

*THE USE OF PHYSICAL RESTRAINT IN THE TREATMENT  
OF SELF-INJURY AND AS POSITIVE REINFORCEMENT*

JUDITH E. FAVELL,<sup>1</sup> JAMES F. MCGIMSEY, AND MICHAEL L. JONES

WESTERN CAROLINA CENTER

Two experiments investigated the effects of a treatment package on the self-injurious behavior of three profoundly retarded persons who appeared to enjoy the physical restraints used to prevent their self-injury. The treatment package included physically restraining subjects contingent on increasing periods of time during which no self-injury occurred, and providing them with toys and attention during intervals between restraints. A reversal and multiple-baseline analysis documented that the rapid and complete reduction in self-injury by all subjects was due to this treatment package. Because these results suggested that physical restraint might function as a positive reinforcer, in a third experiment physical restraint was applied contingent on a marble placement response with one subject. A reversal design demonstrated that toy play systematically increased when each response resulted in restraint. The experiments have implications for the nonaversive remediation of self-injury in individuals who are restrained, as well as for the development and maintenance of self-injury in natural settings.

DESCRIPTORS: self-injurious behavior, restraint, lemon-juice treatment, distraction, toy play, retardates

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Self-injurious behavior continues to be a prevalent and serious problem with severely retarded and emotionally disturbed individuals. The most thoroughly researched and widely used form of treatment for self-injury has been "aversive control", including punishment (*e.g.*, Corte, Wolf, and Locke, 1971; Griffin, Locke, and Landers, 1975; Lovaas and Simmons, 1969; Tanner and Zeiler, 1975; Tate and Baroff, 1966) and time-out from positive reinforcement (*e.g.*, Hamilton, Stevens, and Allen, 1967; Lucero, Frieman, Spoering, and Fehrenbacher, 1976; Wolf, Risley, and Mees, 1964). Although some studies have reported success with positive reinforcement of

noninjury in combination with aversive procedures (*e.g.*, Repp and Deitz, 1974), few have achieved positive effects without the use of any aversive control (*e.g.*, Bailey and Meyerson, 1973; Lovaas, Freitag, Gold, and Kassorla, 1965; Ragain and Anson, 1976). The dearth of effects with nonaversive methods should not imply they have not been tried; several authors have reported that such methods have not been very effective when used alone (*e.g.*, Corte *et al.*, 1971; Meyers, 1975; Risley, 1968). Legal, ethical, and humanitarian concerns dictate the investigation of nonaversive methods of treating self-injury and this study was designed to explore such methods.

During preliminary efforts to develop a non-aversive treatment procedure for three self-injurers, staff reports and informal observations suggested that each participant "enjoyed" only one thing: the physical restraints that were used to prevent their self-injury. Similar informal observations have been noted by several investigators (*e.g.*, Duker, 1975; Jones, Simmons, and

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Frankel, 1974; Lovaas and Simmons, 1969; Myers and Deibert, 1971; Tate, 1972; Tate and Baroff, 1966) who have reported that certain self-injurers appear to enjoy being physically restrained in, for instance, arm splints or camisoles. Such individuals frequently attempt to restrain themselves, seem calm and happy only when restrained, and resist their removal. These observations, in combination with the fact that physical restraint is often used to terminate an episode of self-injury, suggest that the restraint consequence may function to increase or maintain self-injury in natural settings.

In summary, the present research was designed to investigate: (1) the use of nonaversive procedures to control self-injury, among these (2) the use of restraint as a consequence for non-injury with individuals who appeared to enjoy physical restraint, and (3) a direct test of the positive reinforcing function of physical restraint.

## EXPERIMENT I

### METHOD

#### *Subject*

Bess, age 15, was profoundly retarded (Vineland Social Age Equivalent = 1.7 yr) and had been institutionalized for 6 yr. Her records indicated a long history of eye poking and scratching, which had blinded her left eye, and was severely damaging her right. She also frequently bit her arm, resulting in large open sores that did not have time to heal. A variety of programs had proved unsuccessful in reducing her self-injury, including placement with a small group of residents in a low-demand but stimulating environment, extensive individualized attention, food and social attention (both of which she rejected) for incompatible behavior, and medication. Only shock punishment had reliably reduced self-injury, but self-injury had returned after shock was terminated (for administrative reasons). Throughout the years, a helmet (with a face mask) and inflexible arm splints had been applied when self-injury became severe and, by

the time of referral, Bess was restrained almost continually. It was reported that despite constant monitoring, she was inflicting serious damage to her sighted eye during the brief periods that restraints were removed and was in imminent danger of blinding herself. Parental and Human Rights Committee consents were obtained for Bess' participation in the study.

#### *Response Definitions and Recording*

Bess' self-injury consisted of eye poking, defined as touching an eye with a finger, and arm biting, defining as fixing the teeth into the skin on her arm.

An assistant, who had read the response definitions and had practised the measurement procedure, recorded data throughout each session. An event recording method was employed, in which the observer noted each time eye poking or arm biting occurred. A stopwatch was used to measure the total length of time that the subject was not physically prevented from engaging in eye poking and arm biting. Arm bites and eye pokes were combined and divided by time unrestrained, yielding self-injurious responses per minute (rate). During treatment, a second stopwatch was employed to measure the period that the subject was restrained.

#### *Reliability*

Videotapes were used to assess reliability during all baseline sessions, and during treatment sessions 3-5, 9, 10, and 14-16. Two assistants who were not involved in the design or conduct of the program served as reliability observers. These observers read the response definitions and practised the recording procedure by recording from one videotape before conducting reliability checks. They did not receive feedback on the reliability of their scoring. Reliability for self-injurious responses was computed by dividing the total number of responses recorded by one observer by the total number of responses recorded by the other observer (the larger number was the denominator). Agreement on self-injury averaged 100% across both baseline and

treatment sessions (range = 99% to 100%).

Reliability also was calculated for the amount of time out of restraints by dividing the total amount of time recorded by one observer by the amount of time recorded by the other observer (again the larger number was the denominator). Agreement averaged 97% across both baseline and treatment sessions (range = 93% to 100%).

