

THE UNIVERSITY OF MANITOBA

COMPARATIVE EFFECTS OF DEMERIT TOKENS, RESPONSE COST, AND
TIME-OUT TO DECREASE SELF-STIMULATORY BEHAVIOR DURING POSTURE
TRAINING WITH SEVERELY AND PROFOUNDLY RETARDED WOMEN

by

Patricia A. Wrighton

A Thesis

Submitted to the Faculty of Graduate Studies

In Partial Fulfillment of the Requirements for the Degree
of Doctor of Philosophy

Department of Psychology

Winnipeg, Manitoba

January, 1978

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ABSTRACT

Four severely and profoundly retarded institutionalized women served as subjects in an experiment comparing the relative effectiveness of four different procedures in reducing self-stimulatory behavior:

- 1) Response Cost, in which residents received non-contingent token reinforcement at the start of a session, but lost them for each instance of self-stimulation;
- 2) Demerit Tokens, in which residents received tokens for each instance of self-stimulation and which were exchanged for three minutes of time-out on a variable ratio 6 schedule;
- 3) Time-out, in which residents were placed in time-out for three minutes on a variable ratio 6 schedule for self-stimulation;
- 4) No-contingency, in which self-stimulatory behavior was ignored.

Four sessions, one session per condition, were conducted daily in counter-balanced order, for a total of 210 sessions. In addition to the contingencies, posture training was conducted during all sessions. The effects of the four procedures were assessed by a mixed, multiple-baseline, multi-element design divided into three phases: 1) baseline; 2) treatment; 3) baseline. Results showed that Demerit Tokens produced the greatest response reduction relative to Baseline rates. Based on the mean of the last 10 sessions in the Baseline and Treatment Phases for each condition, the mean response reduction was: 1) Demerit Tokens - 59.48%; 2) Response Cost - 38.56%; 3) Time-out - 42.86%. There was evidence of generalization of the response reduction effects to No-contingency sessions during the Treatment Phase for two subjects. For these subjects the effect endured throughout the phase. There was no evidence of generalization of effects to the target behaviors in another setting

for three of four subjects. Further, the suppressive effects of the response reduction procedures did not endure throughout the Reversal Phase with one exception: responding under the Response Cost Condition remained lower in the Reversal Phase for one subject. Finally, there was no apparent improvement or deterioration in posture training performance coinciding with the introduction of the response suppression procedures.

ACKNOWLEDGEMENT

Many events conspire to propel one along, not the least of which is serendipity.

First, there was Jack, a mature student working with me for the summer. Jack's total enthusiasm for his courses at university was infectious; I signed up for a night course.

I had never intended to take Garry Martin's undergraduate course in operant conditioning. When an error was made in registration and I found myself in operant conditioning rather than developmental psychology, I was underwhelmed. Garry Martin had great enthusiasm for his subject, however, and the operant research data he presented sparked hope for the future of the forgotten people, the institutionalized retarded and mentally ill. I remember Garry's smiling patience (and, in retrospect, his amusement) when I burst into his office with excited accounts of what the white rat in my alcohol drinking experiment was doing. Garry's enthusiasm could always be depended upon as could his sympathetic support during some of the more demonic experiences which can wax horrific for graduate students, the most common for psychology students being statistophobia (a rational fear of statistics).

Another affliction, or perhaps it should be called an adventure, which besets graduate students is remaining solvent, that is arranging for funding from term to term and year to year. Glen Lowther, Director of Mental Retardation, provided research and work opportunities without which, right now, I would certainly be an underemployed B.A. graduate, pounding a typewriter, Sisyphus fashion, into the eternal future.

Similarly, I am grateful to the Province and people of Manitoba who through financial assistance, first by way of student bursaries and then University of Manitoba Fellowships, eased the financial burden. I am glad that by remaining in Manitoba, I shall be able to put back something of which I have received.

Having Joseph Pear as a committee member was a comfort, for when Joe commented on my research I felt assured that his questions arose out of a great store of knowledge and a careful and thoughtful analysis of the problem. Pedantic displays are not Joe's style.

Grayson Osborne, my external reader, has a reputation for being academically "tough", and, indeed, his remarks indicated a "close scrutiny" of my thesis. What was also clear and appreciated was that he carefully selected material to question. There were no excesses and every comment was helpful.

Much appreciation is also due to those upon whom the execution of the research was so dependent, particularly Hua Shim Ying and Bruce Cameron. Shim Ying, in spite of having just arrived from Hong Kong and a considerable language barrier, acted as a session observer along with Bruce. Her determination to learn and cheerfulness in the face of acute homesickness and cultural shock was inspiring. Dee Cantwell and Rosemarie Hrydowy dependably and generously acted as assessors in the data collection process.

Dick Gatley gave his precious time and energy. He typed into the late hours of the night. He made meals and served them at my desk while I studied interminably for the candidacy examination. He nourished me by

caring as much as I do about finishing my doctoral studies. He never presumed to criticize my academic work or to complain about the time I devoted to academic pursuits. Dick is my best friend.

My dear sister, Wendy, gave me her joy in my successes. Wendy is a stranger to malice and meanness of spirit.

Finally, I dedicate this to Jessie Thomson Wrighton and John Wrighton, my mother and father. In ways that I do not understand and barely remember, each of them prepared me, very early, to be serious, to have self-confidence, to be self-respecting, and to persevere. It is a pleasure to imagine their pride, if they were here now.

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INTRODUCTION

Severely and profoundly retarded persons pose a challenging problem to applied behavior analysts. Not only are members of this group typically lacking in behavioral skills necessary to their survival and emotional well being, but they usually exhibit a disproportionate amount of behavior which is socially maladaptive.

Self-stimulation is an example of maladaptive behavior and is a class of behavior common to two-thirds of institutionalized retarded persons (Berkson & Davenport, 1962; Kaufman & Levitt, 1965). Self-stimulation is identified by its repetitive, stereotypical and non-functional nature (Repp, Deitz & Speir, 1974). Some examples include rocking, hand waving, and head weaving (Azrin, Kaplan & Foxx, 1973; Kaufman & Levitt, 1965); mouthing of objects (Foxx & Azrin, 1973); hand gazing, paper flipping, cloth rolling, string threading, and pill rolling (Azrin, Kaplan & Foxx, 1973); and hand clapping (Foxx & Azrin, 1973; Wrighton, Martin & Welch, Note 1).

In addition to being non-functional, the high rate of self-stimulation interferes with teaching appropriate skills that have a low probability of occurrence (Repp, Deitz & Speir, 1974). For this reason, several response suppression procedures have been developed by applied behavior analysts for reducing stereotypic responding. Koegel, Firestone, Kramme, and Dunlap (1974) reduced self-stimulation in autistic children by using a slap, saying "No" sharply, and holding the relevant body part. A recently developed procedure, over-correction (Foxx & Azrin, 1973) has successfully reduced self-stimulation.

The rationale of overcorrection is "(1) to overcorrect the environmental effects of an appropriate act, and (2) to require the disruptor intensively to practice overly correct forms of relevant behavior.

. . . The method of achieving the second objective of practicing correct behaviors is designated as Positive Practice Overcorrection (p. 2)." Foxx and Azrin (1973) eliminated mouthing objects, hand clapping, and head weaving using positive practice overcorrection, and Azrin, Kaplan and Foxx (1973) similarly found a combination of positive practice and reinforcement of incompatible behavior effective in eliminating self-stimulation. Foxx and Azrin (1973) found overcorrection superior to three other procedures in reducing the mouthing of objects: a 10-second schedule of differential reinforcement or other behavior (DRO 10 seconds), a thigh slap, and a distasteful solution. Repp, Deitz and Speir (1974) and Repp, Deitz and Deitz (1976) found DRO schedules ranging from 1 second to 30 seconds effective in eliminating a variety of self-stimulatory behavior. Excessive head and face touching was reduced by Carroccio, Latham and Carroccio (1976) by making the opportunity to rent a guitar contingent upon a rate lower than the previous rate recorded during music lessons.

Associated with each of these procedures, however, are difficulties which make them unsuitable for certain situations. First, unconditioned punishment is banned in most institutional facilities for ethical reasons (Wallace, Burger, Neal, Van Brero & Davis, 1976). Positive practice overcorrection has been shown to be a highly effective response suppression procedure, but requires a great deal of time to

administer (Foxy & Azrin, 1972). Further, it is not suited for use in a group training situation where the ratio of supervisor to individual is greater than one-to-one since it is difficult to administer overcorrection to two or more individuals at the same time. DRO and differential reinforcement of low rate (DRL) schedules also require constant supervision of the behavior, making the procedure difficult to administer in groups where more than one behavior is to be treated.

Other response reduction methods have been effectively applied to suppress other types of problematic behavior. One such procedure is response cost which refers here to the contingent removal of reinforcers, usually conditioned, such as tokens, points, or money (Weiner, 1962). Response cost alone has reduced cash shortages in a small business (Marholin & Gray, 1976) and has decreased speech dysfluencies (Siegel, Lenske & Broen, 1969). When compared to other procedures, it has been shown to be as effective or superior to reinforcement for correct responses (Hundert, 1976; Phillips, Phillips, Fixsen & Wolf, 1971; Bucher & Hawkins, Note 2). Burchard and Barrera (1972) found response cost as effective as time-out, and in his review Kazdin (1972) found response cost superior to group therapy (Harmatz & Lapuc, 1968), aversive sound stimulation and feedback (Kazdin, 1972), and shock and disapproval (Schmauk, 1970). In addition to being effective with a variety of behavioral problems, response cost has the advantage of ease of administration in a group training situation, but has the disadvantages of: (a) usually being dependent on an ongoing token reward economy with the result that individuals can be fined at such a high rate that they rarely come into contact with the backup reinforcers (Doty, McInnis &

Paul, 1974); and (b) there is potential abuse by staff (Bassett & Blanchard, 1977).

Time-out also has been shown to reduce responding with a variety of behaviors including banging, fiddling and jerking (Pendergrass, 1972), verbal tics (Lahey, McNeese & McNeese, 1973), student misbehavior (Ramp, Ulrich & Dulaney, 1971), and stuttering (Adams & Popelka, 1971). A disadvantage of time-out in the classroom is that the student loses valuable teaching time (Martin, 1975) particularly if each instance of high rate behavior is timed-out as animal studies suggest is desirable for maximum response suppression (Azrin & Holz, 1966).

Recent research in applied settings, however, has indicated that it might not be necessary to consequence every instance of behavior to achieve response reduction (Calhoun & Matherne, 1975; Clark, Rowbury, Baer & Baer, 1973; Wrighton & Martin, Note 3; Wrighton, Martin & Welch, Note 1). Moreover, in the natural setting, it is difficult to guarantee delivery of a punishing stimulus on a fixed-ratio (FR) 1 schedule (Johnston, 1972).

In conclusion, no procedures have been reported which both effectively reduce self-stimulation and have the advantage of ease of administration in a group-training situation. Further, there do not appear to be any studies of response suppression that use delivery of conditioned punishers that are exchanged for a punishing event. Although a sharp "No" qualifies as a conditioned punisher, it typically does not lead to a backup punisher. An analogy of such a procedure in the natural setting is the use of demerit points for driving infractions

which can result in the loss of a driver's licence. Like response cost, such a procedure would have the advantage of being readily administered in a classroom setting without the disadvantage of being dependent on an ongoing token-reward economy.

For these reasons, the purpose of this study was to evaluate the relative effectiveness of response cost, demerit points with a backup punisher of time-out, and time-out alone in reducing undesirable behaviors occurring at a high rate in the severely and profoundly retarded. Four conditions were compared: (a) no contingency, (b) a condition in which each response resulted in the loss of a reward token, (c) a condition in which each response resulted in the presentation of a demerit token that resulted in time-out delivered on a variable-ratio (VR) schedule, (d) a condition whereby time-out alone occurred on a VR schedule.

Several researchers (e.g., Baer, Wolf & Risley, 1968; Stokes & Baer, 1977) have emphasized the importance of evaluating generalization of behavior change techniques and of assessing side effects of response suppression procedures (e.g., Johnston, 1972).

Thus, two additional purposes were (a) to assess the effects of the response suppression procedures delivered during classroom sessions on a punished behavior in another setting where no contingencies existed, and (b) to assess whether the response-suppression procedures would improve or retard the performance of the individuals on an alternate and desirable behavior being trained.

