

*REDUCING AGGRESSIVE AND SELF-INJURIOUS BEHAVIOR
OF INSTITUTIONALIZED RETARDED CHILDREN THROUGH
REINFORCEMENT OF OTHER BEHAVIORS¹*

ALAN C. REPP AND SAMUEL M. DEITZ

GEORGIA RETARDATION CENTER AND GEORGIA STATE UNIVERSITY

Aggressive and self-injurious behaviors of four retarded children were reduced by combining various techniques with the differential reinforcement of other behaviors (DRO). In one study, aggressive responses of a severely retarded child were reduced when DRO was combined with a 30-sec timeout. In a second study, various aggressive classroom behaviors were reduced when the child was told "no" for an inappropriate response but earned puzzle pieces for periods of time when inappropriate responses did not occur. Exchangeable tokens were given to a third subject for every 15 min in which aggressive responding did not occur, while each inappropriate response resulted in the loss of all tokens accrued. Responding was decreased to a level far below baseline. For a fourth child, self-injurious responses were followed by "no", and intervals of time in which no self-injurious responding occurred earned candy. The rate of this behavior reduced significantly. In each case, the DRO procedure combined with the other techniques proved to be manageable for the teacher and successful in reducing the inappropriate behavior.

Problems of disruptive and self-injurious behavior are particularly evident in mental retardation institutions and other educational settings. These behaviors often interrupt the individual's learning, interfere with appropriate behavior, disrupt other students, and sometimes cause damage to the individual involved.

Previous researchers have used many techniques, as well as combinations of techniques, to deal with these and similar types of behavior. Punishment (Bucher and Lovaas, 1968; Lovaas and Simmons, 1969; Risley, 1968; Tate and Baroff, 1966) and extinction (Ayllon and Michael, 1959; Lovaas and Simmons, 1969; Madsen, Becker, and Thomas, 1968; Williams, 1959) have been used to reduce maladaptive behavior. However, neither method is fully satisfactory. Punishment must often be intense to be effective (Azrin and Holz, 1966), and is

prohibited in many facilities. Extinction requires identification of the reinforcing stimulus, often initially increases behavior, and is usually a long process (Ferster and Skinner, 1957; Lovaas and Simmons, 1969).

Because of these problems and restrictions, researchers have tried to find alternative procedures for reducing inappropriate responding and have often combined these alternatives with punishment and extinction. Some of the other techniques that have been used include timeout (Hamilton, Stephens, and Allen, 1967; Pendergrass, 1972; Wasik, Senn, Welch, and Cooper, 1969; Wolf, Risley, and Mees, 1964) and the reinforcement of behaviors incompatible with the target response (Becker, Madsen, Arnold, and Thomas, 1967; Thomas, Becker, and Armstrong, 1968). Hall, Fox, Willard, Goldsmith, Emerson, Owen, Davis, and Porcia (1971) combined extinction with the reinforcement of incompatible behavior, while Zeilburger, Sampen, and Sloan (1968) combined extinction, timeout, and the reinforcement of incompatible behavior. Foxx and Azrin (1972, 1973) developed a pro-

¹Reprints may be obtained from Alan C. Repp, Director of Special Education, Georgia Retardation Center, 4770 North Peachtree Road, Atlanta, Georgia 30341.

cedure called both overcorrection and restitution to eliminate these types of behaviors, and Webster and Azrin (1973) achieved success with a required relaxation procedure.

An alternative procedure that does not have the potential difficulties of either punishment or extinction, and may be at least as effective as either timeout or the reinforcement of incompatible responding, is the differential-reinforcement-of-other-responding (DRO) procedure. In this procedure, a reinforcing stimulus is delivered when a particular response is not emitted for a specified interval of time (Reynolds, 1961).

Relatively few studies have investigated DRO as a method to reduce inappropriate behavior. Peterson and Peterson (1968) used DRO to reduce a retarded subject's self-destructive behavior. The procedure was effective but was found to be more effective when combined with timeout. Combining DRO with timeout was also found to be relatively effective by Bostow and Bailey (1969). Corte, Wolf, and Locke (1971) compared timeout, punishment, and DRO, and found DRO to be only moderately effective. They also found that food deprivation greatly increased the effectiveness of the DRO procedure when food was used as a reinforcer. Foxx and Azrin (1973) compared DRO, response-independent reinforcement, punishment, a distasteful solution, and overcorrection as procedures to reduce mouthing of objects and hands and found DRO to be one of the least effective techniques.

The present study investigated the efficacy of the DRO procedure when used in conjunction with other procedures. The following studies indicated that DRO, when combined with other techniques, may be more effective for reducing maladaptive responding than previous research has indicated. Aggressive and self-injurious behaviors were reduced in four retarded children at the Georgia Retardation Center, Atlanta, Georgia, by combining a DRO procedure with either mild verbal punishment, brief timeout, or response cost.

EXPERIMENT I

Subject

S-1 was a 12-yr-old male, diagnosed as severely retarded, with microcephaly. His language score on the University of Washington Functional Screening Tool placed him on the four- to eight-month level. At the time of his admittance to the institution, he was described as a very belligerent child. During the 15 months of his institutionalization before this treatment program, he was consistently described as a child who had severe tantrums, engaged in self-mutilation, and who bit and scratched students and staff. S-1 was ambulatory but was neither toilet trained, a self-feeder, nor under verbal control.

Procedure

Observations indicated that S-1 emitted a high rate of "attacking" behaviors. These were defined as biting, hitting, scratching, or kicking other persons, and a program was initiated to reduce these responses. In addition, an appropriate response (touching others without hitting, biting, scratching, or kicking) was recorded, but not reinforced.

