Behavioral Interventions
Behav. Intervent. **19**: 59–72 (2004)
Published online in Wiley InterScience (www.interscience.wiley.com). **DOI**: 10.1002/bin.157

CONTINGENT ELECTRIC SHOCK (SIBIS) AND A CONDITIONED PUNISHER ELIMINATE SEVERE HEAD BANGING IN A PRESCHOOL CHILD

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We report a case in which a Self-Injurious Behavior Inhibiting System (SIBIS) device and a conditioned punisher were utilized to decrease and maintain suppression of severe head hitting/banging in a preschool child. After an experimental evaluation conducted at the hospital, SIBIS was implemented at home. The originality of this particular SIBIS case study is that programmed and systematic effort at establishing conditioned punishment was included in the intervention. Results indicate that a zero-level response was rapidly reached, and that the conditioned punisher (i.e. verbal prompt + movement towards the place where SIBIS was kept) was sufficient to maintain treatment effects. Continuous assessment after treatment and formal observation session at 7 months follow-up revealed that SIBIS could be removed from the natural environment of the child while maintaining a therapeutic effect. These results were interpreted as the effects of the explicit pairing between the delivery of electric stimulations and previously neutral stimuli, which were initially ineffective to elicit any response, or to suppress SIB. Close and extended monitoring during and after treatment failed to reveal the presence of negative side effects associated with SIBIS, whereas a number of positive effects were observed.
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INTRODUCTION

Operant punishment may be critical to treatment success when the variables maintaining problem behavior cannot be identified or controlled (Dura, 1991; Iwata, 1988; Vollmer & Iwata, 1993), or when problem behavior must be suppressed rapidly

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Contract/grant sponsor: NSERC; contract/grant number: ES B-220830.
Contract/grant sponsor: Fonds FCAR; contract/grant number: B2 08A-72388.
Contract/grant sponsor: NIMH; contract/grant number: 1U10MH66768-01.

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to prevent serious injury, as it is the case with self-injurious behavior (Linscheid, 1993; Linscheid & Meinhold, 1990; Linscheid, Pejeau, Cohen, & Footo-Lenz, 1994; Matson & DiLorenzo, 1984; Mulick, 1990; Mulick & Kedesdy, 1988; Mulick, Schroeder, & Rojahn, 1980; Van Houten, 1983). Self-injurious behavior (SIB), displayed by individuals with autism and mental retardation, involves the occurrence of behavior that results in physical injury to one's own body. In the most severe cases, SIB can result in broken bones, bleeding, brain injury, and even death. SIB has been particularly resistant to treatment through solely nonaversive means. In fact, in their review of the scientific literature the Association for Advancement of Behavior Therapy, Task Force on Self-Injurious Behavior, noted that differential reinforcement has produced inconsistent results at best when used as a single intervention for SIB (Favell et al., 1982). Subsequent reviews of the literature on punishment and SIB (e.g. Axelrod & Apsche, 1983; Guess, Helmstetter, Turnbull, & Knowlton, 1987; Matson & DiLorenzo, 1984; Romanczyk, 1986) have essentially produced the same conclusions about the relative effectiveness of punishment versus reinforcement in decreasing behavior (Linscheid, Iwata, Ricketts, Williams, & Griffin, 1990). This said, ethical issues associated with the use of aversive procedures argue strongly for the development of methods that shorten the duration of the punishment intervention and increase its effectiveness and maintenance over time.

Considered by many to be one of the most intrusive behavioral interventions, response contingent electrical stimulation is potentially superior to and safer than a number of other frequently used punishment techniques (Linscheid et al., 1990). The effectiveness of electrical stimulation resides in several potential factors: the immediacy of delivery, the inability of the subject to avoid or escape the punishing stimulus, and the close contiguity between the target behavior and the punishing consequence (thereby minimizing the likelihood that other responses in the individual's repertoire will be affected). In spite of its advantages and the potentially rapid suppression of target behaviors, punishment does not always result in maintenance of such benefits over time. One possible solution to this lack of durability of punishment effects is to use neutral stimuli paired with punishing ones to produce conditioned properties. Application of the conditioned punisher could shorten the individual's exposure to the primary aversive intervention and reduce factors related to program inconsistency when the treatment is extended (Lerman & Vorndran, 2002). This report presents the successful use of contingent electric shock using the Self-Injurious Behavior Inhibiting System (SIBIS; Linscheid, Hartel, & Cooley, 1993; Linscheid et al., 1990; Linscheid, Pejeau, Cohen, & Footo-Lenz, 1994) to suppress severe self injurious behavior in a preschool aged child. The novel aspect of this case is that a previously neutral behavioral sequence was explicitly paired with the delivery of electric stimulations and used as a conditioned punisher to maintain suppression of the target behavior.

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METHOD

Subject

Johanna was a 3-year-old female with partial trisomy on chromosome 2, significant developmental delays, bilateral hearing loss, nearsightedness, and few language skills. Johanna had an 18 month history of SIB including hitting her head with objects (e.g. toys) and head banging against hard surfaces (i.e. walls and floors). The first instance of SIB reportedly occurred when Johanna inadvertently hit her head against her crib as she was trying to stand up.

The SIB was initially infrequent and restricted to her crib, but the behavior rapidly increased over 12 months, to reach a frequency of more than 100 episodes per day at the time of referral. At the time of consultation for treatment, the SIB was occurring across all settings and when Johanna was alone. Johanna had also been removed from preschool and special services she was receiving (i.e. occupational therapist) because of her problem behavior. According to her mother, SIB was elicited whenever Johanna was upset (regardless of the triggering event), tired or sick. As often as possible, Johanna's mother was trying to avoid reinforcing the behavior, but because of its severity the SIB could not be ignored. The SIB may have been intermittently reinforced by Johanna's mother who terminated the behavior by holding and cajoling her daughter or by giving in (e.g. providing her with what she apparently wanted). Johanna's mother had also tried to teach her functional communication or alternative ways to communicate her distress (e.g. showing a sad face and signed language) to express she was upset, but the SIB still occurred at high frequency. Furthermore, during her tantrums, the patient was displaying no responses that could have served as potential targets for reinforcement-based interventions (e.g. DRO, DRA). The patient was referred for evaluation and possible treatment with SIBIS by her physician and an early intervention professional. At the time of admission, Johanna's forehead was markedly bruised in several areas as a result of head banging.

The first intervention attempted with this family was to advise systematic positive reinforcement of incompatible behavior, and to minimize the positively reinforcing attributes of the parental response to the self-injury. Procedures were described and demonstrated for the parent with the child during treatment sessions. This proved ineffective because these procedures were rejected by caregivers after a period of time using them, because they were regarded as too emotionally and practically demanding to implement as much as needed. A decision analysis was then undertaken to select a more feasible approach (see Meinhold & Mulick, 1992, for a discussion of decision analysis as applied to treatment selection when risks must be balanced against costs and benefits). We estimated the risk of significant injury to

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the child and of divisive family stress to be at unacceptable levels, therefore requiring effective and rapid treatment. The risk of poorly implemented or non-implemented positive procedures did not diminish these risks and arguably increased the level of family stress. The cost of implementing any home-based program involved charges for office visits, as well as home visits to monitor procedural implementation and to collect data. On the other hand, a positive-only program would have probably taken more resources (e.g. students helping the mother to implement an intensive DRA and teaching program), without providing a guaranty of the effectiveness of such treatment. The benefits of rapid suppression via contingent electrical stimulation were thought to greatly outweigh the comparable benefits of alternate intervention strategies. We reasoned that rapid suppression would also make more likely the acquisition of potentially competing appropriate behavior maintained by automatic and social reinforcement, primarily because removing the obsessive and socially disruptive SIB from this child's repertoire would increase her interest in sampling available reinforcing alternatives (Mulick & Meinhold, 1994). The SIBIS device for shock delivery was selected because of its excellent safety characteristics.

Apparatus

SIBIS is a device designed to provide a brief electrical stimulation. It consists of a stimulus module usually worn on the leg (measuring 5 cm × 3 cm × 1 cm) that provides the electrical stimulation, and a remote activator (measuring 3 cm × 2 cm × 1 cm) that activates the stimulator in sending coded radio signal. The stimulus module contains a radio receiver, microelectric circuitry for the generation and timing of the electrical stimulus, and a 9 V battery. SIBIS delivers an 85 V electrical stimulation at 24 kΩ skin impedance with a current of 3.5 mA. The stimulation is delivered in 16 pulses of 5 ms duration, evenly spaced across 0.2 s. The insulated electrode, also contained in the stimulus module, is configured in a concentric circle of 1.0 in diameter to ensure that current is localized at the site of the electrode. This design eliminates the risk that current will pass through the body cavity and into the heart. Subjectively, the experience has been described, at its extreme, as similar to having a rubber band snapped on the arm (see also Linscheid et al., 1990, for a detailed description).

Phase I: Experimental Evaluation

Head banging (i.e. forcible contact between head and objects or hard surfaces) was Johanna's most frequent and most serious SIB, and it served as the primary dependent variable. The behavior was recorded as a frequency count. Before starting the

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experimental evaluation trials, Johanna's mother was provided with a thorough description of SIBIS, and she was given the opportunity to ask questions. She was also informed that she would be responsible for carrying out the treatment after an initial phase of evaluation and parent training. She gave her informed consent to use SIBIS. The consent interview with the patient's mother and the subsequent experimental session were videotaped. These procedures are in agreement with the regulations for the therapeutic use of contingent electric shock in the State of Ohio.

During the experimental evaluation,[1] three observers (SJS, JM, and EB) recorded independently the occurrence of SIB through a one-way mirror, while TRL administered the contingent electrical stimulations in a room adjacent to the observation room. The observation agreement throughout the six 10 minute trials was 100% between both the three observers, and between the observers and the person delivering the electrical stimulations.

The effects of SIBIS were evaluated in a reversal design involving four conditions: baseline (BL), SIBIS inactive (SI), SIBIS active (SA), no device (ND), presented in the following sequence: BL, SI, SA, SI, ND, SA, ND. These trials were conducted in a testing room at the Department of Psychology at Children's Hospital. Johanna's mother was in the experimental room with her daughter throughout the evaluation, and physicians were available if needed. Each session lasted for 10 min.

Baseline

No treatment was in effect during this condition.

SIBIS Inactive

At the beginning of each of these trials, the stimulus box was placed on Johanna's leg, but the stimulus module was inoperative (i.e. no electrical stimulation was administered). The purpose of this condition was to evaluate whether the device per se was effective in suppressing SIB.

SIBIS

Prior to each session, the stimulus module was placed on Johanna's leg, and an electrical stimulation was provided each time head banging occurred.

[1]It is important to note that this experimental assessment was similar in many points to a functional analysis manipulation (i.e. empirically identify associations between events in the environment and problem behaviors). However, because the frequency of SIB was quite high and because the consequences were dangerous for the child, only one condition in which we predicted SIB to occur (i.e. removal of a preferred object) was assessed. Furthermore, it became rapidly clear that SIB was occurring every time she was upset or frustrated. Nevertheless, we prefer to use the expression 'experimental evaluation' to describe our procedure to avoid confusion and/or perpetuating an incomplete definition of what constitutes a comprehensive functional analysis.

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No Device

This condition was identical to baseline as no treatment was in effect during this trial. However, since Johanna had been exposed to the experimental manipulation, this condition could not be described as a formal 'baseline'.