METHOD

Subjects

Four adult females, residents of Cedar Cottage which is a self-contained unit of the Manitoba School for the Retarded, served as subjects. Subjects' characteristics are summarized in Table 1. Level of retardation was classified according to the A.A.M.D. classification of retardation.

Each subject had a history of participation in a variety of ongoing behavior modification programs for training self-care and academic skills such as grooming, dressing, object identification, elementary vocalizations, and feeding. Participation in behavior modification programs was determined by each subject's performance on the MIMR Basic Behavior Test (Martin, Murrell, Tallman & Nicholson, 1975). Subjects are placed in programs according to test results and accompanying individualized curricula.

The criteria for the selection of subjects for the present study were that each had failed to perform well in a six-month posture training class. Each behavior was considered undesirable by either social normative standards due to the high rate, or because the behavior had been observed to interfere with the subject's learning appropriate posture in the posture training class. In the case of one individual, the behavior was self-injurious to the resident.

Setting and Apparatus

Experimental sessions were conducted in a classroom under four different stimulus conditions to be referred to hereafter as the Demerit Token Condition, the Response Cost Condition, the Time-out Condition,

Table 1

A Summary of Characteristics of Subjects Participating in the Study

Name	Chrono- logical Age	Social ^a Age	Mental ^b Age	Level of Retard- ation	Diagnosis	Years of Institution- alization	Medication
Kathy	23	3 yrs. 7 mos.	2 yrs. 9 mos.	severe	encephalopathy post-natal infection	18	Mellaril 50 mg T.I.D.
Mary	27	untestable	untestable	profound	familial cultural and deaf	6	Nosinan 25 mg
Paula	25	2 yrs. 11 mos.	2 yrs. 10 mos.	severe	encephalopathy pre-natal scaphocephaly	19	nil
Brenda	23	2 yrs.	untestable	profound	PKU	11	Largactil 25 mg Nembutal 1½ grs Sparine 50 mg

^aVineland

^bStanford Binet

and the No Contingency Condition. For each condition, the classroom was outfitted with four chairs for the subjects. Each chair had attached to the right side of the seat a token peg board painted white to hold pegs. Pegs awarded for correct responding were wooden dowels, 3.75 cm in length. The subjects' chairs were arranged in four different groupings, according to the condition in effect, and faced a one-way mirror. A table for holding recording equipment, pegs, demerit tokens, and edible reinforcers was placed against a wall under the observation window. The reinforcer sampling tray contained a variety of candies.

For each condition, the classroom was equipped with a posture training device consisting of a frame and straps from a backpack. At one end of the room hung a burlap divider behind which individualized posture training trials were conducted. In order to maximize the subjects' learning to discriminate the four experimental conditions, four different sets of stimuli were associated with each condition. The classroom was equipped with two floodlights and two each of red, blue, and green bulbs, each colour corresponding to a different condition. Plus, for each condition, the teacher wore a different outfit: a ski suit, a long dress and blonde wig, coveralls and hat, and a poncho and black wig.

An observation room with a one-way mirror overlooked the classroom. The observation room was equipped with a walkie-talkie for communication with the teacher, a tape recorder and a pre-recorded tape signalling the onset of a session, ten second intervals, and the offset of a session. A desk bell was located between the observers to signal the teacher when a subject should be timed-out.

No contingency condition. During the no contingency condition, the subjects' chairs were arranged in a semi-circle, no stimulus lights were present, and no stimuli associated with contingencies in other conditions were present. The teacher wore a poncho and black wig.

Time-out condition. For the time-out condition, a kitchen timer was mounted on the wall in view of the subjects and a time-out screen was placed just outside the classroom door enclosing a triangular space measuring approximately 1.5 m X .9 m X 1.2 m. The subjects' chairs were arranged in a straight row parallel to the observation window. Blue stimulus lights were present. The teacher wore coveralls and a hat.

Demerit token condition. For the Demerit Token Condition, the kitchen timer and time-out screen were present as described above. In addition, demerit token boards painted black were attached to the left side of each chair. Demerit tokens, which were red poker chips, were displayed in a container placed on the table in front of the subjects. The demerit token boards and poker chips had Velcro strips attached to them to allow the teacher to quickly dispense a demerit token without having to spend time positioning the token on the board. The subjects' chairs were arranged in a square, facing the observation window. The stimulus lights corresponding to this condition were red and the teacher wore a ski suit.

Response cost condition. The Response Cost Condition had no additional materials to those described under the general description for the No Contingency Condition with the exception that green stimulus

lights were present. The subjects' chairs were arranged in a row perpendicular to the observation window. The teacher wore a long dress and a blonde wig.

Television room. The television room in which generalization sessions were conducted was approximately 4.5 m x 9 m and was furnished with sofas, chairs, tables, a television set, and a hi-fi system. The experimenter wore clothes not associated with the training sessions.

General Procedures

Sessions

Four 20-minute daily classroom sessions were conducted Monday to Friday, four subjects per session. Each session corresponded to an experimental condition, i.e., No Contingency, Time-out, Demerit Tokens, or Response Cost. The experimenter conducted each of the four 20-minute daily sessions. Posture training trials were conducted in all sessions. In addition, subjects were observed daily, Monday to Friday, during five-minute periods in the television dayroom to test for generalization of the response suppression procedures.

Posture Training Procedures

Posture training procedures were based largely on those which had been standardized during two previous studies (Wrighton & Martin, Note 3; Wrighton, Martin & Welch, Note 1) and a previous posture training class of six months duration. The difference was that where appropriate sitting and standing previously were taught to subjects, appropriate posture while walking was an added objective in the present study. The levels of performance of three of the four subjects were roughly comparable in that three subjects previously reached a criterion

level of independently standing appropriately for a duration of 30 seconds. The fourth subject, Mary, had reached a criterion of sitting appropriately for 40 seconds.

Appropriate posture was defined as walking with (a) the head held straight with the jawline angled slightly less than the horizontal plane; (b) the shoulders back such that the shoulder blades held the posture training device vertical to the floor with the back of the head and buttocks touching the backpack frame; (c) the arms hanging loosely at the sides; (d) the distance from the toe of one foot and the heel of another during a step not exceeding 30 cm and not less than 20.3 cm; (e) the approximate lateral distance between the heel of the foot which is stepping forward and the toes of the stationary foot not exceeding 5.1 cm; and (f) toes pointed forward.

Posture training class. At the outset of the study, the first step in teaching appropriate walking was standing appropriately using the posture device for 10 seconds. Following this preliminary requirement, residents were required to walk while correctly maintaining the relevant body part according to the preceding definition. The first step in the walking hierarchy was two footsteps which increased by two-footstep increments to a target criterion of 10 footsteps. This procedure was followed for each body part. When a subject had successfully reached criterion on a particular step for three successive trials, the criterion was raised. If a subject was successful on the first trial of the raised criterion, but failed on subsequent trials, three successive failures were required before returning to the previous step mastered. Three trials per subject were conducted during each session.

These procedures were constant throughout all conditions.

Prior to each session, an observer brought the subjects into the classroom, seated them in their chairs, dispensed five non-contingent pegs in all but the Response Cost Condition, and closed the door upon leaving the room. Because a peg was to be removed following each response in the Intervention Phase of the Response Cost Condition, it was necessary that each subject have during these sessions enough pegs to guarantee that she typically would not run out. Thus, it was necessary to dispense more non-contingent pegs at the outset of the Response Cost sessions than the other sessions. Further, it was hypothesized that since behavior would decrease under the Response Cost Contingency, it was not necessary to use the upper limit of the rate of behavior to satisfy this requirement. Thus, the mean rate of responding as determined by baseline rates was used to determine the number of non-contingent pegs dispensed at the outset of Response Cost sessions. For the Response Cost Condition, then, under the baseline phase, the number of non-contingent pegs which were dispensed was based on a subject's mean rate of responding for the last 10 Response Cost sessions. For example, if the mean rate was two responses per minute, 40 non-contingent pegs (2×20 min.) were dispensed at the outset of the Response Cost session. With the onset of the intervention phase and for the remainder of the study, each subject received non-contingent pegs at the outset of Response Cost sessions corresponding to their mean rate during the last 10 baseline sessions.

The observers signalled the experimenter to enter the room at

the onset of a session. Standing in front of the subjects, the experimenter presented trials alternating between individuals. One trial consisted of requesting a subject to take her place on the other side of the wall divider, placing the posture device over her shoulders, and requesting her to stand up straight and walk to the experimenter. If a subject failed to respond to the initial request or only partially responded, the experimenter requested that the relevant body part be corrected. A shaping hierarchy was adhered to as follows: (a) head; (b) shoulders; (c) arms; (d) toes forward; (e) length of step; and (f) lateral distance between feet. That is, a subject was required to attend to only one step in the shaping hierarchy plus previous steps mastered. If a subject successfully completed a trial, the teacher said, "Very good (subject's name)", and gave her a peg. An unsuccessful trial resulted in the subject being asked to sit down, and the experimenter presented a trial to the next subject. Tokens were exchanged for a choice of candies given by an observer at the end of a session on a one-to-one token/candy reinforcer ratio.

Posture training observation. During sessions, the experimenter recorded subjects' responses to the first verbal instruction, additional verbal prompts required to correct a specific body part, whether physical guidance was required, and duration of correct standing or the distance walked appropriately.

Response Suppression Procedures

Behavioral Definitions

Each behavior was selected to be decreased on the basis that

- (a) the behavior occurred at such a high frequency that it readily

identified the subject as deviant (Brenda, Paula, Kathy), (b) the behavior was of such a frequency that it interfered with the subject's learning appropriate posture (Brenda, Kathy, Mary), or (c) the behavior was self-injurious to the subject (e.g., Mary's nails were chewed to the quick). The definitions of the target behaviors were as follows:

Kathy; chin thrust: Chin thrusting was any instance of tossing the head back with the chin thrust forward.

Brenda; hand twiddling: One instance of hand twiddling involved an episode of patting one hand against her leg or chair, against the other hand, pulling at the fingers of the other hand, tapping one finger between the fingers of the other hand, and bending the fingers of the other hand back. If the subject switched hands, this terminated an episode and marked the beginning of another episode.

Mary; excessive head and face touching: Placing a hand on the mouth, face, neck, or any part of the head. Any instance of touching and removing the hand from the head was scored as one response.

Paula; hand clapping: Any instance of clapping the hands together was scored as one response, even though no clapping sound was audible to the observers.

Observation procedures. Although each subject's rate of behavior was high, permitting a time sampling procedure of observation, all responses had to be recorded continuously in order to administer the variable ratio 6 schedule. Interobserver reliability scores, based on continuous recording of high rate of behavior over a period of time such as 20 minutes, however, are subject to inflation of the scores (Hersen & Barlow, 1976). Thus, in order to preserve the requirement

of continuous recording and base interobserver reliability scores on short-time intervals, the following procedure was followed. From an adjacent observation room, two observers recorded target behaviors continuously, two subjects per observer. A pre-recorded tape signalled 10-second recording intervals. Data sheets were blocked into 120 corresponding intervals equalling a 20-minute session. During the intervention phase, for the Demerit Points and Time-out Conditions only, a different data sheet was used. It consisted of dash marks representing one response per dash mark. When a response occurred, the observer entered an oblique slash mark above the corresponding dash mark. The purpose of this data sheet was to permit the observers to signal the experimenter when a subject should be timed-out during the Demerit Tokens and Time-out Condition, according to the appropriate variable ratio. Pre-selected dash marks signalling time-out were circled in red prior to a session according to a variable ratio 6 schedule to be described later under Experimental Phases. Throughout all conditions and phases, the observers signalled the teacher following each response by means of a walkie-talkie in order that the teacher could apply the appropriate contingencies. Each subject was numbered (1, 2, 3, 4) and the observers called these numbers when the corresponding subject made a response. Additionally, during the Demerit Tokens and Time-out Conditions, the observers signalled the teacher to send a subject to time-out by means of a desk bell. Thus, an observer rang the bell and called the subject's number at the appropriate time.

Television room observations. Once daily, in the television room,

the teacher recorded the subjects' target responses, five minutes per subject. The onset and offset of observation periods was signalled by means of a pre-recorded tape.

Interobserver reliability. Prior to the Baseline Phase, the observers practiced recording until agreement of at least 80% was reached at least once for each subject. Interobserver reliability data was gathered for 23% of the sessions by two independent observers who were located in the same observation room as the regular observers. Agreement was calculated for each interval by dividing the number of responses per interval in which the observers agreed by the number of responses per interval in which the observers did not agree plus the number of responses per interval in which the observers agreed and multiplying by 100 to yield percentage of agreements. Intervals in which both observers did not record responses were eliminated from the calculations.