Data were recorded for both appropriate and inappropriate responses on two wrist counters by one teacher trained in the definitions of the target responses. Observer agreement was established for both responses by having the teacher and a second trained observer record responses. When the per cent agreement (calculated by dividing the larger number of observations per day into the smaller) was greater than 85% for two consecutive sessions, the baseline phase began. One additional agreement check was made during each phase of the program.

The experiment was conducted in an activity room, approximately 13 by 8 m, located in the cottage in which S-1 lived. Nine fellow students, all severely or profoundly retarded, and three cottage staff members were in the activity room

during most sessions. No more than one session occurred per day; 48 of the 52 sessions lasted 120 min.

The experiment was conducted in four phases. Phase 1, a baseline condition, consisted of four sessions in which the teacher recorded the aggressive and appropriate responses of S-1. During the baseline condition, a modified timeout procedure was employed. For each aggressive response, the subject was restrained by the teacher for 30 sec.

Phase 2 then began and lasted 17 sessions. During these sessions, a kitchen timer was set to a prescribed number of minutes. If the child made no aggressive responses during the interval, a bell rang and the subject was given an M & M candy. If the child made an aggressive response, the timer was stopped, and the subject was restrained for 30 sec. When the 30 sec had elapsed, the timer was reset. The DRO procedure was supplemented by the 30-sec timeout, because when the subject emitted one aggressive response, he tended to emit a succession of aggressive responses. Initially, the DRO interval was 5 sec but was increased rapidly, so that by the third session in Phase 2, the interval was 10 min, and by the twelfth session, it was 15 min.

The criterion for increasing the DRO interval was determined by the teacher in consultation with the experimenters. No standard increase was used and often small increases occurred within sessions. The increase in the DRO interval was never more than 5 min, and increases of that size were not used until the later stages of the program. None of these studies formally investigated the possible parameters concerning the size of an increase in the interval.

Baseline conditions were reinstated in the third phase for five sessions. Following this phase, the basic conditions of the second phase were applied in Phase 4 for 26 sessions. The single procedural difference between Phases 2 and 4 was the DRO interval, which was eventually extended to 30 min.

RESULTS

The observer-agreement criterion was fulfilled in five sessions before Phase 1. The mean agreement for aggressive responding in the last two sessions was 90%, with a range of 79% to 100%; the mean agreement for appropriate responding was 85.2%, with a range of 78% to 94%. The mean agreement for aggressive responding in sessions during the experiment was 93%, with a range of 88% to 100%; the mean agreement for appropriate responding was 90.2%, with a range of 78% to 100%.

Figure 1 displays the rate of aggressive and appropriate responding during the four phases. In Phase 1, the behavior varied between 0 and 0.44 responses per minute, with a mean of 0.19 responses per minute. These sessions varied in duration, and Session 2, in which no responding occurred, lasted only 15 min.

In Phase 2, aggressive responding varied between 0 and 0.05 responses per minute, with a mean of 0.01 responses per minute. In addition, mean appropriate responding increased from 0.01 responses per minute in Phase 1 to 0.06 in Phase 2. Phase 3, the five-session return-to-baseline condition, shared with Phase 1 a lack of steady state responding. Aggressive responding, however, increased as the rate of this behavior varied between 0 and 0.23 responses per minute, with a mean of 0.12. In addition, appropriate responding ceased for these five sessions. The conditions of Phase 2 were reinstated in Phase 4, and the behavior was immediately suppressed. Aggressive responding varied between 0 and 0.04 responses per minute, with a mean of 0.01, while appropriate responding increased to a mean of 0.05 responses per minute.

DISCUSSION

The repeated differences between baseline and treatment conditions support the effectiveness of combining the DRO and timeout procedures for reducing this child's aggressive responding. Since the 30-sec timeout was also