Phase II: Implementation at Home

Two weeks after the experimental evaluation, Johanna's mother was asked to record the occurrence of SIB over three consecutive days. On the fourth day, SIBIS was implemented at home and evaluated in a reversal design conducted over three consecutive days (SA, ND, SA). Johanna's mother began administering electrical stimulations under the supervision of the observers. On the SIBIS active days (days 4 and 6), and for the remainder of the treatment, Johanna's mother was instructed to place the SIBIS stimulus module on Johanna's leg contingent on SIB, that is whenever she first hit her head against a surface or an object. Johanna's mother was instructed to precede all electrical stimulations by the verbal prompt 'No hit Johanna' and to repeat this sentence to bridge the delay between head banging and application of SIBIS. She was also asked to keep SIBIS in her purse so she could reliably perform and repeat the same behavioral sequence to get SIBIS out and ready for use even when not at home.

On the no device day (day 5), Johanna's mother was provided with a 3 h training session on SIB (i.e. nature, causes, triggering factors, functions), which also included teaching of (i) differential reinforcement of Johanna's appropriate behaviors such as asking for help, independent play, and showing a sad face when upset; (ii) attending skills; and (iii) appropriate use of extinction.

During the three days of implementation, two or three observers were present for 3 h daily. The observers and Johanna's mother, independently counted head hits. The authors' observations concurred with the mother's observations that SIB was systematically occurring in response to being told 'no', and when Johanna was upset regardless of the triggering event. These sessions were also videotaped. Reliability observations conducted during these three sessions were performed during the entire 3 h. Comparison of observer's records from these observations yield no instances of disagreement. Observation agreement with Johanna's mother ranged from 80 to 100%, with a mean of 95%. This procedure was used in order to insure that her observations were reliable for the rest of the treatment. It is important to note that Johanna's mother was actually more accurate than the observers in recording target behaviors, probably because of her long-lasting experience with subtle instances of SIB.

Johanna's mother was contacted daily for the first 30 days of treatment and weekly for the following 30 days. Sixty days after the initial implementation, SIBIS was removed from the home, since the device had not been used for 34 days. Also, on the

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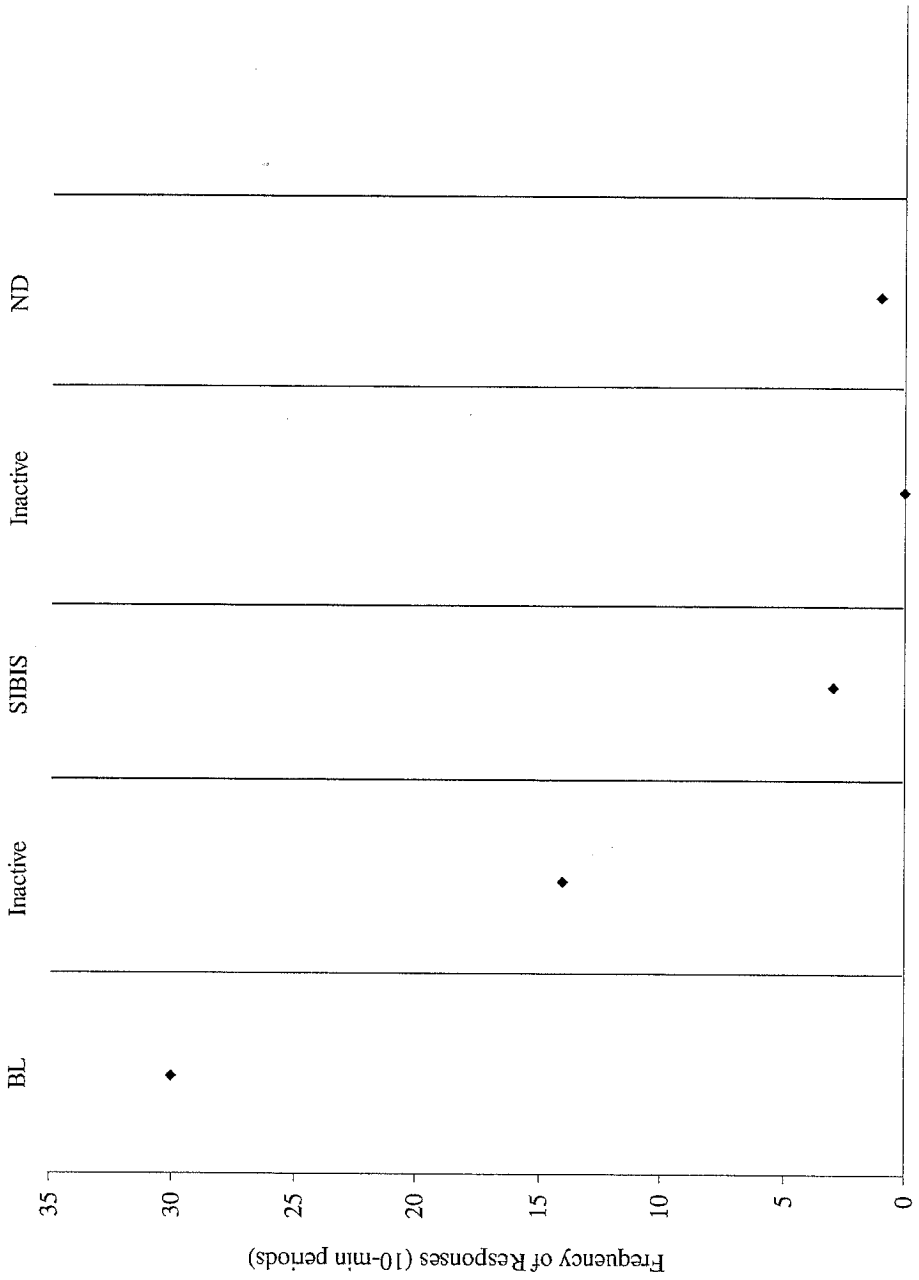

Figure 1. Head bangs exhibited by Johanna during the experimental evaluation (phase I).

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rare instances of SIB, or topographically similar behaviors (i.e. gentle contact between forehead and object), the prompt and movement towards the purse (where SIBIS had been kept) were sufficient to instantly stop the behavior and to trigger a response similar to that elicited by SIBIS. After removal of SIBIS, Johanna's mother was contacted monthly for five months post-treatment. A formal follow-up observation session was conducted at home 7 months after the initial implementation of SIBIS.

RESULTS

Phase I: Experimental Evaluation

Johanna's mother reported that head hitting had occurred 109 times the day prior to the experimental evaluation, which was described as 'low' compared with the average day. During the experimental evaluation, Johanna's mother was asked to simulate typical playtime with Johanna, and each condition was implemented for 10 minutes. As shown in Figure 1, head hitting occurred 30 times during the baseline condition. Head banging systematically occurred in response to being told 'no', being denied access to a toy, or when the toy was taken away from her. These observations agreed with the report of Johanna's mother. During the SIBIS-inactive condition, rate of head hitting decreased to 14 responses. Further decreases in head hitting were observed following the introduction of SIBIS. Head hitting occurred three times during the first SIBIS trial and zero times (SIBIS inactive), once (no device) and once (SIBIS active) during the following trials. While Johanna initiated head hitting motions during the latter conditions, she stopped each response before actually contacting a surface. Johanna hit her head 46 times throughout the experimental evaluation session. During SIBIS trials, an electrical stimulation was delivered contingently on the first occurrence of SIB, for a total of four stimulations delivered contingently. The rate obtained during the SIBIS condition represents a 90% reduction over baseline.

Phase II: Implementation at Home

Figure 2 shows Johanna's daily rate of head hitting during the home implementation stage. Mean rate of head hitting during the baseline condition was 117 responses per day (109, 141, and 102 responses on each of the three days, respectively). Rate of head hitting declined to 35 responses on day 1 of the SIBIS-active condition in the home, and 62 responses were observed on day 2, which was a no device day. On day 3, SIBIS was reintroduced, and a zero-level response was reached by day 6 (range 0–14). A zero-level response rate was sustained for the subsequent days, with the exception of days 12, 14, 16, and 26, in which one, one,

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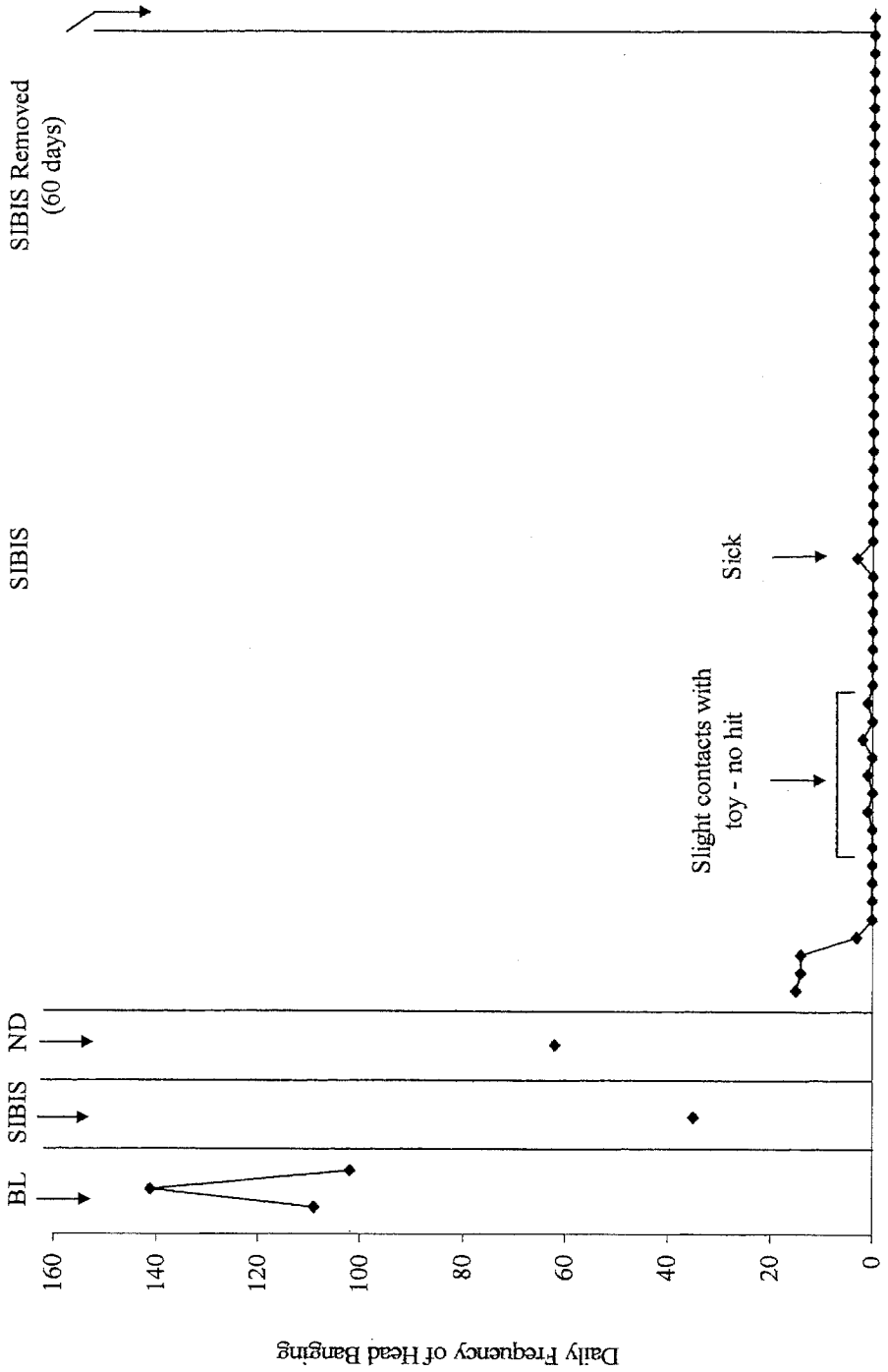

Figure 2. Head bangs exhibited by Johanna during the treatment at home (phase II).