Experimental Phases

As shown in Table 2, the experimental design was a mixed ABA multiple baseline design, with multiple elements in the B phase (Sidman, 1960; Ullman & Sulzer-Azaroff, 1975). That is, after the initial baseline, intervention procedures were introduced on a multiple baseline across subjects and were withdrawn according to a multiple reversal design. Further, at the onset of the intervention phase for each subject, three different conditions (Demerit Tokens, Time-out, Response Cost) were introduced simultaneously while no contingencies continued in the fourth condition (No Contingency). Throughout the study, one session for each experimental condition [No Contingency (NC), Demerit Tokens (DT), Time-

Table 2
Experimental Design

Experimental Phase			
Subject	Baseline	Intervention	Baseline
Kathy	NC ^a DT TO RC	NC DT TO RC	NC DT TO RC
Mary	NC DT TO RC	NC DT TO RC	NC DT TO RC
Brenda	NC DT TO RC	NC DT TO RC	NC DT TO RC
Paula	NC DT TO RC	NC DT TO RC	NC DT TO RC

^aNC refers to No Contingency; DT refers to Demerit Tokens;
TO refers to Time-out; RC refers to Response Cost.

out (TO), and Response Cost (RC)] was conducted daily, totalling four daily sessions. Sessions were conducted in random order as follows: RC, DT, NC, TO; NC, RC, TO, DT; DT, TO, RC, NC; TO, NC, DT, RC; and then recycled.

Baseline

During the initial Baseline Phase, only posture training procedures were in effect for all conditions. No punishment contingency for the target responses prevailed. The stimuli associated with each condition were present during baseline sessions. That is, during Demerit Token sessions, the demerit tokens, kitchen timer, time-out screen, black demerit token boards, and red stimulus light were present, and so on for each condition.

Treatment

No contingency. For the purpose of assessing generalization of the response suppression procedures as well as possible contrast effects, baseline procedures were conducted daily during one session during the Treatment Phase.

Demerit tokens. During the Demerit Token sessions, demerit tokens were delivered contingent upon each instance of the target behaviors. Upon receiving the signal from the observer, the teacher placed a demerit token on the subject's demerit token board. Nothing was said to the subjects, but the teacher frowned while presenting the token and then turned quickly away.

Demerit tokens were exchanged for a three-minute period of time-out on a VR 6 schedule of time-out. When a subject was to be timed-out after receiving the appropriate number of tokens and upon receiving a

signal from the observer, the teacher asked the subject to leave the room and set the timer. A VR 6 schedule was selected since Wrighton and Martin (Note 3) found that a VR 6 schedule of a handslap effectively decelerated undesirable behavior in three of the present study's four subjects (Kathy, Mary, Brenda) to an acceptable level within twenty 20-minute sessions. Using the same VR schedule in this study as that used in the previous study facilitated a comparison across studies.

In the earlier experiment, responses to be punished were selected from a table of random numbers. Each 2nd, 14th, 17th, and 18th response in a 24 response sequence was punished. Thus, in the present study, each subject was removed from the classroom after collecting 8, 12, 3, and 1 demerit tokens representing the 2nd, 14th, 17th, and 18th responses. The number of responses that could occur without resulting in time-out, therefore, ranged from 0 to 11. The program recycled after a sequence of 24 responses was emitted. Within each 24 response cycle, four responses were timed-out, yielding the VR 6.

To control for subjects learning the sequence, the VR 6 schedule was programmed continuously over all sessions. This method of programming also ensured that occasionally each subject was punished after the first response was emitted in a session and, therefore, controlled for the subject's learning that one response was "safe" per session. The VR 6 schedule began immediately upon the experimenter's opening the classroom door and terminated upon closing the door when leaving. Thus, any responses that might not have entered into the schedule were not emitted in the presence of the experimenter.

Time-out. During the time-out sessions, the observers signalled the experimenter when a subject should be timed-out according to the VR 6 schedule as described under Demerit Tokens. The difference between the Demerit Token sessions and Time-out sessions was that demerit tokens were not delivered after each response during Time-out sessions.

Response cost. During response cost sessions, pegs were removed contingently after each response. The observers signalled the experimenter when a response had occurred. If a subject lost all of her pegs during a response cost session, the observer explained to the subject at the end of the session that if she did not have any pegs she did not receive any candy.

Return to Baseline

Following a differential number of sessions for each subject in the Intervention Phase, a return to baseline procedures was instituted for all conditions.

RESULTS

Reliability

Interobserver reliabilities were gathered in 23% of the sessions. Mean reliability scores for the four subjects ranged from 81.33% to 86.4% with individual session scores for each subject ranging from 31.81% to 100%.

Demerit Tokens versus Time-out versus Response Cost

Figure 1 shows mean responses per minute for the last 10 sessions for each condition for each subject. Results indicate that Demerit Tokens produced the greatest response reduction within the Treatment

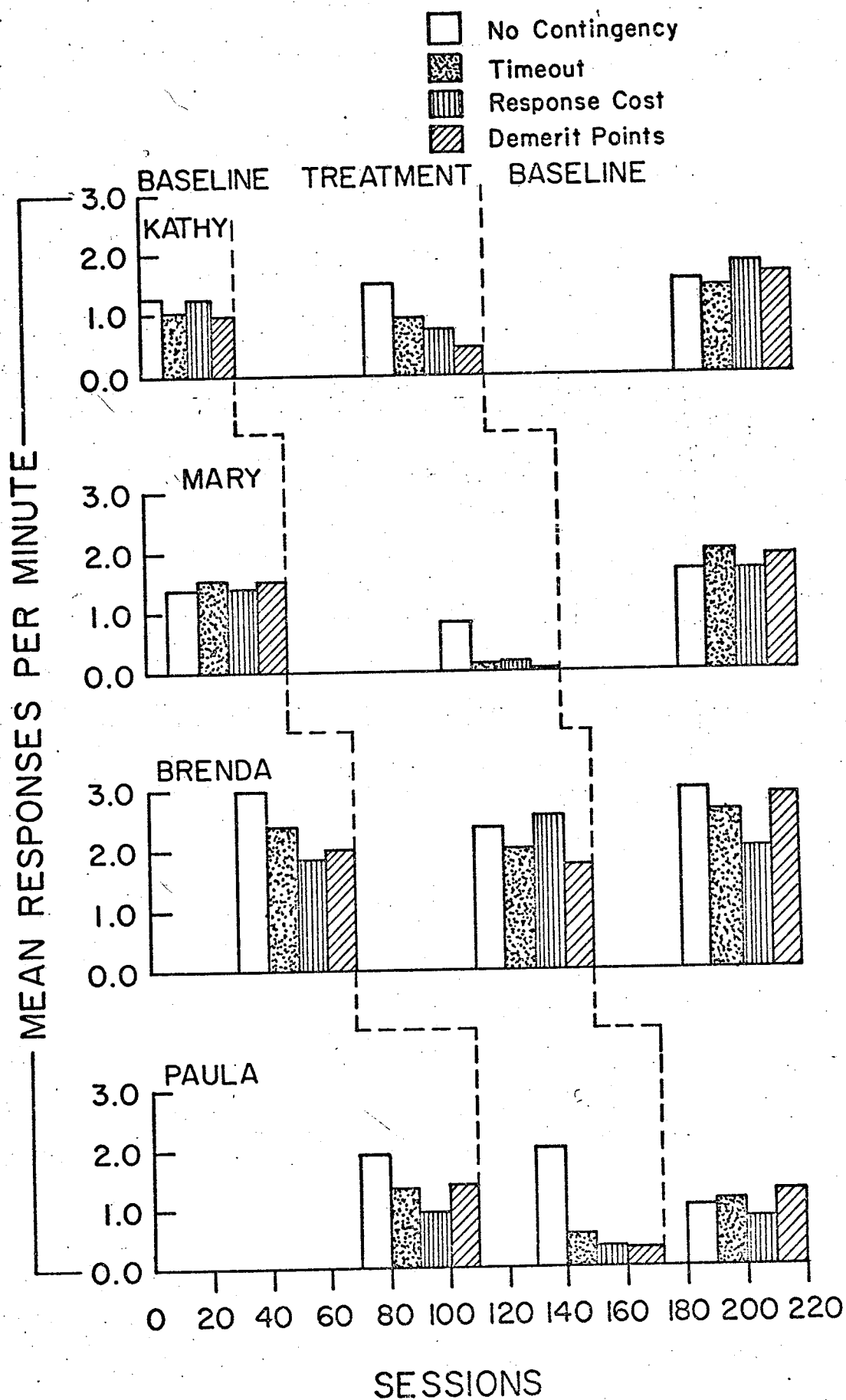


Fig. 1. Mean responses per minute per condition based on the mean of the last 10 sessions per condition in each phase.

Phase for all subjects. During the treatment phase across subjects, No-contingency produced a mean of 2.62 times as much responding as Demerit Tokens; Time-out produced a mean of 1.43 times as much responding as Demerit Tokens. Response Cost produced a mean of 1.47 times as much responding as Demerit Tokens, and Response Cost resulted in 1.02 times as much responding as Time-out.

Table 3 shows the percent of response change per condition for each subject from Baseline to Treatment Phases. The results indicate that Demerit Tokens produced the greatest response reduction relative to the baseline rates for the four subjects. The mean response reduction was: 1) Demerit Tokens = 59.48%; 2) Response Cost = 38.56%; 3) Time-out = 42.86%; 4) No-contingency = 14.24%.

Generalization to the No-contingency Condition

The No-contingency Condition (●—●) in Figure 2 shows mean responses per minute in blocks of four sessions for each subject across experimental conditions. Some transitional generalization appears evident in the Treatment Phase for Kathy, and clear generalization effects are evident for Mary. For Brenda and Paula, however, generalization effects are borderline. Paula's data in particular, are too variable to evaluate.

Generalization Across Time

As shown in Figures 1 and 2, the suppressive effects of the response reduction procedures did not endure in the Reversal Phase, particularly for Kathy and Mary.

Setting Generality

Figure 3 showed no evidence of generalization effects to the

Table 3Percent Response Change From Baseline Rate^a

Subject	No-contingency	Time-out	Response Cost	Demerit Tokens
Kathy	+17.96	-9.80	-41.5	-53.00
Mary	-40.70	-89.74	-88.57	-95.36
Brenda	-25.39	-13.39	+38.17	-13.30
Paula	-8.85	-58.51	-62.36	-76.26

^a Calculated on the mean responses per minute for the last 10 sessions of baseline and treatment phases for each condition.