### *Procedure and Design*

Sessions were conducted at the same time each weekday morning in the Infirmary playroom in which toys, a TV, and several chairs and tables were located. The therapists, who were the first two authors, an observer, and occasionally a nurse were present. By design, all baseline and treatment sessions were to continue for a minimum of 30 min and a maximum of 1 hr, the precise daily duration being dictated by the other scheduled activities for both the therapists and the room in which treatment was conducted. However, all baseline and two treatment sessions had to be terminated before 30 min elapsed because the subject was in serious danger of inflicting damage to her arm and especially her eye.

A reversal design was employed in which baseline (A) and two treatment conditions (B and C) were alternated in an *A B C A C B C* sequence.

*Baseline A.* On two consecutive days, Bess was observed for 4.5 and 9 min, respectively. She was unrestrained and provided with preferred toys, such as strings of bells and keys. During each baseline session, she bit her arm until it bled profusely and poked her eye repeatedly. Since a single eye poke seriously endangered her sighted eye, it was agreed by all that further observation without intervention could not be justified. Therefore, each observation was terminated by placing Bess in her arm splints. She was left with an attendant in the playroom.

*Treatment B: lemon juice.* Though the impetus for this research was the development of a

nonaversive treatment, the severity of Bess' self-injury required that remediation efforts begin, even though a promising nonaversive treatment had not yet been identified. Previous research (Sajwaj, Libet, and Agras, 1974) had demonstrated the effectiveness of lemon juice in decreasing life threatening rumination in an infant. It was decided then to employ lemon juice in this initial effort to decrease self-injury by squirting 5cc in Bess' mouth contingent on each occurrence of arm biting and eye poking. During the five sessions of this condition (each session averaged 42 min in duration and ranged from 30 min to 53 min), Bess was unrestrained and provided with access to toys.

Following each session, Bess was again placed in arm splints and left with an attendant in the playroom.

*Treatment C: lemon juice, restraint for noninjury, and "distraction".* The lemon juice consequence was continued during the single 47-min session of this condition. Further, since Bess had rejected conventional reinforcers and appeared content (*i.e.*, ceased crying and screaming) only when placed in arm splints after each session, she was offered these restraints following each 5-min period during which she had not self-injured. When 5 min with no self-injury had elapsed, the therapists delivered general praise (*e.g.*, "You are really doing well") then led her to a rocking chair (in which she was typically placed when in chronic restraints), fastened the arm splints and walked away. After 3 to 5 min they removed the splints and helped Bess from the chair.

Since the 5-min period between restraints was long, relative to Bess' usual rate of self-injury, the therapists "distracted" her during periods of nonrestraint. Specifically, one therapist remained within 1.5 m of Bess, shook strings of bells and keys for her, and offered her toys. Although Bess did appear to attend to and enjoy this distraction, she spent much of her time walking around and independently jingling the keys and bells next to her ear. On four occasions, she took one therapist's hand and walked around the room with

the therapist. Approximately halfway through the session, she stood next to the outside exit, and was therefore allowed outdoors. She immediately began pulling grass and was therefore allowed outdoors to pull grass during periods between restraint. These activities were not physically incompatible with self-injury, *i.e.*, Bess occasionally poked her eye or bit her arm while engaging in them, but they did appear to be entertaining. Despite this, Bess would increasingly whine, grimace, and evidence other signs of agitation as the period out of restraints continued. The 5-min period between restraints was selected because it appeared informally that if Bess was distracted by the procedures described she could remain out of restraints for this period before becoming so agitated that she was likely to self-injure.

The session ended by allowing Bess to remain in the restraints that had been applied following a period of noninjury.

*Baseline A.* After one session of the preceding treatment condition, Bess broke her splints during the night. Since it was not possible to conduct training, she was observed only for an 8-min period. This baseline probe was identical to the first baseline condition and was terminated because of her severe self-injury. Since it was suspected that physical restraint was a positive reinforcer, to avoid accidentally increasing self-injury, the therapist manually prevented self-injury for approximately 1 min at the end of the observation before restraining Bess in a chair.

*Treatment C: lemon juice, restraint for non-injury, and "distraction".* The procedures conducted during the four sessions in this condition (which averaged 47 min in duration and ranged from 38 to 55 min) were identical to those in the previous "C" treatment. Bess was praised and restrained after each 5-min period of noninjury and was distracted during intervals between restraint. If self-injury occurred, lemon juice was administered and restraint delayed 5 min.

The sessions ended by allowing Bess to remain in the restraints that had been applied following a period of noninjury.

*Treatment B: lemon juice.* For two sessions (of 24 min and 10 min duration, respectively), only the lemon juice consequence for self-injury was employed, just as during the initial "B" treatment. Both sessions were terminated because Bess' biting (through a bandage) severely injured her arm.

Both sessions ended with the therapist manually preventing self-injury for approximately 1 min before placing Bess in restraints and leaving her in the company of an attendant in the playroom.

*Treatment C: lemon juice, restraint for non-injury, and "distraction".* The same praise and restraint for noninjury, and lemon juice for self-injury were employed during these four sessions (which averaged 48 min in duration and ranged from 35 to 64 min). However, the therapists began gradually to reduce their distraction. Instead of remaining in close proximity and initiating contacts, they tended to sit and offer her toys and jingle keys and bells only when Bess approached (which she did approximately every 3 to 5 min). When weather permitted, she was allowed outdoors to pull grass during approximately 60 to 75% of each session. By the final 44-min session of this condition, Bess played independently approximately 95% of the time, and almost never became agitated between periods of restraint. Across the four sessions, the period of noninjury required to obtain restraint was gradually increased to an average of 22 min.

The sessions ended by allowing Bess to remain in the restraints that had been applied following a period of noninjury.

*Maintenance.* Bess was moved from the Infirmary (where the previous conditions were conducted) to her regular residential unit. The therapists had previously trained that unit's direct-care staff to employ the procedures. Bess was to be provided with her favorite toys, offered her arm splints after every 15 min of noninjury, given lemon juice contingent on self-injury, and interacted with as often and as long as she seemed willing. Over a period of 14 weeks, the interval between restraints was gradually length-

ened to the point that restraint was totally discontinued.

RESULTS

Figure 1 shows Bess' rate of eye poking and arm biting (combined) during periods in which she was not restrained. During each of two baseline sessions (labelled "A"), Bess engaged in three to four self-injurious responses per minute. During condition "B", self-injury decreased to an average of 0.5 responses per minute when lemon juice was applied contingent on that behavior. During Session 8 (labelled "C"), in which a combination of lemon juice contingent on self-injury, physical restraint for noninjury, and distraction was employed, self-injury decreased to zero. Self-injury increased to its previous baseline level during one baseline probe, but de-

clined again to near zero after the combined treatment package ("C") was reinstated. The behavior increased when only contingent lemon juice was employed ("B"), but was again reduced to near zero when distraction and restraints for noninjury were added ("C").

