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PROTECTIVE EQUIPMENT: CONTINUOUS AND CONTINGENT APPLICATION IN THE TREATMENT OF SELF-INJURIOUS BEHAVIOR

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This study evaluated the use of protective equipment in treating self-injurious behavior (SIB) exhibited by three retarded persons. In Experiment 1, the equipment was first applied continuously during 20-min sessions in individual multiple baseline designs across settings. Results showed substantial reductions in head hitting, eye gouging, and hand biting. Brief periods of time-out with the protective equipment were later made contingent on SIB and combined with a differential reinforcement procedure. Reduced levels of SIB was maintained with all subjects. Additionally, the amount of time during which the equipment was applied decreased as the SIB diminished. Experiment 2 evaluated the use of contingent protective equipment (the final condition in Experiment 1) when applied directly in the subjects' living uints during the day. During Experiment 2, SIB remained at or below the levels found at the termination of Experiment 1. Finally, in an effort to assess the long-term effectiveness of the procedure, responsibility for implementation was given to the staff who were typically assigned to provide therapy to the subjects. Follow-up probe observations conducted up to 104 days after termination of the final experimental condition showed continued low levels of both SIB and equipment usage. Results of these experiments suggest that contingent protective equipment and differential reinforcement may be effective in reducing chronic self-injury.

DESCRIPTORS: retardation, self-injurious behavior, protective equipment, restraint, time-out

The reduction and maintenance of self-injurious behavior present major problems, both in terms of habilitative programming as well as protecting individuals from self-inflicted harm. The use of mechanical restraint devices has become the most prevalent method of control and protection of self-injurious persons clients (Schroeder, Note 1). Unfortunately, many forms of restraint have been noted to cause long-term negative side effects such as demineralization of bones, shortening of tendons, and arrested motor development, secondary to disuse of the restrained individual's limbs (Lovaas & Simmons, 1969). The restraint of physical movement may also interfere with other client training goals (Rojahn, Schroeder, & Mulick, 1980). Problems such as these have become the basis for a num-

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ber of legal and regulatory controls limiting the use of restraint (Joint Commission on Accreditation of Hospitals, 1975).

Despite the attention paid to restraint devices in applied settings, research regarding their use in programs designed to eliminate self-injury has been relatively limited. A review of this literature suggests a variety of therapeutic uses for restraint, including applications as consequence (Favell, McGimsey, & Jones, 1978; Favell, McGimsey, Jones, & Cannon, 1981; Hamilton, Stephens, & Allen, 1967; Rapoff, Altman, & Christophersen, 1980) as well as antecedent events (Parrish, Aguerrevere, Dorsey, & Iwata, 1980; Rojahn, Mulick, McCoy, & Schroeder, 1978), and both as punishing (Hamilton et al., 1967; Rapoff et al., 1980) as well as reinforcing stimuli (Favell et al., 1978, 1981). Hamilton et al. (1967) reported the use of a time-out procedure involving a padded restraint chair for periods ranging from 30 min to 2 hrs, with five individuals who engaged in self-injurious and aggressive behaviors. Rapoff et al. (1980) presented a case study of a 7-yr-old blind child who engaged in self hitting. A 30-sec period of physical restraint was used successfully in the elimination of her self-injury. Favell et al. (1978), on the other hand, described the successful use of restraint, contingent upon the *absence* of self-injury, for three profoundly retarded persons. Because their results suggested that restraint functioned as a reinforcer, Favell et al. (1981) conducted a subsequent experiment in which contingent restraint was found to increase appropriate toy play.

Two studies have examined the antecedent effects of restraint upon self-injury. Rojahn et al. (1978) reported the successful use of adaptive jackets with large pockets, designed to allow appropriate "self-restraint," in the reduction of self-injury. Parrish et al. (1980) investigated the effects of a padded football helmet on rates of head hitting in a profoundly retarded client. During a series of brief reversal periods, an average of 60 responses per min occurred during non-helmet periods as compared with 5 responses per min during periods with the helmet on.

The results of the Parrish et al. (1980) study lend some support to the position that many forms of behavior, which appear to provide no external consequence, may be maintained by their sensory-stimulating properties (Carr, 1977). Research by Rincover, Cook, Peoples, and Packard (1979) and Rincover (1978) with children exhibiting self-stimulatory behavior suggests that an apparatus designed to attenuate or mask sensory stimulation derived from a specific response may create an extinction effect, causing a reduction in retarded children's self-stimulatory behavior. This analysis seemingly may be applied to self-injury. Clearly, many forms of self-injury are topographically similar to self-stimulatory behavior, and may occur in the absence of identifiable reinforcement contingencies. For example, in assessing the differential effects of environment on the self-injurious behavior of nine subjects, Iwata, Dorsey, Slifer, Bauman, and Richman (1982) found that four exhibited higher levels of self-injury in a situation where opportunities for social stimulation and reinforcement were absent, and external sources of physical stimulation were minimized (i.e., toys and other manipulable items were unavailable). The major difference between self-injury and self-stimulatory behavior is that the immediate or long-term effect of self-injury is some form of physical trauma. Thus, a procedure that either attenuates or masks the self-stimulatory components of self-injury and, at the same time, protects the client from the deleterious results of the behavior, might prove to be both clinically effective and medically safe.

The initial focus of the present research was to extend previous work by Dorsey, Iwata, Ong, and McSween (1980), in assessing the effects of a punishing stimulus—a water mist applied to the face—across time and settings. This procedure was found ineffective in reducing self-injury during the initial stages of treatment with one sub-

ject. Rather than using more intrusive measures (e.g., electric shock), the purpose of the research was altered to evaluate the effects of equipment designed to protect the individual from self-inflicted harm, and potentially attenuate the sensory stimulation which occurred as a result of the self-injurious behaviors. Additionally, the study investigated the maintenance of reduced levels of self-injury via the use of response-contingent application of the apparatus combined with a differential reinforcement procedure.