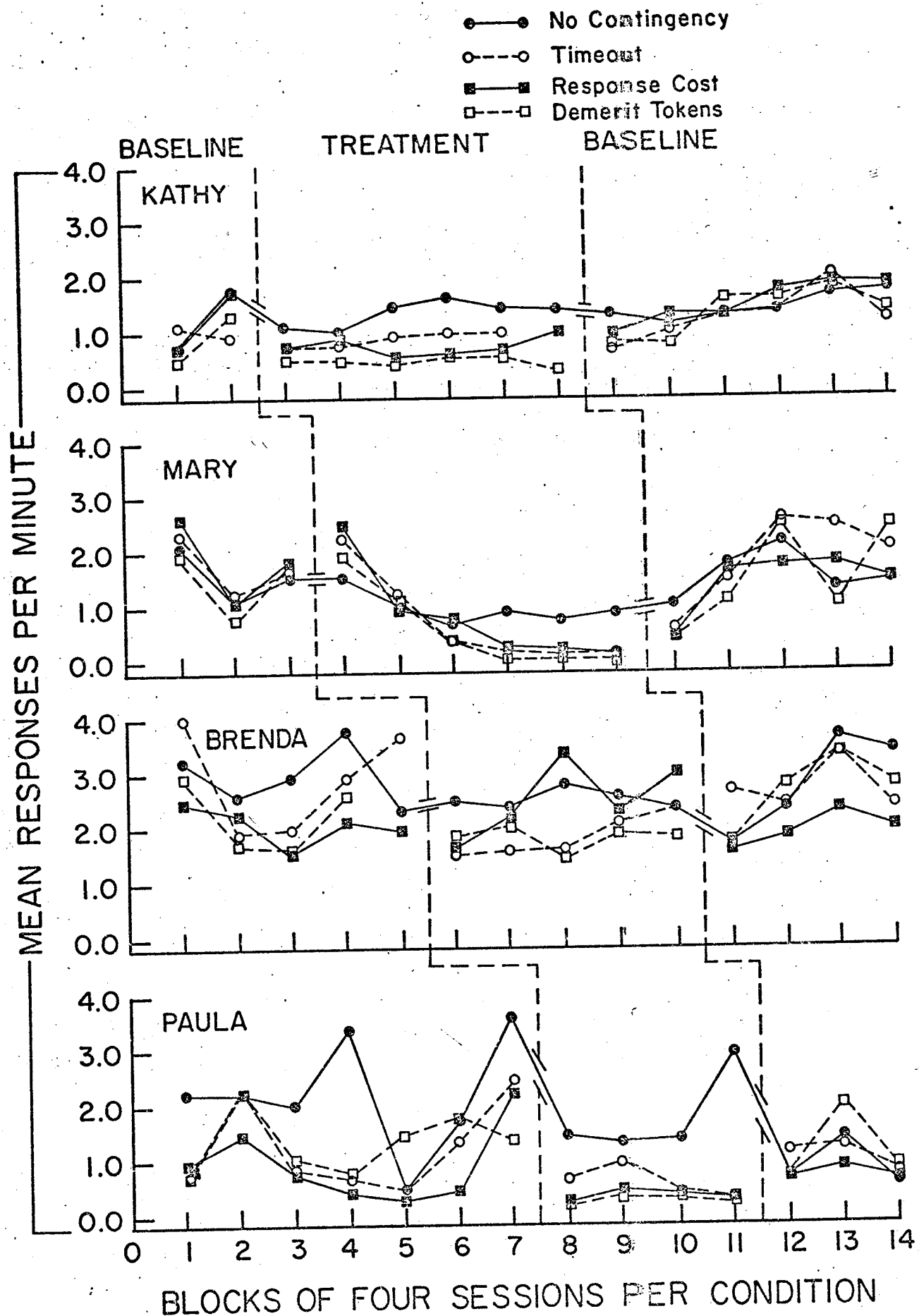


Fig.2. Mean responses per minute per condition shown in blocks of four sessions for each subject.

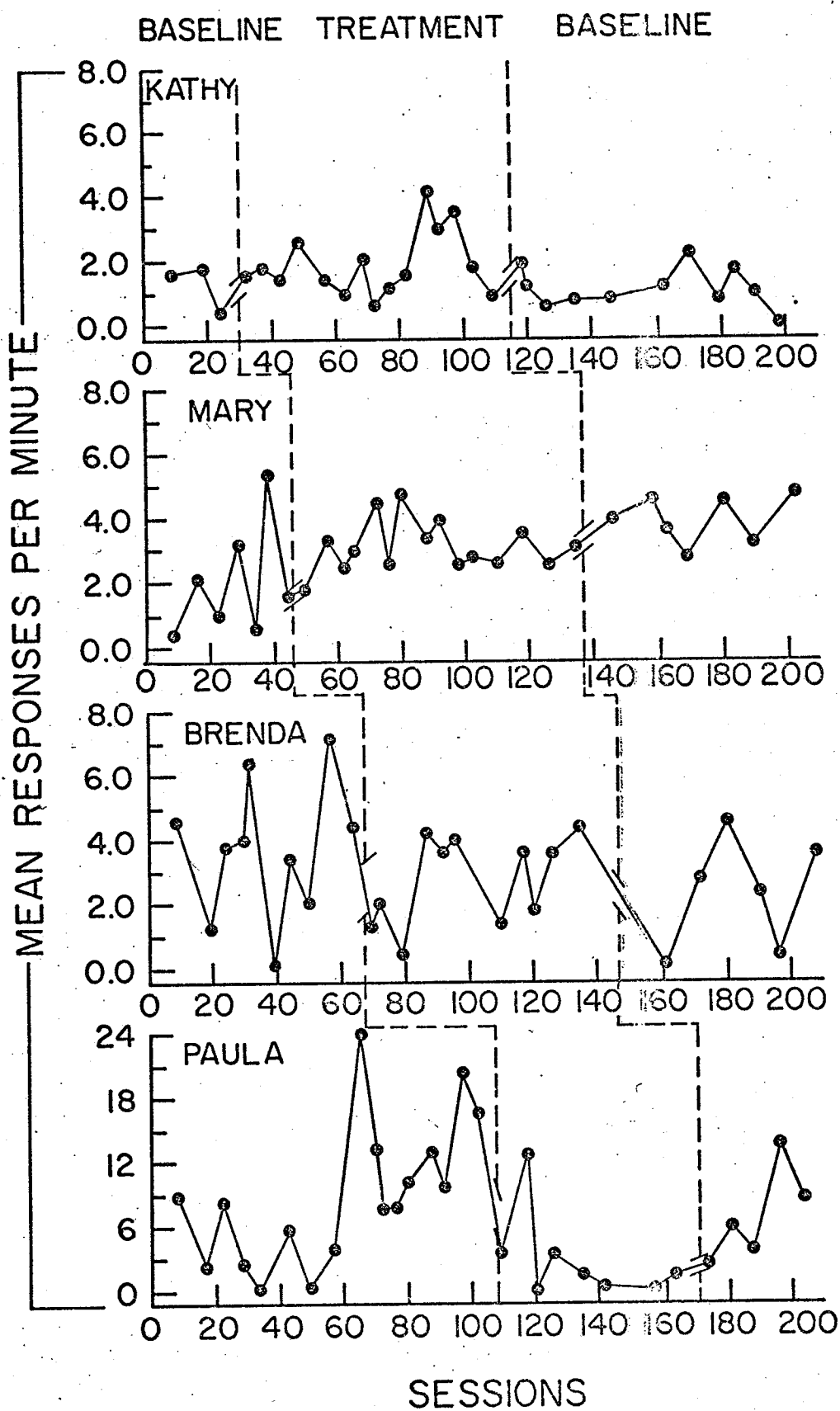


Fig. 3. Mean responses per minute for each subject in the television room.

punished behavior in another setting with the possible exception of Paula, although the data appear to be more variable than during sessions.

Interactions with Posture Training

There is no evidence of correlation between the onset of the Treatment Phase and improvement or deterioration in the subjects' performance during posture training.

DISCUSSION

For all subjects, the data indicate that demerit tokens in conjunction with a backup punisher of time-out reduced self stimulatory behavior more effectively than either time-out alone or response cost. Response cost resulted in an intermediate rate while time-out was least effective. None of the response suppression procedures, however, entirely eliminated responding and there were no apparent differences across conditions in the immediacy of response reduction nor duration of response suppression.

Several explanations for the relative weakness of the time-out procedure are plausible. First, the duration of time-out might have been inappropriate for these subjects. Since none of the subjects, however, had previous experience with time-out and since current research appears to indicate that short periods of time-out are effective if they do not follow longer durations (White et al., 1972), duration is not likely a significant factor. Second, a constant duration of time-out was used in this study irrespective of the subjects' behavior at the time of release. Since all the subjects had the opportunity to engage in the target behavior just prior to being released, it is possible that self-stimulation was adventitiously reinforced during time-out. Third, the schedule of time-out might not have been sufficiently frequent. Clark et al. (1973) found a variable-ratio 3 (VR 3) schedule of time-out equally as suppressive as fixed-ratio 1 (FR 1) although higher values of the schedule were not. Wrighton and Martin (Note 3), however, successfully reduced the same

behaviors in three of the present study's four subjects using a VR 6 schedule of a handslap, suggesting that the nature of the punishing stimulus may be more critical than the schedule.

An advantage of the VR 6 schedule of time-out used in the present study was that it involved less loss of training time than would an FR 1 schedule. Additional work on the part of the teacher, however, was required to monitor the schedule.

A comparison of demerit tokens to response cost is difficult since the backup punishers differed for each procedure. Moreover, the difference in effects between the two procedures was small. Within the Demerit Tokens Condition, it can be inferred that the demerit tokens component was a more-critical variable than time-out in the demerit token procedure, since VR 6 time-out alone produced higher responding than response cost, while the addition of demerit tokens (dispensed on FR 1) to VR 6 time-out decreased responding to below that of response cost. Thus, FR 1 demerit tokens possibly are more suppressive than FR 1 response cost.

In response cost, the backup value of a token depends on the number of points which can be earned, the cost of the backup reinforcers, and the points needed to survive the system (Kazdin, 1972). In demerit points, the backup value of a token depends only on the cost of the backup punishers. As Kazdin (1972) has remarked about Response Cost and which applies to Demerit Tokens as well, the actual backup value might not be the most crucial component. Rather the actual signalling function of the tokens might be more important.

Few procedural differences exist between response cost and demerit tokens. Typically for each the behavior is consequence after every response and very little time is involved in the delivery or removal of a token. In the case of response cost, particularly with high rate behaviors, there is the problem of the individual losing all of her or his tokens (Doty, McInnis & Paul, 1974). This occurred on four occasions for Brenda and once for Kathy in the present study. Responses which occurred after all pegs had been lost did not result in a debit to the subjects which carried over to the next response cost session. Thus, it is possible that subjects learned that responses occurring after all tokens were removed would not be punished. Indeed, Brenda's responding increased during the treatment phase under Response Cost by 38.17% over Baseline rates.

Demerit tokens circumvent the problems associated with the interdependency of response cost and a token reward economy, but require that an additional backup punisher be programmed and administered. The backup punishers available are considerable (e.g., time-out, loss of privileges, handslap, social punishment) and can be chosen with special regard to the severity of the behavior and an individual's responsivity to particular types of punishment. Moreover, demerit tokens can be programmed to interact with an ongoing token economy. For example, the backup punisher could be either the loss of conditioned reinforcers or backup reinforcers. For example, Kazdin (1972) reported a study by Upper (Note 5) who issued demerit tickets which denoted token loss for rule violations by psychiatric patients on a token economy ward.

A major concern associated with response suppression procedures, particularly those involving punishment rather than reinforcement, involves the positive and negative side effects of these procedures. Azrin and Holz (1966) have documented several negative side effects associated with the presentation of an aversive stimulus including attempts to escape the punishing stimulus and heightened emotionality of an undesirable nature. As well, Coughlin (1972) came to the tentative conclusion that withdrawing positive reinforcement can function as an aversive event. On the other hand, some studies have reported unplanned improvements in behavior occurring in conjunction with a response suppression procedure (Doleys, Wells, Hobbs, Roberts, Cartelli, 1976; Moore & Bailey, 1973; Risley, 1968; Wrighton & Martin, Note 3). Although, in the present study, there was no noticeable improvement in the subjects' performance of the posture task being trained, one subject (Mary) became noticeably alert and attentive to the teacher after the introduction of the treatment variables.

Some additional observations were made of the subjects' behavior during the response suppression sessions. Table 4 presents typical comments by observers.

Twelve standard opportunities (4 subjects X 3 procedures) existed in which side effects could have been displayed. As shown, only Kathy reacted with undesirable emotionality and behavior during isolation in time-out. During the Time-out Condition, while in the time-out space, she frequently swore, yelled, bit her arm, banged her head and kicked the wall. During the Demerit Token Condition, while in time-out, she

Table 4

Reactions To The Delivery of A Contingency

Response Suppression Procedure	Kathy	Mary	Brenda	Paula
Time out	Yelled in TO 26 face slaps. 32 head bangs. Kicked screen off.	No reaction. Looked puz- zled. Might have smiled faint- ly when leav- ing.	No change in expression. Quiet and relax- ed coming out. No change in ex- pression. Smiled when told to leave. Looked startled; yelled "no". Muttering, laugh- ing & yelling in TO.	Smiles at teacher when leaving room. Seemed "pouty" upon returning. Tried to hug teacher. Makes muttering noises in TO; agitated.
Response Cost	Looked up. Smiling. Looked down. Smiled.	Looked at token. Put hand down, Looked at teacher.	No reaction. Chewed hand. Looked around room. Chewed hand. No reaction. Smiled; said "Ah".	Stared at pegs. Appeared pouty. Agitated. Stared at pegs. Smiled. Sat most of session with one hand on laces & one on face.
Demerit Tokens	Looked at floor, smiled. Looked at token.	Looked at token. Put hand down. Blank expres- sion.	Left room quietly. No twiddling. Looks startled. Looked at teacher. Said "No". Looked at token.	Looked at token. Played with hair. Smiled on way to TO. Looked at pegs after returning from TO.

behaved similarly, although she exhibited pleasure in this condition when given demerit tokens. Kathy also smiled when her pegs were removed during Response Cost, and Paula sometimes showed pleasure during all three punishment conditions when the contingency was applied. Brenda and Mary consistently did not show discernible reactions under the punishment conditions. It is clear that in the present study, all three procedures were suppressive to varying degrees even though the procedures did not necessarily generate undesirable emotionality and behavior in 10 out of 12 situations. Of note is that the case of most extreme emotionality (Kathy during the Time-out Condition) correlated with the least response reduction.