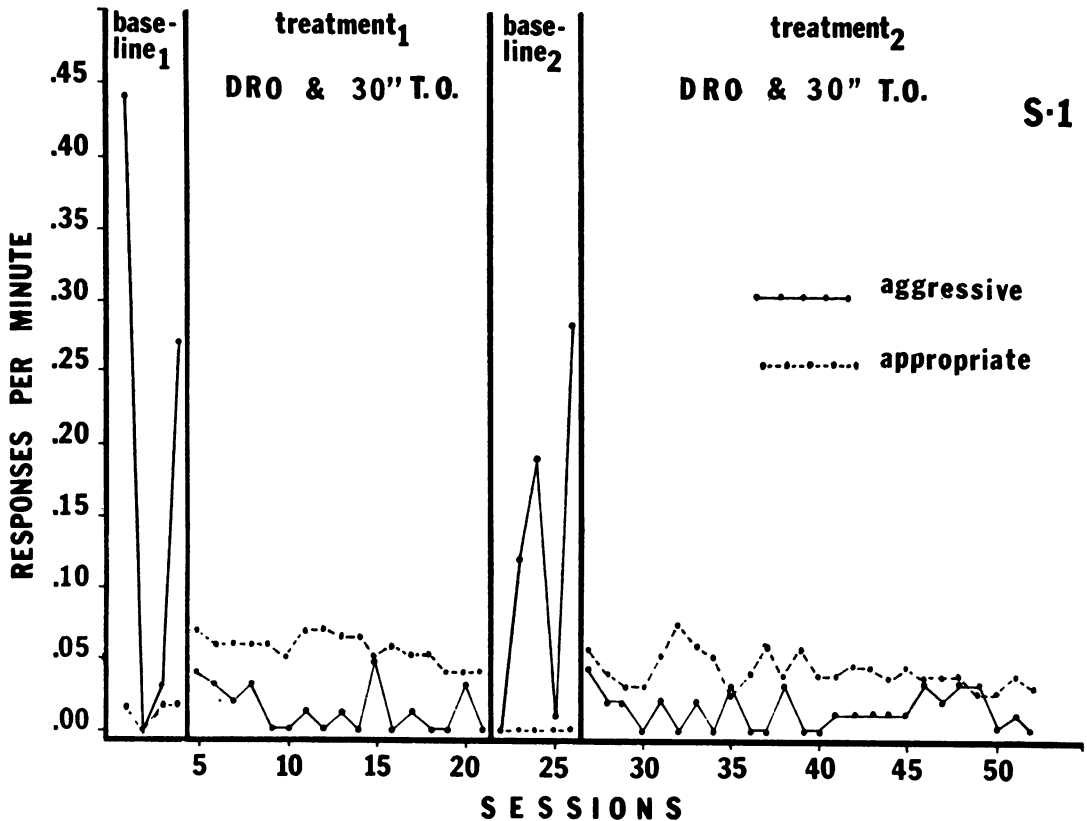


Fig. 1. The rate of aggressive and appropriate responses for S-1. During baseline phases, a 30-sec timeout was scheduled for each aggressive response. In the treatment phases, the timeout was continued and the subject earned food for each specified period of time in which he did not emit any of the aggressive responses. No reinforcement was scheduled for appropriate responses.

used during baseline, the DRO procedure was largely responsible for the decrease. The collateral increase in appropriate responding during the treatment phases is interesting, as the teacher made no direct effort to reinforce this responding. A possible explanation, given the procedure involved, is that appropriate responding was adventitiously reinforced, an occurrence that often accompanies DRO schedules of reinforcement.

The ultimate purpose of this program was to define, implement, and simplify a procedure that could be used in the activity room by cottage staff, who have many other responsibilities. At present, the staff is working with the child. At the time of this writing, more than 30 sessions have been conducted by the staff, without the teacher, and have resulted in data very sim-

ilar to that in Phase 4. These data are not presented, however, because they were not recorded by the same person who recorded in Phases 1 to 4, and we have been unable to administer observer-agreement checks.

EXPERIMENT II

Subject

S-2 was an 8-yr-old male with a diagnosis of moderate retardation associated with congenital rubella, blindness in the left eye, severe speech difficulty, hyperkinesis, and several other organic dysfunctions. His I.Q. score was 47 as measured on the Stanford-Binet Intelligence Scale. During his 15 months of institutionalization before treatment, he was consistently described in reports as a highly aggressive and

attacking child. S-2 was ambulatory but was neither toilet-trained nor under verbal control (*i.e.*, did not consistently follow commands).

Procedure

The DRO program was implemented in a classroom in which nine retarded children were enrolled for 135 min per day. Based upon observations in the classroom, aggressive responses were defined as: throwing objects; hitting, biting, kicking, or pinching others; tearing papers; spitting; and pushing or knocking over furniture.

Data were recorded on a wrist counter by one teacher trained in the definition of the target behavior. Observer-agreement was established by having the teacher and a second trained observer record responses. When the per cent agreement (calculated by dividing the larger number of observations per day into the smaller) was greater than 85% for two consecutive sessions, the first phase began. One additional observer-agreement check was made during each phase.

This experiment was conducted in four phases. Phase 1, baseline, consisted of 15 sessions in which responses were recorded, but no systematic consequences were scheduled. In Phase 2, a kitchen timer was set at the prescribed DRO interval. If an aggressive response occurred, the teacher told the child "no", and the timer was reset. This arrangement combined mild verbal punishment with DRO. If such a response was not made before the timer bell sounded, the timer was reset, and a star was placed on the student's board. Each star could be traded for a puzzle piece. When all pieces (usually about 10) were earned, the student earned the puzzle and could take it to his home cottage. In this 12-session phase, the interval was initially set at 5 min (approximately the mean interval between responses in Phase 1) and gradually increased to 10 min. The procedure for increasing the DRO interval was the same as in Experiment I. In Session 16, the

first session of the second phase, instructions concerning response definitions, the timer and bell, and the stars and puzzles were given to the student.

Phase 3 consisted of 13 baseline sessions and five probe sessions. The teacher conducted all 18 sessions but during the probe sessions used the DRO procedure (including "no" and instructions) rather than the baseline procedure. The probes were used to determine the immediacy as well as the continued efficacy of the procedure. Phase 4 consisted of 17 sessions in which the teacher employed the DRO procedure and in which the DRO interval was extended to 15 min.

RESULTS

The observer-agreement criterion was established in eight sessions before Phase 1. The mean agreement for the last two sessions was 88%, with a range of 86% to 90%. The mean agreement for the sessions during the experiment was 92%, with a range of 86% to 100%.

Figure 2 displays the rate of responding during the four phases. In Phase 1, the behavior did not represent steady state responding and varied between 0.05 and 0.46 responses per minute, with a mean of 0.23. Responding reduced substantially in Phase 2, varying between 0.01 and 0.16 responses per minute, with a mean of 0.05.

Phase 3 responding occurred under two conditions. For the 13 baseline sessions, responding varied between 0.02 and 0.26 responses per minute, with a mean of 0.12. For the five probe sessions, numbers 37, 38, 40, 41, and 42, the mean rate was 0.01 responses per minute. Responding in the baseline conditions of Phase 3 was substantially greater than that in the second phase; it was, however, less than the response rate in the first phase. Phase 4, in which the DRO program was again instituted, resulted in an immediate decrease in response rate and variability. For these 17 sessions, re-