EXPERIMENT 1

METHOD

Participants

Three retarded clients of a state residential facility participated in this study. Selection was based upon a display of a high rate of behaviors considered to be self-injurious. Each resident was considered to be a chronic self-abuser whose behavior resulted in some form of tissue damage. Previous unsuccessful attempts at eliminating these behaviors included differential reinforcement, overcorrection, restraint, time-out, and various drugs.

Ron was a 16-yr-old male, institutionalized since the age of 2. His primary diagnosis was profound mental retardation due to encephalopathy, secondary to a prenatal injury that caused anoxia. He had impaired hearing and vision and was nonambulatory. His medical records indicated a history and variety of SIBs, with head hitting and hand biting being predominant. Physical damage, consisting of scalp nodules (i.e., subdural hematomas) and abrasions of the skin resulted from his SIB.

Margie was a 16-yr-old female, institutionalized since the age of 6. Her primary diagnosis was severe mental retardation of undetermined causes, combined with congenital glaucoma. She was ambulatory and seemed to have normal hearing. Medical records indicated a long history of self-injurious behaviors, including inserting her fingers into her eye sockets, hand biting, and head hitting. Superficial cuts, callouses, and scar tissue resulted from the hand biting behavior while reddened areas and scar tissue around her face and eyes occurred as a result of the other behaviors.

James was a 14-yr-old male, institutionalized since the age of 4. His primary diagnosis was severe mental retardation secondary to rubella during pregnancy, combined with a severe loss of vision. He was ambulatory and had a hearing impairment. His target behavior was eye gouging—inserting his index finger into the eye socket between the eye ball and eye lid to approximately the second knuckle. This resulted in swelling to both the eyeball and the tissue within the eye socket. Medical records indicated that James had fractured a cataract as a result of this behavior.

Setting

Two daily sessions were conducted individually with each client. Afternoon sessions were held in the day area of the institution's living unit, while morning sessions were conducted in the day area for Ron and James, and in a special education classroom at a local public school for Margie. The day areas measured approximately 5.8 × 5.8 m, and were used as activity areas in which residents spent time while not engaged in other structured activities. Sessions were conducted by both institution psychology staff and paraprofessionals hired through the Comprehensive Employment and Training Act (CETA) program. Immediate supervision was provided by the first author.

Observation

Response definitions were as follows:

1. Head hitting. Striking the head with any portion of the hand, or (during treatment sessions) contact of a glove with the helmet (Ron and Margie).
2. Hand Biting. Insertion of the hand into the

mouth, or (during treatment sessions) contact of a glove with the face mask (Ron and Margie).

3. Eye Gouging. Contact of the fingers with the skin within the orbit of the eye, or insertion of the fingers into the eye socket; or (during treatment sessions) contact of a glove with the face mask (Margie and James).

4. Toy Play. Physical contact with available toys in which a toy was elevated manually from the floor or table by the participant a minimum of 1 in (Ron).

Occurrences of these behaviors and the use of protective equipment were recorded during noncontinuous intervals in which the observer recorded the behavior for five consecutive 10-sec intervals and rested during the sixth, using a partial interval observation procedure (Powell, Martindale, & Kulp, 1975). A cassette tape containing prerecorded prompts was used to indicate the beginning of each interval. The percentage of intervals during which the target responses and/or use of the equipment occurred was obtained by dividing the positively scored intervals by the total number of intervals and multiplying by 100. All sessions were of a constant 20-min length for each participant.

Observations were conducted by the trainer assigned to the session. Observers were trained through instructions and modeling, and each achieved a minimum criterion of 90% reliability with the first author prior to formal data collection.

Reliability

Interobserver agreement on the target behaviors and protective equipment usage was assessed during 23% of the total sessions, distributed across all participants and conditions. During sessions in which reliability was assessed, data were collected by both the trainer assigned to that session and an independent observer. Agreement percentages were calculated on an interval by interval basis by dividing the number of agreements on the occurrence or nonoccurrence of the behavior and/or equipment usage by the number of agreements plus disagreements and multiplying by 100. Scores ranged from 87% to 100% (mean = 90%) for agreements of occurrence and 80% to 100% (mean = 95%) for agreements of nonoccurrence for Margie; 68% to 100% (mean = 91%) for agreements of occurrence and 33% to 100% (mean = 97%) for agreements of nonoccurrence for Ron; and 88% to 100% (mean = 99%) for agreements of occurrence and 66% to 100% (mean = 99%) for agreements of nonoccurrence for James. Lower occurrence agreement scores were obtained during sessions in which relatively few occurrences of the target behaviors were recorded (e.g., 68% occurrence reliability for Ron in session 61 [unit] with SIB = 28%).

Procedure

Baseline. Target behaviors were observed and recorded during individual sessions for each participant. No contingencies were applied to the target responses. Clients were not involved in educational or recreational activities at this time, with the exception of Margie during school sessions, and the observers did not interact with the clients. Margie's teacher was instructed to treat her as she had in the past relative to the target behaviors, as well as all academic tasks.

Reinforced toy play plus verbal reprimand. Four to five toys, selected from those available on the clients' living units, were placed within reach of each participant during this condition. Social praise and edibles (e.g., cookies, M&Ms) were provided on a 30-sec schedule contingent upon toy play, and the absence of SIB. Each occurrence of self-injurious behavior was followed by a verbal "no" from the trainer in a forceful but normal speaking voice (American Sign Language was used with James).

Reinforced toy play plus verbal reprimand plus mist. Social and edible reinforcement were provided contingent on contact with toys in a manner identical to that described previously. In addition, the verbal reprimand provided in the previous condition was paired with a fine

mist of water directed toward the client's face contingent upon the occurrence of a target SIB. The mist was delivered from a standard plant sprayer and the method of application was identical to that described by Dorsey et al. (1980).