On the basis of these findings and in the relative absence of guidelines governing the use of response suppression procedures plus the fact that parents and others appear to use punishment procedures rather extensively (Forehand, King, Peed & Yoder, 1975; Johnson & Lobitz, 1974), continued research into the effects and side effects of a variety of response suppression procedures appears not only warranted but necessary.

APPENDIX

REVIEW OF THE LITERATURE

Severely and profoundly retarded persons pose a challenging problem to applied behavior analysts. Not only are members of this group typically lacking in behavioral skills necessary to their survival and emotional well being, but they usually exhibit a disproportionate amount of behavior which is socially maladaptive.

Self-stimulation is an example of maladaptive behavior common to two-thirds of institutionalized retarded persons (Berkson & Davenport, 1962; Kaufman & Levitt, 1965). Self-stimulation is identified by its repetitive, stereotypical and nonfunctional nature. Some common examples include rocking, hand waving, and head weaving (Azrin, Kaplan & Foxx, 1973; Kaufman & Levitt, 1965; mouthing objects (Foxx & Azrin, 1973); hand gazing, paper flipping, cloth rolling, string threading, and pill rolling (Azrin, Kaplan & Foxx, 1973); and hand clapping (Foxx & Azrin, 1973; Wrighton, Martin & Welch, Note 1).

Foxx and Azrin (1973) have developed a theoretical analysis of self-stimulatory behavior, characterizing it as an imbalance of reinforcement for self-directed rather than outward-directed behavior:

From a reinforcement orientation, profound retardates can be considered to suffer from a deficit of functional (reinforced) behaviors directed toward their physical and social environment because of their intellectual, physical and perceptual deficits, which probably cause such behaviors to be extinguished or

punished . . . the process can be considered
as self-perpetuating. (p. 13)

The reinforcers, according to this view, are tactual, proprioceptive, and sensory stimuli (Azrin et al., 1973) in contrast to behavior which acts on the environment and which is reinforced by stimuli of a tangible and social nature and thus is dependent on the existence of a complex repertoire for their procural. The severely and profoundly retarded, in particular, typically lack the complex behavioral repertoire necessary to mediate between themselves and others, and teaching these skills to this population is frequently hindered by the presence of high rate self-stimulation. To permit the learning of new behavior and to decrease social unattractiveness, several response suppression procedures have been developed for reducing stereotypic responding.

The most obvious treatment for this behavior, extinction, is implied by a traditional operant analysis of self-stimulatory behavior. In this view, behavior is assumed to be reinforced by events external to the individual. Thus, extinction (discontinuance of reinforcing stimuli) should eventually eliminate troublesome behavior. Limitations of this analysis have been noted by Gardner (1969). First, it is difficult to identify reinforcing events, and once identified, controlling their occurrence frequently proves impossible. Further, the analysis of Foxx and Azrin (1973) mentioned above poses another problem for the use of extinction in the treatment of self-stimulation in that internal reinforcement precludes the use of extinction.

Fortunately, applied researchers who have sought to reduce self-stimulatory behavior have developed effective methods of response reduction other than extinction. These include punishment and reinforcement procedures. Studies of punishment procedures for self-stimulation will be reviewed here for retarded and other populations. In addition, punishment studies which have been shown to be effective in reducing other types of inappropriate responding will be identified for the purpose of evaluating their potential effectiveness in suppressing self-stimulation. The present review will focus on human punishment studies reported in the last five years. Studies prior to 1972 reporting on punishment procedures used with humans have been reviewed elsewhere (Gardner, 1969; Johnston, 1972; Kazdin, 1972), but will be referred to when appropriate. In addition, recent studies of reinforcement response suppression procedures also are included in the present review.

Punishment

Definitions of punishment have varied (e.g., from Thorndike, 1911, to Dollard & Miller, 1950, to Skinner, 1953, to Azrin & Holz, 1966). The definition of punishment adopted by this paper will be that of Azrin and Holz (1966) with a minor modification. The definition will read: a reduction of the future probability of a specific response as a result of the immediate delivery or withdrawal of a stimulus following that response. The modification, or withdrawal, permits inclusion of punishment procedures which can be grouped into two classes on the basis of whether the operations followed involve the presentation

of stimulus conditions following a specified response or whether the operations involve the withdrawal of stimulus conditions following a specified response. In the first category are procedures which involve the presentation of unconditioned aversive stimuli (e.g., electric shock) and conditioned aversive stimuli (e.g., "No"). In the second category are such procedures as time-out and response cost.

Unconditioned Aversive Stimuli

The most widely investigated punishment stimulus undoubtedly has been electric shock, studied for the most part with animals. Shock with humans began to be used in the early 1960's (Gardner, 1969) primarily for self-destructive behavior, tantrums, and behaviors otherwise dangerous to the self and others (e.g., climbing, ruminating). Ethical considerations have confined the use of shock to serious individual behavioral problems, usually as a last resort procedure (Gardner, 1969). During the eight years since Gardner's (1960) review, only seven studies were found using shock; two with alcoholics, two to reduce cigarette smoking, one for drug ingestion, and two with the retarded. In contrast, Gardner (1969) found seven studies between 1964 and 1968 using electric shock with the severely and profoundly retarded alone.

There appear to be no recent reports using electric shock to treat self-stimulation, but Corte, Wolf, and Locke (1971) found that contingent shock was effective in decreasing self-injurious behavior compared with extinction which was entirely ineffective with the two subjects with whom it was used. The effects of shock were specific

only to the setting in which it was applied, however, limiting its therapeutic value.

Kircher, Pear and Martin (1971) compared reinforcement for correct responses plus a sharp "No" for errors to reinforcement for correct responses plus electric shock and "No" for errors and inattentive behavior. The condition using shock produced more words learned and less inattentive behavior than the no shock condition.

Other unconditioned punishing stimuli have been used effectively with humans. Gardner (1969) reported two studies, one which used cayenne pepper (Blackwood, 1962) and another which used a hairtug (Banks, & Locke, Note 4) to control vomiting and eye gouging respectively. Johnston (1972) reported a hand-slap (Birnbrauer, 1968) and noise to control errors in button pressing, multiple tics, and stuttering (Barret, 1962; Flanagan, Goldiamond & Azrin, 1958; Goldiamond, 1967).

For the problem of self-stimulation, Koegel, Firestone, Kramme, and Dunlap (1974) successfully treated two autistic children using a slap, or briefly holding the relevant body part, in addition to a sharp "No!". No analysis of the separate components of the procedure was attempted. Of note, is that appropriate play behavior increased concurrently with the onset of punishment, but decreased to baseline levels with the withdrawal of punishment.

Sajwaj, Libet, and Agras (1974) used lemon juice squirted into the mouth of an infant to control rumination, and Tanner and Zeiler (1975) found aromatic ammonia effective in controlling self-abusive

behavior in an autistic person.

Summary. It appears that recent applications of unconditioned punishing stimuli have tended to be used primarily with life-threatening behavioral problems. Apparently, however, the decreasing trend in the use of shock has not appeared to correlate with an increase in the use of other unconditioned punishing stimuli. Perhaps with the advent and refinement of other behavioral control techniques, serious behavioral problems are being controlled by other, less-painful, means. Alternately, it is possible that journals are refusing to publish articles which report using primary aversive stimulation out of fear of arousing public criticism.

Response Cost

Response cost will not be used here to denote physical effort (e.g., McLaughlin & Nay, 1975); rather, the term will be used to refer to the contingent removal of reinforcers, usually conditioned, such as tokens, points, or money (Weiner, 1962). Response cost, then, conforms to the definition of punishment used here in that it involves the withdrawal of a stimulus event immediately contingent upon a specified response which reduces the future probability of that response.

Withdrawing privileges or imposing fines have been popular methods of social control for centuries. Kazdin (1972) cited biblical references of withdrawal of privileges, and fines comprised a part of penal codes early in recorded history.

The withdrawal of reinforcers implies, of course, that an individual is in possession of reinforcers prior to their removal. This is accomplished by two methods. An individual can be given reinforcers non-contingently at the outset of a specified period whereby they are lost contingently when specified responses are emitted (Weiner, 1962). Alternatively, the individual can earn conditioned reinforcers for specified appropriate responding and lose them for specified inappropriate responding (Kazdin, 1972). On the other hand, in laboratory settings, fines have generally been levied for the same response that is reinforced, such as button-pressing (Kazdin, 1972). The majority of systematic investigations of response cost have been conducted with human subjects with points used as conditioned reinforcers.

As Azrin and Holz (1966) noted, the greatest suppression of responding occurs when an alternative response to the punished one is reinforced. Accordingly, in applied research or the clinical setting, response cost and reinforcement of alternative desirable behavior are frequently used. Hence, studies which investigated the effects of response cost alone have been few. Most investigations have involved evaluating response cost superimposed over a reward token system (reviewed by Kazdin & Bootzin, 1972) while a few have investigated the comparative effects of response cost with other procedures to reduce responding (Burchard & Barrera, 1972; McLaughlin & Nay, 1975).

Response cost only. Kazdin (1972) reviewed ten investigations

evaluating response cost alone with the general finding that response cost is effective in suppressing behavior.

Siegel, Lenske, and Broen (1969) investigated response cost to suppress speech dysfluencies in normal speaking college students. Each dysfluency (repetition or interjection of a sound, syllable, word, etc.) resulted in the loss of a point which equalled one cent. Points were awarded non-contingently at the outset of a session. Dysfluencies were suppressed to near-zero levels of responding for four of five subjects during spontaneous speech episodes. Further, although there was some recovery during the second baseline, the dysfluency rate showed durability of effects over time and generalization of the effects to no-contingency reading probes.

In a small business setting, Marholin and Gray (1976) used response cost to control cash shortages. The response cost contingency was applied on a group basis to overcome the difficulty of not being able to identify the persons responsible for the shortages. Any shortage exceeding one percent of the cash sales was averaged among the employees and subtracted from each cashier's salary. An ABAB reversal design was used to evaluate the effect of the contingency. As predicted, the combined response cost and group contingency effectively suppressed cash shortages to below one percent of the daily cash receipts. Further, the total cost to each employee for the experiment was \$8.70, demonstrating that the actual fine need not be large to be effective in its suppressive effects. The study, however, did not control for employees underreporting sales of short-

changing customers if stealing was (one of) the reason(s) for the shortages. The authors caution against using such a procedure until more is known about the employee behaviors responsible for the shortages. If theft is the reason, then shortchanging the customer rather than the employer simply solves the employer's problem and not society's. In addition to these issues is the problem of "shortchanging" the honest employee.

Response cost versus reinforcement. The conclusions which can be drawn regarding the relative effectiveness of response cost contingent on undesirable behavior and reinforcement contingent upon desirable behavior and a combination of the two are tentative. Further, not all studies have attempted a separate analysis of each. Kazdin's (1972) review of the literature found equivocal results in studies comparing token reinforcement for appropriate responses and response cost for errors. In one study, response cost for errors was more effective than reinforcement for correct responses (Phillips, Phillips, Fixsen & Wolf, 1971, Expt. IV) in reducing errors on a quiz while the combination of the two was most effective. Contrarily, two other studies (Bucher & Hawkins, Note 2, Panek, 1970) found no difference in effects between token reinforcement for an alternative response and response cost for disruptive responses in reducing disruptive behaviors or generating common word associations in schizophrenics.

Studies published since 1971 have tended to support the finding of no difference in effects of token reinforcement for appropriate responses and response cost for errors. Reisinger (1972)

reported successfully treating anxiety-depression by combining token payments contingent on smiling and token costs contingent on crying. While no attempt was made to evaluate the respective effects of token reinforcement and response cost, noteworthy is the durability of effects over a fourteen month period following discharge.

Kaufman and O'Leary (1972) found no significant differences using an ABAB design between token rewards for reading skills and response cost procedures for disruptive behavior in psychiatric patients. Further, the token loss condition did not generate adverse emotional and behavioral side effects.

