rating had specific behavior descriptors. The dentist and assistant each independently provided a rating of the child during the preceding procedure by holding up the appropriate number of fingers to the observers (while the other dental professional turned his or her head) five times during each visit. These ratings occurred within 20 s after each of the following events: the dentist's entrance, injection, drilling, restoration, and at the end of the visit (reflecting the entire visit). These ratings were recorded by the observers.

Physiological measures. Heart rate and blood pressure were taken automatically using the 845XT DINAMAP® Adult/Pediatric Vital Signs Monitor with a pediatric cuff. Throughout each session, the monitor provided a digital readout every 2 min of the current heart rate and blood pressure. These readings were recorded every 2 min by an observer. Reliability measures were taken on at least half of the sessions by a reliability observer who also recorded the digital readouts. Steps taken to ensure the independence of the recordings were identical to those described above for the other two observers. Each time a readout was recorded, the observers also recorded the dental procedure at the time of the sampling. Guidelines for coding dental procedures were the same as those described above.

A 10-min habituation period was conducted prior to each treatment visit to allow the children to adapt to the dental surroundings. During habituation, the dental assistant engaged the children in nondental-related discussion as the children rested in the dental chair. During visits in which practice was conducted, the habituation period followed the completion of practice. The last four readings of the monitor during this period were averaged to provide a basal heart rate and blood pressure level for each visit.

Procedures

Each child's restorative visits were scheduled with 1 to 2 weeks between appointments and lasted 15 to 60 min depending on the restorative work required and the disruptive behavior of the child. Scoring of disruptive behavior began when either the dentist or dental assistant was looking at and touching the child's mouth.

Baseline. Procedures during baseline were those typically followed at the dental clinic. The dentist or dental assistant explained what was about to be done and the sensations that the child might experience. The dentist occasionally praised the child for cooperative behavior or remaining quiet. In addition, at the end of the appointment the child was given a small prize if he or she exhibited less than 30% disruptive behavior during the appointment.

Reinforced practice. During the reinforced practice condition, the senior author told the child that he or she would have a chance to practice being a "big helper" (i.e., lying still and quiet) during a practice visit. The child was told that during this practice, the senior author and dental assistant would stop each procedure when the child was observed being a big helper. Initially, the amount of time that the child was required to remain still and quiet was only 3 s. Increasingly longer periods of cooperation were required (e.g., 10 s, 20 s, etc.) until the child was able to remain quiet and still for 30

s. For example, the drill was turned on by the dental assistant and moved gradually closer, then in and around the child's mouth. It was only removed when the child had demonstrated cooperative behavior for the required length of time. During uncooperative periods, all verbal and nonverbal interactions were terminated. Eye contact was avoided and the investigator and dental assistant would orient their bodies away from the child as practice continued. None of the actual dental work was done and, to ensure the safety of the child, the drill bit and the needle of the syringe were removed during practice. A protective plastic cap was left on the syringe to simulate the needle.

During practice, increasing amounts of cooperation were also rewarded with praise and small stickers. Paper reinforcement tabs were used and placed on a colored index card with a picture of a pie sliced into six pieces on it. The card was attached to the dental light above the child where it could easily be seen. Completed cards were removed and given to the child.

Practice typically began with a procedure the child was likely to master quickly (e.g., looking in the mouth with a mirror). This feature allowed the child to experience some early success. Practice then moved immediately to the dental procedures in the presence of which the child had exhibited the most disruptive behavior (e.g., drilling). This was done to enhance the salience of the escape contingency.

When the child was able to demonstrate 30 s of cooperation in the presence of each procedure, a 6-min mastery test was conducted by the senior author and dental assistant. The child was exposed for 1 min to each of the six procedures to which he or she would be exposed during actual dental treatment. Criterion for successful completion of the test was 25% or less disruptive behavior during each dental procedure. If the child mastered the test, the dentist entered the room and regular dental work began. If the child failed to meet the criterion on one or more of the procedures, additional practice was initiated with those procedures and subsequent tests included only those procedures. If the child had not met criterion on the mastery test within 40 min, the entire visit (60 min) was devoted to practice. Practice was conducted prior to each dental visit and was terminated when the child had mastered the test.