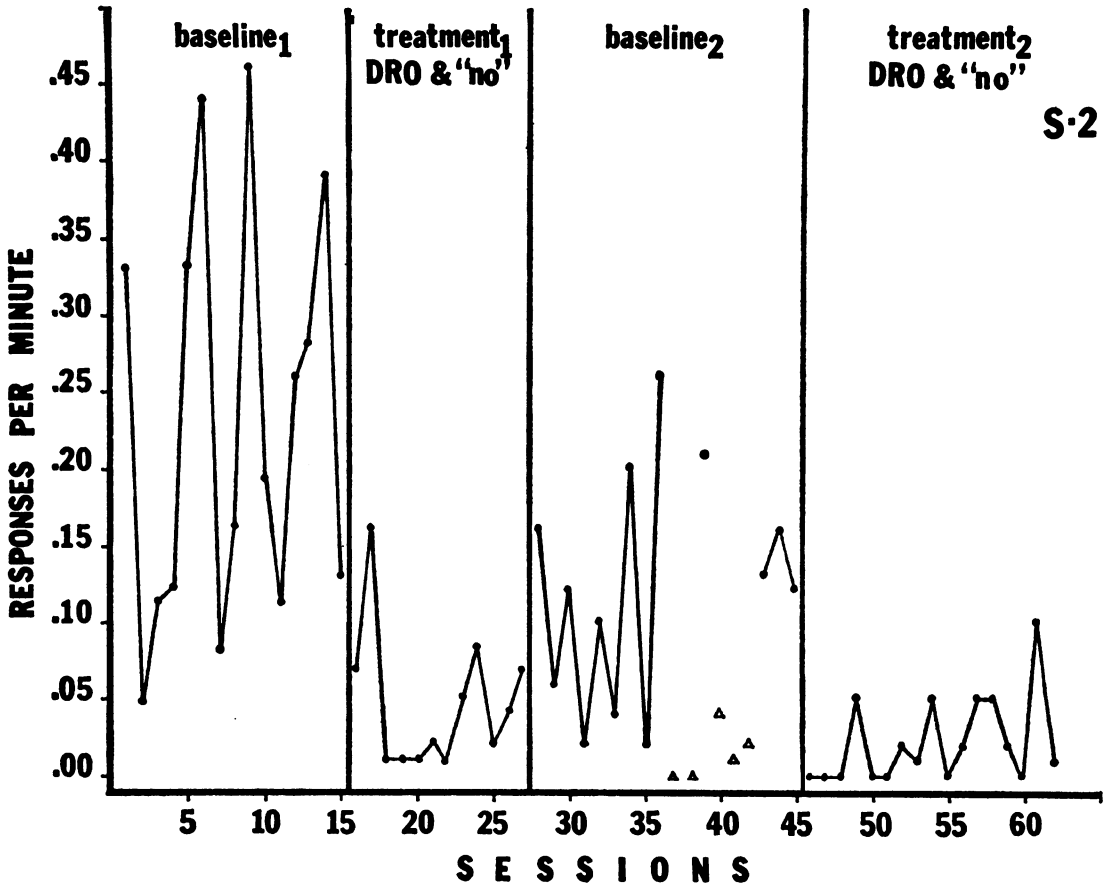


Fig. 2. The rate of aggressive responses for S-2. During treatment phases, the subject could earn puzzle pieces when no inappropriate responses occurred during specific intervals of time. Aggressive responses resulted in a loud "no". During the five probe sessions in baseline₂ (the data are represented by triangles), the treatment conditions were in effect.

sponding varied between 0 and 0.10 responses per minute, with a mean of 0.02.

DISCUSSION

Combining DRO, punishment, and instructional procedures for this child proved quite successful. Responding during treatment was less than one-twentieth of that found in baseline. In the reversal phase, Phase 3, the behavior increased to a high level, but was immediately reduced when the DRO probes were instituted. A similar reduction occurred in Phase 4 when the procedure was again employed. One should note that this procedure was employed for 34 sessions with the same terminal reinforcer, puzzles. The behavior might have been suppressed

even more if a variety, or "menu", of reinforcers had been available in exchange for the stars.

EXPERIMENT III

Subject

S-3 was a 13-yr-old male, diagnosed as moderately retarded. He had self-help skills, conversational speech, and was ambulatory. His I.Q. score as measured on the Stanford-Binet Intelligence Scale was 54. In his 17 months of institutionalization before treatment, S-3 was described in clinical reports as an "easily frustrated boy who sulks, is physically abusive, and exhibits inappropriate physical interactions with females". Previous incidents included attacks on staff and students.

Procedure

The program was conducted in a class of nine students and two teachers (not the same class as that in which S-2 was enrolled) for 3 hr daily. Observations resulted in a definition of six responses: leaving the room, abusive language, threats or commissions of physical abuse, inappropriate body contact with teachers (all physical contact other than handshaking), inappropriate body contact with students (often aggressive), and aggressive misuse of room equipment.

This experiment was conducted in two phases, baseline and treatment. Data were collected and recorded on a wrist counter by the classroom teacher, who was trained in definition of the target behavior. Observer agreement was established before baseline. A second trained observer also recorded responding, and per cent agreement was calculated by dividing the larger number of daily observations into the smaller. When the per cent agreement was greater than 85% for two consecutive days, Phase 1 began. Four additional agreement checks were made during Phases 1 and 2.

Phase 1 conditions were in effect for 28 sessions. During these days, the teacher systematically ignored the six inappropriate responses previously defined. In Session 29, the first session of Phase 2, a program began in which, for every 15-min interval in which no inappropriate responding occurred, five stars were placed in a small notebook carried by the subject. An inappropriate response was followed by three events: the subject was told he was wrong, all stars were taken from the book, and the timer was reset. The DRO procedure in this study was combined with response cost (removal of stars) and a mild punishment ("wrong").

In Session 29, the program was explained to the student, including the response definition and the token-exchange procedure. During this phase, the stars were exchanged at the subject's initiation for a variety of individually priced

back-up reinforcers, including records, camera film, cassette tapes, the opportunity to bake cakes, trips to a drive-in restaurant, bike riding, television watching, and various other events. This phase was in effect for 33 sessions. During the last six sessions of Phase 1, several serious responses occurred (*e.g.*, hitting the teacher with a hammer and with scissors). Because of the seriousness of these responses, no reversals were made in this experiment.