Iwata and Bailey (1974) found no differences in the effectiveness of rewards for arithmetic performance versus cost procedures in reducing rule violations and off-task behavior in elementary special education students. While arithmetic output doubled, accuracy was unaffected and given a choice of either contingency, no preference emerged. One socially significant finding was that the procedures generated some differences in the teacher's behavior in that the token reinforcement condition led to an increase in comments of approval by the teacher.

Walker, Hops, and Fiegenbaum (1976), using a variation of the ABAB design, evaluated the relative effectiveness of (a) changing the setting; (b) social reinforcement; (c) token reinforcement; (d) and response cost in modifying deviant classroom behavior. The most powerful treatment effects were produced in those phases in which all three treatment variables and one setting variable were in operation. The



procedure of adding variables cumulatively, as this study did, does not permit a clear evaluation of the variables in isolation. Further, the response cost condition was the last to be added and a ceiling effect was imposed by reporting behavioral change in terms of percentage of appropriate behavior. Nevertheless, the proportion of appropriate behavior accounted for by the addition of response cost was 17% compared to the addition of tokens which accounted for approximately 19% of appropriate behavior generated. The overall finding was that a combination of variables was most effective.

Hundert (1976), on the other hand, compared the relative effectiveness of token reinforcement, response cost, and a combination of both in increasing attending and arithmetic performance in elementary school children and found no differences across the three procedures and no clear preference for procedures across subjects. Hundert evaluated the variables using a multi-element training phase (Sidman, 1960) preceded and followed by a baseline thereby eliminating possible sequence effects as in the Walker et al. (1976) study. A weakness of the Hundert study, however, was that it did not include a baseline condition during the treatment phase. Thus, it is not possible to evaluate potential generalization or contrast effects.

In summary, studies which have used the ABAB reversal design, or a modification of it, suggest that no differences exist between response cost and reinforcement in decelerating undesirable behavior

and generating desirable behavior, but that the combination of the two procedures is superior to either response cost or reinforcement alone. The latter effect supports the general findings of Azrin and Holz (1966) using animals as subjects, namely that greater suppression occurs when a reinforced alternative is provided. The Hundert study, however, using a combination ABA multi-element (with multiple conditions in the B phase) design rather than an ABAB design casts doubt on the superiority of the combination of token reinforcement and token response cost over either element alone. As Walker et al. (1976) have stressed, additional component analyses are required.

Response cost relative to other response suppression procedures.

In Kazdin's review, the author found response cost superior to group therapy in treating obesity (Harmatz & Lapuc, 1968), aversive sound stimulation and information feedback (Kazdin, 1972) in suppressing speech dysfluencies, and shock and disapproval in facilitating avoidance learning (Schmauk, 1970).

Burchard and Barrera (1972) found "few appreciable differences" between the effectiveness of time-out and response cost of comparable magnitude (e.g., 30 minutes time-out vs. 30 tokens). Higher values of each procedure were more suppressive and became increasingly so vis-a-vis lower values (5 tokens vs 5 minutes). It is questionable whether number of minutes can be equated with number of tokens, but it is, nevertheless, interesting that equal numerical values of the different procedures produced comparable results.

Myers (1975) compared extinction, differential reinforcement of other behavior (DRO) and response cost procedures in suppression of serious finger biting in a retarded boy. While extinction had no effect and DRO was moderately suppressive, response cost combined with DRO, completely eliminated the behavior. No evaluation was made of response cost alone.

Issues related to response cost. As with any behavioral change program, several issues are related to the use of response cost in the applied setting. Some, such as durability over time and settings are of general concern to all clinical applications. Another, such as emotional side effects, is common to all punishment procedures.

Azrin and Holz (1966) have documented several side effects associated with the presentation of an aversive stimulus including attempts to escape the punishing stimulus and heightened emotionality of an undesirable nature. That the issue of unwanted side effects is limited to punishment procedures involving presentation of an aversive stimulus is not clear, however. Coughlin (1972) came to a tentative conclusion that withdrawing positive reinforcement can function as an aversive event. Kazdin (1972), however, reported that only one study showed evidence of escape behavior, namely, when fines were imposed for failing to attend ward meetings, the number of subjects who did not attend increased (Boren & Colman, 1970).

Elucidating yet another problem with response cost, Doty, McInnis, and Paul (1974) reported that when individuals are fined

at a high rate, they rarely come into contact with the back-up reinforcers. This problem has implications for using response cost to treat self-stimulatory behavior which usually occurs at a high rate, although no studies have been conducted in this area.

Summary. Too little research has been conducted across a variety of problem behaviors to draw clear conclusions regarding the generality of the effectiveness of response cost relative to other procedures. Nevertheless, its ease of administration and the lack of physical pain for the subject, together with indications of its effectiveness relative to other popular methods of decelerating behavior, support the need for further comparisons with other response suppression procedures across a wide variety of behavioral problems. Its effectiveness may vary with the type of behavior being suppressed (e.g., self-abusiveness versus classroom disruptions) and type of population. For example, Bandura (1960) has asserted that self-abusive behavior is possibly maintained by variables other than reinforcement, and Schmauk (1970) found that sociopathic individuals were particularly non-responsive to shock and disapproval relative to normal subjects, but that response cost improved responding of sociopaths to the level of normals.

Only one study reported using response cost with self-injurious behavior (Myers, 1975), and none reported using it to decelerate self-stimulation. A distinct advantage of response cost is its ease of administration, both with groups and on a one-to-one

basis. A potential disadvantage is that where earned conditioned reinforcers are removed, the positive and negative token economies are interdependent. With some populations such as the severely and profoundly retarded this could prove a difficulty in that it is feasible that the discriminations involved are less clear than when a punisher is delivered independently for each occurrence of misbehavior.

Time-out

Johnston (1972) reported that time-out (TO) is used in more applied studies of punishment than any other kind of punishing stimulus. In the applied setting, many of the reinforcing stimuli are assumed to be social such that contingent removal from socially reinforcing stimuli will lead to deceleration of a specified behavior. Johnston (1972) delineated two parts to the TO paradigm: (a) stimuli signalling extinction and (b) removal of stimuli maintaining the response of interest. The extent to which each part of the procedures contributes to the effectiveness of TO has not been determined. A consideration when using TO with humans is that the TO duration should be terminated only when the individual is engaging in desirable behavior to avoid negative reinforcement of undesirable responses.

Only one researcher, Pendergrass (1972) reported using TO to treat self-stimulation. Two minutes of contingent TO successfully reduced persistent banging, fiddling and jerking in two autistic children.

Time-out has been used to treat other behaviors, however.

Lahey, McNeas, and McNeas (1973) report placing a subject with an obscene verbal tick into TO for a minimum of 5 minutes and until the subject had been silent for one minute. The treatment was successful in reducing the behavior to an acceptable level where negative practice (being forced to repeat the behavior) had failed to do so.

Ramp, Ulrich, and Duloney (1971) using an ABAB design evaluated the effectiveness of TO when a delay was imposed between the occurrence of the behavior to be timed-out and the delivery of TO. Each time the student misbehaved, a stimulus light on the subject's desk flashed, signalling a 5-minute loss of recess of gym plus 5 minutes in the TO booth later in the day during these periods. The student's misbehavior was reduced to zero responding.

Adams and Popelka (1971) evaluated two concurrent conditions with stutterers. In one condition there was no contingency for stuttering while reading, and in another condition, 10 seconds of TO was contingent upon stuttering. Both conditions reduced stuttering significantly, but the TO condition reduced stuttering more rapidly and to a greater extent. Suppression of stuttering in the no contingency condition could possibly be due to generalization of effects from the TO condition. An evaluation of generalization effects was not conducted, however.

A major issue related to the use of TO is the duration of the TO used. Johnston (1972) reviewed TO durations ranging from three seconds to two hours. In the present review, TO durations ranged from 10 seconds (Adams & Popelka, 1971) to 30 minutes (White,

Nielson & Johnson, 1972).

The question of the relative effectiveness of various TO durations is still unsettled. Martin (1975) questioned the value of brief TO durations during training programs as consequences for errors - a common practice in the training of retarded persons. The author compared three values of TO duration (10, 20, 30 seconds) and no TO on three learning tasks (antonym learning, picture naming, drawing) with four autistic and eight retarded children. In all three experiments, subjects either made the same or fewer errors on the longer TO duration. Where fewer errors were made on a longer TO duration, the author concluded that its use was not warranted in terms of training time which was consequently wasted.

In another comparison of TO duration to decrease aggression, tantrums, and self-destructive behavior in 20 retarded individuals and using longer periods of TO (1, 15, and 30 minutes) than in the Martin study, White, Nielson, and Johnson (1972) found 15 minutes and 30 minutes of TO to be distinctly superior to a 1 minute TO duration, with no appreciable difference between the 15 minutes and 30 minutes TO. When 1 minute TO's preceded rather than followed 15 and 30 minutes TO, however, 1 minute TO was equally effective. Thus, sequence effects emerged as perhaps a more-important variable than duration.

Kendall, Nay, and Jeffers (1975) evaluated 5 minute and 30 minute TO's to decrease unwanted behavior in adolescent male delinquents using an A, B₁, B₂, B₁ design where A is a baseline condition,

B_1 is a condition in which responses were consequted by 5 minutes TO, and B_2 is a condition in which responses were consequted by 30 minute TO's. When 5 minutes preceded the 30 minute TO, verbal aggression, physical aggression, and out-of-area behavior were suppressed. When 5 minute TO's followed 30 minute TO's, verbal aggression, physical aggression, and out-of-area behavior were not suppressed, with verbal and physical aggression occuring at a rate greater than baseline. The differential effectiveness of the first and second presentations of 5 minutes of TO were interpreted as a contrast effect. In general, the finding seems to be that the first parameter of duration of TO in a series is at least as effective if not moreso than subsequent parameters regardless of the duration.

Since the ABAB reversal research design does not control for sequence of contrast effects, a more definitive demonstration of comparisons of TO duration might be achieved by using multiple baseline and/or multi-element research designs (Sidman, 1960), or group studies. This problem of the ABAB design generating sequence or contrast effects has been noted previously by Sidman (1973) who remarks that "whether the complete elimination of the variable, as in the 'reversal' design, is simply an extreme instance of quantitative variation is not a simple problem" (p. 534). That is, if the reversal phase can be regarded as a condition where the independent variable has a value of zero, then it is possible that re-applications of the experimental variable produce contrast effects. Research into this problem would be beneficial to applied behavior analysts.

Schedule of TO. A major variable, in addition to the nature of the punishing stimulus, which affects the suppression of behavior is the schedule of punishment. Azrin, Holz, and Hake (1963) concluded that the most effective schedule of delivery is fixed-ratio 1 (FR 1). Two studies have undertaken an empirical analysis of schedule effects on TO.

Calhoun and Matherne (1975) compared FR 5, FR 2, and FR 1 schedules of TO in suppressing aggressive behavior in a retarded girl and found FR 5 an ineffective schedule, but FR 2 and FR 1 nearly equal in effectiveness. They pointed out the practical advantages accruing when every response need not be consequted in order to reduce behavior to an acceptable level.

Clark, Rowbury, Baer and Baer (1973) investigated the effects of FR 1, variable ratio 3 (VR 3), VR 4, VR 8, and differential punishment of high rates (DPH), whereby, in the last-mentioned case, TO was delivered contingent upon any disruptive behavior that occurred within 10 minutes of the last-recorded disruptive behavior. VR 3 proved to be slightly more effective than an FR 1 schedule of TO, and the authors found an inverse, negatively accelerated relationship between the probability of a disruptive behavior being timed-out and the rate of disruptive behavior. That is, the authors found that as the probability of a response being timed-out increased, the actual rate of that response decreased until the probability of TO was 0.23 (VR 4). Beyond the 0.23 probability value to 1.0, the rate did not decrease further. The range from 0.23 to 1.0 included VR 3, DPH, and FR 1 schedules of TO.

As Johnston (1972) pointed out, it is very difficult in the natural setting to guarantee delivery of a punishing stimulus on an FR 1 schedule as the animal studies would suggest must be done in order to decrease behavior. Of course, it is not always necessary or desirable to eliminate misbehavior entirely, and intermittent schedules which permit behavior to be reduced to an acceptable level have the advantage of the individual not coming into contact with the punishing stimulus as frequently as an FR 1 schedule would require. Further, the generality of the effects to other settings of intermittent punishment schedules, particularly VR schedules, is probably enhanced since behavior in the natural environment is likely to be consequted on VR schedules.