Following completion of practice, the child selected a prize from an assortment of inexpensive, age-appropriate toys. After the desired toy was selected and placed on the counter next to the child, he or she was told that to be able to take the prize home, he or she needed to lay quiet and very still, as practice, while the dentist did his work. Two success criteria were established. A changing criterion (15% reduction in the disruptive behavior from the previous visit's mean disruptive behavior) permitted the gradual shaping of cooperative behavior when disruptions occurred more than 30% of the time. No reductions were required after the child met a final success criterion of less than 30% overall disruptive behavior. This was established based on a survey by Ingersoll et al. (1984) indicating that dentists typically consider children exhibiting less than 30% disruptive behavior to be cooperative. Failure to meet either criterion resulted in the loss of the chosen toy.

Experimental Design

A multiple baseline design was used to evaluate treatment effectiveness. The practice procedures were introduced sequentially across subjects after varying amounts of time in dental treatment (30 to 110 min) and number of visits in baseline (1 to 5 days) to show that behavior changes occurred after the introduction of the practice procedure.

RESULTS

Reliability Assessment

Reliability was assessed on all measures for 50% of the sessions for each child, distributed across experimental conditions. Reliability was calculated by dividing the number of agreements on occurrence by the number of agreements plus disagreements and multiplying by 100. Occurrence reliability on disruptive behavior (including the test) averaged 85% (range, 80% to 91%) during baseline and 84% (range, 76% to 100%) during intervention. Occurrence reliability on dental procedures averaged 98% (range, 96% to 99%) during both baseline and intervention. Occurrence reliability on the scoring of the professionals' ratings and the physiological measures were consistently 100%.

Disruptive Behavior

Disruptive behaviors for each child are presented in Figure 1. During baseline, the disruptive behavior of each child was stable or increasing across visits and ranged from 30% for Judy to 88% for Clark. Following introduction of the practice procedure, four of the five children showed immediate and large reductions in disruptive behavior. For example, Judy, who had been getting more disruptive with each visit during baseline (including vomiting at least twice each visit), exhibited no disruptive behaviors and no vomiting during her first postpractice visits. Clark showed reductions from 88% during baseline to 6% during his first postpractice visit. By the time dental treatment was complete, all five children had demonstrated reductions in disruptive behavior to levels at or below 15%. In addition, with minimal practice, these effects were maintained across multiple treatment visits.

Table 1 presents the time spent in practice for each child following completion of the baseline condition. Asterisks indicate those visits that were devoted solely to practice; dental treatment was not performed. The average amount of time spent in practice was 23 min, with a range of 6 to 60 min.

Disruptive behavior for each of three different procedures is presented in Figure 2. Reductions in disruptive behavior were demonstrated across each of the different procedures. Even during injection, baseline rates typically greater than 80% were reduced to levels generally less than 35% following reinforced practice visits.

Ratings

Ratings of cooperation and anxiety by the dental professionals are presented in Figure 3. Ratings of cooperation and anxiety were typically above 3 (i.e., uncooperative and anxious) during baseline. At the conclusion of treatment, the dentist and assistant rated all of the children at or below 1.5 for cooperation (i.e., very cooperative) and 2.0 for anxiety (i.e., very relaxed). For example, Heidi, who was