RESULTS

The observer-agreement criterion was established in nine sessions before the baseline period. The mean agreement for the last two sessions was 91%, with a range of 88% to 94%. The mean agreement for the sessions during Phases 1 and 2 was 97%, with a range of 91% to 100%.

Figure 3 shows the rate of inappropriate responding by the subject during the two phases. During baseline, responding varied between 0 and 0.22 responses per minute, with a mean of 0.08. During the next 33 sessions, with combined DRO, response cost, and verbal punishment, responding varied between 0 and 0.04 responses per minute, with a mean of 0.002. Responding occurred in only two sessions, numbers 44 and 49, and only 12 responses were emitted.

DISCUSSION

The effect of the DRO procedure was extremely dramatic. Three factors in addition to the reinforcer in the DRO schedule itself may have contributed to the decrease in inappropriate behavior. A substantial amount of verbal approval for appropriate responding was directed toward the subject by the classroom teachers, other teachers and administrators, and staff from the cottage in which the student lived. This approval may have contributed to the power of the DRO procedure, which was supported in the class by the token program. A second factor that probably added effectiveness was the extreme cost of an inappropriate re-

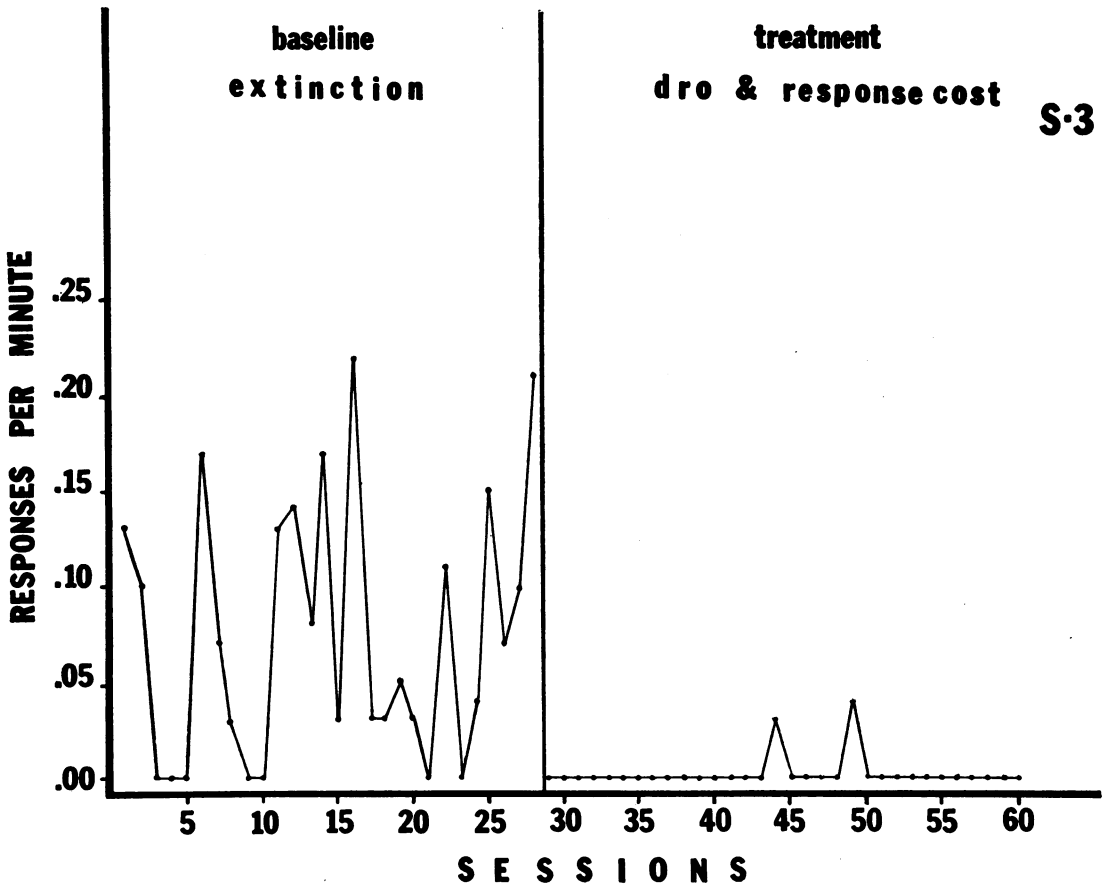


Fig. 3. The rate of aggressive responses by S-3. During baseline, the inappropriate behaviors were ignored (extinction). During treatment, response cost was combined with the DRO procedure where the absence of these behaviors for 15 min earned exchangeable tokens.

sponse—loss of all stars accrued since the last exchange. Many events required a large number of tokens, and, as the subject often saved tokens for a week or more, one inappropriate response could result in substantial loss. As in Experiment II, a third factor, instructions to the subject, probably facilitated the rapidity with which responding decreased.

EXPERIMENT IV

Subject

S-4 was a 10-yr-old female, diagnosed as severely retarded. She had almost no language or self-help skills (*e.g.*, she did not dress herself and was not toilet trained), but was ambulatory. On the University of Washington Functional

Screening Tool, S-4 functioned at the nine- to 12-month level on motor activity and language expression. In much of her 23 months of institutionalization before this treatment program, she was restrained with elbow splints to prevent her from reaching, and thus scratching, her face.

