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Behavioral procedures to increase cooperation of developmentally disabled children with dental treatment

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Abstract

This study evaluated the effectiveness of reinforcement procedures in increasing cooperation and reducing disruptive behavior during restorative dental treatment. Four mentally retarded children received praise and tokens for cooperating with direct requests from the dentist and for sitting quietly in the chair; tokens could later be exchanged for toys. A multiple-baseline, across-subjects design was used to assess levels of cooperation during varying length baselines and during the intervention. Uncooperative behavior decreased in all children (substantially in three subjects) following implementation of the reinforcement-based intervention. Comparing the subjects' baseline and intervention sessions showed a statistically significant decrease in the level of uncooperative behavior during the intervention. Issues relating to generalization of the findings and factors influencing maintenance of treatment effects are discussed.

Behavior management procedures to increase cooperation during dental treatment are being used increasingly by pediatric dentists.[1,2] Recent research has shown that a number of behavioral technics are effective in reducing fear and uncooperative behavior during dental treatment of normal children using modeling procedures,[3–8] modeling plus reinforcement,[9] and desensitization.[10] However, research in the application of behavioral technics with developmentally disabled children has been limited. Management of the mentally retarded child during dental treatment is more complex. The pedodontist is more likely to encounter aggressive behavior, behavior that is physically dangerous to the child, and poor cooperation, which can result in inefficient and lengthy treatment.[11]

Kohlenberg et al.[12] used fruit juice squirted into the mouth as a reinforcer to encourage severely retarded individuals to sit quietly in the chair, attend to the dentist, and keep their mouths open. They found that two 45-minute training sessions resulted in more cooperation and less need for physical restraint compared to a control group. Unfortunately, the reinforcement procedure was only evaluated during examination—not during restorative treatment. Savide et al.[13] used a combination of reinforcement and systematic desensitization to complete eight sessions of restorative treatment in a 13-year-old mildly retarded individual. However, this program required three sessions per week of relaxation training and systematic desensitization to dental procedures for 14 weeks before restorative treatment could proceed.

Behavioral interventions also have been shown to be effective in teaching oral hygiene skills in an effort to reduce the need for restorative treatment. Horner and Keilitz[14] used tokens and praise as reinforcers to teach toothbrushing skills to eight mild to moderately retarded children. The behavioral performance sequence of toothbrushing was analyzed, and 14 sequential components were identified. Six of the children were successfully taught the step-by-step sequence in from 20 to 30 sessions, and their oral hygiene improved considerably.

The present study attempted to extend the application of behavioral procedures in pediatric dentistry, particularly during restorative treatment of developmentally disabled patients. Uncooperative mentally retarded children were selected for whom restorative treatment posed an increased risk. These children previously had been so disruptive during dental examinations or treatment that sedation, including general anesthesia, was recommended or required before treatment could proceed. The procedures were designed to be implemented by a dentist and a dental assistant with a minimum amount of instruction, using common apparatus and materials, and to obviate the need for premedication or physical restraint.

The present study also was designed to evaluate the effectiveness of a procedure known as differential reinforcement of other behaviors (DRO) in reducing uncooperative behavior during restorative treatment.[15] The

DRO procedure involves reinforcing the first neutral or desirable response that is emitted following a set interval in which another, usually undesirable, response has not occurred. Pilot research revealed that successful completion of restorative treatment requires that the child cooperate with direct requests such as to open his/her mouth, and to cooperate passively by sitting quietly in the chair. Much of the disruptive behavior observed occurred during periods when the child should have been sitting quietly. During intervals when the child was actually sitting quietly, the dentists tended to infrequently reinforce this cooperative behavior. Understandably, the dentists involved were interested in completing treatment carefully but quickly in response to the child's lack of cooperation. Therefore, in addition to reinforcing cooperative responses to direct requests, a DRO procedure was implemented to systematically reinforce passive cooperation in fixed, short intervals. The net effect of a DRO procedure is to decrease the frequency of undesirable behavior by reinforcing behavior which is not disruptive. Videotaping the sessions allowed a detailed analysis of the topography of the behaviors being studied and assessment of the effectiveness of the experimental procedures.