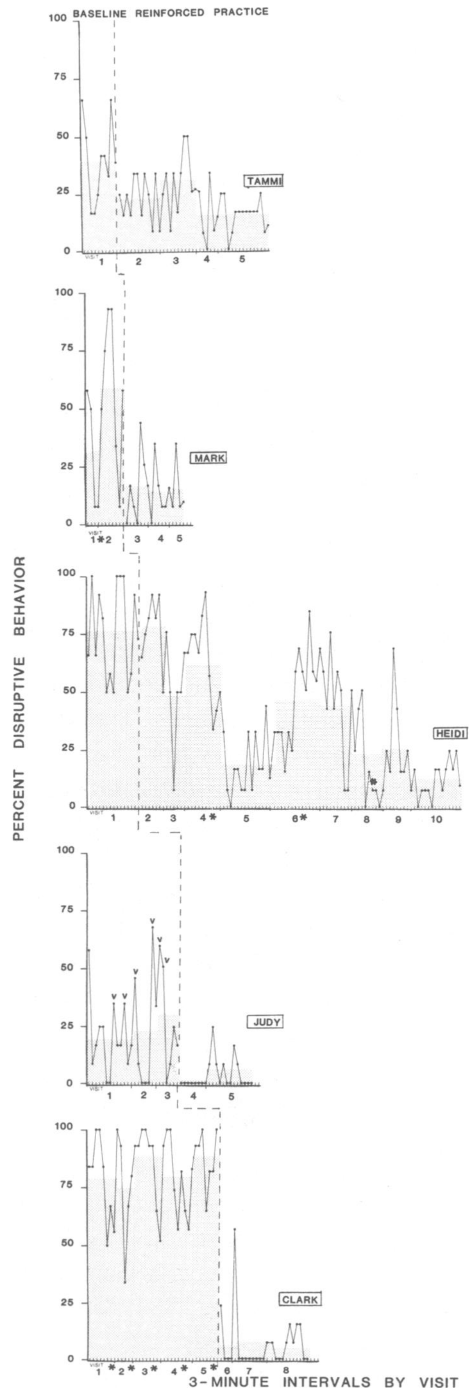

Figure 1. Percentage of 15-s intervals containing disruptive behavior per 3 min of treatment for each child. Vertical dashed lines separate conditions. Shaded regions indicate the mean disruptive behavior per session. Asterisks indicate visits in which a prize was not earned. A (v) over a data point indicates vomiting during that 3-min interval.

Table 1
Amount of Time Spent in Reinforced Practice Prior to Actual Dental Treatment. Asterisks Indicate Visits Devoted to Practice Only

Subjects	Practice visits 1	2	3	4	5	6	7	8	9	10	*M*
Tammi	40	20	10	6							19
Mark	60*	30	15	6							27.8
Heidi	30	60*	30	30	15	25	25	15	6	6	24.2
Judy	45*	15	6								22
Clark	45*	45*	15	10	6						24.2

rated as disruptive and very anxious during baseline, was rated as extremely cooperative and relaxed during her last visit.

Physiological Measures

Figure 4 shows the changes that occurred in heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) from the habituation period to the dental treatment period during baseline and then following practice. The figure also shows physiological changes from habituation to the administration of the anesthesia during baseline and postpractice visits. Overall, there tended to be smaller increases in heart rate and blood pressure during treatment following the practice sessions. These reductions were particularly noticeable during injection, where four of the five children showed reductions in heart rate of 15 to 36 beats per minute.

DISCUSSION

This study supports previous research suggesting that the use of reinforcement can be an effective strategy for managing children during dental treatment (Ingersoll, Nash, Blount, & Gamber, 1984; Ingersoll, Nash, & Gamber, 1984; Kohlenberg et al., 1972; Stokes & Kennedy, 1980). Further, it was found that extremely disruptive children as young as 3 years can be effectively managed during restorative dental treatment with a practice procedure that features both negative (i.e., temporary escape from treatment) and positive (i.e., praise and tangible rewards) reinforcement. In addition, the effectiveness of the practice was not limited to mildly invasive procedures. Both Clark and Mark had multiple anterior injections and extractions during their last visits, yet they remained cooperative throughout. Finally, there was some evidence that the practice procedure was effective in reducing overall heart rate and blood pressure reactivity during dental treatment. These results were validated by the dental professionals who rated the children as more cooperative and relaxed during treatment following practice.