Procedure

This experiment was conducted in two phases, each occurring in the cottage in which the subject lived. Because of the severity of the response and the clarity of the results, no reversals were made. Observations indicated that, when one or both of the elbow splints were removed, the child picked the side of her nose and face with her index finger at a very high rate. Each movement of the finger against the

child's face was counted as a response. Observer agreement was established by having two observers trained in the definition of the target behavior count responses during seven sessions. One of the observers was the teacher whose data are reported. The per cent agreement was calculated by dividing the larger number of daily observations into the smaller.

Phase 1 consisted of 10 baseline sessions, with each session divided into three 5-min periods. In the first period, the right arm was freed from the elbow splint for 5 min, and the number of responses was recorded on a wrist counter. Another 5-min period followed in which the splint was replaced and the left-arm splint was removed. In the third period, both splints were removed, and the number of responses by each hand was recorded. The baseline was established in three parts to determine accurately whether responding was done by one particular hand. During this phase, all observations were made in an activity room that included three staff and 10 severely retarded children. The only consequence for responding during baseline was the teacher's saying "no".

In Phase 2, S-4 was taken initially from the activity room into an adjoining room occupied only by the teacher and subject. Both splints were removed from the child's arms, the total number of responses (by either hand) was recorded, and on the first day of this phase, the session length was increased to 25 min. After short intervals in which no self-mutilating behavior occurred, the subject was given bits of M & Ms. If a scratching response occurred, the child was told "no", the hand was pulled down to her side, and the timer was reset. In this study, the DRO technique was combined with the same verbal punishment used in baseline. Initially, the DRO interval was 1 sec, but was gradually increased to 120 min.

Beginning with Session 21, the subject was brought into the activity room for increasing lengths of time. Initially, this increase was about 1 min per day. In Session 21, 2 min of the session were in the activity room, and by Session

31, 15 of the 25 min were in this room. Beginning with Session 32, session length was increased to 45 min. By the end of the experiment, session length had been increased to 120 min, with the entire session occurring in the activity room.

RESULTS

The seven observer-agreement checks resulted in a mean agreement of 86%, with a range of 79% to 100%.

Figure 4 displays the results of Phases 1 and 2. When only the right elbow splint was removed, right-hand responding varied between 12.6 and 32.8 responses per minute, with a mean of 20.0. Responding by the left hand varied between 3.0 and 21.0 responses per minute, with a mean of 11.5. The overall mean, that is, the rate at which the face was picked by either hand, was 15.8 responses per minute. The overall mean rate for either hand in the sessions in which both hands were free was 17.2 responses per minute.

Phase 2 responding reflected the effect of the combined DRO-verbal punishment procedure. Responding decreased rapidly to a consistently low level. Using the activity room for a portion of the session (beginning with Session 21) and increasing the session length (beginning with Session 32) had no apparent effect on responding.

Responding decreased rapidly and orderly in the first portion of Phase 2. The principal contribution to the mean response rate in the second phase is from the first three sessions of that phase. For example, the mean response rate for Sessions 14 through 56 is only 0.01 responses per minute, while the mean rate for Sessions 11 through 13 is 0.80. Comparison of the last 43 sessions of Phase 2 with the 10 sessions of baseline in which both hands were free showed that responding was reduced to 1/1000 of the baseline level. This substantial decrease was made while the DRO interval was increased to 2 hr.

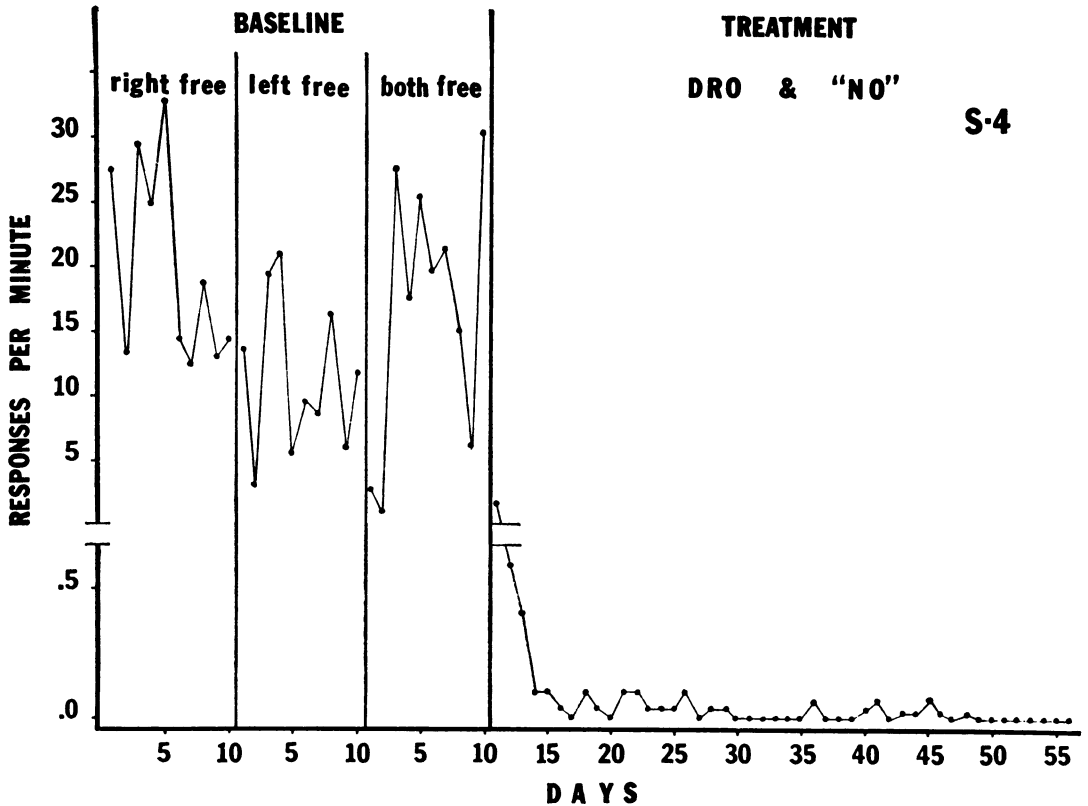


Fig. 4. The rate of face-picking by S-4. During baseline, loud "no's" were scheduled for each response. Baseline data show responding by the right hand, by the left hand, and by both hands. During treatment, responses resulted in a "no", while periods of no responding resulted in food and praise. The DRO interval was increased from 1 sec to 120 min.