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two, and three responses were observed, respectively. On these days, Johanna reportedly exhibited slight touching of forehead to play objects and the mother's verbal warning 'No hit, Johanna' paired with her movement towards the purse where SIBIS was kept were sufficient to prevent further head hitting. Following 34 days of consistent zero-level response, SIBIS was removed from the home.

Johanna's mother was contacted monthly for the following 3 months. One month following SIBIS removal, Johanna's mother reported that while Johanna occasionally 'touched objects slightly' to her forehead when upset, a verbal warning was sufficient to prevent an actual head hitting response. Therefore, no head hitting responses were observed during this time. At two and three months following SIBIS removal, Johanna's mother reported that Johanna no longer engaged in any semblance of head hitting responses, and she was getting 'upset' less frequently and to a lesser degree over time. Johanna had also reportedly become better at displaying a 'sad face' when upset.

Follow-Up

Seven months after the initial implementation, a 120 min period of observation was conducted at home. According to her mother's report, Johanna was not attempting to bang her head any more, even when she was upset. Johanna's mother recounted that since SIBIS was removed her daughter had rarely hit her head, and even in these instances the topography was markedly different, as Johanna was not 'hitting' her head but was slightly touching or stroking the surface/object against her forehead. Furthermore, the prompt ('no hit Johanna') and the behavioral sequence (moving towards her purse where SIBIS was previously hidden) were sufficient to terminate this behavior. When visited at home for follow-up, Johanna was sick and extremely irritable, an establishing operation that had been previously tightly linked to the occurrence of head banging. Nevertheless, even though Johanna cried and displayed negative affect during the entire 120 min period, she made not one attempt to head bang. The absence of bruising on her forehead was also a notable positive outcome at follow-up, and this was a further indication of the validity of the mother's report that the head banging no longer occurred.

DISCUSSION

Results obtained in the present case study indicated that brief and mild electric stimulation produced rapid, large, and durable[2] decreases in severe SIB. These results are consistent with previous studies and reviews of the literature (Lichstein &

[2]The patient's mother has been contacted since the submission of this article (i.e. 1 year after the initial implementation of SIBIS), and she reported that SIB was still absent.

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Schreibman, 1976; Linscheid, 1993; Linscheid & Cunningham, 1977; Linscheid et al., 1993, 1990; Linscheid & Meinhold, 1990; Linscheid & Reichenbach, 2002; Newsom, Favell, & Rincover, 1983). Nonetheless, the fact that the procedure was so rapidly effective in this particular case is worth mentioning. It is possible that the client's young age and relatively short history of SIB contributed to the substantial effectiveness of the intervention. As we have seen, in the case of Johanna SIB quickly increased in frequency and generalized to several situations. It is reasonable to speculate that if left untreated Johanna's SIB would have worsened over time and become more resistant to interventions.

Close and extended monitoring during and after treatment failed to reveal the presence of negative side effects associated with SIBIS, whereas a number of positive effects were observed. With respect to response generalization, Johanna appeared to be less distressed when upset, most likely because she no longer additionally hurt herself when she was upset. She simultaneously started to be more responsive to reinforcement contingencies, and she began to exhibit a number of positive behaviors reinforced by her mother, such as showing a sad face to communicate she was upset, playing independently, and requesting help. A unique feature of this particular SIBIS case study is that programmed and systematic effort at establishing conditioned punishment was included in the intervention. Continuous assessment after treatment and formal observation session at 7 months follow-up revealed that SIBIS could be removed from the natural environment of the child while maintaining a therapeutic effect. These results were interpreted as the effects of the explicit pairing between the delivery of electric stimulations and previously neutral stimuli (i.e. the verbal prompt and the movement towards the purse), which were initially ineffective in suppressing SIB. This being said, the effectiveness of the 'no hit Johanna + movement toward the purse' was not systematically assessed prior to the introduction of SIBIS, so it is not possible to conclude unequivocally that these stimuli were 'neutral'. On the other hand, the fact that the verbal prompt was Johanna's mother most reliable response to SIB before SIBIS intervention seems to indicate that the pairing with SIBIS was necessary for these stimuli to acquire punishing properties.

In the present case, the prompt–behavioral sequence antecedent to SIBIS stimulation was interpreted (or classified) as a conditioned punisher. Alternatively, this antecedent event could have acted as a discriminative stimulus (Sd) signaling the occurrence of SIBIS. However, the resulting effect of an Sd signaling punishment is to increase the occurrence of a particular behavior reinforced by negative reinforcement (i.e. avoidance of the punishing consequence). Therefore, if the behavioral sequence actually acted as an Sd, its benefits on treatment maintenance were indirect, consisting mainly in increasing alternative responses (e.g. showing a sad face). On the other hand, if the Sd suppressed SIB and elicited a response similar to the one produced by the primary punisher, then it is clear that discriminative

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stimuli operated in a manner similar to a conditioned punisher, at least in this particular case. Although the data gathered here do not permit a definite conclusion as to whether these stimuli acted as a conditioned punisher or an Sd, we are tempted to speculate that both processes functioned simultaneously. On some occasions, Johanna's mother performed the sequence when Johanna was *about to* head bang (i.e. before she actually did so), and as a result the child abstained from hitting her head. We actually witnessed instances where Johanna refrained from head banging contingently on the prompt. In these cases, Johanna started the motion, stayed still a few inches above the floor for a few seconds, stared at her mother and then engaged in another activity.

It can be argued that our failure to obtain immediate (phase I) or complete (phase II) reversals suggests that some generalization may have occurred without the utilization of the conditioned punishment or systematic intervention for stimulus fading. However, continuation of the ND condition following the experimental evaluation (i.e. 3 days of baseline before the implementation at home) was associated with recovery of baseline levels of SIB in the natural environment. Therefore, the stable and enduring maintenance of treatment effects after discontinuation is more likely to be explained by the acquired punishing properties of the neutral events paired with SIBIS.

SIBIS was not designed to be used in isolation from other procedures. The device should be used within the context of a comprehensive program that includes positive reinforcement for establishing and strengthening alternative behaviors. The intervention reported here involved such positive components, thus it does not permit conclusions about the effects of SIBIS alone. Nevertheless, in the present case, SIBIS was implemented because positive interventions were demonstrated to be ineffective when used alone. We do not suggest that the only active ingredient was SIBIS, but that suppression of SIB might have served as an establishing operation to enhance the effectiveness of positive alternative interventions. Our findings are consistent with previous studies in indicating that positive side effects generally outnumber potential negative effects, and that SIBIS can sometimes be necessary, although not sufficient, to eliminate severe and harmful SIB in the natural environment. This study may also suggest that early intervention with an aversive conditioning program may actually negate the need for longer term aversive interventions if SIB becomes more firmly established during periods of no treatment or less aversive but ineffective treatment.

ACKNOWLEDGEMENTS

This paper was made possible with the support of the NSERC (ES B-220830) and of the Fonds FCAR (B2 08A-72388) awarded to S.-J. Salvy. James A. Mulick and Eric Butter were partially supported by NIMH Contract 1U10MH66768-01.

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Treatment of Aggression with Behavioral Programming that Includes Supplementary Contingent Skin-Shock

Matthew L. Israel, Nathan A. Blenkush, Robert E. von Heyn, and Patricia M. Rivera

Abstract

Behavioral treatment of aggression with contingent skin shock (CSS) has been investigated in relatively few studies and never with cognitively typical individuals. We evaluated CSS during a 3-year period with 60 participants, half to two-thirds of whom functioned at normal or near-normal cognitive levels. Sixty individual charts, arranged in a multiple baseline across participants display, reveal clearly the effectiveness of the treatment. When end-of-baseline data were compared with end-of-treatment data, CSS, as a supplement to positive programming, showed effectiveness (defined as a 90% or greater reduction from baseline) with 100% of the participants. This compares favorably with positive behavior support procedures, which, according to the 1999 treatment outcome review by Carr at al., achieved that effectiveness standard with only 55.5% of the cases (Carr et al., 1999). Higher functioning participants showed from 2 to 6 times more reduction than did lower functioning participants. Psychotropic medications were reduced by 98%, emergency takedown restraints were reduced by 100%, and aggression-caused staff injuries were reduced by 96%. As a result of the treatment, 38% of participants no longer required CSS and some returned to a normal living pattern.

Key words: aggression, contingent shock, skin-shock, punishment

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Individuals who exhibit high frequency and/or high intensity aggressive behaviors are often treated with psychotropic medication and behavioral procedures. Unfortunately, psychotropic drugs have proven ineffective in treating the aggression of many individuals, including all of the participants in the present study. They also sometimes produce unfortunate side effects such as sedation, severe weight gain, tardive dyskinesia, neuroleptic malignant syndrome, etc.

The behavioral procedures employed in current clinical practice to treat aggression are usually limited to "positive-only" procedures such as the manipulation of positive reinforcers, the arrangement of antecedents and setting events, provision of educational procedures, and the use of decelerating procedures other than physical aversives. If such procedures prove to be insufficiently effective, the individual is likely to continue to receive high doses of psychotropic medication, may be subjected to substantial amounts of restraint or isolation, and/or may be transferred to a highly restrictive environment (Foxx, 2003).

Contingent skin-shock (CSS), when used as a supplement to other behavioral procedures, has proven effective in treating various problem behaviors that were otherwise intractable. Most of the CSS treatment studies that have been published since 1965 have involved self-injurious behaviors (e.g., Salvy, Mulick, Butter, Bartlett, & Linscheid, 2004; Linscheid & Reichenbach, 2002; Duker & Seys, 1996; and Mudford, Boundy, & Murray, 1995). Other behaviors treated have included (ordered according to the frequency with which the topic has been reported) aggression (e.g., Foxx, McMorrow, Bittle, & Bechtel, 1986); ruminating and/or vomiting (e.g., Wright, Brown, & Andrews, 1978; Cunningham & Linscheid, 1976; Toister, Condron, Worley, & Arthur, 1975; Browning, 1971; Kohlenberg, 1970), auditory hallucinations (Turner, Hersen, & Bellack, 1977; Alford & Turner, 1976; Bucher & Fabricatore, 1970), destruction (e.g., Foxx, McMorrow, Bittle, & Bechtel, 1986; Bucher & King, 1971; Birnbrauer, 1968) screaming (Lebow, Gelfand, & Dobson, 1970; Hamilton & Standahl, 1969), obsessive behaviors (Anderson & Alpert, 1974); wrong answers (Kircher, Pear, & Martin, 1971; Birnbrauer, 1968), self-

induced seizures (Wright, 1973), stereotypic rocking (Baumeister & Forehand, 1972), and noncompliance with a direction to approach (Lovaas, Schaeffer, & Simmons, 1965).

With respect to the use of CSS to treat aggression, we found nine original published studies but none in the last 13 years. The topographies treated included aggressive biting (Foxx, Zukotynski, & Williams, 1994), hair-pulling and aggressive/destructive episodes (Foxx, Bittle, & Faw, 1989), pinching, kicking, hitting, and hair-pulling (Foxx, McMorrow, Bittle & Bechtel, 1986), assaults toward others (Ball, Sibbach, Jones, Steele, & Frazier, 1975), biting, kicking, and choking (Brandsma & Stein, 1973), physically striking another person, (Browning, 1971), hitting, kicking, biting, spitting, and verbal threats to aggress (Ludwig, Marx, Hill, & Browning, 1969), biting, (Birnbrauer, 1968) and aggression toward a brother (Risley 1968).

The CSS literature has limitations. First, most papers report CSS use with only one or relatively few individuals. The largest study was by Duker and Seys (1996) who reported CSS use with 12 participants.