The identification of negative reinforcement (escape contingencies) in maintaining disruptive, uncooperative behavior is consistent with literature showing that escape factors may play a role in the maintenance of a wide variety of problem behaviors, including tantrums (e.g., Solnick, Rincover, & Peterson, 1977), vomiting (e.g., Wolf, Birnbrauer, Williams, & Lawler, 1965), disruptive classroom behavior (Plummer, Baer, & LeBlanc, 1977), and aggression (Carr, Newsom, & Binkoff, 1980). In the dental environment, the presentation of potentially aversive stimuli is a natural feature of restorative dental treatment. So although escape responses may be expected, those escape responses that are disruptive are problematic. Consequently, we strengthened, through contingent escape, the probability of an alternative, nondisruptive escape response (the "good dentist chair behaviors").

The small changes in physiological arousal following the practice sessions raise questions about respondent conditioning features of the procedure and the role of repeated or graduated exposure in accounting for observed changes. We find it unlikely, however, that exposure features of the procedure could account for the degree of clinical change

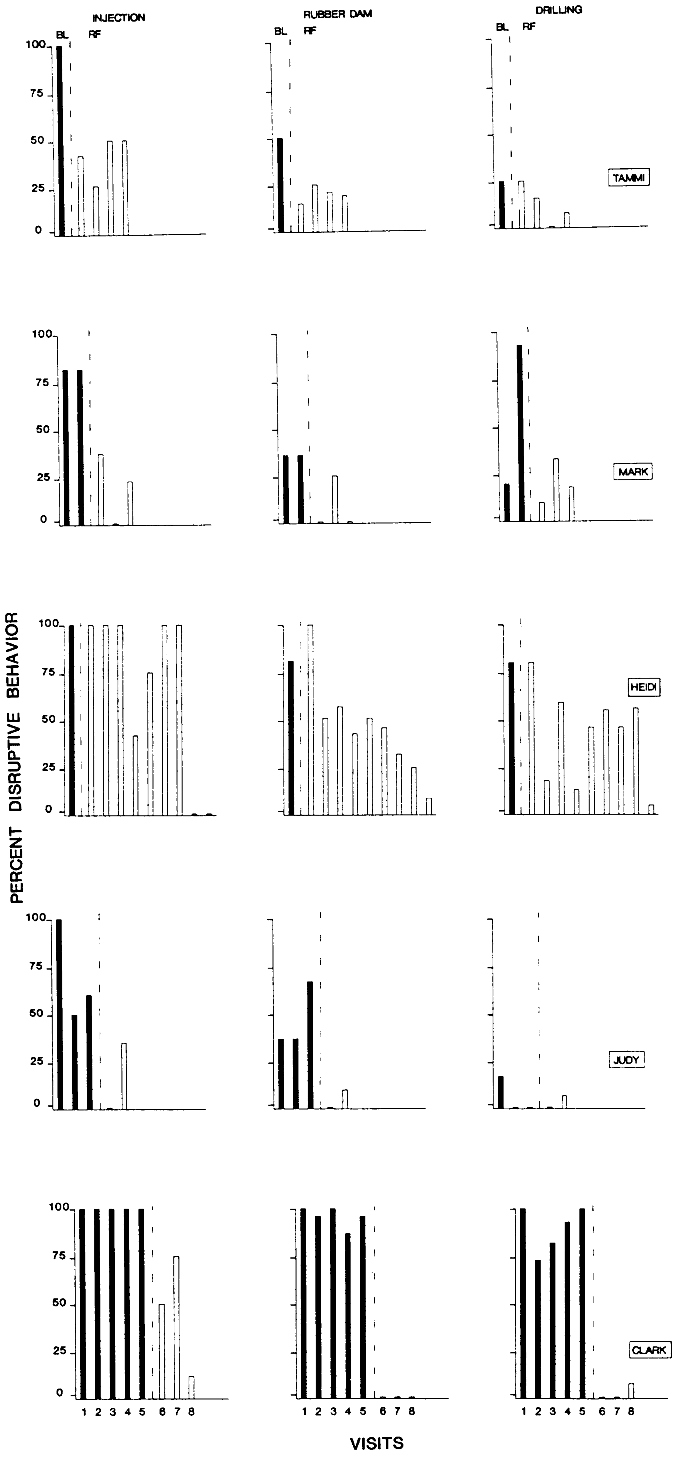

Figure 2. Mean percentage of 15-s intervals of disruptive behavior during injection, rubber dam, and drilling at each visit.

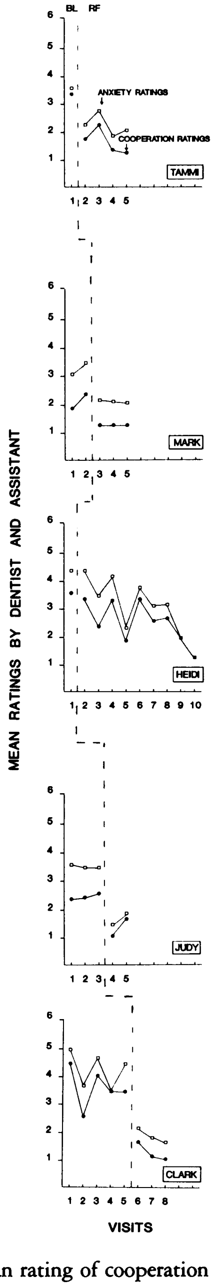

Figure 3. Mean rating of cooperation and anxiety given by the dentist and assistant during each treatment visit.

observed in disruptive behavior. First, repeated exposure to dental treatment was present throughout baseline, yet none of the children improved (in fact, many of them got worse). This is consistent with other research that has shown that children do not improve with repeated exposure to dental treatment (e.g., Venham, Bengston, & Cipes, 1977). Second, the practice sessions were not graduated; we moved quickly to the procedures with which the children had the most difficulty to establish the salience of the escape contingency. Finally, in spite of continued pairings of some stimuli (e.g., the syringe) with aversive events, distinct changes in the discriminative control of the dental stimuli were observed. After practice, the syringe clearly occasioned "big helper" responses.