Methods and Materials

Subject and Setting

Four mild to severely retarded children were selected on the basis of poor cooperation during previous dental examinations. Three of the subjects were extremely uncooperative and disruptive during the initial examination. Previously, such behavior resulted in excessively long examinations and the use of sedation. The fourth subject previously had required a muscle relaxant, 30–50% nitrous oxide, and containment in a Pediwrap® on five occasions, and general anesthesia on another occasion before restorative treatment could be completed. It was recommended that future examinations or restorative treatments to these subjects involve sedation or, in one case, general anesthesia. Subjects ranged in age from 6 to 8 years, had a mean IQ of 45 (range: 38 to 60), and exhibited behavior problems.

Normally the subjects lived at home and attended special education classes in the public school system. However, for the three weeks of the study, they were hospitalized in the behavior unit of the John F. Kennedy Institute for Handicapped Children, Baltimore, MD. They were studied in one of the dental operatories of the Institute's Division of Pediatric Dentistry. There were two reasons for this. First, all subjects required extensive restorative treatment with moderate to severe caries involvement.[16] It was felt that restorative treatment could best be accomplished if they were inpatients. Second, the subjects presented with general behavior problems including hyperactivity, aggressiveness, noncompliance, and frequent tantrums. Both the school system and the subjects' parents requested further evaluation and behavioral programs to manage these problems. Previous attempts to develop behavioral programs for these other problems on an outpatient basis largely had been unsuccessful and more intensive evaluation in the behavior unit was indicated. The subjects were able to continue with academic activities in a fully accredited special education program at the Institute.

Measurement

The uncooperative behavior of the subjects during restorative dental treatment was assessed by trained observers who viewed videotapes of experimental sessions. The observers did not participate in the planning or execution of the study. Five uncooperative behaviors were selected for evaluation based on observations of other children undergoing restorative treatment and discussions with dentists at the Institute. The following definitions were used to score uncooperative behavior during each session:

1. Attempts to dislodge—an attempt to remove or to expel dental instruments, materials or the dentist's fingers with the hands, tongue, or by spitting
2. Inappropriate mouth closing—any time the subject closes his/her mouth during the session without previously being instructed to do so
3. Inappropriate vocals—crying, verbal requests to terminate, expletives, groaning, whining, and any speech not directly in response to a question
4. Restraint—any head, hand, leg, or body movement that requires physical restraint and causes a delay in dental work for a 5-second period or longer
5. Aggression—acts of biting, hitting, or kicking the dentist or assistant.

The five categories were scored using a 1-minute interval recording procedure. An occurrence of one or more of these behaviors was noted by checking the appropriate category within the interval on a data sheet. Attempts to dislodge, inappropriate vocals, and mouth closing, and aggression were scored in the interval in which they occurred or, if there was overlap, in both intervals. Restraint was scored in the interval in which the definition requirements were fulfilled. Observation began when the subject was asked to sit in the dental chair and ended when the chair was raised to a sitting position and the napkin removed.

Data are presented as the percentage of 1-minute intervals in which one or more of the five categories of uncooperative behavior occurred. Percentages were calculated based on the total number of minutes each subject spent in the baseline and treatment conditions, respectively.

Reliability

The reliability of the recording system was assessed by comparing the ratings of the two trained observers

obtained for 6 of 8 baseline and 5 of 7 treatment sessions. Two standard methods for calculating reliability were calculated.[17]

Occurrence reliability was calculated by summing the number of observer agreements that a behavior (for each category) occurred in an interval and the number of disagreements (i.e., one observer noted the behavior in that interval but the second observer did not). The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to yield the interobserver reliability percentage.