Although formal reliability was not assessed under the maintenance regime (since the rate of self-injury was so low, cottage records and frequent observations by the therapists indicated that Bess' rate of self-injury averaged approximately 10 per day for the first three weeks following the study and was further reduced to approximately four per day in the final three months that the subject's progress was followed closely. In the five months since that time, Bess has been included in the full schedule of regular cottage programs and has not been restrained

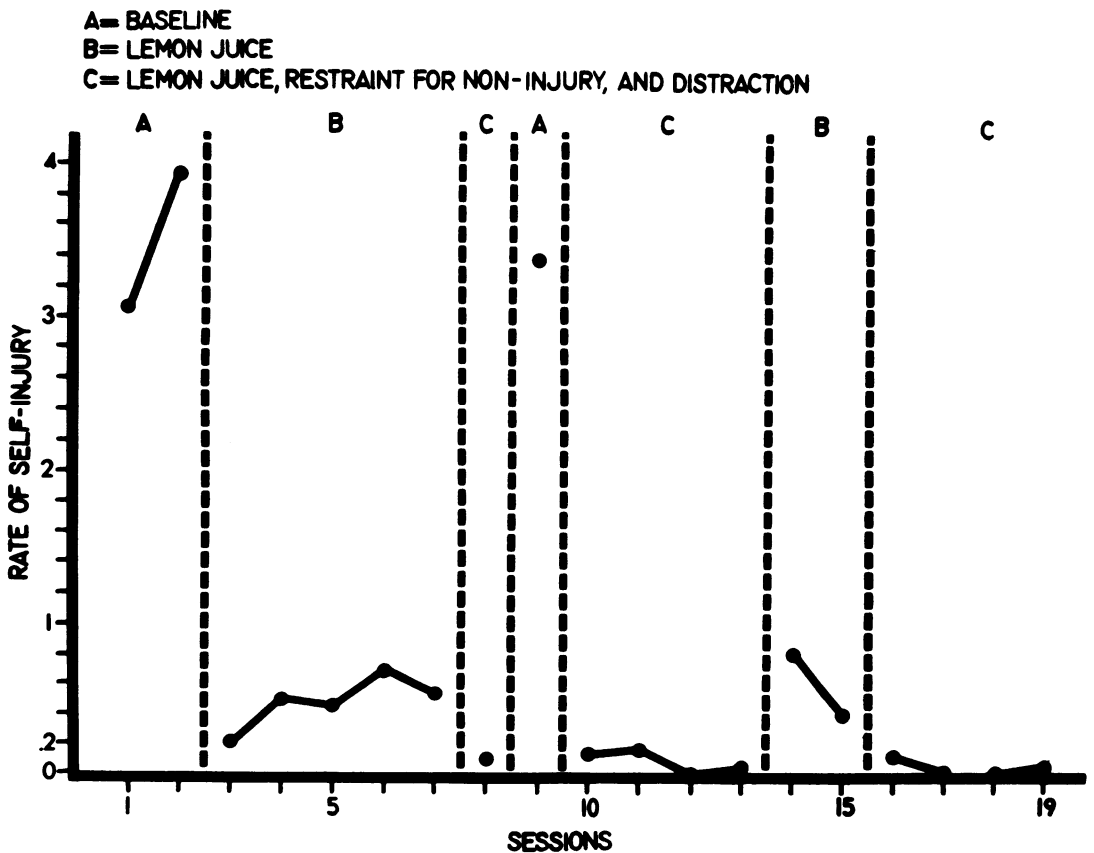


Fig. 1. Bess' self-injurious responses per minute across conditions of baseline (A), presentation of lemon juice contingent on self-injury (B), and the same lemon juice contingency plus physical restraint for non-injury and entertaining activities ("distraction") during nonrestrained periods (C).

at all. Staff reports that she "never" self-injures have been validated by medical examinations that revealed a dramatic improvement in her sighted eye and no evidence of damage to her arm.

#### DISCUSSION

The results indicated that contingent lemon juice was effective in reducing self-injury, but not to an acceptable level, considering the severity of the behavior. Near-zero levels were obtained only when a treatment package including distraction and restraint for noninjury was employed. Since the latter two components appeared critical to the elimination of self-injury and were considered a far more positive approach to its treatment, a second experiment was designed to investigate the effects of distraction and restraint for noninjury on two additional subjects.

### EXPERIMENT II

#### METHOD

##### *Subjects*

Tim, age 8, was profoundly retarded (Vine-land Social Age Equivalent = 1.38 yr) and had been institutionalized for 2 yr. Although records indicated a long history of hyperactivity and unmanageability, his headbanging and faceslapping were first reported eight months before referral. Attempts at involving him in programs such as self-help and recreational training were said to be unsuccessful and seemed to intensify his self-injury. For two months he had been allowed to remain in the bedroom all day (which he seemed to prefer) and was restrained in bed with cloth wrist ties when his self-injury became severe. Tim had self-inflicted open sores and bruises over much of his forehead and was said to be in serious danger of incurring cranial and neural damage if his headbanging continued.

Peg, age 27, was profoundly retarded (Vine-land Social Age Equivalent = 1.35 yr) and had been institutionalized for 11 yr. Her records indicated a long history of hyperactivity, "uncon-

trollable" behavior, and self-inflicted hair pulling. The latter had left bald, swollen and red areas over much of her scalp. The only documented attempts at reducing her self-injury were placement in a straightjacket at another institution, medication (Prolixin), and a contingency whereby her hands were restrained for 10 min after each episode of self-injury. All were reported to be unsuccessful, and the staff had resorted to keeping Peg in a helmet and inflexible arm splints during most of each day.

Parental and Human Rights Committee consents were obtained for Tim and Peg's participation in the study.

##### *Response Definitions and Recording*

Peg's hairpulling was defined as forceful yanking of the hair with one or both hands. Removal of hair was not required for scoring, but often occurred.

Tim's headbanging was defined as hitting hard surfaces with his forehead; headslapping consisted of forceful slapping of his head with the palms of one or both hands. These two categories were not differentiated in scoring.