Second, a variety of shock delivery systems with varying shock intensity and durations have been used. For example, within the past 21 years, shock delivery systems have included the HSP 3012 (Duker & Seys, 1996), Therapeutic Shock Device (TSD) (Mudford, Boundy & Murray, 1995), Hot Shot Power Mite (Williams, Kirkpatrick-Sanchez, & Iwata, 1993), Self-injurious Behavior Inhibiting System (SIBIS) (Linscheid, Iwata, Ricketts, Williams, & Griffen, 1990), and Tritronics A1-70 (Foxx, McMorrow, Bittle, & Bechtel, 1986). The differing devices and often incomplete descriptions of their parameters make it difficult to compare the effect of CSS treatment across studies or individuals.

Third, most CSS studies have been with participants who functioned at a relatively low cognitive level and who had diagnoses such as severe mental retardation (MR) and related disabilities. Few studies have involved participants with normal or near-normal cognitive levels who had diagnoses such as conduct disorder, bipolar disorder, oppositional defiant disorder, and impulse control disorder.

In this paper we report data and procedures that address these issues. We treated aggression in 60 individuals with widely differing levels of cognitive functioning for periods of up to three years, using positive behavioral procedures supplemented with CSS. We report the immediate effects of the introduction of CSS on behavior frequency, the overall reductive effect of CSS, and its effect on ongoing accelerations or decelerations. We compare the reductive effect of CSS with the reductive effect of positive behavior support in treating aggression. We describe the differential effect of CSS treatment on participants with differing levels of cognitive functioning. And we describe the effect of CSS treatment of aggression on the need for psychotropic medication, on the need for emergency takedown restraint, and on aggression-caused staff injuries.

METHOD

Participants

A total of 60 (41 male and 19 female) residents, who were enrolled at the Judge Rotenberg Center (JRC) in Canton, MA participated in the study. The median age was 18 (range 9-36). Prior to enrolling in JRC, the participants had attended a median of 4 (range 0-42) special needs day, residential, psychiatric or correctional programs and had been prescribed, at various points in their history, a median of 6 (range 1-21) different psychotropic medications. Although treatment histories varied, all participants in this study had been rejected by, unsuccessfully treated in, or expelled from other settings that had used a combination of positive-only behavioral interventions and psychotropic medications. Demographic information for the participants is presented in Table 1. Note that the total of Other

Diagnoses (81) exceeds the number of participants (60) because many participants had multiple diagnoses. Forty-seven percent did not have an MR diagnosis.

Table 1
Participant demographic information including frequency count of all assigned diagnoses (N=60)

		Number	%
Gender			
male		41	68
female		19	32
	Total	**60**	**100**
Age			
<10		1	1.7
10-15		12	20.0
16-20		40	66.7
21-25		5	8.3
26<		2	3.3
	Total	**60**	**100**
Diagnosis re Mental Retardation Status			
No Mental Retardation		28	46.7
Mild		11	18.3
Moderate		7	11.7
Severe/Profound		14	23.3
	Total	**60**	**100**
Other Diagnoses			
Autism		16	
Mood Disorder NOS		10	
Intermittent Explosive Disorder		10	
Conduct Disorder		8	
Oppositional Defiant Disorder		8	
Bipolar Disorder		8	
Pervasive Developmental Disorder		6	
Attention Deficit Hyperactive Disorder		4	
Impulse Control Disorder		3	
Disruptive Behavior Disorder		2	
Antisocial Personality Disorder		1	
Borderline Personality Disorder		1	
Depressive Disorder NOS		1	
Mental Disorder NOS		1	
Schizophrenia		1	
Tourette's Disorder		1	
	Total	**81**	

The participants were all of the JRC residents, for whom CSS had been added to their programs at some point during the 3-year period from June 1, 2003 to May 31, 2006 and whose enrollment had not been significantly interrupted by absences. During this period a total of 65 residents met this criterion. Four were excluded because of logistical difficulties in obtaining written consent. One guardian did not consent to participate. Another 7 residents had CSS added to their programs during this period; however, their data were excluded from this study because of long absences from the program due to medical needs or other circumstances.

CSS was not considered for each participant until a variety of positive-only procedures had been tried at JRC and had been found or judged to be insufficiently effective in light of the clinical needs of each participant. The median number of weeks during which positive-only procedures alone were tried, prior to the introduction of CSS, was 38 (range 5-108). In a few cases, where the aggressive behavior was judged to be so extreme or problematic that even a single occurrence could be extremely dangerous, CSS was started shortly after the participant was admitted to JRC.

Psychotropic medication

Forty-eight of the 60 participants were receiving a median of 2 (range 1-6) psychotropic medications when they enrolled at JRC. Under the direction of a consulting psychiatrist, these medications were gradually reduced over a median of 5 (range 0-42) months. Most participants were weaned from psychotropic medication during the baseline phase. In a few cases the weaning extended into the treatment phase.

Safeguards

The following safeguards were in effect prior to the use of CSS: (a) The parent/guardian gave informed written consent to the use of CSS. (b) If the participant was of school age, CSS was placed in his or her Individual Education Plan. (c) A doctoral level clinician, with training in behavioral psychology, headed the participant's treatment team and composed a treatment plan that included the option to employ CSS. (d) A physician and, where appropriate, a neurologist and/or cardiologist certified the absence of medical contraindications to the use of CSS for each participant. (e) A psychiatrist certified the absence of psychiatric contraindications to the use of CSS for each participant who had a mental illness diagnosis. (f) An internal peer review committee reviewed the plan and deemed it appropriate. (g) A human rights committee composed of JRC parents, as well as community members unaffiliated with JRC, approved the plan. (h) A Massachusetts Probate Court judge authorized the treatment plan through a "substituted judgment" petition in an individual court hearing in which the participant was represented by his or her own court-appointed attorney. (i) The court-appointed attorney retained his or her own psychologist to provide advice concerning the proposed treatment.

Additional safeguards were in effect after the treatment plan went into effect. Reports on the participant's treatment status were submitted to the Probate Court every 3 months and the judge held a formal review each year. In all cases in which CSS was used for 3 or more years, a special committee composed of JRC staff and consultants, including two independent clinicians unaffiliated with JRC, reviewed the treatment and its results to determine if it should continue.

Setting

All participants lived in apartments or homes operated and staffed by JRC and were transported to and from JRC's day program where they received treatment, education, and vocational instruction and opportunities. During the first 4 months of the 3-year period reported here, participants attended the day program 5 days per week. During the remaining 32 months of the period, participants attended the day

program 7 days per week. The same treatment procedures were in place and carried out consistently in the school building, in the residence, on field trips, and during transportation to and from school.

The participants' programs in both day and residential settings were monitored directly by on-scene supervisors, as well as remotely by supervisors who watched live and recorded video and audio, on a sampling or continuous 24/7 basis. Video cameras and microphones were mounted in all appropriate locations of the school and residences. This equipment allowed the supervisors to monitor from a central office, in real time over the Internet, all activities in the participants' classrooms and residences.

Behavior categories and topographies

A supervising clinician, with a caseload of 15 to 20, oversaw each participant's program with the assistance of other members of the treatment team, such as the teacher, residence supervisor, and a case manager. The behavior category treated was termed "aggression," meaning any behavior that inflicted harm on other persons. Because there are an unlimited number of topographies that a participant could use to inflict harm on others, and because new topographies could emerge abruptly, each participant's clinician identified the topographies that were currently in the participant's repertoire and was authorized, in the court-approved treatment plan, to identify and add other topographies to the treatment plan as soon as they were displayed.

Examples of topographies within the aggression category included the following: hit others, bite others, kick others, throw objects at others, head butt others, choke others, and pull hair of others. The topographies treated included not only the ultimate aggressive behaviors themselves, but also antecedent behaviors, attempts and threats to execute the behavior, shaped-down (vestigial) versions that were displayed during the deceleration of the behavior, as well as initial and intermediate members of the chain that included the ultimate aggressive action.

For all participants, aggression was only one of several behavior categories that were treated with CSS at the same time. The other categories that were treated depended on the participant's treatment plan and could include health dangerous (self-injurious), destructive (e.g., breaking windows, desks, computers), noncompliant (e.g., refusal to follow a request), and major disruptive (e.g. swearing, yelling, disrobing in public, etc.), behaviors. Data for the treatment of these other behavior categories are not included in this report.

Data collection

Frequency data was collected by direct care staff 24 hours per day, 7 days per week. Each aggressive topography was tallied as it occurred, using recording sheets that were segmented by hour and that accompanied the participants in all activities. Hand counters were used to count high frequency behaviors. Aggressive behavior sometimes occurred in episodes in which several aggressive actions occurred within a short period of time. In these cases, the staff member administered one application of CSS to consequate the entire episode, but tallied each individual aggressive behavior. The total number of aggressive behaviors exhibited each day was entered in a database and displayed on daily, weekly, monthly, or yearly software charts that were updated daily and made available to clinicians, teachers, and parents through a computer network. Total CSS applications were recorded separately and totaled across all treated behaviors, but were not separated by behavior categories such as aggression.

To evaluate the effects of CSS treatment of aggression on participants of differing functioning levels we classified students by functioning level and compared the reductive effect of the treatment on the two groups. To obtain information about psychotropic medication use, emergency takedown restraints, and aggression-caused staff injuries we reviewed the participants' records as well as records of staff injuries.

Materials

CSS was administered by means of a skin-shock device called the Graduated Electronic Decelerator (GED). GEDs of two strengths were used—the GED-1 and GED-4. The GED-1 produced an average current of 15 mA RMS and an average voltage of 60 V RMS when applied to a resistor of 4 kΩ (typical skin resistance for the GED-1). The electrical stimulus was a preset, 2 s train of direct current square waves with a duty cycle of 25% and a pulse repetition frequency of 80 pulses per second. The GED-4 produced an average current of 41 mA RMS and an average voltage of 66 V RMS when applied to a resistor of 1.6 kΩ (typical skin resistance for the GED-4). The other parameters of the GED-4 were identical to those of the GED-1.

Each GED system was comprised of a remote control transmitter, a shock generator (the GED device itself), a battery and an electrode. The transmitter, a SECO-LARM (model SK-919TD2A) two-channel RF transmitter, operated at 315 MHz and transmitted a uniquely coded signal to the receiver which was worn by the participant. The transmitter was housed in a lexan box (104 mm x 76 mm x 38mm) with the participant's name and photo on the outside.

The shock generator consisted of a receiver (SECO-LARM model SK-910) set to the same code as the transmitter, a shock controller circuit board that created the shock stimulus, and a stimulation-indication beeper (Mallory piezoelectric ceramic buzzer model PLD-27A 35W). The shock generator was housed in a lexan box (140 mm x 89 mm x 38 mm) and the unit weighed 269 g.

A 12 V rechargeable nickel metal hydride battery pack (Panasonic P/N HHR-AAB 2000 mAh) provided power to the shock generator and was housed in a lexan box with the same dimensions as those of the shock generator. The battery unit weighed 397 g. The battery was attached by Velcro to the shock generator and connected to it electrically by a short cable (Hirose Electric Co., Ltd., Part # H0063-ND). The battery and shock generator were both carried in a back pack or fanny pack worn by the participant. A cable (Hirose Electric Co., Ltd., Part # H0063-ND) connected the shock generator to the electrode. Each electrode was attached to one of several pre-approved locations, typically the arms, legs, or torso. The electrode and connecting cable were hidden by the participant's clothing.

The electrodes employed during the 3-year period were of two types: (1) a "concentric" electrode which consisted of a stainless steel button (diameter 9.5 mm, thickness 3.25 mm) surrounded by a stainless steel ring (outer diameter 21.5 mm, inner diameter 16.5 mm, thickness 3.25 mm) with 2.35 mm between the outer edge of the button and the inner edge of the ring; or (2) a "distanced" electrode consisted of two stainless steel buttons (diameter 9.5 mm, thickness 3.25mm) mounted up to 15.24 cm apart on flexible nonconductive material. During the 3-year period covered in this report, the vast majority of the participants wore distanced electrodes.