Continuous protective equipment. At the beginning of each session, an apparatus was placed on the client designed to prevent injury and possibly attenuate the tactile stimulation received as a result of the SIB. Due to the topographical similarities of the behaviors, a combination of foam-padded gloves and a football helmet lined with additional foam padding was used for all participants. The equipment did not fully prevent participants from engaging in the target responses, but did prevent injury from resulting. For example, Ron could continue to engage in a head hitting and/or hand biting response with the apparatus on by striking the football helmet with the foam-padded gloves, or biting the gloves. The apparatus remained in place throughout each session during this condition.

Two-minute protective time-out plus sensory stimulating toy play. Contingent upon the occurrence of a target SIB, the protective equipment was applied for a period of 2 min, and the toys provided were removed. The contingent use of the protective equipment was based on results obtained during the continuous protective equipment condition and the hypothesis that if antecedent application suppressed SIB, consequent application might also be effective. The equipment was left in place until 30 sec had elapsed with no SIB. Due to the fact that the clients were physically restrained from responding during the application and removal of the apparatus, data were not collected during these periods and the session length was increased to compensate for this lost time. In the absence of SIB, continuous access was provided to toys designed to provide sensory stimulation within the same sensory modality as their SIB. Again, due to the topographical simularities of Ron and Margie's SIBs, the same types of toys were provided to both participants (e.g., a hand puppet with a battery operated vibrator enclosed, Busy Box), while James was provided with visually stimulating toys (e.g., a flashlight, mirrors).

Experimental Designs

Multiple baseline designs (Baer, Wolf, & Risley, 1968) across settings were used for each client. Following initial baselines in both morning and afternoon sessions, the reinforced toy play and verbal reprimand condition was introduced simultaneously in both sessions for Ron. Next, the verbal reprimand was combined with the water mist during afternoon sessions while a return to baseline was introduced in the morning sessions. These conditions were implemented for two reasons: (a) to establish the verbal reprimand as a conditioned punisher (first setting) and (b) to allow for a functional relationship between the treatment and behavior to be demonstrated later. Next, the continuous protective equipment condition was implemented, first in the afternoon and later in the morning sessions. This was done to evaluate the effects of the protective equipment prior to beginning the sensory stimulating toy-play condition. Finally, the two minute protective time-out plus sensory stimulating toy play condition was introduced in a multiple baseline fashion across sessions.

Two deviations from this basic design were made for Margie. The reinforced toy play plus verbal reprimand plus mist condition was not conducted. Additionally the continuous protective equipment condition was implemented only in the first setting. These changes were made for two reasons. First, the water mist procedure was dropped because Margie had a history of aggressive reactions to water. Second, the *continuous protective equipment* condition was withheld from the second setting to control for possible sequence effects between this and the final condition.

Finally, one additional deviation from the original design was made for James. Prior to the use of the protective equipment, access to sensory stimulating toys was made available to James throughout the session as long as no SIB occurred. The toys were removed contingent upon

the occurrence of SIB, plus an additional 30 sec change over delay. This change was implemented to control for the possibility that the sensory stimulating toys alone would act to control SIB, without the need for protective equipment.

Results and Discussion

Data for Ron, Margie and James, expressed as percent intervals of total SIB, are presented in Figures 1, 2, and 3, respectively. Participants typically exhibited high rates of SIB during baseline. Ron's SIB was highly variable throughout baseline, and no particular events could be identified to account for either high or low levels of responding. Inconsistent changes in responding were noted during the initial treatment conditions. The mean changes in behavior were as follows: Ron's SIB increased from 33.8% and 34.4% in the afternoon and morning baseline sessions to 81.8% and 60% upon implementation of the verbal reprimand and reinforced toy play condition. Margie's SIB, however, decreased from 87.7% to 79.1% with the introduction of the same procedure. Use of the water mist procedure reduced Ron's SIB from 81.8% to 34.6%. Finally, the use of contingent access to sensory stimulating toys reduced James' SIB from 92% to 73%. Similar changes were noted in other conditions, in that none of the initial attempts at eliminating the clients' SIB resulted in clinically significant reductions.

Upon implementation of the continuous protective equipment conditions, SIB decreased noticeably for all three participants. For example, Ron's SIB was reduced from 34.6% to 8.3% in the afternoon sessions and from 90% to 3.6% in the morning sessions. Margie's SIB decreased from a mean of 79.1% to 18%, and James' from 73% to 4%. Across all participants, SIB was reduced from the mean of the prior conditions of 69.4% to a treatment mean of 8.5%. During the last five days of treatment, SIB across all participants averaged 1.25% with a range of 0.0% to 6%.

The final change in treatment to the two minute protective time-out plus sensory stimulating toy play condition was effective in maintaining low levels of SIB, and reduced the percentage of time which clients were exposed to the protective equipment. SIB for this condition averaged 11.7% in the afternoon sessions and 18.6% in the morning sessions for Ron, 14.7% on the unit and 12% in school for Margie, and 1.2% in the afternoon and 0.7% in the morning for James. The last five days of treatment for Ron showed SIB averaging 2.6% in the afternoon