One of the therapists was the regular observer for Peg. A student intern, who was not involved in the design or conduct of the program, was the regular observer for Tim. Both observers had read the response definitions and practised the measurement procedure during one session. Self-injury was measured by an interval method. In each 30-sec interval during which subjects were not physically restrained, the observer recorded whether or not self-injury occurred. The stopwatch was stopped at the moment the subject was restrained, and started again when restraints were removed. A second stopwatch was used to measure the duration of the restraint period.

Data were recorded continuously during each session. An exception occurred during Tim's last four sessions when observations were conducted at one randomly selected time during each 4-hr session, and averaged 15 min in duration (range = 10 to 35 min). (The observation times were determined by the observer's schedule

of other duties, but tended to be evenly distributed across the 4-hr sessions.)

### Reliability

Interobserver agreement was assessed during nine baseline and 31 treatment sessions with Tim and during seven baseline and 17 treatment sessions with Peg. Two student interns and two assistants who were not involved in the design or conduct of the program served as reliability observers. The observers read the response definitions and practised for one session before conducting reliability checks. During sessions in which reliability was assessed, the regular observer called out the passage of intervals. The observers received no feedback on the reliability of the data. Agreement was assessed interval by interval and defined as both observers scoring the occurrence of self-injury in a given interval.

Occurrence reliability was calculated by the following formula:

$$\frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100 = \% \text{ Agreement.}$$

Agreement on Tim's self-injury averaged 98% across both baseline and treatment sessions (range = 90% to 100%). Reliability on Peg's self-injury was always 100% across both baseline and treatment sessions.

### General Procedure and Design

Sessions were conducted at the same time each weekday in the bedroom of each subject's residential unit. One or two of the authors, who served as therapists, and one or two observers were present for each session. Baseline and treatment sessions were to be a minimum of 20 min and a maximum of 75 min (the precise daily duration to be determined by the schedule of other activities for the subjects, room, and therapists). However, in all baseline and one treatment session with Peg, and in six baseline and two treatment sessions with Tim, sessions were terminated before 20 min elapsed because subjects either inflicted serious damage to them-

selves or were judged to be in danger of doing so.

At the conclusion of each baseline and treatment session, subjects were re-restrained to prevent their self-injury between sessions. Since restraint was being used experimentally for non-injury only, it was necessary during many baseline sessions manually to prevent self-injury for a brief period before applying the physical restraints and leaving the subject with an attendant.

A multiple-baseline design across two subjects was employed. After baseline data were obtained on both subjects simultaneously, treatment was first begun with Tim while periodic baseline observations were continued on Peg. After 18 treatment sessions with Tim, the same training procedure was introduced with Peg. In general, treatment consisted of physical restraint for noninjury and distraction during unrestrained periods.

### Procedure: Tim

*Baseline.* During each of 12 baseline sessions, Tim was observed for an average of 30 min (range = 2 to 75 min). He was unrestrained and provided with a string (a preferred toy), but staff did not initiate interactions with him.

*Treatment.* Treatment sessions were conducted once each in the morning and afternoon and averaged 42 min in duration (range = 10 to 75 min).

During the first 10 treatment sessions, Tim was restrained in bed following each 3-min period in which he did not self-abuse. The therapists established the precise period of noninjury required to obtain restraint by observing the subject while he was receiving distracting activities and informally estimating how long he could remain out of restraint without becoming highly agitated (and thus likely to self-injure). After each 3-min interval in which self-injury did not occur, the therapist said "Tim, get in bed" in a neutral tone, led him to bed, placed him in either a prone or supine position, and restrained each wrist to the bed with cloth ties. After 3.5 min

during which he was ignored, Tim was unrestrained and taken out of bed. He was not allowed in bed between periods of therapist-imposed restraint. In addition, Tim was distracted during nonrestrained intervals. During the first two to three sessions, the therapists walked him around the room while holding each of Tim's arms and physically preventing his self-injury. During much of this time, Tim whined and tried to pull away. However, occasionally he would take the strings that the therapists carried and would begin to flip them in front of his eyes in a self-stimulatory manner (he did not attend to other toys). By the end of the third session, Tim spent most of his time flipping strings while wandering around the room. One therapist would take Tim's hand every 1 or 2 min and walk around the room with him; however, he was always allowed to disengage (and usually did so after a few seconds). If self-injury occurred, the therapists continued to distract the subject, but bed-restraint was delayed by 3 min. If Tim self-injured while being restrained, the therapists completed tying him and ignored the self-injury.

During Sessions 22 to 26, the noninjurious response requirement to obtain the restraints was gradually lengthened from 3 min to 18 min. In addition, during these sessions Tim occasionally whined and began to tug at his ties when restrained. Therefore, after periods of no self-injury, he was only placed on his bed for a maximum of 3.5 min (he was allowed to get up at anytime). Further, the distraction procedure had been faded out to the point that the therapist stayed within 3 to 4.5 m of Tim, handed him strings if he dropped them, responded to Tim's displays of affection (which he now initiated several times per session), but did not walk him. Self-injury delayed the bed consequence but was otherwise ignored.

During Sessions 27 to 44, Tim was gradually included in the usual playroom activities with other residents. He was offered access to his bed after variable periods of time in which no self-injury occurred. Specifically, after an average of

10 min (range = 5 to 30 min), he was led to his bed, but was not placed in it and was not restrained. He typically returned to the recreational activities in the playroom within a minute, but if he fell asleep in bed he was required to return after 1 hr. When in the playroom, Tim was occasionally given toys and interacted with. During those sessions, self-injury was ignored but delayed access to bed by a minimum of 5 min.

During this period (Sessions 27 to 44), the same procedure was prescribed for 12 hr each day to be conducted by regular cottage staff who had been trained by the therapists. One contingency was added; the staff were told to ignore Tim's self-injury unless it became either intense or frequent, at which time he was to be manually prevented from engaging in self-injury until he remained quiet for 1 min. Spot-checks throughout these 12-hr periods revealed lack of compliance with the procedures, and when it became apparent that the general cottage organization precluded proper conduct of the program, all treatment was suspended.

During Sessions 45 to 48, Tim was observed under conditions identical to the first baseline. Each of these 4-min sessions was terminated because of frequent and severe self-injury.