We found that simply providing a prize contingent on cooperative behavior during treatment was insufficient to reduce the disruptive behavior of children, regardless of the magnitude of that disruptive behavior. For example, Clark, Mark, and Heidi showed no improvements during baseline, in spite of failing to earn the selected prize at least once. Clark failed to earn his prize four times without any improvements. After practice, however, the prize appeared to have an impact. For example, Heidi lost her prize following her second, fourth, sixth, and seventh visits. Yet during each subsequent visit, Heidi improved. Three of these improvements met the criterion for earning the selected prize.

It may be that prior to the practice, the children were unable to earn the prize because of a "skill deficit" (i.e., the required cooperative responses were not in the repertoire). It seems more likely, however, that prior to training, the temporary escape from dental treatment following disruptiveness was simply more powerful than the opportunity to earn a prize for being cooperative. Reversing the escape contingency during practice, however, increased the probability of cooperative responses during treatment. The increase in cooperation during treatment increased the likelihood that the child would earn the prize and perhaps enhanced the effectiveness of the reward contingency.

Although the practice procedure was clearly effective, the time commitment and behavioral sophistication required to implement the practice procedure may prohibit its use by dental professionals. In its present form, the effective implementation of the practice procedure would, in all likelihood, require the skills of a properly trained psychologist. However, there would be no time or monetary costs to a dentist requesting such services because the psychologist would conduct the practice sessions and the child's family would be financially responsible for the services provided. To help reduce the costs of these services to the family, future investigations might address whether practice with the more invasive procedures (injection, rubber dam, and drilling) would produce sufficient improvements in cooperation and whether children need to continue to practice with each visit once a certain level of cooperation is attained.