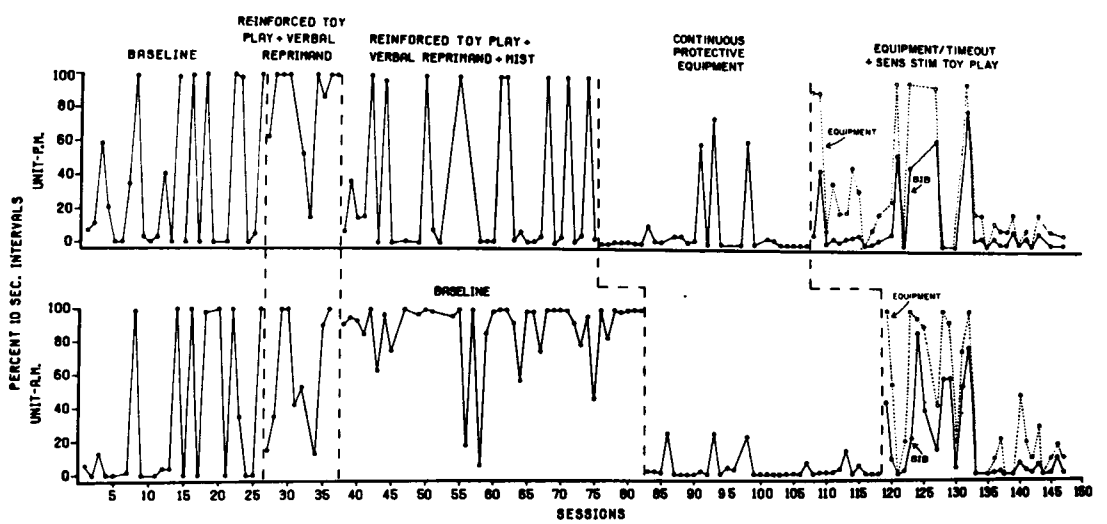

Fig. 1. Percentage of intervals of SIB (closed circles) and protective equipment usage (open circles) across experimental conditions for Ron (Experiment 1).

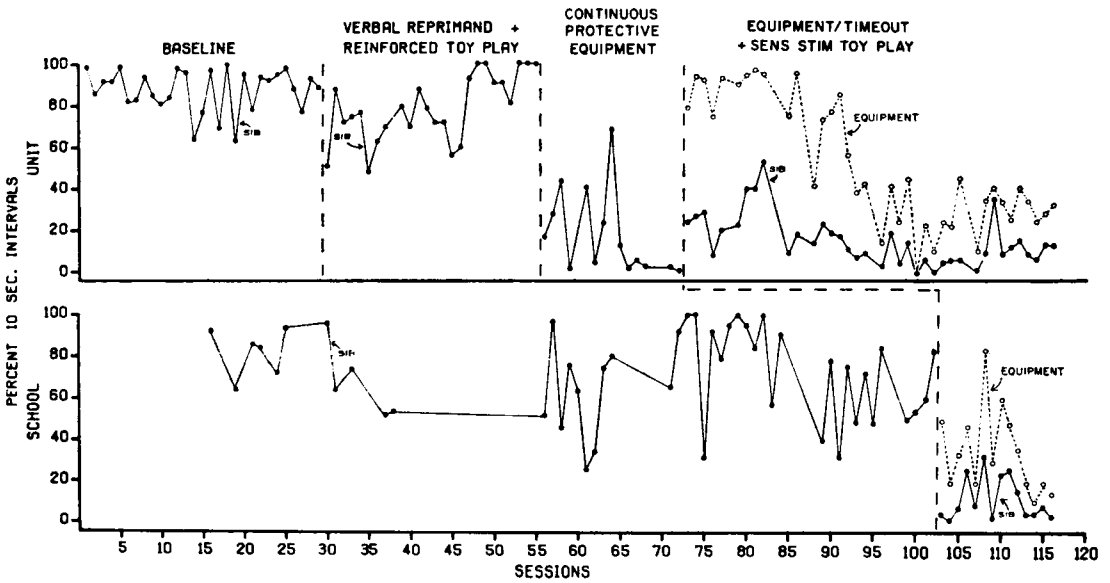

Fig. 2. Percentage of intervals of SIB (closed circles) and protective equipment usage (open circles) across experimental conditions for Margie (Experiment 1).

sessions and 9.4% in the morning sessions, while Margie had a mean of 11.2% SIB for the last five days of treatment on the unit and 7.8% in school, while James remained at 0.0% during both a.m. and p.m. sessions over the last five days of treatment. Similar results can be noted for the percentage of time the participants were exposed to the protective equipment. The mean percentage of time that clients spent wearing the equipment during this condition was: 29.9% in the afternoon sessions and 39.7% in the morning sessions for Ron, 50.9% on the unit and 35.4% at school for Margie, and 9.7% in the afternoon and 6.0% in the morning for James. As with the SIB data, these means do not accurately reflect descending trends noted for all three participants. For example, the means for the last five days of treatment for Ron were 9.4% in the afternoon sessions and 13.6% in the morning sessions.

One possible explanation for the procedure's suppressive effect on behavior is that the weight of the gloves may have increased the "response effort" of SIB. Alternatively, the wearing and/or corresponded to reductions in SIB. Ron was in striking of the helmet alone may have had punishing properties. In order to evaluate these confounding variables, several pre- and posttreatment probes were conducted with Ron, on ses-

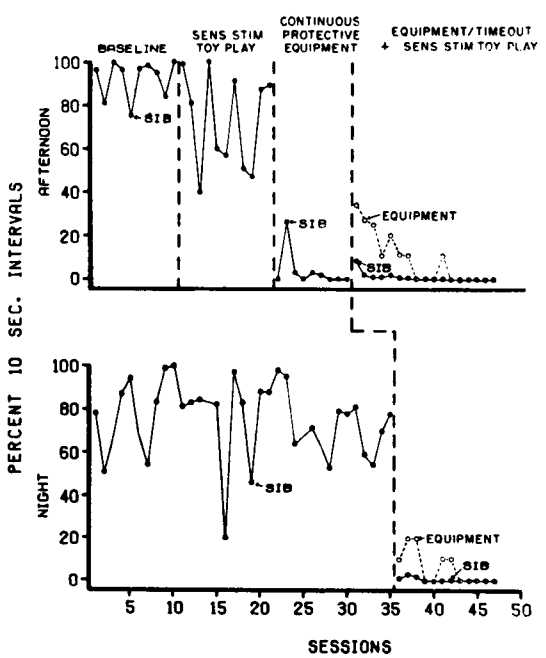

Fig. 3. Percentage of intervals of SIB (closed circles) and protective equipment usage (open circles) across experimental conditions for James (Experiment 1).

sion days 113, 114, and 115, in which only the gloves or only the helmet was applied. In all cases, Ron engaged in his particular SIB at rates comparable to those observed during the initial baseline, averaging 73% SIB with the helmet alone and 92% with the gloves alone across the three sessions.