Each participant wore from one to five GED sets (each consisting of battery, shock generator, and associated electrode), depending on the decision of the participant's clinician as to the following: (a) whether it was necessary to consequate attempts by the participant to remove the equipment or interfere with the application; and/or (2) whether the participant would otherwise be able to defeat much of the effect of the CSS by tensing the muscles in the affected area prior to the application. Each remote control unit sent a signal to only one particular GED shock generator and that shock generator was connected to one electrode on the participant's body. When a participant wore more than one GED set, the therapist possessed a separate remote control for each set. In these cases, on any given application the participant did not know which electrode would deliver the skin-shock (i.e., which remote control device the staff member would employ). Electrodes were rotated to different skin locations at the end of each hour and after a skin-shock was applied.

Procedure

There were two phases, baseline followed by treatment.

Baseline (Positive Programming).

Upon admission, functional assessments were completed for each participant. These suggested functions that were varied among individuals and were sometimes multiple and unknown.

To take account of the various possible functions, all environments and staff procedures were designed so that regardless of what event or events might function as a reinforcer on any given instance of the behavior, inadvertent or deliberate reinforcement of undesired behaviors would be avoided or minimized. In particular, systems were set up, and staff were trained, to insure that (a) any inadvertent reinforcement from positive or negative attention would be minimized or avoided whenever problem behaviors occurred; (b) any escape from demands that inevitably had to occur after a problem behavior was displayed would be minimized or avoided; and (c) desired tangible items or activities would never be arranged or allowed as the immediate consequence of a problem behavior. All participants were taught how to gain attention, escape from work, and obtain desired items or activities through appropriate and easily executed behaviors.

The participant's clinician reviewed daily behavior frequencies and frequency trends over time. As the clinicians prescribed and adjusted combinations of antecedent, reinforcement, extinction, response cost, and other procedures, they were able to see the effects of these changes in the charted data and make compensating adjustments when required. This amounted to an ongoing, *in vivo* functional analysis.

During the baseline phase, a variety of positive programming procedures were employed to decrease the aggressive behavior and to teach alternative desired behaviors. Each participant had DRO/DRA contracts in which, if the participant avoided displaying the problem behaviors during a certain period of time or activity, and also displayed desired behaviors in their place, reinforcers would be earned. Typically, each participant had multiple overlapping contracts covering different stimulus situations and periods (transport, overnight, less-than-a-day length, multiple-day length, etc.). The length of the contracts was gradually lengthened whenever possible. When a participant passed (i.e. met the conditions of) a contract, he/she was given points, tokens, or immediate access to desired items or activities. By passing a sufficient number of contracts, students could advance to higher level classrooms and residences with more privileges, gain more independence, and/or earn a part-time or full-time paid job inside or outside JRC.

Participants also received points, tokens, and other reinforcers on an intermittent basis throughout the day (essentially on an intermittent, momentary DRA schedule) provided they were "on contract" and engaging in appropriate behavior at the time the reinforcer was delivered.

Points, tokens, and direct access to reinforcers could also be earned by learning new academic, self-care and vocational skills and by responding appropriately to programmed stimuli, sometimes designed to represent stimuli that triggered problem behaviors, presented at various points during the day.

Points and tokens could be turned in for access to one or more of the following: money (participants could earn as much as $30 per week); field trips; the Reward Corner of the classroom; the Big Reward Store, which was an arcade-type room with pool table, pinball machines, video games etc.; the Internet; the Contract Store, which was a retail "store" with a variety of items for sale; items in the Classroom Reward Box; weekly field day activity, including barbecue and other desired activities; extra phone calls to parents and friends; opportunity to watch TV, play video games, or listen to music using entertainment consoles in the participants' bedrooms and living rooms; etc.

Other procedures included functional communication training, training in social skills, self-instruction in academic skills using personal computers as teaching machines (Skinner, 1958), and

vocational training. Higher functioning participants were given behavioral counseling, self-management training, a course in behavioral psychology presenting a simplified version of the concepts presented in Skinner's "Science and Human Behavior" (Skinner, 1953), and weekly behavioral chart shares with other participants/students.

Every item or activity that the participants might enjoy was used as a contingent reward to encourage desired behavior. Undesired behavior resulted in money or point fines and/or a loss of privileges previously earned. Extremely dangerous behaviors were contained using emergency restraint and protective equipment. In some cases, mechanical restraint was employed to insure the participant's safety.

Treatment (Added CSS).

In this phase, all of the positive procedures employed during the baseline phase continued to be used and adjusted by the clinicians; however, all topographies listed under the aggression category were now also "consequated" with a single GED application as soon after they occurred as possible. The normal procedure for administering a GED application required the staff member to enlist a second staff member to insure that (a) the person about to administer the GED had selected the correct recording sheet for the participant, (b) the topography that had just occurred (or which was still occurring) had been pre-identified on that recording sheet as being a treatment target, (c) the consequence (GED) was the correct consequence for that topography, and (d) the person administering had selected the correct remote control for the participant. These requirements introduced a slight delay in the administration of the consequence; however, the gains in insuring proper execution of the procedure were judged to be worth the slight delay involved.

Some participants wore more than one GED, and up to a maximum of five GEDs, if it was necessary to consequate attempts by the participant to remove the equipment or interfere with the application, and/or where the participant would otherwise defeat much of the effect of the CSS by tensing the muscles in the affected area prior to the application. Electrodes were rotated to different skin locations at the end of each hour and after a skin-shock was applied.

In certain cases, when equipment failure or other factors prevented the administration of the skin-shock, a verbal reprimand was substituted.

During the treatment phase, each time the student displayed an aggressive behavior, the staff member who administered the GED recorded the apparently-triggering stimulus as well as other setting information on the participant's daily recording sheet. This information was used by the clinician in his or her ongoing *in vivo* functional analysis of the aggressive behavior.

Although a detailed analysis of the gradual removal (fading) of the GED device was beyond the scope of this study, fading was accomplished with many of the participants. As their behaviors improved, the requirement that the GED device be worn was gradually diminished. If participants had been wearing more than one GED, the number was gradually reduced to just one. At that point, and in cases where the participant had always been using only one device, the number of hours each day during which the device was worn was gradually reduced to zero

All 60 participants were included in the Treatment phase. A total of 52 were started on CSS using the GED-1, and 8 were started using the GED-4. The decision as to which to start with was made by the clinician, and depended on factors such as the seriousness and severity of the problem behavior, the participant's previous history, and the need to maximize the likelihood of rapid and effective treatment.

In two cases, the GED-1 was employed first and the participant was later switched to the GED-4 either because the GED-1 was judged to be insufficiently effective in treating the aggression, or because it

was insufficiently effective in treating one or more of the other behavior categories that were being treated concurrently.

RESULTS

Chart display

Individual charts showing weekly totals for the participants' aggressive behaviors are presented in Figure 1. There is one chart for each participant and each participant is identified as Participant 1, Participant 2, etc. The charts are multiply/divide charts in which a relative change (e.g., a doubling, tripling, or halving) occupies a constant up-down distance anywhere on the chart. Each vertical line represents 1 week and heavy vertical lines represent every 5th week. A dashed vertical phase line indicates the week during which the participant's treatment program was supplemented with the GED-1 or GED-4. These charts are very similar, but not identical[1], to the weekly version of the Standard Celeration Chart (Pennypacker, Guiterrez and Lindsley, 2003) that is employed in Precision Teaching (Lindsley, 1990).

The data point for each "CSS introduction-week"—i.e., the week within which the GED procedure was introduced—has been omitted because the total for that week, which was based on one or more days from both the baseline and treatment phases, belonged in neither phase. The data for those weeks are provided in the Appendix. Similarly, in the two cases (Participants 29 and 31) in which a participant was changed from the GED-1 to the GED-4 during the treatment phase, the data point for the week during which the change was made has been omitted because the total for that week, which was based on one or more GED-1 days as well as one or more GED-4 days, belonged in neither condition. The data for those weeks also, are provided in the Appendix.

The charts are arranged vertically in a single column according to the date on which the GED was added to the participant's program. As a result, the charts are displayed in what amounts to a multiple-baseline-across-participants display with the intervention line (that shows the introduction of the GED) jogging to the right after each chart to show the passage of time before the next participant started on the GED.

Casual inspection of these charts shows that the supplemental use of the GED was effective in decelerating aggression in almost every single case. This is particularly evident when one takes into account the fact that on these charts (when displayed at 100% size on a computer screen) a vertical distance of approximately 6.35 mm (1/4 in) upwards or downwards, represents a doubling or halving, respectively, of the frequency.

For some participants gradual removal or fading of the GED occurred. As of December 1, 2007, 23 of the 60 participants (38%) had been able to dispense totally with wearing any GED device. Eight of these 23 had left JRC after being completely faded from the GED and moved on to less restrictive settings such as other residential schools, day programs, regular school settings, or their own home. Fifteen others were still enrolled at JRC and had various forms of partial independence in the school and in their residence. Three of the 15 had paid in-school jobs. Because many of the participants were still undergoing active treatment at the time of this report, further removals and fading that occurred after the end of the 3-year period covered in this report are not included.

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[1] On the charts of Figure 1, a data series that doubles *every 5 weeks* produces a slope of 34 degrees. On the weekly version of the Standard Celeration Charts, a doubling *every month* produces the same slope.

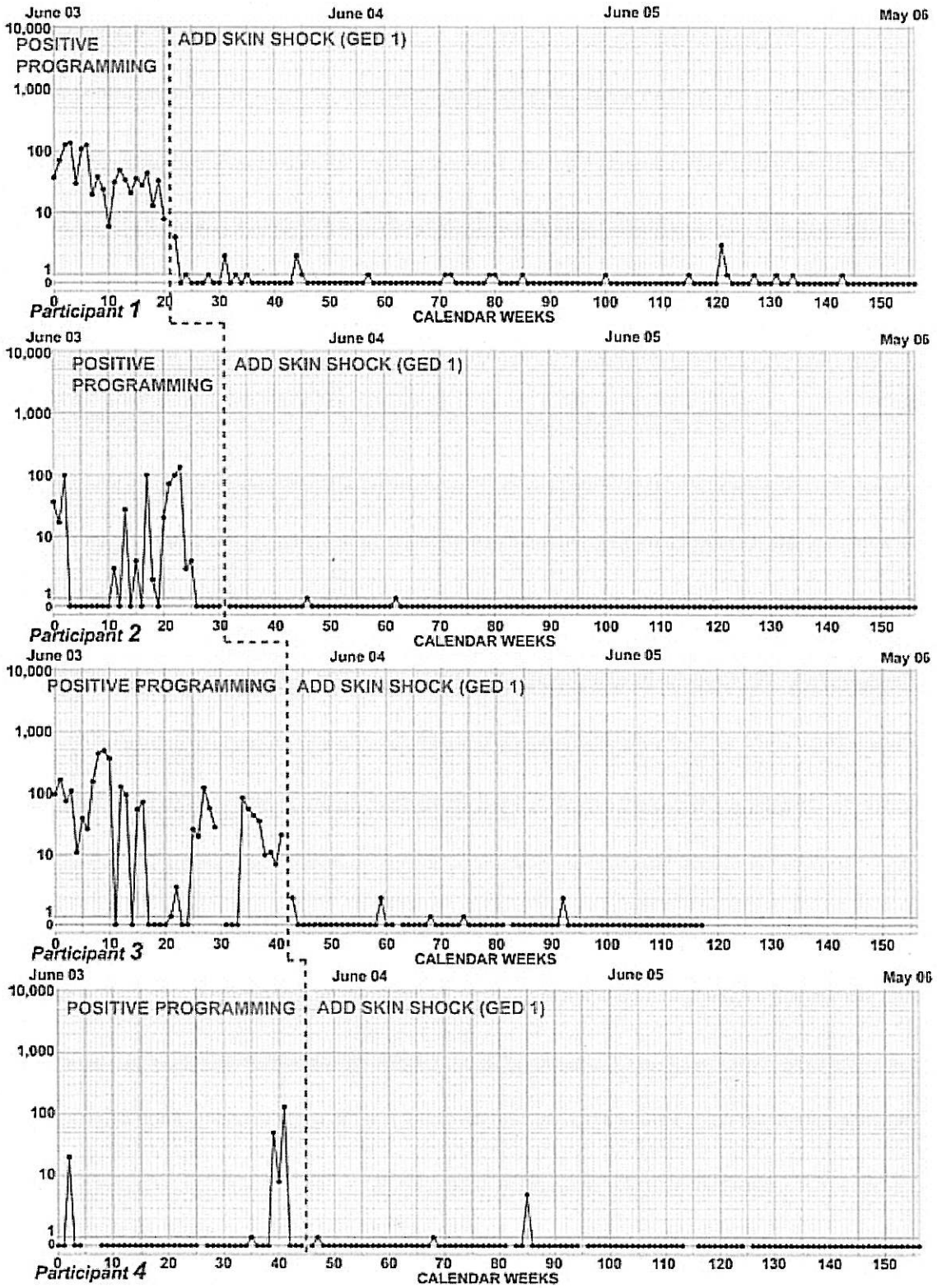

June 03
June 04
June 05
May 06
10,000
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 1
Participant 2
Participant 3
Participant 4