DISCUSSION

There were three purposes to this experiment: (1) to define a procedure that would decrease this child's self-mutilating behavior, (2) to make this procedure manageable for cottage personnel, and (3) to teach this procedure to the staff. Previous attempts (loud "no's", pushing the child's hand away, ignoring the child when she emitted the behavior) by other personnel were unsuccessful; the DRO-punishment procedure, combined with pulling the hand down, however, proved to be quite successful. The verbal "no" was used across all phases of the experiment, but the DRO procedure in this case was combined with pulling the hand down after a response. Therefore, it is difficult to determine the effect of the DRO

procedure alone. Still, because pulling the hand down was a previously tried and ineffective alternative, and since the "no's" were used in baseline also, it is probable, in this study, that the DRO procedure produced the primary effect. We are now attempting to meet simultaneously the second and third purposes.

GENERAL DISCUSSION

Combining the DRO procedure with other procedures for these four retarded children proved to be much more successful than the staff and the teachers anticipated. In each case, the procedures successfully reduced the maladaptive behavior, and the speed with which the behavior was reduced was substantial.

Some aspects of these studies, however, deserve further consideration. First, because the

DRO procedure was never used alone, one cannot determine from the data the effectiveness of just the DRO procedure. In all cases it was combined with either timeout, mild verbal punishment, instructions, or response cost. In Experiments I and IV, the treatment combined with the DRO procedure was also present during baseline conditions, and in these cases the major variable responsible for a decrease in responding probably was the DRO treatment. In Experiments II and III, neither treatment was used in baseline, and no case can be made for suggesting that one of the procedures contributed more to the effect than did the other.

Other aspects of Experiments III and IV also deserve mention. Although the data show a significant change in responding when the procedures were implemented, one cannot assess conclusively the effect of the treatment because of the design. Most investigators would agree that a reversal in these situations would be unwise. An alternative to the reversal, and one that would provide a greater degree of experimental control than the AB designs used here, would be the use of a multiple baseline design (Hall, Cristler, Cranston, and Tucker, 1970). Future researchers should consider this when investigating responding where the use of reversals is undesirable.

A third problem raised by these studies involves the DRO interval. Some decision has to be made concerning the initial size of the interval and, once control is established, changes in the interval length must be scheduled. In these studies, the initial interval was always the average interresponse time during baseline, or less. For DRO to gain control over responding, the initial interval must be carefully chosen. The questions of when and by how much to increase the DRO interval present a different problem. In an applied study, the long-term goal is to reduce the behavior to a point at which experimental manipulation can be phased out. Increasing the DRO interval provides a highly useful tool for reaching that goal. In these studies, the parameters involved for the

most efficient method of increasing the DRO interval were not investigated and future researchers should investigate this area.

Another problem is that the DRO procedure, even when combined with other procedures, is more susceptible than other methods to developing superstitious behavior. In this procedure, if the defined response has not been emitted, reinforcement is delivered independent of responses. Therefore, a response may be adventitiously reinforced (Herrnstein, 1966; Skinner, 1948). As Zeiler (1970) indicated, if a response is occurring at a moderate rate, it may occur several times before reinforcement and, therefore, increase in frequency, despite the fact that its correlation with reinforcement is adventitious.

Data were recorded on behaviors other than aggressive ones only for S-1 in these experiments. These data indicate that appropriate responding was much higher during DRO than during baseline conditions. Casual observations did not indicate a substantial increase in any other response by S-2, but did indicate increases in other responses by S-3 and by S-4. Perhaps because of the DRO procedure, but more probably because of social approval given to him in his cottage, S-3 developed high, but appropriate, rates of saying statements such as "I've been good". The fourth subject developed a fairly high, but transient, rate of gently slapping her side while receiving reinforcement for not scratching her face. This behavior occurred during the first seven or eight sessions of the DRO procedure but subsequently ceased.

In all institutions, there is an increasing awareness of extra-experimental considerations when conducting research investigating behavior reduction. Punishment is becoming increasingly prohibited at many facilities and timeout is often restricted. At the Georgia Retardation Center, where this research was conducted, research proposals must be approved by a Committee on Human Rights, and while mild verbal punishers are approved, the more severe forms of punishment (such as electric shock)

are prohibited. Another prohibition kept the authors from replicating the work of Corte *et al.* (1971), who found food deprivation to increase the effectiveness of the DRO procedure. Food deprivation is not allowed at the Georgia Retardation Center and, while the results from Experiments I and IV were significant, more rapid response reductions might have been possible with mild food deprivation.

At institutions and other facilities where aversive techniques are prohibited, effective procedures using positive reinforcement to reduce behavior must be identified. The DRO procedure, as used here, is one effective procedure. Another nonaversive method that has been found to be effective with less severe responses, or when responding does not need to be completely reduced, is the differential reinforcement of low rates of responding (Deitz and Repp, 1973). Both procedures require the identification of reinforcers stronger than those maintaining the maladaptive behavior, and, if that problem can be solved, they represent two techniques highly suitable to the present requirements of most institutions.