Nonoccurrence reliability was calculated in similar fashion except that the number of observer agreements and disagreements that a behavior did not occur in an interval were used to calculate reliability. Occurrence reliability is more appropriate for low frequency behaviors and nonoccurrence reliability more appropriate for high frequency behaviors in offering less inflated reliability estimates. Since the frequency with which disruptive behavior occurred by response category was highly variable, reporting estimates using both methods presents a more complete picture of internal consistency and stability of the observational data (Table 1).

Table 1. Two methods of calculating reliability for uncooperative behavior.

Method	Attempts to Dislodge	Inappropriate Mouth close	Inappropriate Vocals	Need for Restraint	Hitting/ Kicking
Occurrence[a]					
Baseline	.82	.66	.96	.84	.71
Treatment	.82	1.00	.84	.81	1.00
Nonoccurrence[b]					
Baseline	.93	.99	.81	.95	.99
Treatment	.96	1.00	.90	.95	1.00

[a] Observations from six sessions. [b] Observations from five sessions.

Procedures

The experimental design consisted of a multiple-baseline across subjects.[15] The essential feature of this procedure is that treatment is systematically implemented with some subjects while other subjects remain in the baseline condition for a longer period of time before treatment begins. Table 2 illustrates the application of this design by showing the number of sessions and total treatment time for each subject during baseline and the intervention.

During the first week, subjects were medically evaluated and adapted to the behavior unit. They were introduced to the token economy: the unit's standard behavior modification procedure to reduce inappropriate behavior and increase cooperative behavior. Tokens (poker chips) were earned for cooperative responses which could be exchanged for privileges and inexpensive toys. None of the subjects were exposed to DRO procedures as part of their treatment on the unit. They were also refamiliarized with the dental operatory, and the dentist examined and radiographed the subjects' teeth to determine the course of restorative treatment. All subjects required restorations in at least 3 of the 4 quadrants of the mouth, and two subjects required extensive restorations in at least one quadrant. All subjects had at least one Class II and one stainless steel crown restoration, with pulpotomies comprising the bulk of the restorations. An experimental session consisted of restoration of one randomly selected quadrant except in the case of a grossly involved quadrant which was completed in two sessions.

The experiment was conducted during the second and third weeks of hospitalization. The same dentist and dental assistant treated all of the subjects. Experimental sessions were conducted at various times of the day with the restriction that at least 24 hours had to elapse between sessions for an individual subject. Individual sessions varied in length from 21 to 57 minutes depending on the subjects' level of cooperation and the type and extent of restorations scheduled.

Baseline. Restorative dental treatment commenced during baseline. During baseline the dentist and dental assistant were instructed to proceed with treatment in their usual manner, using the methods (praise, admonitions, and restraint) they typically employed to control inappropriate behavior.. For the experiment the dental operatory was equipped with a timer connected to a foot pedal. The dentist was instructed to operate the foot pedal whenever the subject was "disruptive" to the point of delaying treatment. Operation of the foot pedal reset the timer, set to time out at 1-minute intervals. When the timer timed out, a brief, loud clicking noise could be heard. Subjects were not given any information about the purpose of the timer at this point. If they asked, they were told it was part of the dentist's equipment. A videotape camera was also present in the operatory to record the session.

Intervention. The intervention consisted of implementing the token economy in the dental operatory. Subjects were escorted into the clinic by the dentist and asked to sit in the chair. When they did so, they earned

Table 2. Number of sessions, treatment time, and percentage of uncooperative behavior for each subject during baseline and intervention.