Finally, treatment was reinstated during 14 daily treatment sessions; the first 10 averaged 35.5 min (range = 13 to 70 min), the final four were each 4 hr in duration. The procedure was nearly identical to that employed in the first treatment condition. The required period of no self-injury was gradually increased from 3 min to 1 hr across the 14 sessions. During the first six sessions, after periods of noninjury Tim was to be restrained for 3.5 min or until he tugged at his ties. The actual time in restraints ranged from 30 sec to 2.5 min. During the remaining eight treatment sessions, Tim was no longer restrained but only placed on his bed after periods of noninjury. If he self-injured while being restrained or while in bed unrestrained, he was removed from bed for a minimum of 5 min. Between periods of restraint (or in bed), Tim was initially walked, and given string just as during the first



treatment phase. After the first two sessions of this treatment phase, the therapist only handed Tim strings if he dropped them and responded to displays of affection, which Tim initiated several times per session. During the last four sessions, one direct-care staff member conducted the entire procedure for 4 hr each weekday. She included Tim in small-group and outdoor activities for approximately a 1-hr period before offering him access to his bed. At this point, responsibility for treatment was turned over to the cottage, which included Tim in a daily 8-hr program of recreation and habilitation. Over a three-month period, the use of contingent access to bed was discontinued.

#### *Procedure: Peg*

*Baseline.* During 10 baseline sessions, Peg's arm splints and helmet were removed and she was allowed to move freely around the room. Baseline sessions were always terminated after 5 min because of the subject's continuous hair-pulling.

*Treatment.* After 18 treatment sessions with Tim, treatment was begun with Peg. The 50 sessions each averaged 48 min in duration (range = 21 to 87 min). Initially, after each 5-min period of noninjury, the therapist said "Peg, here are your restraints" in a neutral tone and then secured a splint on each arm. (Peg's helmet was removed and not used during treatment sessions.) The therapists established the precise period of noninjury required to obtain restraint by observing the subject while she was receiving distracting activities and informally establishing how long she could remain out of restraint without becoming highly agitated (and thus likely to self-injure). The nonrestraint interval was gradually increased from 5 min (Sessions 1 to 13) to 12 min (Sessions 14 to 32) to 20 min (Sessions 33 to 50). Initially, during non-restrained periods, the therapist held Peg by the wrists continuously throughout each session and occasionally talked to her. Although Peg appeared to enjoy this procedure, it did not physically prevent self-injury; she easily could—and

occasionally did—disengage from the therapist and pull her hair. The therapist gradually released one of Peg's wrists and began to stroke and gently squeeze the released arm. This contact was made successively lighter until it was faded out completely. The same procedure was next applied to the other arm. During the final 15 sessions, the therapist briefly and lightly touched one arm and spoke to Peg approximately every 3 to 5 min. Initially, after periods of noninjury, Peg was restrained for 4 min. This duration was successively shortened, in approximately 30-sec decrements, to 2 min over the 50 treatment sessions. During periods of restraint, the therapist did not interact with Peg. If self-injury did occur, Peg's hands were removed from her hair and the therapist continued the distraction procedure, but restraint was delayed.

This treatment program has not yet been adopted by the regular cottage staff because of personnel shortages.

#### RESULTS

Figure 2 shows the average per cent of self-injury across blocks of two sessions for Tim (upper half of the figure) and Peg (lower half). (All data shown are from sessions conducted by the therapists.) Tim engaged in frequent and severe headbanging and slapping during baseline observations, particularly in the last four sessions. Self-injury was reduced to near-zero levels after the treatment package was introduced; it increased to 100% during the four subsequent baseline sessions but again declined when treatment was reinstated.

After the program was implemented throughout each day by regular cottage staff, formal reliability assessment was discontinued (since the rate of self-injury was so low). However, Tim's head wounds have remained healed and staff data show a daily rate of no more than four self-injury episodes.

Peg maintained a 100% level of hairpulling during all baseline observations. After the treatment package was introduced, her self-injury declined to, and remained at near-zero levels

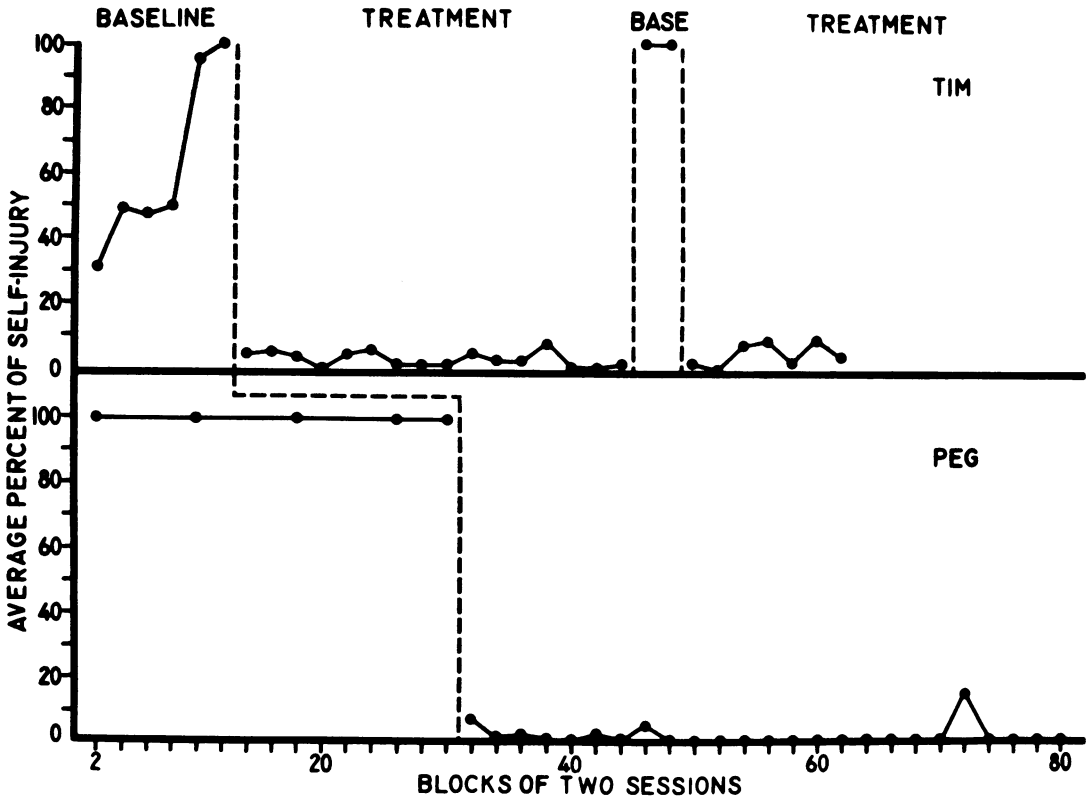


Fig. 2. Tim's (upper portion) and Peg's (lower portion) average per cent of self-injury across baseline, and treatment, *i.e.*, physical restraint for noninjury, and entertaining activities ("distraction") during non-restrained periods.

throughout therapy. Because the treatment program was not adopted by the cottage staff, Peg remains in a protective helmet but arm splints are no longer employed.