Figure 1. The weekly frequency of aggressive behaviors for each participant between June 1st, 2003 and May 30, 2006.

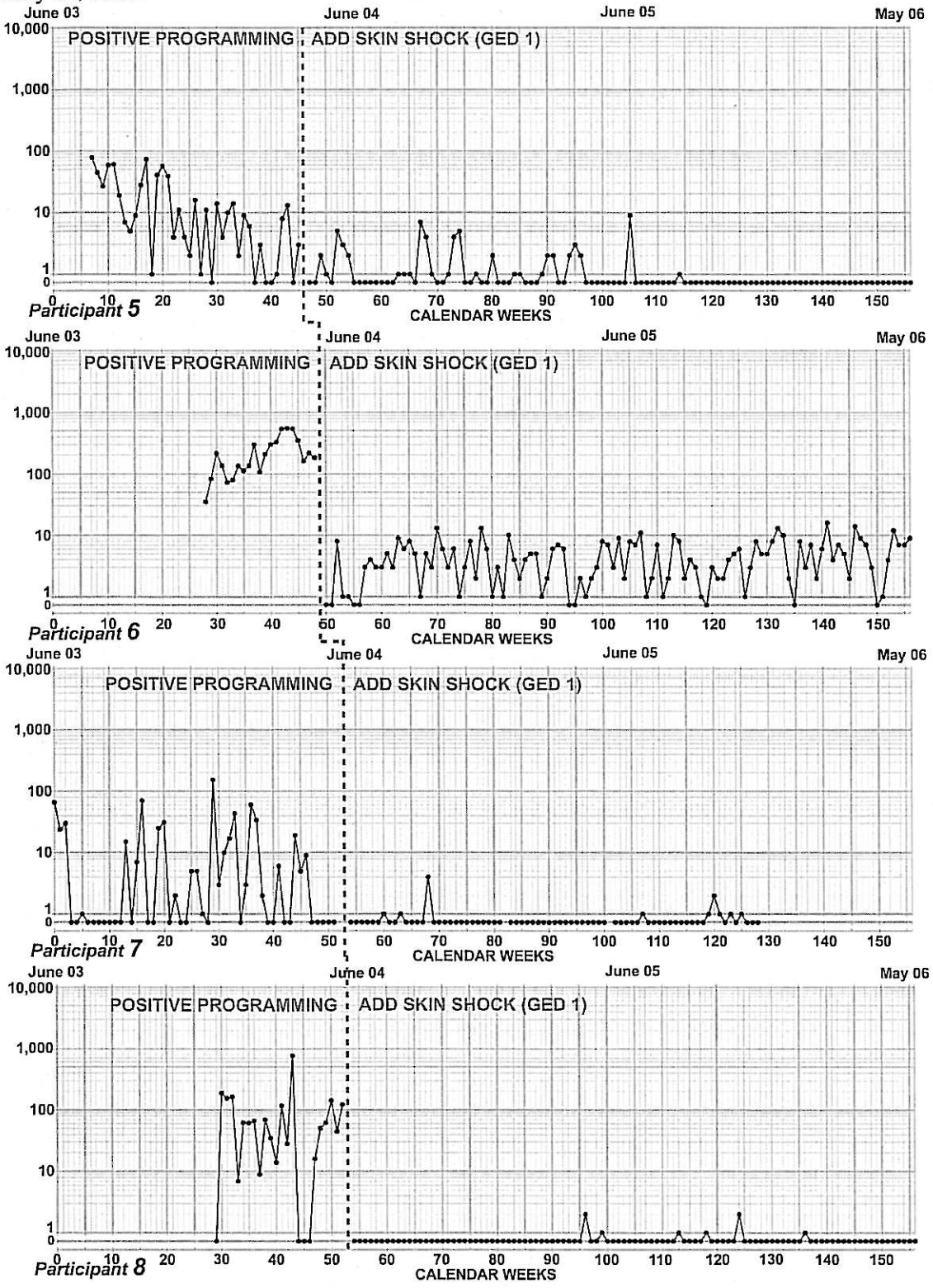


Figure 1(continued).

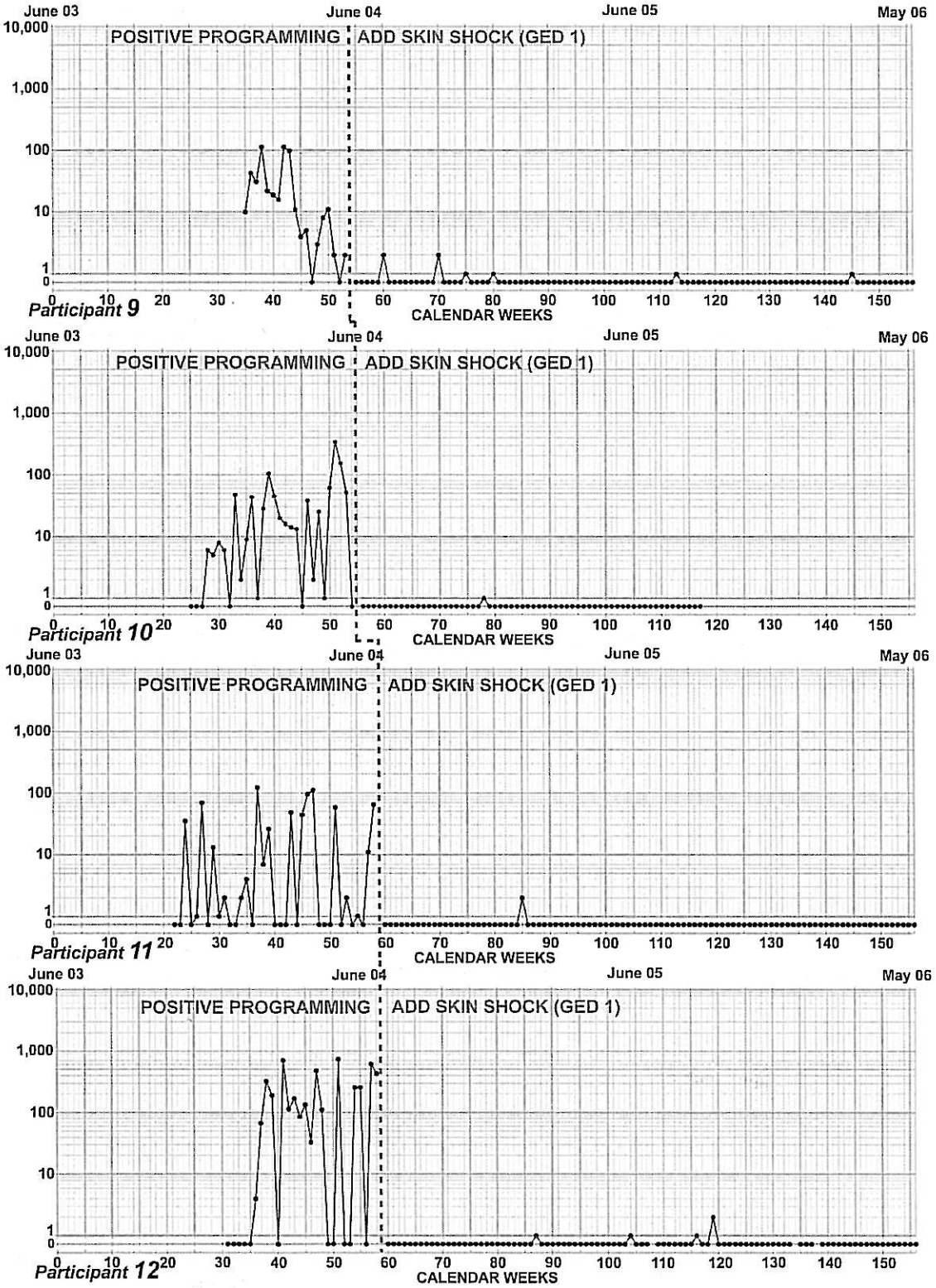
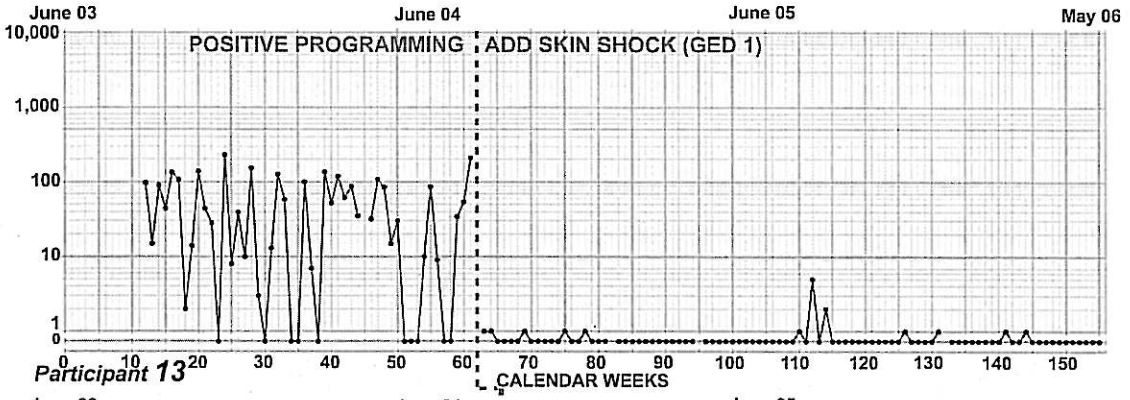
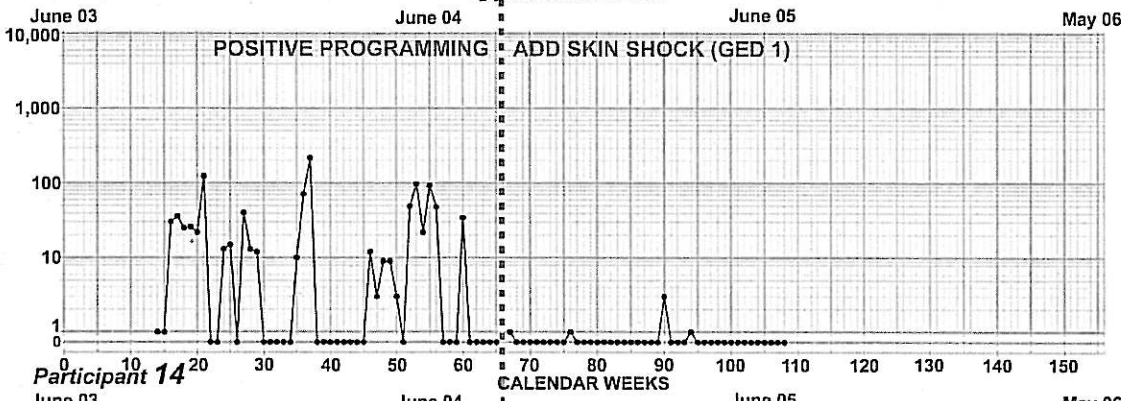
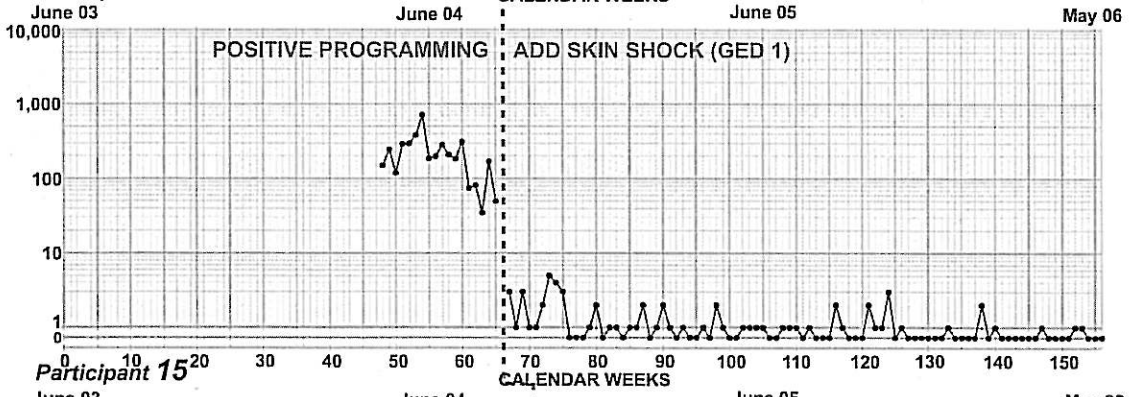