	Baseline			Intervention		
Subject	# of Sessions	Total Time[a]	Uncooperative Behavior[b]	# of Sessions	Total Time	Uncooperative Behavior
Joe	1	53	38(15)	2	75	13(9)
Ginette	2	84	29(15)	2	52	12(7)
Willie	2	89	10(8)	1	40	4(7)
Jeff	3	92	19(11)	2	60	14(11)

[a] Minutes. [b] Numbers in parentheses indicate standard deviations.

a token which was immediately exchanged for a small toy. At this point the subjects were told they could earn more tokens by cooperating with the dentist's requests, and these tokens could be exchanged for additional toys at the end of the session. The toys (balloons, plastic rings, cards, etc.) were displayed on a board kept in view of the subject. In addition, the DRO procedure was implemented. The subjects were told that by resting quietly in the chair they could earn additional tokens. Every time the timer timed out, it was a signal to them that another token had been earned, providing the subject was not engaging in disruptive behavior at that precise moment. The dentist was instructed to operate the foot pedal to reset the timer as before, with each occurrence of disruptive behavior. The dental assistant placed tokens in a small cup held by the subject. The dentist and the dental assistant were instructed to ignore, as much as possible, inappropriate behavior, and to praise (e.g., "good job," "thank you for being quiet," "you're so helpful," etc.) cooperative behavior including instances when tokens were earned. As the end of the session, the tokens were exchanged at the rate of 10 tokens per toy up to a maximum of 3 toys per session.

Results

The mean duration of the eight baseline sessions for the four subjects was 40 minutes with a standard deviation of 12 minutes. The mean level of uncooperative behavior during baseline was 24% with a standard deviation of 12%. During the seven intervention sessions, the mean duration decreased to 32 minutes with a standard deviation of 7 minutes. Uncooperative behavior correspondingly decreased to a mean of 11% with a standard deviation of 8%. A t-test for correlated means (two-tailed)[18] showed that the decrease in time to complete treatment from baseline was not significant ($t = 1.01$, $df = 3$, $p > 0.05$). However, the decrease in uncooperative behavior from baseline to treatment was significant ($t = 3.2$, $df = 3$, $p < 0.05$).

Table 2 shows the percentage of uncooperative behavior for each subject. The baseline data show that the level of uncooperative behavior was quite variable between subjects. One subject exhibited relatively low levels of uncooperative behaviors during baseline: this was unexpected based on his behavior during previous visits. All subjects showed decreases in uncooperative behavior during the intervention. The intervention resulted in an average 13% reduction in uncooperative behavior for all subjects comparing all baseline with all intervention sessions. Comparing the first baseline session with the last intervention session for all subjects showed an average reduction in uncooperative behavior of 18% ($t = 4.2$, $df = 3$, $p < 0.05$).

Figure 1 shows the effects of the intervention on individual response categories. All five categories of uncooperative behavior show decreases, in some instances to zero, during the intervention. Decreases in attempts to dislodge instruments, etc., was statistically significant ($t = 4.3$, $df = 3$, $p < 0.05$).