#### DISCUSSION

In summary, self-injury was reduced in two subjects with a treatment package that included distraction and physical restraint contingent on periods in which no self-injury occurred. The various components of this treatment package that might have contributed to the obtained results are discussed under General Discussion. However, a methodological feature that may have contributed to the results bears mentioning here. Though the minimum duration of both baseline and treatment sessions was to be identical (30 min in Experiment I, 20 min in Experiment II), most baseline and a few treatment ses-

sions had to be terminated after a shorter period because the subjects began to harm themselves seriously. These short baseline observations may have revealed a spuriously high rate of self-injury because they were terminated during bursts of self-injurious responding. It could be argued that subjects might have ceased their self-injury if they had been allowed to continue. However, as Bucher and Lovaas (1968) indicated, autistic subjects self-injure thousands of times over extended periods when allowed to continue without intervention. Similarly, staff involved with the present three subjects agreed that all tended to continue their self-injury until staff intervened. It is thus very possible that obtained baseline levels of self-injury were actually lower than would have been obtained during longer sessions of fixed duration, since periods during which little or no self-injury occurred were sys-

tematically included in the data, and data collection was terminated during episodes of severe self-injury that were likely to continue if uninterrupted.

One interpretation of the results from Experiments I and II was that physical restraint functioned as a positive reinforcer for these individuals, that its contingent use increased a variety of unspecified noninjurious responses and thus decreased self-injury. To investigate whether physical restraint could function as a positive reinforcer, the following experiment was conducted with Peg: brief periods of restraint were applied contingent on a response to determine if that consequence would produce an increase in that response.

### EXPERIMENT III

#### METHOD

##### *Subject*

Peg was selected to participate in the present study because it was felt that the use of rigid arm splints would not cause an increase in attempted self-injury. Parental and Human Rights Committee consents were obtained for this experiment.

##### *Response Definition and Recording*

A correct response was defined as placement of a marble into a hole in a box within 5 sec of the start of each trial. Peg was very proficient at this task. Each trial began with the therapist placing a marble on the table in front of Peg and saying her name, and ended either when Peg placed the marble in the box or after 5 sec elapsed, whichever occurred first. The therapist timed each trial while an observer recorded correct or incorrect responses.

In addition, through each session the observer recorded whether or not the therapist physically contacted the subject in each successive 30-sec interval. Physical contact was defined as touching the arms in the wrist or bicep area.

Two assistants alternated in the role of therapist and observer.

##### *Reliability*

Three baseline and six experimental and control sessions were videotaped so that interobserver agreement could be assessed. These videotapes showed only the trials in each session; the restraint consequence was not filmed and thus was not observable by the reliability observers. In this manner, the differential characteristics of baseline and treatment sessions (*i.e.*, the application of restraint during treatment) were not apparent, thus eliminating a potential source of observer bias.

Videotapes were observed and scored by two observers who had previously read and practised recording with the response definition but were naive as to the purpose, design, or expected outcome of the experiment. The observers were given no feedback as to the reliability of the obtained data.

Trial-by-trial agreement for marble placement and interval-by-interval agreement for physical contact were assessed by comparing the data of each reliability observer with the other and with the data recorded by the observer during actual sessions. The following formula was used to obtain a percentage of agreement on correct marble placement between the three observers:

$$\frac{\# \text{ trials scored the same by all observers}}{\text{Total } \# \text{ trials per session}} \times 100 = \% \text{ Agreement.}$$

Occurrence reliability on physical contact was calculated by the following formula:

$$\frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100 = \% \text{ Agreement.}$$

Reliability on correct marble placement and for physical contact was 100% for all baseline and treatment sessions.

##### *Procedure and Design*

All sessions were conducted in the bedroom of Peg's residential unit with the therapist and an observer present. When reliability tapes were made a cameraman was present. During all ses-

sions, Peg wore her helmet and was seated at a table with the therapist standing behind her; a small box with a hole in the top, Peg's arm splints, 40 marbles, and a stopwatch were present on the table. Each session consisted of 40 trials. Baseline sessions averaged 10 min in duration; treatment and control sessions averaged 23 min.

Using a reversal design, baseline sessions (A) were alternated with an experimental condition (B), in which 30 sec of restraint was applied contingent on each correct response, and with a control condition (C), in which a 30-sec period without restraint followed each correct response. The specific sequence of these conditions was: ABABCB.

During baseline sessions, at the start of each trial the therapist placed a marble in front of Peg and said her name, then timed the 5-sec time limit. After 5 sec, the therapist retrieved the marble if Peg had not responded, but otherwise both correct and incorrect responses were followed by the same events: a 10-sec intertrial interval and the start of a new trial. During each of the first four baseline sessions, the therapist physically assisted Peg three times in placing the marble into the box to ensure that she "understood" the task; these prompted responses were not included in the 40 trials. After these four baseline sessions, prompting was no longer used.

To control for the possible effects of the physical contact involved in applying the physical restraints used during the experimental condition, the therapist touched Peg's wrists and biceps noncontingently and continually throughout all baseline and subsequent treatment and control sessions. However, the therapist did not smile at, make eye contact, or interact with Peg in any other manner.

Procedurally, baseline and experimental sessions differed in only one respect: during experimental sessions, each correct response resulted in the therapist restraining Peg in her arm splints for 30 sec. Aside from the necessary physical contact, the therapist did not interact with Peg while restraining her. The noncontingent physical con-

tact with Peg's arms was continued while she was in arm splints.

During the 23 sessions of the control condition, the procedures were identical to those used during experimental phases, with one exception: each correct response was followed by a 30-sec period before the start of a new trial (as during the experimental phases), but the subject was not restrained during that time. Such a procedure controlled for the 30-sec pause between trials *per se*, independent of physical restraint.