Figure 1(continued).


June 03
June 04
June 05
May 06
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
10,000
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 13


June 03
June 04
June 05
May 06
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
10,000
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 14


June 03
June 04
June 05
May 06
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
10,000
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 15

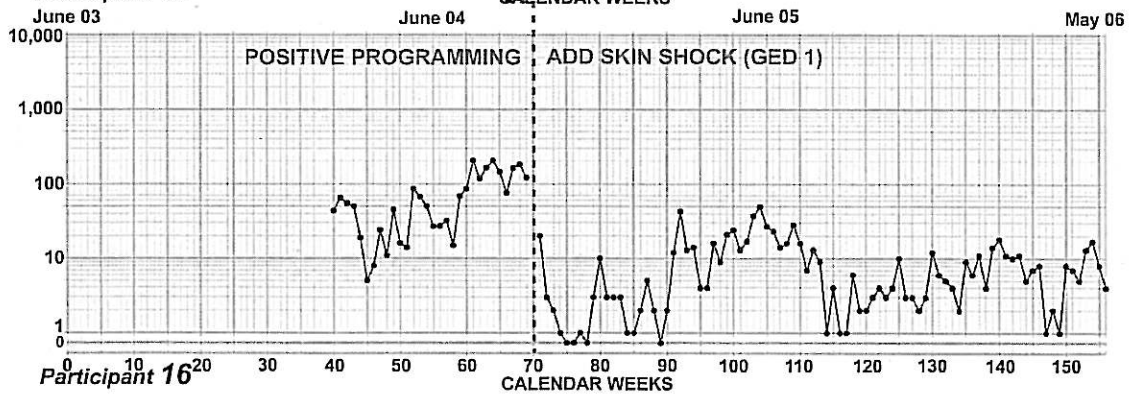
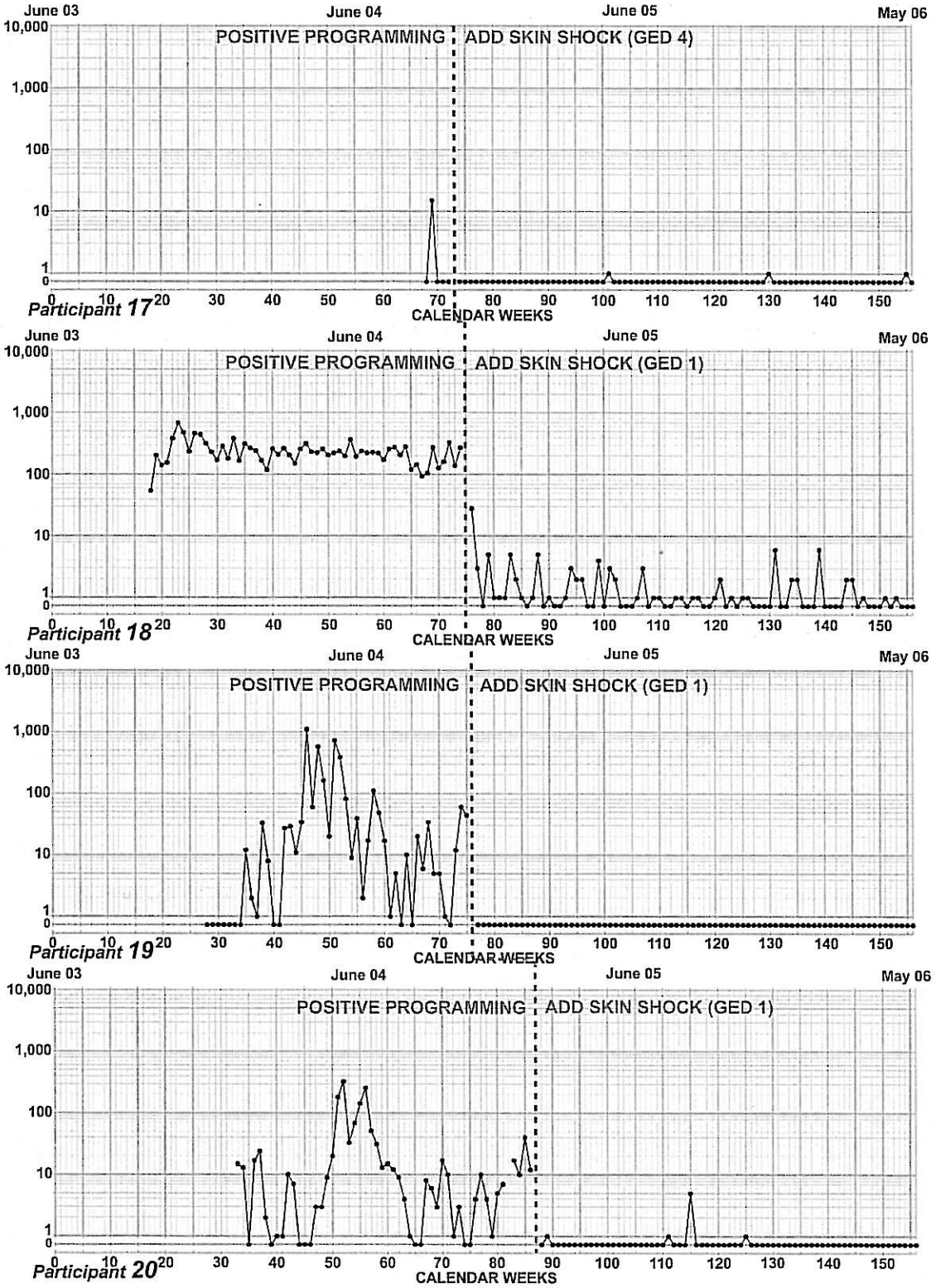

June 03
June 04
June 05
May 06
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
10,000
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 16

Figure 1(continued).



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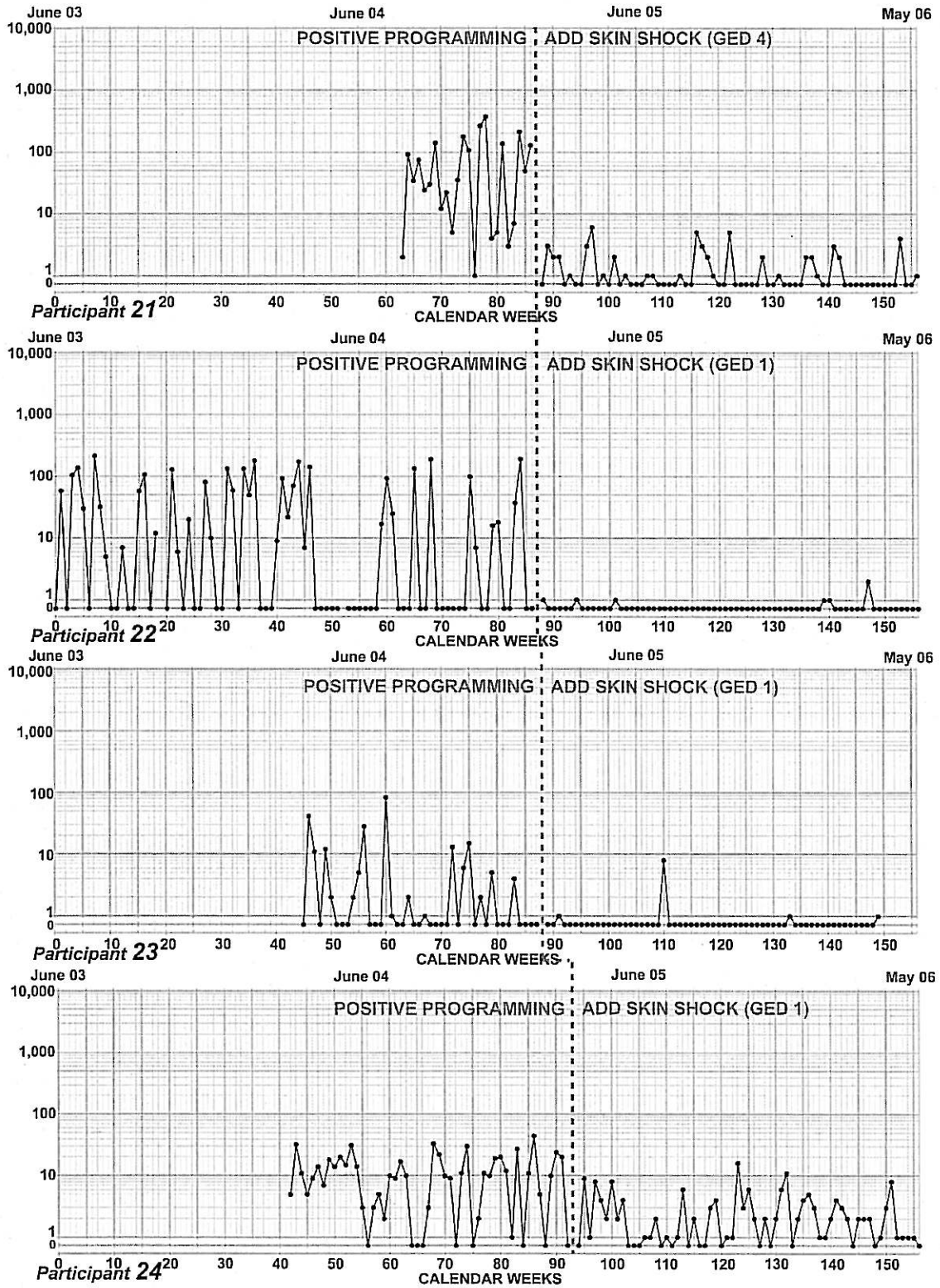