Dentists themselves might be able to cost-effectively implement the important features of the practice procedure during dental treatment rather than as a preparation for dental treatment. That is, the use of escape and attention contingent on cooperative behavior could be implemented as a regular feature of restorative treatment. The procedure-related interruptions during treatment caused by the escape contingency could gradually be reduced until escape would be a natural product of the rapid completion of each dental procedure. Since children who become compliant and cooperative early in treatment are more likely to earn the positive attention of the dentist and dental assistant, appropriate behavior would likely be strengthened and maintained. Future research should assess the potential value and feasibility of teaching dentists to implement this type of procedure during regular procedures.

The reinforced practice procedure was selected for investigation because it was an appropriate strategy given a functional analysis that identified escape and attention as relevant controlling variables in the dental operation. This highlights the importance of a functional analysis in the assessment of environmental variables controlling target responses and in the subsequent development of appropriate treatment strategies. It also suggests that reliance on the application of existing technology, in the absence of a functional analysis, may limit the contributions one can make when faced with novel or challenging clinical problems.

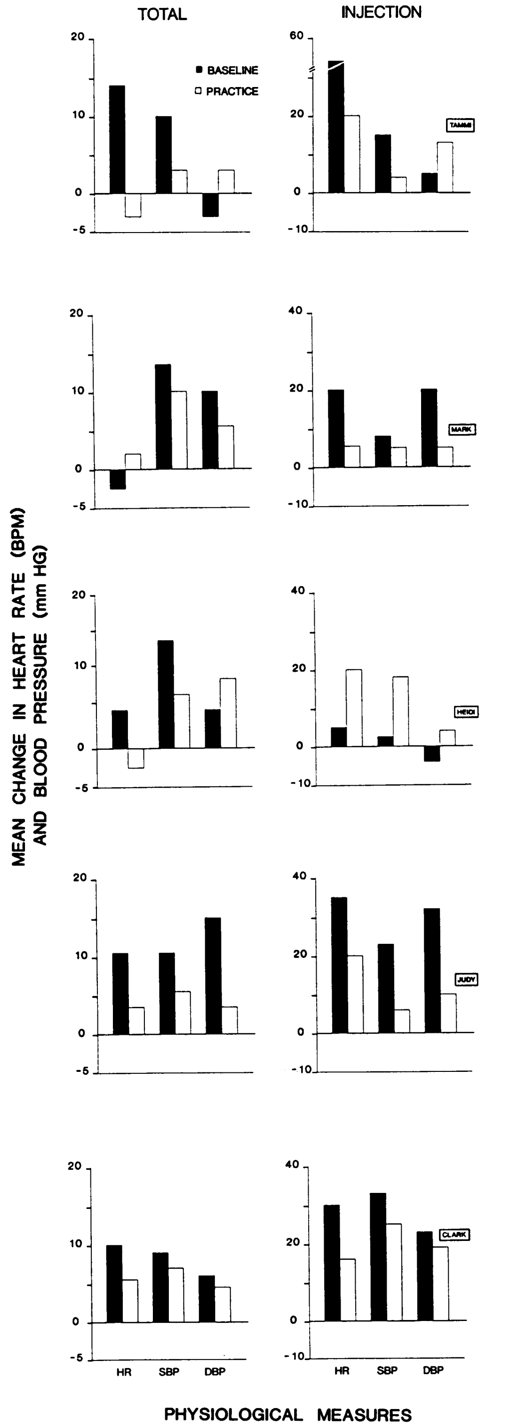

Figure 4. The changes in mean heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) from the habituation period to the treatment period (including all procedures) are shown on the left. Physiological changes from habituation to the injection are shown on the right.

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