## RESULTS

Figure 3 shows the average per cent of correct marble placements across blocks of two sessions. Correct responses increased from a mean of 7.9% (range 0% to 33%) during baseline to a mean of 93.7% during the first experimental condition. Following a return to baseline, the average per cent of correct responses steadily decreased, but returned to near 100% when restraint was again applied contingent on correct marble placements. Responding showed a variable, but decreasing trend during the control phase, but increased to near 100% when contingent restraint was again instituted.

## DISCUSSION

This experiment demonstrated that an arbitrary response could be systematically increased by the contingent application of physical restraint, *i.e.*, that restraint functioned as a positive reinforcer. Control procedures documented that these results were due to the restraint itself, and not to the physical contact by an adult or the scheduled pause from responding that was associated with the restraint consequence. Further research is being conducted to determine the generality of this finding, as well as factors in an individual's history that might establish restraint as a reinforcer.

## GENERAL DISCUSSION

In summary, the results of Experiments I and II indicate that self-injury was reduced by a com-

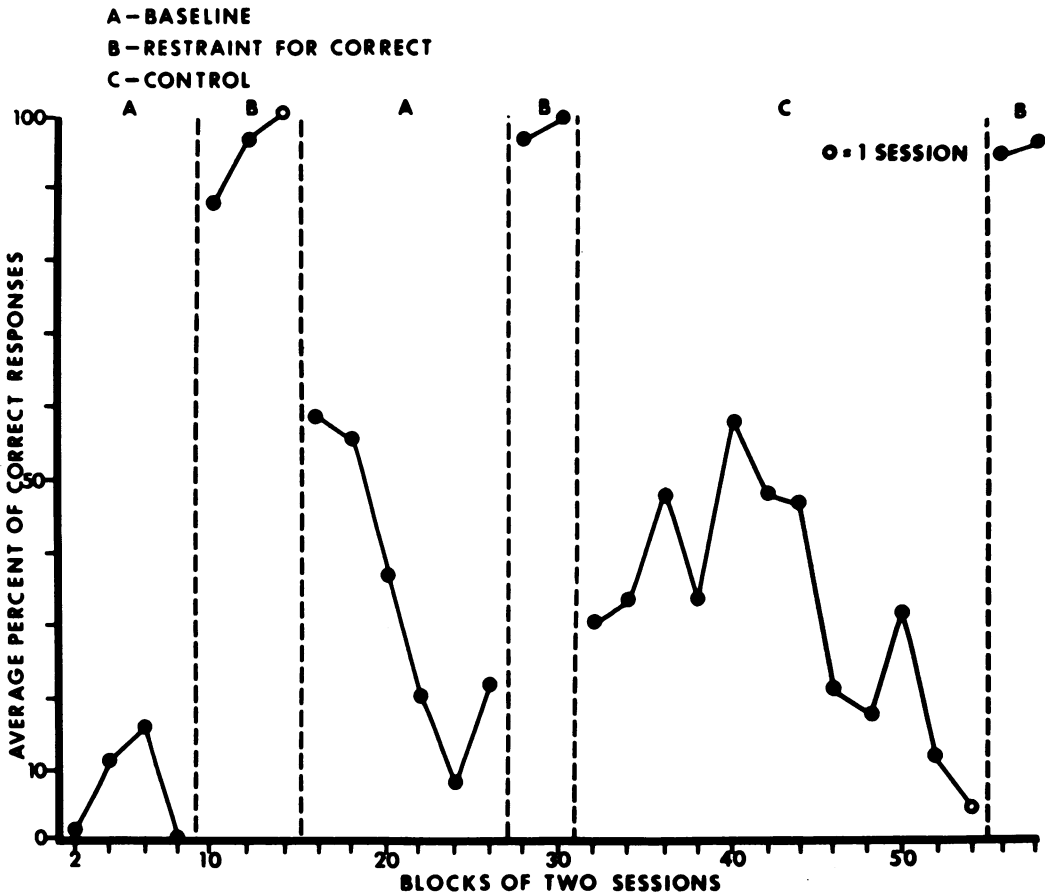


Fig. 3. Percentage of correct responses emitted by Peg across baseline sessions (A), a treatment condition (B) in which 30 sec of restraint was applied contingent on each correct response, and a control condition (C) in which a 30-sec period without restraint followed each correct response.

plex treatment package. A reversal design in Experiment I and a multiple-baseline analysis in Experiment II demonstrated that this package was responsible for the decline below levels observed during either baseline or a contingent lemon juice condition. This rapid suppression to near-zero levels was replicated across different subjects and topographies of self-injury. In all cases, the reduction in self-injury enabled subjects to be freed from chronic restraint for periods ranging from 20 min to all day.

These results were shown to be a function of the total treatment package, which consisted of many procedures. Further research (now ongoing) is required to assess the relative contribution of the various components to this package.

First, social attention is a well-known reinforcer for many individuals and clearly accompanied the application of restraints. With the present subjects, it is doubted that the social attention involved functioned as a potent reinforcer, at least initially. The therapists attempted to minimize physical contact during application of the restraints, and with Tim and Peg presented only a brief verbal signal in a neutral tone to indicate that restraints would be forthcoming. Indeed, the period in restraints represented a decrease in overall attention in comparison to the nonrestrained intervals in which subjects were distracted by the therapists. Further, Bess and Tim usually actively avoided interacting with adults; Peg showed minimal and transitory responsive-

ness. However, as the study progressed, all subjects became more responsive to social contact and, at the same time, less interested in their restraints.