Within the present experiment little data can be provided to demonstrate the establishment of behavioral alternatives to SIB (i.e., toy play). Although this was an initial goal of the present research, final use of the data collected toward this end was not possible due to a particular flaw in the observation procedure. Specifically, "toy play" was initially defined as "physical contact with available toys involving their manual elevation from the floor or wheelchair table a minimum of 1 in." The purpose of this particular definition was to exclude instances in which participants merely rested an arm or hand upon the toy. However, such a definition precluded the recording of many appropriate "toy play" responses in subsequent sensory stimulating toy play conditions. That is, when presented with a toy that provided the client with the same stimulation regardless of the topography of his or her interactions with it, the highest probability response would be the one with the least effort (i.e., resting an arm or hand on the toy). In order to prevent confounding the data by changing definitions across conditions, this particular response was eliminated from the observational system at the conclusion of treatment for Ron (both Margie and James were involved at some earlier point in the study at the time the definitional problem was discovered, eliminating the possibility of correcting the problem for either of them). Data using this definition of "top play" for Ron are presented on Table 1, expressed as the mean percentage of intervals across conditions. As the table shows, Ron engaged in the highest levels of toy play during the final protective time-out plus sensory stimulating toy play condition during both morning and afternoon sessions. Although problems do exist with these data, it is interesting to note that SIB and toy play appeared to be inversely related. Finally, subjective observations of all three participants suggested that interactions with the various toys did increase as a function of the introduction of sensory stimulating toys in the final condition.

Results of Experiment 1 indicate that protective equipment may be a useful treatment for SIB. However, the results are limited because of the short duration of experimental sessions, as well as the specialized training of the staff who implemented the procedure. Experiment 2 was designed to assess the effects of the treatment implemented in more naturalistic settings across a longer period of the day by staff normally employed on institutional wards.

EXPERIMENT 2

METHOD

Participants and Settings

Ron, Margie, and James also participated in this study. Daily sessions were conducted indi-

Table 1

Mean percentage of toy play and self-injurious behavior by condition for Ron.

Condition	*Afternoon Sessions* *Toy Play*	*SIB*
Baseline	No Toys Available	
Reinforced Toy Play + Verbal Reprimand	2	81.8
Reinforced Toy Play + Verbal Reprimand + Mist	14	34.6
Continuous Protective Equipment	No Toys Available	
Two Minute Protective Time-out + Sensory Stimulating Toy Play	19	11.7
Condition	*Morning Sessions* *Toy Play*	*SIB*
Baseline	No Toys Available	
Reinforced Toy Play + Verbal Reprimand	3	91
Baseline	No Toys Available	
Continuous Protective Equipment	No Toys Available	
Two Minute Protective Time-out + Sensory Stimulating Toy Play	12	18.6

vidually within their day area, bedroom, and dining room, beginning approximately 1 mo after the conclusion of Experiment 1. Sessions were run Monday through Friday, from the time each client returned to the center from school (3:00 p.m.) until bedtime (8:00 p.m.). No attempt was made to isolate the participants from environmental distractions or to restrict their normal daily schedule. Therapists were three CETA/grant employees, one assigned to each participant. During follow-up observations, procedures were conducted by direct care staff of the institution.

Observation

Response definitions were identical to those used in Experiment 1. The occurrence of these behaviors and the application of the protective equipment were recorded using a partial interval observation procedure (Powell et al., 1975). Observations were conducted daily, with behavior sampled for six continuous 10-sec intervals every 15 min.

Reliability

Reliability on the occurrence of the target behaviors and the use of the protective equipment was assessed during all conditions by assigning two observers to record independent observations a minimum of four days per week, overlapping 2-3 observation periods per participant. Results were calculated as described previously. Scores ranged from 91% to 97% (mean = 94%) for occurrence and 80% to 100% (mean = 97%) for nonoccurrence.

Procedure

Baseline. Target behaviors were recorded daily for each participant during regularly scheduled activities. Examples included games, crafts, outside play, and involvement with nursing or rehabilitation staff in various therapies. No experimenter-controlled contingencies were in effect for the target responses during this condition. Staff were informed that data were being collected and were instructed to interact with the clients as they had previously. Examples of contingencies currently in effect were: nonsystematic differential reinforcement procedures, response interruption, verbal reprimands, and physical prompting of other behaviors.

Two minute protection time-out plus contingent sensory stimulating toy play. Contingent upon the occurrence of SIB, the apparatuses used in Experiment 1 were placed on the clients for a period of 2 min, as described previously. Contingent upon the absence of a target SIB, sensory-stimulating toys were made available in the same manner as described previously. Implementation of these procedures was accomplished by the CETA staff member assigned to each participant.

Follow-up. During follow-up sessions, contingencies remained essentially the same as in the previous condition. However, implementation of the treatment program was turned over exclusively to the direct care staff assigned to the clients' living unit. Feedback was given to the staff regarding the application of the procedure via the unit program supervisor (fourth author) in a manner similar to that concerning other programs conducted on the living unit.