In the cases presented here, DRO procedures combined with other techniques were highly successful in reducing aggressive and self-injurious behavior of four retarded children. In each instance, the reduction was orderly and rapid. The diversity of the responses indicates the success with which the DRO procedure can be used to reduce various types of responding. Finally, because DRO presents a technique utilizing positive reinforcement to decrease responding, it should be suitable for use in institutions with even severe restrictions.

REFERENCES

- Ayllon, T. and Michael, J. The psychiatric nurse as a behavioral engineer. *Journal of the Experimental Analysis of Behavior*, 1959, 2, 323-334.
- Azrin, N. H. and Holz, W. C. Punishment. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 380-447.
- Becker, W. C., Madsen, C. H., Arnold, C. R., and Thomas, D. R. The contingent use of teacher attention and praise in reducing classroom behavior problems. *Journal of Special Education*, 1967, 1, 287-307.
- Bostow, D. E. and Bailey, J. B. Modification of severe disruptive and aggressive behavior using brief timeout and reinforcement procedures. *Journal of Applied Behavior Analysis*, 1969, 2, 31-37.
- Bucher, B. and Lovaas, O. I. Use of aversive stimulation in behavior modification. In M. R. Jones (Ed.), *Miami symposium on the prediction of behavior, 1967: aversive stimulation*. Coral Gables, Florida: University of Miami Press, 1968. Pp. 77-145.
- Corte, H. E., Wolf, M. M., and Locke, B. J. A comparison of procedures for eliminating self-injurious behavior of retarded adolescents. *Journal of Applied Behavior Analysis*, 1971, 4, 201-213.
- Deitz, S. M. and Repp, A. C. Decreasing classroom misbehavior through the use of DRL schedules of reinforcement. *Journal of Applied Behavior Analysis*, 1973, 6, 457-463.
- Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Foxx, R. M. and Azrin, N. H. Restitution: a method of eliminating aggressive-disruptive behaviors of retardates and brain-damaged patients. *Behaviour Research and Therapy*, 1972, 10, 15-27.
- Foxx, R. M. and Azrin, N. H. The elimination of autistic self-stimulatory behavior by overcorrection. *Journal of Applied Behavior Analysis*, 1973, 6, 1-14.
- Hall, R. V., Cristler, C., Cranston, S. S., and Tucker, B. Teachers and parents as researchers using multiple baseline designs. *Journal of Applied Behavior Analysis*, 1970, 3, 247-255.
- Hall, R. V., Fox, R., Willard, D., Goldsmith, L., Emerson, M., Owen, M., Davis, F., and Porcia, E. The teacher as observer and experimenter in the modification of disrupting and talking-out behaviors. *Journal of Applied Behavior Analysis*, 1971, 4, 141-149.
- Hamilton, J., Stephens, L., and Allen, P. Controlling aggressive and destructive behavior in severely retarded institutionalized residents. *American Journal of Mental Deficiency*, 1967, 71, 852-856.
- Herrnstein, R. J. Superstition: a corollary of the principles of operant conditioning. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 31-51.
- Lovaas, O. I. and Simmons, J. Q. Manipulation of self-destruction in three retarded children. *Journal of Applied Behavior Analysis*, 1969, 2, 143-157.
- Madsen, C. H., Becker, W. C., and Thomas, D. R. Rules, praise, and ignoring: elements of elementary classroom control. *Journal of Applied Behavior Analysis*, 1968, 1, 139-150.

- Pendergrass, V. E. Timeout from positive reinforcement following persistent, high-rate behavior in retardates. *Journal of Applied Behavior Analysis*, 1972, **5**, 85-91.
- Peterson, R. F. and Peterson, L. R. The use of positive reinforcement in the control of self-destructive behavior in a retarded boy. *Journal of Experimental Child Psychology*, 1968, **6**, 351-360.
- Reynolds, G. S. Behavioral contrast. *Journal of the Experimental Analysis of Behavior*, 1961, **4**, 57-71.
- Risley, T. R. The effects and side effects of punishing the autistic behaviors of a deviant child. *Journal of Applied Behavior Analysis*, 1968, **1**, 21-34.
- Skinner, B. F. "Superstition" in the pigeon. *Journal of Experimental Psychology*, 1948, **38**, 168-172.
- Tate, B. G. and Baroff, G. S. Aversive control of self-injurious behavior in a psychotic boy. *Behaviour Research and Therapy*, 1966, **4**, 281-287.
- Thomas, D. R., Becker, W. C., and Armstrong, M. Production and elimination of disruptive classroom behavior by systematically varying teacher's behavior. *Journal of Applied Behavior Analysis*, 1968, **1**, 35-45.
- Wasik, B. H., Senn, K., Welch, R. H., and Cooper, B. R. Behavior modification with culturally deprived school children: two case studies. *Journal of Applied Behavior Analysis*, 1969, **2**, 181-194.
- Webster, D. R. and Azrin, N. H. Required relaxation: a method of inhibiting agitative-disruptive behavior of retardates. *Behaviour Research and Therapy*, 1973, **11**, 67-78.
- Williams, C. D. The elimination of tantrum behavior by extinction procedures. *Journal of Abnormal and Social Psychology*, 1959, **59**, 269.
- Wolf, M., Risley, T., and Mees, H. Application of operant conditioning procedures to the behavior problems of an autistic child. *Behaviour Research and Therapy*, 1964, **1**, 305-312.
- Zeilburger, J., Sampen, S. E., and Sloane, H. N. Modification of a child's problem behaviors in the home with the mother as therapist. *Journal of Applied Behavior Analysis*, 1968, **1**, 47-53.
- Zeiler, M. D. Other behavior: consequences of reinforcing not responding. *The Journal of Psychology*, 1970, **74**, 149-155.

(Received 18 January 1973.)

(Revision requested 10 April 1973.)

(Revision requested 25 September 1973.)

(Final acceptance 31 January 1974.)