Summary. That TO has been demonstrated to be an effective response suppression procedure is clear. The issue of duration of the TO period, however, requires further investigation. A question to be answered is whether it is the sequence or the duration which controls behavior. If sequence of application is the important factor, then the general finding that TO is effective regardless of the duration would be understandable.

The present review demonstrated TO to be effective with a variety of behaviors including the more intractable, such as self-stimulation (Pendergrass, 1972) and verbal and physical aggression (Kendall et al., 1975). No studies reported using TO with self-abusiveness, a reasonable precaution since the individual's physical well-being would likely be endangered if left alone in a TO space.

TO can have other disadvantages, particularly if a source of reinforcement is available to the individual while she or he is being timed-out. Some examples would include the opportunity to pick at floor tiles and to escape from an aversive situation. Another disadvantage to the use of TO involves social sanctions against placing an individual in an austere physical space, although this is not an empirically demonstrated requirement for TO (simply turning one's head away from an individual for a period of time may also qualify as TO).

Reinforcement Response Suppression Procedures

Given the official and unofficial sanctions against using punishment techniques with humans and the dictum that reinforcement procedures should be used to control problematic behavior, it might be expected that an increasing trend would be the use of differential reinforcement procedures. Differential reinforcement refers to the practice of differentially reinforcing other (DRO) behavior than the target behavior; differentially reinforcing low rates (DRL) of the target behavior; or differentially reinforcing behavior incompatible (DRI) with the target behavior to be decreased.

DRO. While the effectiveness of DRO, DRL, and DRI schedules has been demonstrated, DRO is perhaps the most investigated schedule in the applied setting. The usual procedure for administering a DRO schedule is to reinforce any behavior that occurs other than the target behavior, on a fixed-interval schedule. For example, Repp, Deitz, and Deitz (1976) socially reinforced a retarded person for

any behavior other than hair-twirling, handbiting, and thumbsucking at 30-second intervals. This interval was gradually increased until a final DRO 5 minutes was reached. While Repp et al. (1976) found DRO a sufficiently powerful variable to decrease high rate self-stimulatory behavior, other studies have not reported such successes. Corte, Wolf, and Locke (1971), Foxx and Azrin (1973), and Mulhern and Baumeister (1969) found DRO ineffective when used alone. In the Corte et al. (1971) study, a DRO 15 seconds schedule of food reinforcement failed to decelerate self-injurious behavior in two individuals, although when food deprivation was introduced, the rate dropped to zero for one subject, but did not decrease for another subject.

Foxx and Azrin (1973) compared non-contingent reinforcement, DRO 10 seconds, a thigh slap, a distasteful solution, and an over-correction procedure contingent on mouthing objects in severely retarded children. The DRO schedule and non-contingent reinforcement were the least effective techniques while overcorrection was the most effective.

Repp et al. (1976) attributed the preceding two failures of DRO to the length of the time intervals that were used. Repp et al. used a method of calculating the interval whereby the mean interresponse baseline interval was used. This procedure ensured that the rate of reinforcement for not responding equalled the maximum possible rate for responding. Another explanation for the equivocal results obtained in these studies might be an interaction between the treatment

and the behavior, that is, certain behaviors might be insensitive to DRO. Contrary to this hypothesis, however, Repp, Deitz, and Speir (1974) were able to reduce difficult behaviors such as stereotypic "lip flapping", rocking, and hand motions to below .9 responses per minute for all three subjects using DRO intervals, calculated as above, starting with 1, 2, and 3-second intervals. Further, the deceleration in behavior was immediate.

In another study, Repp and Deitz (1974) investigated the effects of DRO in combination with a 30 second TO, a mild verbal punishment "No", and response cost. Severe aggressive and self-injurious behavior was reduced substantially in two subjects and to near zero in another two subjects. Appropriate behavior increased in the case of one individual.

It is clear that Repp et al. have demonstrated the effectiveness of DRO schedules to reduce a variety of stereotypic and self-injurious behaviors. Their results support those of Peterson and Peterson (1968) who found DRO in combination with TO to be more effective than DRO alone. DRO in combination with TO was also found to be effective by Bostow and Bailey (1969).

A major issue related to the use of DRO schedules concerns the length of the DRO interval as it relates to the rate of behavior. No studies appear to have investigated various interval durations systematically. A related issue involves whether starting with a short interval and increasing it is necessary, and if so, when and by how much. In applied research and therapeutic endeavors, the goal,

of course, is to fade out explicit controls as much as possible. Increasing the DRO interval would seem necessary for this reason, in addition to the practical consideration that administering a DRO with a brief interval for the duration of a specified period demands a great deal of one-to-one supervision of the subject.

Another problem associated with DRO is that, theoretically, other inappropriate responses can become superstitiously reinforced (Skinner, 1948). Only one study reported a temporary development of undesirable behavior in one subject (Repp *et al.*, 1974), while in the same study another subject developed an increase over baseline of appropriate responding under the DRO condition. As with punishment procedures, a good policy would be to monitor behaviors other than the target behavior when investigating DRO schedules.

DRL. Deitz and Repp (1973) in their continuing attempt to find effective alternatives to punishment procedures, investigated DRL schedules in which reinforcement occurred when the number of responses in a specified period of time was less or equal to a prescribed limit. The authors investigated three DRL schedules: (a) DRL 3 talkouts per 50 minutes of classtime with a trainable mentally retarded boy; (b) a DRL 5 talkouts per 50 minutes of classtime as a group contingency with ten trainable mentally retarded students; and (c) a DRL schedule consisting of four steps (6, 3, 2, 0 responses) to eliminate changing the topic during class discussions as a group contingency with fifteen high school seniors. In these experiments, on only one occasion did the rate of responding exceed the DRL limit.

In another study, Carroccio, Latham, and Carroccio (1976) investigated a DRL schedule using an ABAA₂ research design, where A was baseline, B was intervention, and A₂ was follow up, whereby guitar rental was contingent upon a rate equal to or lower than the rate in the previous music lesson to decrease excessive head and face touching in an adult schizophrenic. Verbal feedback in the form of telling the subject his rate per lesson, and visual feedback in the form of posting a graph in the nursing station were also used, but no separate evaluation of these components was made. Using tokens earned during music lessons, the subject was able to rent a guitar on his ward at a fee of one token for 30 minutes. Twenty-one sessions of treatment were required to decelerate the behavior to criterion (.8 responses per minute). Noteworthy is that the effect of the contingency generalized to the ward and music therapy sessions and no appreciable recovery was observed during the reversal and follow-up conditions. The authors speculate that social reinforcement (posting) was not sufficient to suppress behavior, but that it served to maintain low rates.

In another study, using only conditioned reinforcers (stars), Dietz and Repp (1974) reduced talking-out and out-of-seat behavior in three elementary school children with a DRL 2 responses per session. The students were not informed of their responses as they accumulated but were informed at the outset of the study of the contingency in effect. The differential effects of providing or withholding this feedback need to be investigated.

The DRL schedule seems particularly suited to those behaviors which are not inherently maladaptive or inappropriate, but are troublesome due to their frequency, e.g., talking out. A weakness of the procedure is that it requires constant supervision and would be difficult to administer throughout the day. For this reason, it might be of particular benefit in environments such as classrooms which have a time limit, provided, however, that a variety of other behavioral problems do not require the teacher's attention as well.

DRI. The rationale for using a DRI schedule to reduce behavior is straightforward: one cannot engage in a given behavior while engaging in an incompatible behavior. Liberman, Tiegen, Patterson, and Baker (1973) moderately reduced the duration of delusional speech in four schizophrenic individuals by combining extinction for delusional speech and reinforcement for non-delusional speech which consisted of providing an opportunity to chat with a therapist and snacks. The treatment reduced delusional speech incompletely and only temporarily.

Vukelich and Hake (1971) addressed themselves to the problem of reducing behavior quickly, effectively, and with enduring effects using only reinforcement procedures. The subject was a profoundly retarded person with a high rate of aggressive behavior who was physically restrained and drugged to control her behavior. The authors compared non-contingent reinforcement (delivered at such a high rate that the subject had to engage in consummatory behavior) with TO and the combination of both procedures. The combination of

the DRI schedule and TO proved to be the most effective. Interestingly, the authors did not consider TO as a punishment procedure and thus viewed their study as involving only positive reinforcement. The authors discuss the problems involved in terms of the great amount of staff time required to conduct such a program. Nevertheless, the treatment was highly successful as evidenced by data at a seven month follow-up which indicated that the subject's aggressive behavior had been maintained at low levels. Few studies appear to have investigated DRI schedules in isolation. The DRI procedure is more typically included in a program in combination with another response suppression technique (see the section on response cost) and frequently is not evaluated separately.

Summary. DRO schedules are the most investigated reinforcement response suppression techniques. DRO and DRL appear to be particularly suited to reduce high rate self-stimulation, although the time involved to administer these procedures is considerable. Further, since these procedures require constant supervision, they would not lend themselves readily to group training situations. In the one study which investigated DRO alone in reducing self-abusive behavior, it failed to do so (Corte et al., 1971); but, when combined with TO, DRO was effective in reducing self-destructive behavior (Repp & Dietz, 1974). The DRL schedule has been demonstrated to be effective with socially inappropriate behaviors (talking-out) but has not been investigated with self-directed or other-directed aggressive behavioral problems. Studies investigating the effectiveness of DRI

schedules are few, but in one study, when combined with TO, DRI proved to be highly effective (Vukelich & Hake, 1971).

In general, too few investigations manipulating reinforcement alone have been reported to permit drawing firm conclusions, but the data indicate that this is a fruitful area for research.

Miscellaneous Response Suppression Procedures

A variety of studies using response suppression procedures which do not readily fit into the categories of punishment or reinforcement have been reported. These will now be discussed.

Overcorrection

A recently developed response suppression technique is overcorrection or restitution (Foxx & Azrin, 1972). The rationale and method of overcorrection is explained by the authors in terms of the following:

The general rationale of the proposed restitution procedure is to educate the offender to assume individual responsibility for the disruption caused by his misbehavior by requiring him to restore the disturbed situation to a greatly improved state - hence the designation of Restitution or Overcorrection.

The general method for accomplishing this objective is to (1) identify the specific and general disturbance created by the misbehavior and (2) to require the offender to overcorrect these disturbances whenever he misbehaves The restitutive acts are designed to have the following characteristics:

(a) The restitution should be directly related to the misbehavior lest it become arbitrary and punitive. This characteristic of relevance should also motivate the educator to apply the restitution procedure since the behavior would otherwise be forced to correct the general disturbance himself. Further, the offender experiences directly the effort normally required by others to undo the disruption created by the misbehavior. (b) The restitution should be required immediately after the behavior, thereby accomplishing two objectives. First, extinction of the offence will be provided since the offender will have little or no time to enjoy (be reinforced by) the product of the aggressive offence (Azrin & Hutchinson, 1967). Secondly, greater inhibition of future misbehaviors should result since immediate negative consequences are known to be more effective than non-immediate consequences (Azrin, 1956; Azrin & Holz, 1966).

(c) The restitution should be extended in duration. While engaging in the restitution, the offender cannot engage in other activities that are reinforcing. Consequently, the restitution period constitutes a time-out from reinforcement. This time-out is known to be more effective at longer durations

(Ferster & Appel, 1961; Zimmerman & Ferster, 1963).

(d) The offender should be very actively performing the restitution and without pausing. Restitution constitutes work and effort. An increased work or effort requirement is known to be annoying and serves as an inhibitory event (Appelzweig, 1951).

(p. 16)

This hypothetical analysis appears to be based on several assumptions. First is that extinction is in effect since the reinforcement by the outcome of the behavioral offence is prevented from occurring. This assumption depends on the hypothesis that the reinforcement for the offence is restricted to the disruption. It is equally plausible, of course, that the attention resulting when the overcorrection procedure is applied can act as a reinforcer. The second assumption is that overcorrection involves negative consequences and, therefore, acts as a punisher. Again, a plausible alternative hypothesis is that overcorrection can have reinforcing properties. The third assumption is that time-out is occurring since the individual has been removed from the opportunity to be reinforced by the outcome of destructive acts. As part of their rationale, Foxx and Azrin (1972) base the requirement that restitution be extended in duration on the findings from animal studies that time-out is more effective at longer durations. Recent research, however, casts doubt on the generality of this finding to the applied setting (Kendall et al., 1975; Martin, 1975; White et al., 1972). Finally, the authors attri-

bute a response cost interpretation to overcorrection in the sense of increased behavioral output rather than in the sense of a reinforcer being removed from the individual.