Experimental Design

Following the collection of baseline data for all three participants, the two minute protective time-out plus sensory stimulating toy play condition was implemented in a multiple baseline design across Ron and Margie, and in an A-B fashion for James, The follow-up condition was implemented for Margie and James to provide an assessment of the procedure when run completely by direct care staff on a long-term basis (i.e., over a period of 104 and 100 calendar days, respectively). Follow-up was not possible for Ron, due to his transfer to a nursing home during the final experimental condition.

Results and Discussion

Data for Ron and Margie are presented in Figure 4, and data for James are presented in Figure 5. All three clients typically exhibited rates of SIB during baseline equivalent to those

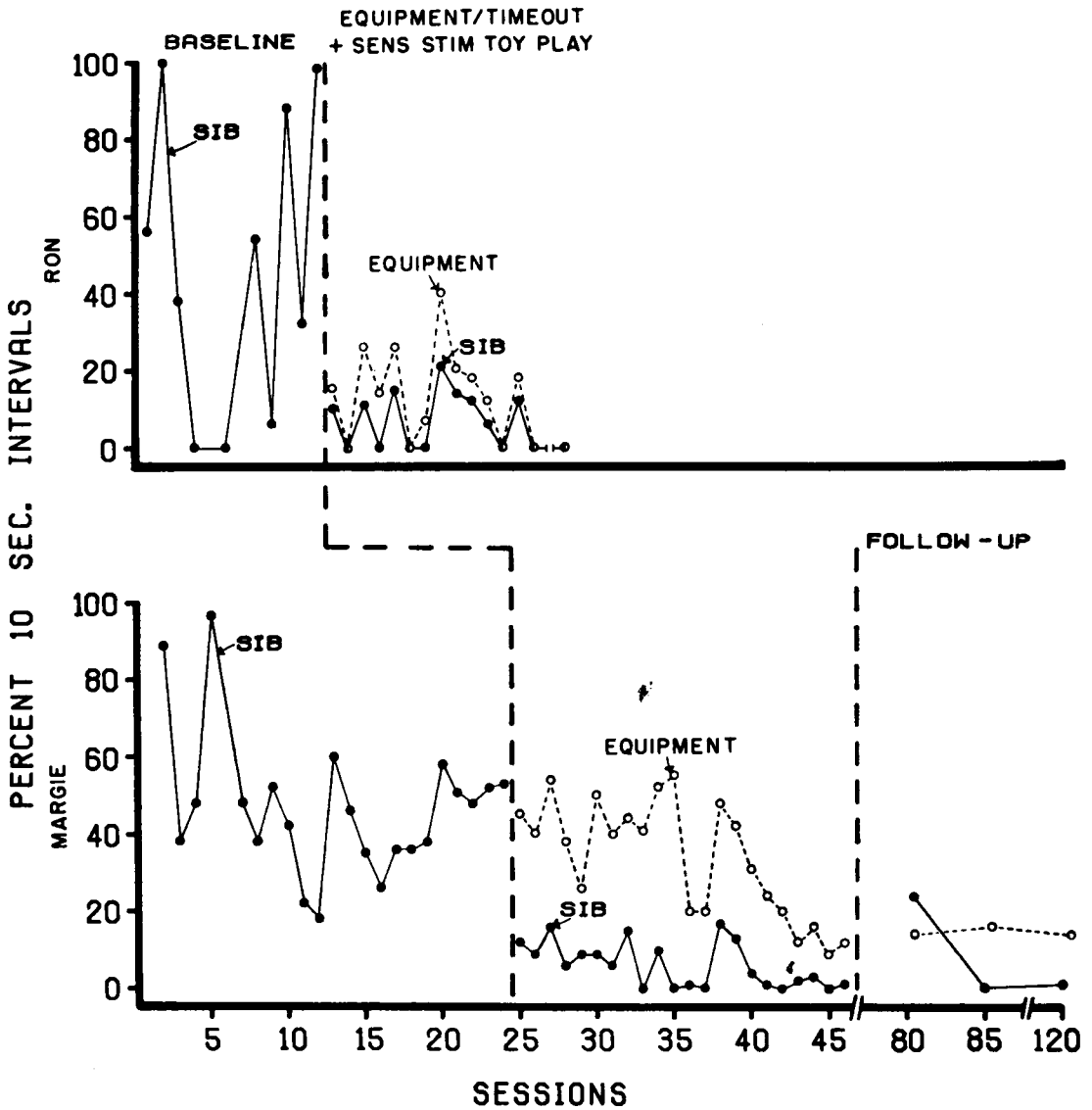

Fig. 4. Percentage of intervals of SIB (closed circles) and protective equipment (open circles) across experimental conditions for Ron and Margie (Experiment 2).

seen at the onset of Experiment 1. Upon implementation of treatment, rapid reductions were noted for all three participants. Mean changes from baseline to treatment were as follows: Ron, 48% to 7.2%; Margie, 47% to 6.4%; James, 63.2% to 1.9%. Additionally, the percentage of time each client wore the equipment also decreased throughout the treatment condition and corresponded to reductions in SIB. Ron was in protective equipment an average of 13.1% of his days, Margie 33.6%, and James 4.2%. Means for the final five days of treatment showed further reductions in equipment usage. During this period, Ron was in the protective equipment 6%, Margie 13.8%, and James 0.0%. Thus, both the reductions in SIB as well as the percentage of time in protective equipment were very close to the results found in Experiment 1.