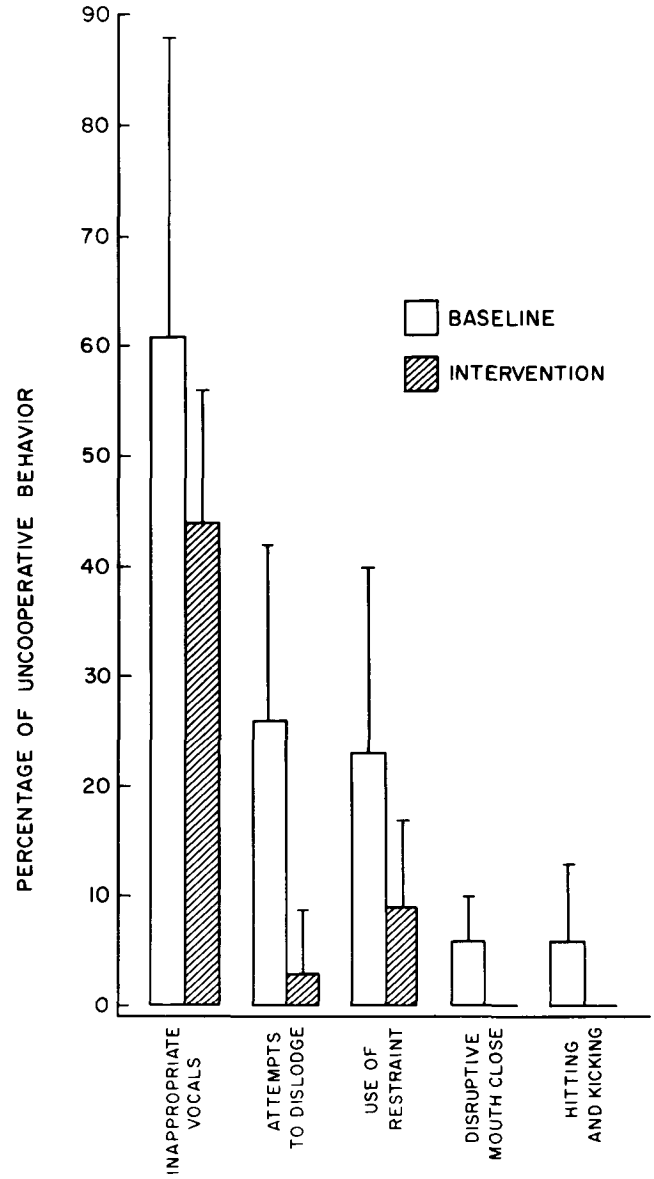

Figure 1. Percent of uncooperative behavior by observational category for all subjects during baseline and the intervention. Standard deviations are indicated with T-bars.

Discussion

The results of this study suggest that the DRO and tokens plus praise reinforcement procedures were effective in increasing cooperative behavior during restorative treatment. Concurrently, disruptive behavior was reduced and in some instances eliminated. However, it is somewhat surprising that the magnitude of these effects was modest in comparison to the results of our pilot investigations. There are several possible explanations to account for these observations.

One major difficulty in interpreting the effectiveness of these procedures is in the relatively low levels (mean = 24%) of disruptive behavior observed during baseline. This means that none of the children had to be preme-

dicated during baseline as had been expected. The subjects in the present study were selected on the basis of their reported high levels of uncooperative behavior in the dental operatory. Our pilot research indicated that disruptive behavior occurred at high levels (70–90% of the observed intervals) in three children with similar histories and IQ scores. In contrast, Stokes and Kennedy[9] found baseline levels of disruptive behavior (using definitions and a measurement system very similar to those in this study) averaged 35–40% in eight, 7-year-old children of normal intelligence who already had some familiarization with dental procedure. It may be necessary to screen patients carefully via behavioral observation (as Stokes and Kennedy did with 40 children) before selecting subjects to test an intervention's effectiveness. It would, therefore, be valuable to test the DRO and token plus praise reinforcement procedures on a sample of mentally retarded children who are more disruptive and uncooperative than our original sample and who are more homogenous with respect to intellectual functioning.

Another possible explanation for these results is that the baseline procedures themselves set the occasion for less disruptive behavior in the dental operatory. For example, the dentist and/or the dental assistant may have inadvertently increased their usual rate of praise of cooperative behavior as a function of the experimental procedures. It is also possible that the children reacted positively to the experimental setting which atypically included electronic timers, a videotape camera, toys, and the experimenters. The behavior unit's token economy may have been a factor in decreasing disruptive behavior during baseline even though the children were only in the initial stages of exposure to the program. These factors should be more closely controlled in any subsequent studies which attempt to replicate these results and establish their general nature.

Conclusion

The demonstration of the use of a DRO procedure to control disruptive behavior by reinforcing passive cooperation suggests that it is a useful technic in the dental operatory, particularly with mentally retarded children who are responsive to social cues. Future research building on this study should compare a DRO procedure with one systematically praising the child for resting quietly in the chair. The durability of the improvement in behavior also should be evaluated in a systematic withdrawal of treatment during a follow-up appointment.

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