Future research also must clarify the contribution of the distraction procedure to the obtained improvement. Though not as intensive, distraction in the present study resembled massive attention, the introduction of which has been correlated with gradual decreases in rumination (*e.g.*, Menking, Wagnitz, Burton, Coddington, and Sotos, 1969). In addition, the distraction procedure is highly similar to continuous, noncontingent reinforcement, which Vukelich and Hake (1971) used (in combination with timeout) to decrease aggression in a severely retarded individual. Further, the distraction procedure may be conceptualized as sensory input. Some (*e.g.*, McKinney, 1962) have speculated that self-injury in certain retardates represents an effort to obtain sensory input under deprived environmental conditions. Support for such an assertion was provided by Bailey and Meyerson (1973), who used noncontingent crib vibration to reduce the self-injury of a profoundly retarded, non-ambulatory individual. On the other hand, Lovaas and Simmons (1969) found no change in one subject's self-destructive behavior when given continual, excessive attention, such as being talked to, walked, hugged, and generally stimulated. Similarly, noncontingent reinforcement was found ineffective as a treatment procedure with self-stimulation (Foxy and Azrin, 1973). In the present study, since intensive distraction was successfully faded out (although, of course, the subjects continued to have access to play materials and adult contact), the maintenance of improvement clearly did not depend on this procedure. It is also doubted that the distraction procedure by itself would have been sufficient initially to produce the obtained results. Despite distraction, all subjects increasingly whined, grimaced, and engaged in other agitated movements as the interval between restraints elapsed. They would then calm down while restrained, but begin the cycle again when re-

leased. Since self-injury always accompanied high levels of agitation, and restraint appeared to be the only event that ameliorated it, everyone observing the subjects agreed that without restraint, eventually the subjects would work themselves up to self-injury. On the other hand, though it is felt that the present results would not have been obtained with distraction alone, it appeared necessary to the initial reduction in self-injury because very few self-injurious responses occurred from the onset of treatment, *i.e.*, before reinforcement could be expected to exert an effect. Distraction appeared to slow the process of escalating agitation, and was therefore probably critical in bringing subjects in contact with the restraint consequence under the requirement of a relatively long interval between restraints. During baseline, subjects began to self-injure within seconds after restraints were removed. Such short latencies would have necessitated requiring only a few seconds of no self-injury before periods of restraint. The longer 3- to 5-min interrestraint period was instituted because shorter values, which would have increased subjects' chances of coming in contact with restraint, appeared to constitute delayed positive reinforcement for self-injury. Residents of most institutions probably have a long history of delayed (and otherwise improperly administered) reinforcement. In informal work with Bess, physical restraint was applied following 5-sec periods of noninjury (a procedure analogous to a DRO 5-sec). Under such a procedure, her rate of self-injury appeared to increase. Thus, in the first formal treatment condition with this subject, and routinely with the other two subjects, treatment began with requiring a 3- to 5-min period of noninjury to obtain restraint, and distraction to aid them in waiting through the interval between restraints.

The present results also may have been due to the gradual increase in the duration of periods between restraints *per se*, and not to the *contingent* use of restraints following increasing periods of time in which no self-injury occurred. It is also possible that simply interrupting sub-

jects' general activity by the various distraction techniques and physical restraint may at least partially account for the decline in self-injury from baseline levels. Further, the treatment package featured discontinuation of restraint for self-injury, a procedure that had not (and could not) have been tried with these subjects previously.

Perhaps the most intriguing component of the treatment package consisted of the use of physical restraint contingent on the nonoccurrence of self-injury. The documentation of the positive reinforcing function of physical restraint with one subject in Experiment III suggests that it may indeed have been functional in increasing a variety of unspecified, noninjurious responses and thus decreasing self-injury. The present demonstration that restraint can be a positive reinforcer has, as indicated, received informal corroboration by several other researchers.

A number of factors might contribute to the effectiveness of physical restraint. First, in the nonstimulating environments in which many retarded persons live, it is plausible that the stimulus-change components of restraint might constitute positive reinforcement. Restraint is also paired with adult attention, and may be associated with relative physical comfort, *e.g.*, drowsing off to sleep. Alternatively, restraint may be paired with a reduction in aversive aspects of an environment, such as staff-imposed demands. Sailor, Guess, Rutherford, and Baer (1968) demonstrated that tantrum behavior by a retarded girl increased when followed by a change to lower-difficulty items on a verbal training task (and decreased when consequated by a change to higher-difficulty items). Similarly, a self-imposed timeout phenomenon has been demonstrated with infrahumans responding, for example, under fixed-ratio (Azrin, 1961) and progressive-ratio food reinforcement schedules (Dardano, 1973). Further, Steeves, Martin, and Pear (1970) reported that one autistic subject's bar-press responses were increased when these produced 30 sec of timeout from a training task; Solnick, Rincover, and Peterson (1977) demon-

strated that tantrumous behavior by an autistic child was systematically increased by the application of timeout. Several authors (*e.g.*, Bucher and Lovaas, 1968; Myers and Deibert, 1971; Wolf, Risley, Johnston, Harris, and Allen, 1967; Duker, 1975) have noted that self-injury in some individuals may function in a similar manner to escape a variety of aversive situations. In support of such an assertion, Carr, Newsom, and Binkoff (1976) demonstrated that an increase in the self-injury of a psychotic child was produced by placing demands on him. All three subjects in the present study behaved in a similar fashion. It is important to note that staff would then typically remove them from the situation, whereupon the subjects' self-injury ceased (at least temporarily). In cases such as this, restraint might represent a "safety signal" (Jones, Simmons, and Frankel, 1974), indicating that response requirements or any other aversive aspects of the environment are reduced. The fact that the present experimental environment did not obviously include any of these features may account for the gradual decrement in the apparent desirability of restraint to these subjects. Specifically, restraint did not represent the only stimulus change or differential adult attention, and the obvious pleasure with which subjects responded to distraction would seem to reduce the possibility that restraint functioned in an escape paradigm.

If the generality and reliability of restraint as an accelerating consequence is established, the results may have important implications for the etiology and/or maintenance of self-injury in natural settings. In addition to many other physical and developmental disadvantages associated with its use, physical restraint may be at least partially responsible for generating or maintaining self-injury (and perhaps other undesirable behaviors with which it is used). It may further be found responsible for the lack of success obtained with nonaversive treatments, since such methods are often employed in conjunction with continued use of restraint for severe self-injury. Such possible deleterious effects with the use of

restraint contradict a widespread assumption that restraint is a benign "holding pattern" that prevents the undesirable behavior from occurring until treatment can be effected. It further confirms again that a given stimulus may have different functions with different individuals. Although restraint has been successfully used as a punisher to reduce self-injury (e.g., Hamilton, Stephens, and Allen, 1967), it may exert an opposite effect; its function must be empirically tested in each case. Thus, the results of Experiment III suggest the use of caution in instituting a restraint regime.

However, even if considerable caution is shown before employing restraint regimes in the future, many individuals are at present maintained in restraints, or have a long history of restraint and some of these individuals show informal signs of enjoying their restraint. The results from Experiments I and II suggest an effective treatment package that can be used to decrease the inappropriate behavior that restraint was used to prevent, while the client is gradually released from restraints.

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