A major goal of Experiment 2 was to evaluate the procedure when implemented by nonprofessional staff. This was accomplished during the follow-up phase of treatment with Margie and

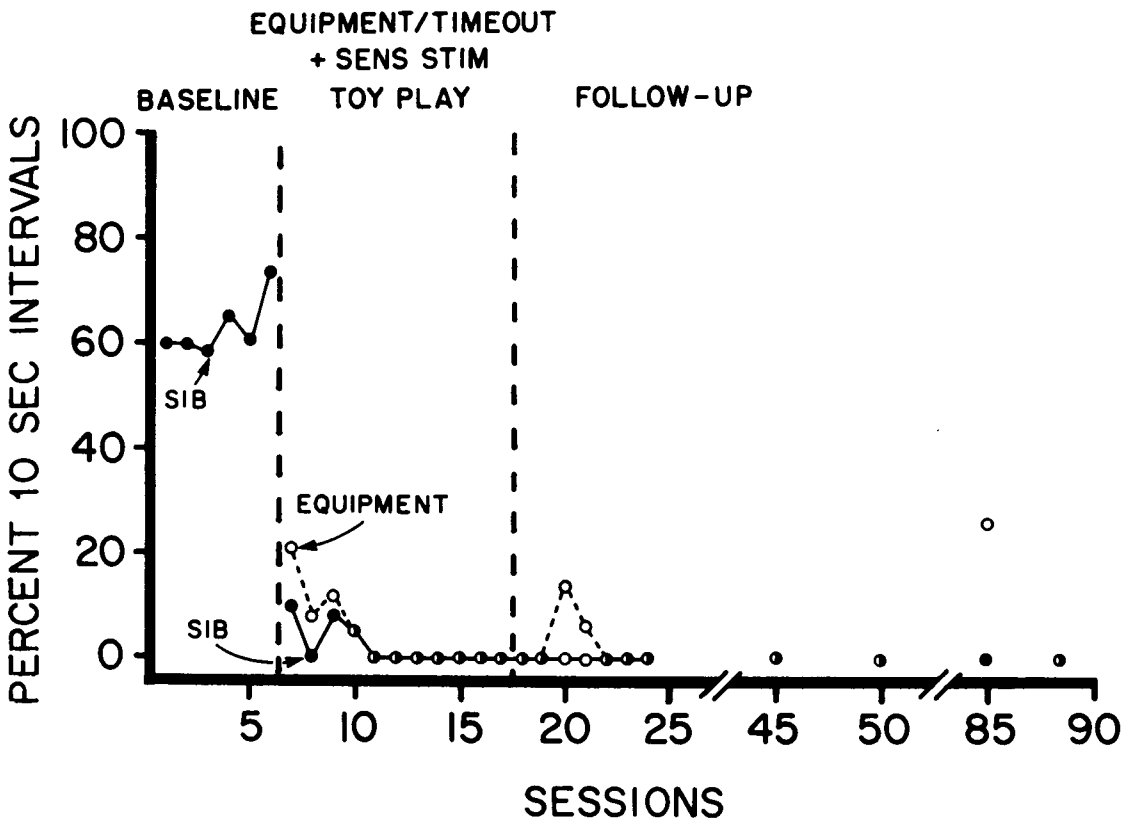

Fig. 5. Percentage of intervals of SIB (closed circles) and protective equipment usage (open circles) across experimental conditions for James (Experiment 1).

James. Although Ron was discharged to a nursing home, his discharge was contingent upon the development of a procedure that would successfully control his SIB. Several visits to the nursing home conducted by the institution's social service staff over a period of 6 mo suggested that the procedure was being carried out and that Ron's level of SIB was being maintained at acceptably low levels.

Follow-up data for Margie and James indicated that the direct care staff assigned to work with them were able to implement the procedure successfully. Results of the first probe conducted with Margie 48 calendar days after the termination of the treatment condition showed an increase in SIB, while data for the second and third probes conducted 55 and 104 calendar days posttreatment were comparable to those found at the termination of experimenter-implemented treatment. Similar results were noted for James, with these use of the equipment observed during only one of the follow-up probes over a period of 100 calendar days following the termination of experimenter-implemented treatment.

GENERAL DISCUSSION

Results suggest that the use of protective equipment may affect both rapid and substantial decreases in SIB. In addition, the data from Experiment 2 suggest that the combination of contingent protective equipment and access to sensory-stimulating toys may support the maintenance of treatment gains.

The use of the protective equipment procedure in the reduction of SIB seems justified relative to many aversive procedures currently available. The development of a hierarchy of techniques, based upon the model of "less restrictive" procedures (May, Risley, Twardosz, Fried-

man, Bijou, Wexler et al., 1975), would seem to include contingent protective equipment as a more desirable procedure than even "mild" aversive stimulation. The techniques does not require that the client be exposed to stimuli which, subjectively, cause pain to the individual. In addition, the procedure affords the client some degree of protection from self-inflicted injury during treatment, but does not include many of deleterious components of common forms of restraint (e.g., arm splints, camisoles). However, two issues should be considered prior to its general use.

First, precautions should be taken to ensure the safety of the client, as well as others within his or her environment when the procedure is used. Care should be taken to protect the client from extreme bursts of responding which may occur initially as a function of the procedure. That is, one should go beyond the intensity of the response as it exists in baseline when considering the type of apparatus to be used. Although this aspect may be critical for a small segment of the total treatment duration, the final effectiveness of the procedure may rest upon this specific issue. It is possible that the use of an apparatus that does not attenuate severe levels of responding may serve only to intensify the initial level of responding. Additionally, physical features of the apparatus must be considered in relation to its potential use as an instrument of aggression. Devices such as helmets or faceguards may be potentially used by the client to increase the effectiveness of aggressive behavior. Whenever possible, the apparatus selected should be designed so as to take these potential problems into consideration.