If, indeed, all four of these procedures are operative in every overcorrection procedure, then it might be expected that overcorrection would be a powerful response suppression technique. Whether this is the case, however, is an empirical question.

Overcorrection necessarily requires that the individual not be permitted to receive reinforcement for appropriate behavior while engaging in restitution activities to prevent its becoming a period of reinforcement. This, conceivably, could be a difficult criterion to meet. The authors stress the use of physical guidance where verbal instructions alone fail to generate the desired behavior. Physical guidance and verbal instructions are conceptualized as a conditioned avoidance procedure on the assumption that physical guidance is aversive, and hence the individual will attempt to avoid it by responding to verbal instructions alone. That physical guidance is aversive, however, would vary considerably with individual cases.

Foxx and Azrin (1973) distinguish between two types of overcorrection: (a) restitutional overcorrection, i.e., the misbehavior must restore the disrupted environment to a state representing vast improvement over that which existed before the disruption; and (b) positive practice overcorrection to be used where no disruption of the environment has occurred.

Restitution. In their pioneering study of overcorrection, Foxx and Azrin (1972) effectively eliminated furniture destruction by a profoundly retarded person, aggressiveness towards others by another profoundly retarded person, and screaming by a brain-damaged individual. Although the authors did not present data, they report that overcorrection was more effective than previously tried procedures of time-out, social disapproval, instructions, and brief correction of the disturbances. Moreover, evidence was presented favouring long durations of overcorrection in that when training was conducted for less than the 30-minute minimum criterion, the frequency of misbehavior remained static or increased.

In another study, stealing by profoundly retarded adults was eliminated by restitutional overcorrection whereby the offender was required to return the stolen item plus an identical item to the victim. Of 34 subjects, 27 stole at least once. For these persons, overcorrection was superior to simple correction (returning the environment to its original state) in reducing thefts (Azrin & Wesolowski, 1974).

Positive practice. Mouthing objects, head weaving, and hand clapping were eliminated by positive practice in three severely retarded children and an autistic child (Foxx & Azrin, 1973). Relative to other procedures (non-contingent reinforcement, DRO 10 seconds, a slap on the thigh, and a distasteful solution painted on the hand), the positive practice procedure was most effective. Further, following intervention, a verbal warning followed by an occasional over-

correction was sufficient to maintain the therapeutic effect.

Positive practice also successfully eliminated floor sprawling in 28 profoundly retarded institutionalized persons within eight days (Azrin & Wesolowski, 1975). Thereafter, verbal reminders were sufficient to correct a resident. Overcorrection, in this instance, was superior to reinforcement for incompatible behavior and simple correction procedures.

Webster and Azrin (1973) applied a variation of positive practice overcorrection to eliminate the agitative state which frequently preceded disruptive behavior in moderately and severely retarded persons. Using an AB design, overcorrection was administered by requiring that the individual lie quietly in bed for two hours (required relaxation). Disruptions were reduced to near zero in 7 of 8 subjects within 84 days. Noteworthy is that staff preferred to administer relaxation rather than other response suppression procedures.

Azrin, Kaplan, and Foxx (1973) used reinforcement and positive practice with nine severely and profoundly retarded persons to eliminate self-stimulatory behaviors. Reinforcement (30 seconds of attention) alone reduced autistic behaviors to about one-third of their baseline level. When positive practice was added, self-stimulatory behaviors were eliminated. To maintain the low levels, an average of one positive practice session was required per week.

Azrin, Gottlieb, Hughart, Wesolowski, and Rahn (1975) used a combination of reinforcement (edible and verbal), positive practice (required relaxation for two hours), hand control, and awareness

training to eliminate self-injurious behavior in eleven severely and profoundly retarded persons using an AB design. No analysis of the separate treatment components was attempted. As with the other studies, the effect was almost immediate, second only to shock.

Restitution and positive practice. Foxx and Martin (1975) treated scavenging behavior (coprophagy and pica) in four profoundly retarded adults using a multiple baseline ABAB design and oral hygiene and personal hygiene variations of restitutional and positive practice overcorrection (Foxx & Azrin, 1972; Foxx & Azrin, 1973). The behavior was reduced by 90% within 4 days and was further reduced to zero in 2 weeks. Further, the results endured: scavenging remained at zero or near zero for the duration of the treatment (55 to 84 days) and was superior to physical restraint of the same duration.

Restitution overcorrection and positive practice overcorrection were combined by Foxx (1976) to eliminate public disrobing in two profoundly retarded adults and proved to be superior to 30 minutes of TO and physical restraint. The author notes that overcorrection was as effective as any previous reports of reducing public disrobing which have used TO, and response cost plus reinforcement, in terms of immediacy and duration of effectiveness.

For the problem of "voluntary" vomiting (i.e., not due to illness), Azrin and Wesolowski (1975) used restitution (cleaning up vomit) and positive practice whereby the individual was required to practice the correct method of vomiting (i.e., in the toilet, and not on the floor). Compared to required relaxation (Webster & Azrin,

1973) and TO, only overcorrection eliminated "voluntary" vomiting with a duration of one year at the last follow-up.

Summary. In all the studies reviewed, overcorrection was entirely successful in eliminating unwanted behaviors with the retarded and was superior to other forms of response suppression (TO, unconditioned punishment, required relaxation, DRO). The types of behaviors treated included self-stimulation, toilet training, eating, self-injury, student disturbances, vomiting, scavenging, aggressiveness, disrobing, agitative-disruptive, stealing, and floor sprawling.

The successes reported in these studies warrant further comparisons with other punishment and reinforcement response suppression techniques. Although overcorrection cannot claim reinforcement as a feature of the procedure, it has the advantage of eliminating physically painful effects while incorporating an educative component. A disadvantage of the procedure is the time required to administer it. It requires a one-to-one administration and, therefore, would not be suitable for group teaching situations, at least in its extended form.

Peer Influence

Brown, Reshly, and Sabers (1974) decreased aggressive behaviors in a head start classroom using tangible reinforcement (candy) and TO in conjunction with peer influence. They found that the combination of group contingencies, reinforcement, and TO was more effective than the combination of only reinforcement and punishment adminis-

tered on an individual basis. The authors conceptualize their group contingency as peer influence although no data were presented to support their view that peers engaged in modification of each other's behavior.

Discussion

Punishment

The studies reviewed support the general conclusion that punishment procedures do effectively decelerate responding in humans. Unconditioned punishing stimuli, particularly electric shock, appear to have been reserved for more severe behavioral problems and have been used as a "last resort" strategy. In this sense, they might be regarded as the most effective procedure for the most serious behavioral problems.

For the problem of self-stimulation, only one recent study reported using unconditioned punishing stimuli in the form of a handslap (Koegel et al., 1974). Of the studies which do not use unconditioned punishing stimuli, response cost and TO appear to be the most popular and effective. Of these, however, only one (Pendergrass, 1972) treated self-stimulation. Both of these response suppression procedures, however, have been shown to be effective with a variety of other behavioral problems. Only one study undertook to compare response cost to TO and no appreciable differences in effectiveness were found (Burchard & Barrera, 1972).

Response cost has the advantage of ease of administration in a group situation, but since it is dependent on an ongoing reward-

token system, there exists the potential problem, particularly with self-stimulation, that individuals will lose tokens at such a high rate that they will rarely come into contact with the backup reinforcers (Doty et al., 1974).

TO has been demonstrated to be an effective response suppression procedure with a variety of behavioral problems as well. It is not suitable to reduce such behaviors as self-abusiveness for the obvious reason of danger to the individual if left alone in TO. Further, if administered during a training situation, there is a potential loss of considerable teaching time if each instance of the behavior is timed-out (Martin, 1975). This would be particularly true with high rate behaviors such as self-stimulation. Clark, Rowbury, Baer, and Baer (1973), however, have obtained evidence that every instance of an undesirable response need not be timed-out for effective response suppression, as the animal studies would suggest is necessary (Azrin & Holz, 1966). More research into the effects of intermittent punishment with humans would be a valuable addition to the literature.

Punishment procedures have included either the removal of conditioned stimuli (response cost and TO) or the presentation of unconditioned stimuli (e.g., electric shock). No applied studies, however, reported investigating the presentation of conditioned aversive stimuli which are exchanged for a backup punishing event. Such a procedure might be likened to the use of demerit points in the natural environment whereby an individual accrues demerit points

for infractions which ultimately result in a backup punishing event being administered, such as the loss of a driver's license. Like response cost, such a procedure would have the advantage of ease of administration in both one-to-one situations and in groups, no loss of training time, and independence from an ongoing token economy if one were in effect. Further, a demerit point system would have the advantage of the experimenter being able to tailor the back-up punishers to the individual's sensitivity to punishment without the individual having to come into contact with the more severe punishment every time. Such back-up punishers could include many conventional forms of punishers such as loss of privileges, loss of edibles, TO, a hand-slap, and so on.

Ethical considerations, however, have tended to preclude the usage of punishment procedures. First, punishment procedures are frequently viewed as unethical, inhumane and non-professional (Gardner, 1969). Additionally, the effects of punishment are believed by some to be temporary and to produce undesirable emotional side effects (Estes, 1944; Skinner, 1938). Although these extrapolations are from basic animal research using primarily electric shock, they appear to have substantially inhibited research with humans including studies using less physically painful procedures such as TO. Indeed, a survey by Wallace, Burger, Neal, Brero, and Davis (1976) revealed that over 50 percent of institutions for the mentally retarded indicated that they do not use aversive conditioning under any circumstances although 62 percent of chief psychologists reported that

this type of therapy would benefit some of their residents. Not all researchers have agreed, however, with this anti-punishment attitude. Redd (1975), in an editorial comment, remarked on the paradoxical situation whereby, in the absence of sufficient research on the effects of punishment with humans to warrant an anti-punishment stance, clinician/researchers tend not to advocate its use at all; and, Johnston (1972) concluded in his review that since it appears impossible to eliminate punishment in the everyday affairs of human life, it seems as irrelevant to ask whether punishment should be used with humans as it is to ask whether reinforcement should be used.

Reinforcement

Differential reinforcement of other behavior is the most frequently studied reinforcement response suppression procedure and has been shown to be effective in reducing self-stimulation (Repp et al., 1976; Repp et al., 1974) plus a variety of other behaviors. The results of the effectiveness of DRO are equivocal, however. Some researchers have found it ineffective when used alone (Corte et al., 1971; Foxx & Azrin, 1973). Repp et al. (1976) attribute the failures of DRO reported by these authors to their not ensuring that the reinforcement rate for not responding equalled the reinforcement rate for responding.

DRL is another reinforcement procedure which has successfully reduced self-stimulation (Carroccio et al., 1976), but no comparisons with other procedures have been reported. There appear to be no studies using DRI to treat the problem of self-stimulatory behavior.

These reinforcement suppression procedures seem particularly suited for situations where it is possible to supervise them on a one-to-one basis. Due to the constant high rate of attention required by the supervisor, however, these procedures do not seem particularly appropriate for group situations where the behavior of more than one individual needs to be modified. In general, too few studies have been reported to draw firm conclusions at present.

Miscellaneous Response Suppression Procedures

Overcorrection has been demonstrated to be effective in reducing a wide variety of problematic behaviors, including self-stimulation. Whether or not an extended period of time, such as 30 minutes (Foxy & Azrin, 1972), is required each time overcorrection is applied is an empirical question, but poses a problem for use in a group situation where the ratio of supervisor to individual is greater than one-to-one since it is not possible to administer overcorrection to two or more individuals at the same time.

In conclusion, no effective punishment procedures other than one study investigating unconditioned punishment (Koegel et al., 1974) and one TO study (Pendergrass, 1972) have been reported which effectively reduced self-stimulation. Whether TO is suitable for a group training situation depends on the number of behaviors requiring TO and the availability of a convenient TO space. The reinforcement response suppression procedures, although possibly effective in reducing self-stimulation, are probably unsuitable for a classroom setting due to the one-to-one supervision and the considerable amount of time required

to administer them. Response cost and demerit points appear to be the best suited procedures for group training situations although neither procedure has been reported in the literature as a treatment for self-stimulation.

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NOTES

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