Second, learning principles from which this treatment is derived may be important when considering its use. The procedure was originally designed, based upon the work of Rincover (1978) and Rincover et al. (1979) with self-stimulatory behaviors. Rincover suggested that certain classes of behavior directly produce reinforcement of a sensory nature, and that if one could mask or attenuate this source of stimulation, the response would decrease as a function of extinction. Although the present study did not provide data to support such a position, clearly, the behaviors had many similar characteristics to those behaviors studied by Rincover, in that they were highly repetitious and seemed to occur in the absence of any external consequences. Because of the risk of physical injury these behaviors posed to the participants, however, manipulations such as those conducted by Rincover were not attempted. In the absence of such data, one can only speculate as to the actual conceptual basis of the procedure. However, one means of empirical support can be seen through a within-session analysis of responding during treatment. Skinner (1938) described a typical extinction curve as having "a high rate of elicitation maintained for a short time" subsequent to the termination of the delivery of reinforcement contingent upon responding, a fluctuating response rate later within the session, and a smooth flattened curve finally developing. Continued reexposure to such a situation, as was created in this experiment, should have caused progressively flatter curves each time the client came in contact with the protective equipment. That is, a discrimination would be established between the within-session equipment condition and the between-session reinforcement condition. The records presented in Figure 6 show cumulative, within-session responding for Ron during sessions 91, 98, and 107 within the continuous protective equipment condition of Experiment 1. The data appear to match the typical pattern of responding described by Skinner and add some support to the position that the phenomenon observed in this experiment was an extinction effect. If, in fact, such a conceptual basis is a correct assumption, the procedure would provide an alternative whose focus is directly in line with those variables responsible for the maintenance of some forms of SIB. Such an approach in the selection of a treatment technique would seem to have a higher probability of success than an attempt to reduce SIB through the manipulation of contingencies irrespective of the variables responsible for the behavior.

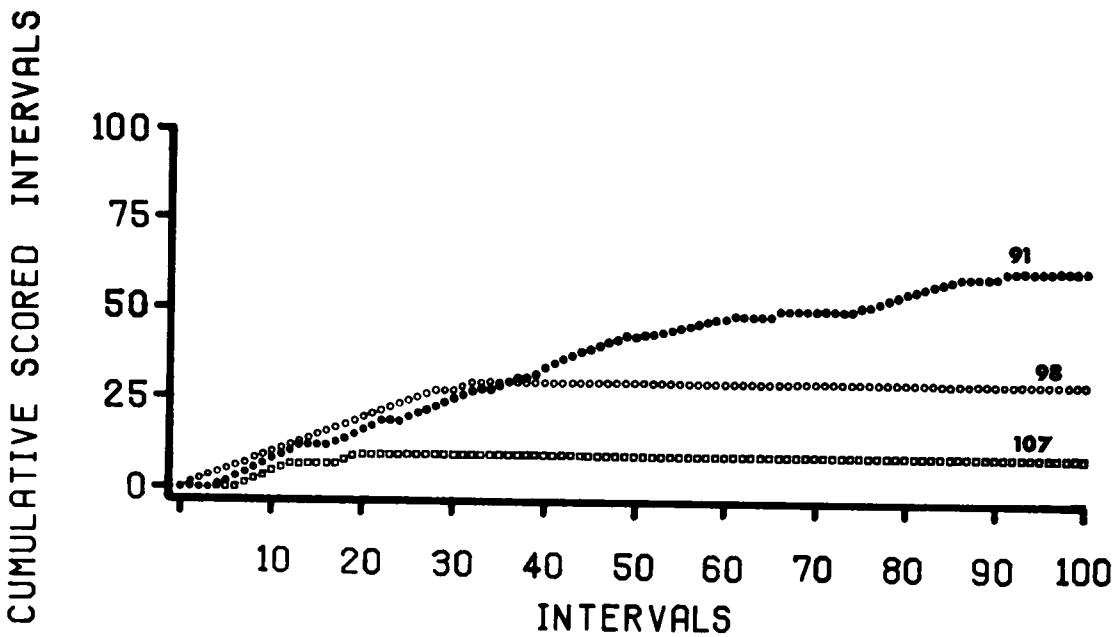

Fig. 6. Cumulative number of intervals in which Ron engaged in SIB during sessions 91, 98, and 107 (Experiment 1).

An alternative explanation for the procedure's effectiveness is that the placement of equipment on the client and removal of access to toys combined with systematic ignoring is simply a time-out procedure in which the client is protected from physical injury. The reduction in SIB would then be attributed to the contingent removal of social attention and/or preferred activities. A third position that must be considered is that the application of the apparatus acts as an aversive stimulus, causing a decrease in responding simply as a function of punishment. The determination of which, if any, of these three potential variables are responsible for the procedure's effectiveness seems to be an important issue and one that should be resolved through future research. The results of such an analysis should not detract from the procedure's technical or ethical significance. In fact, if those results tended to support either the time-out or punishment paradigms, as opposed to the sensory extinction model, the technique's generalized applicability would seem enhanced.

Finally, the results of the present study should be considered in relation to other research findings on the use of restraint procedures. As noted previously, restraint may have reinforcing as well as punishing properties. Although the present study adds yet another example of the punishing effects, it should be noted that the devices used were different from those described by Favell et al. (1978, 1981), in that they did not restrict the subjects' movement during treatment. Rather, the served only to protect the individual's from self-inflicted harm. Although this difference may have contributed to a divergence in the results of the two studies, a number of other variables may function to establish restraint as either a reinforcing or punishing event, including increased adult attention and/or increased physical comfort during periods of restraint (Favell et al., 1978), the opportunity to escape from a more aversive environment (Carr, 1977), or the discriminative properties of restraint as a "safety signal" from response requirements or aversive events (Jones, Simmons, & Frankel, 1974). Nevertheless, it is apparent that restraint can have similar effects on the occurrence of a common target behavior when used in different ways. This observation underscores the impor-

tance of improving our understanding of the motivational variables responsible for a client's behavior prior to attempting to treat the client (e.g., Iwata et al., 1982), while taking advantage of the idiosyncratic nature of reinforcers and punishers.

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