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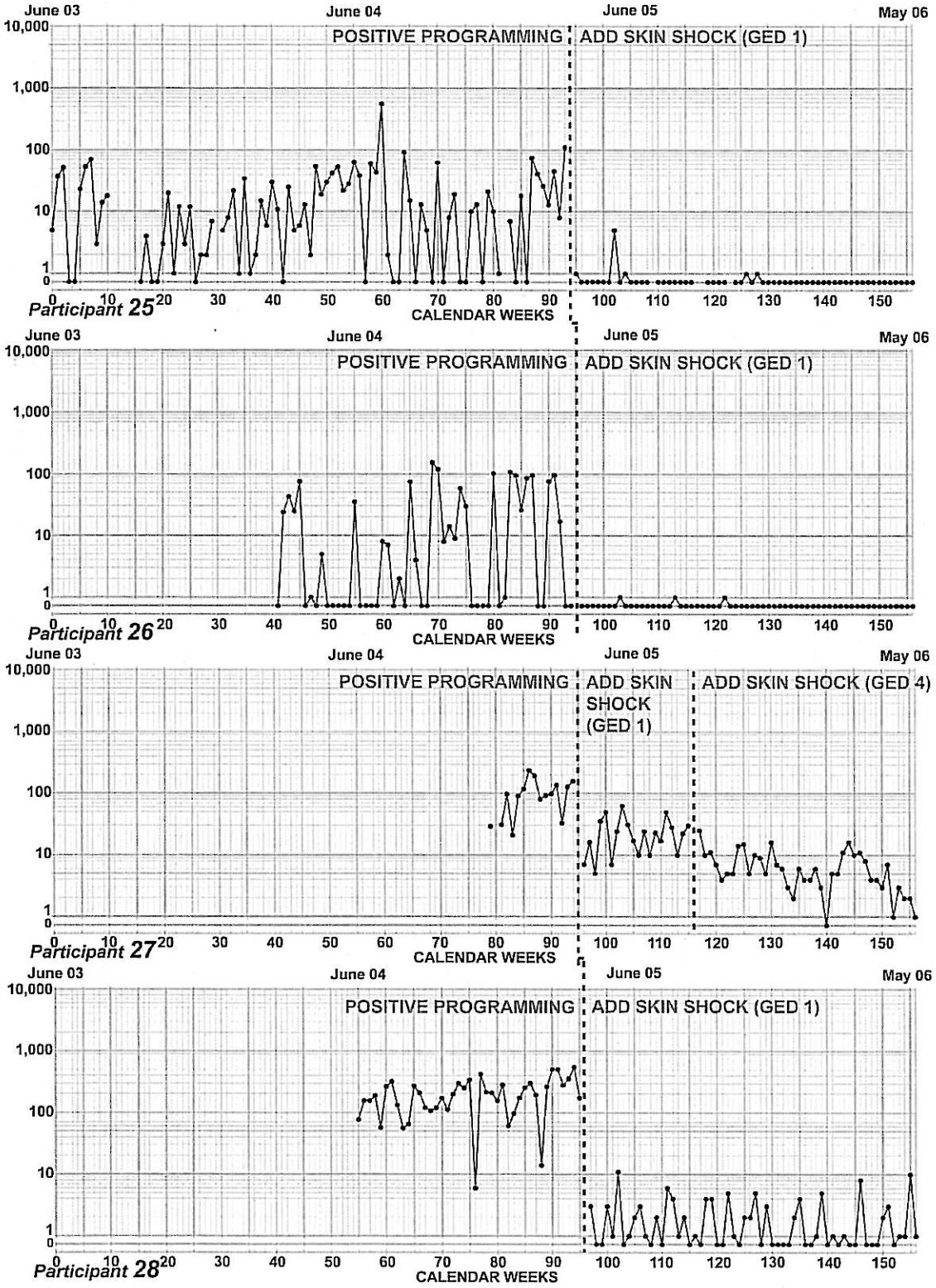

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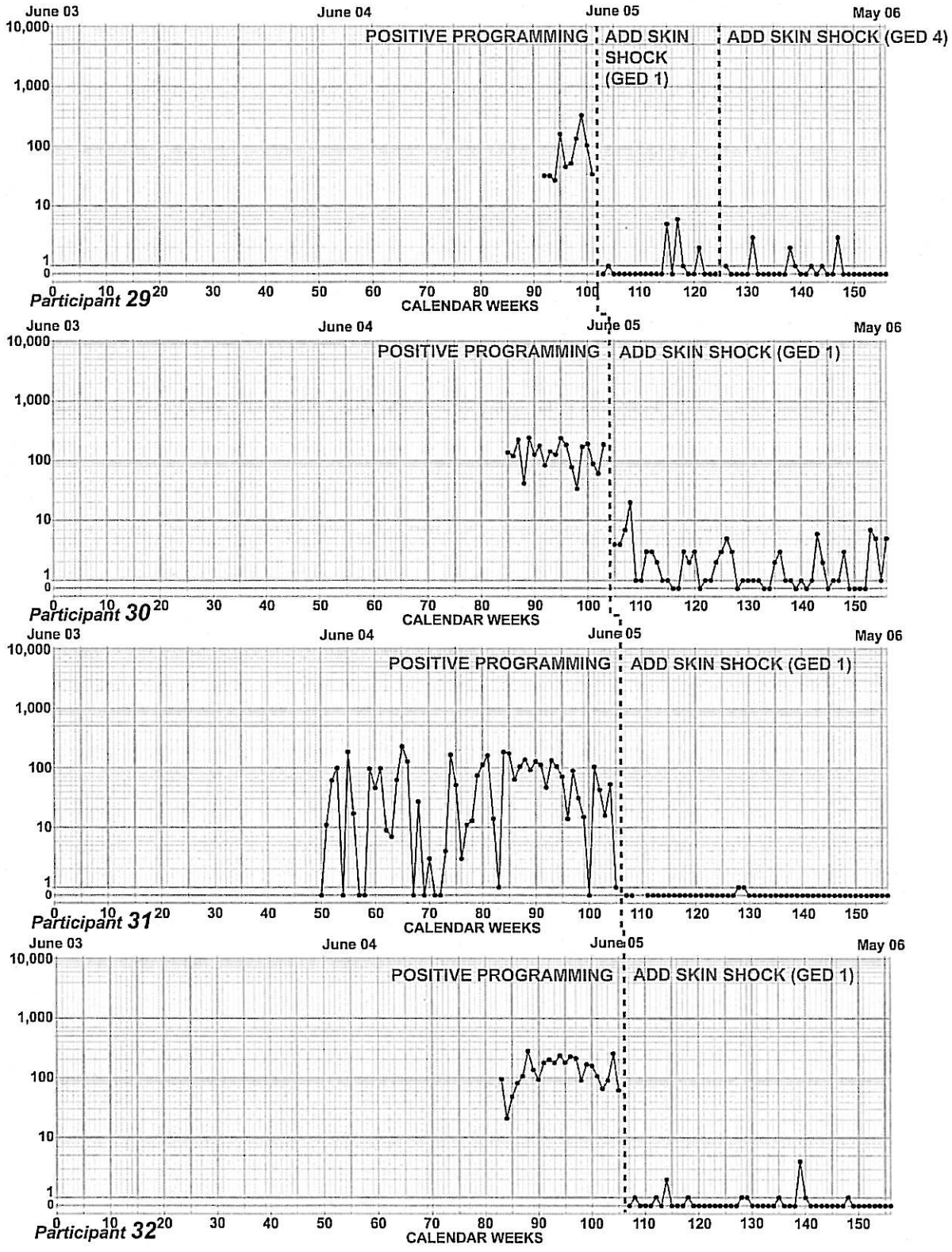

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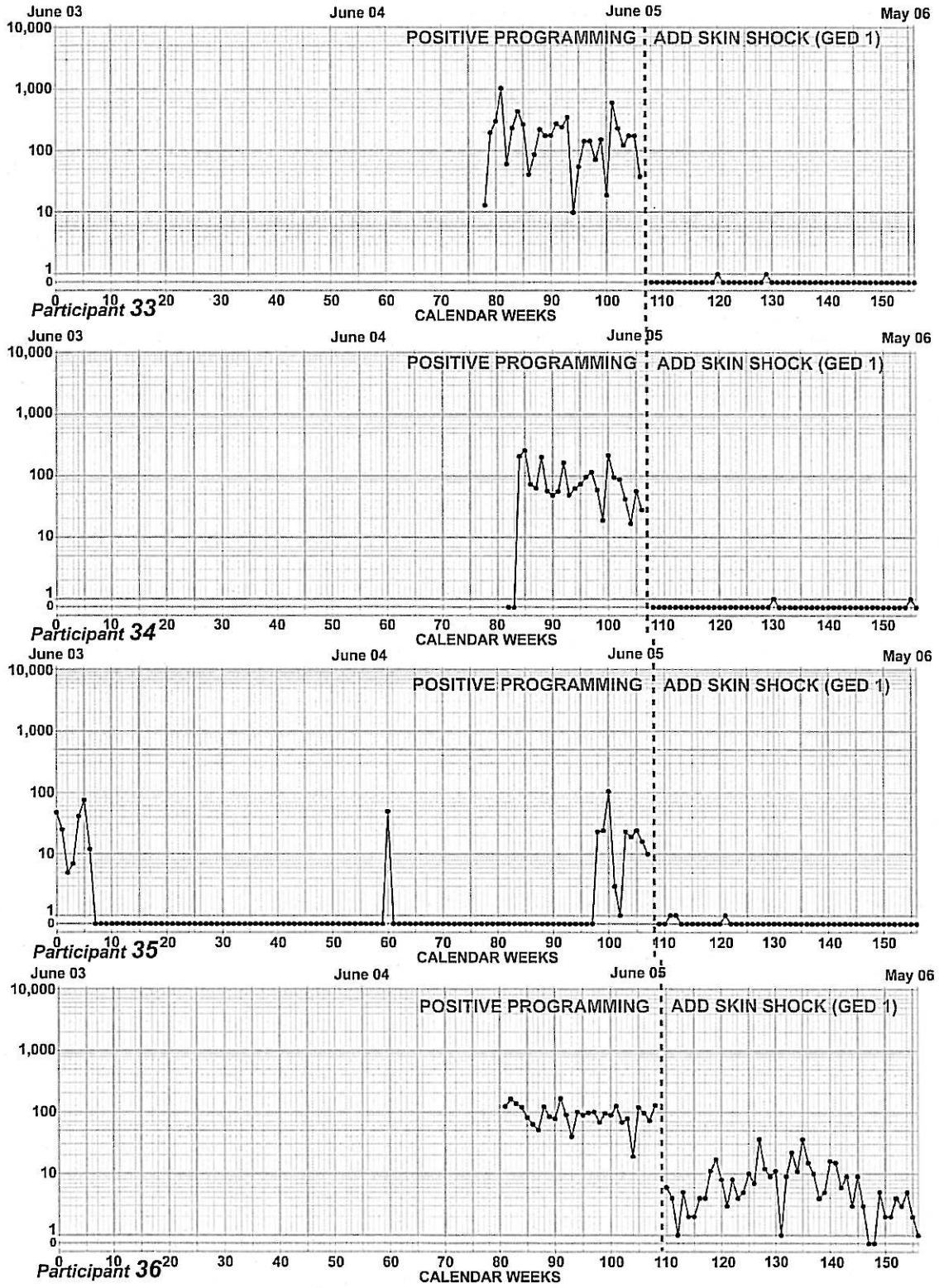
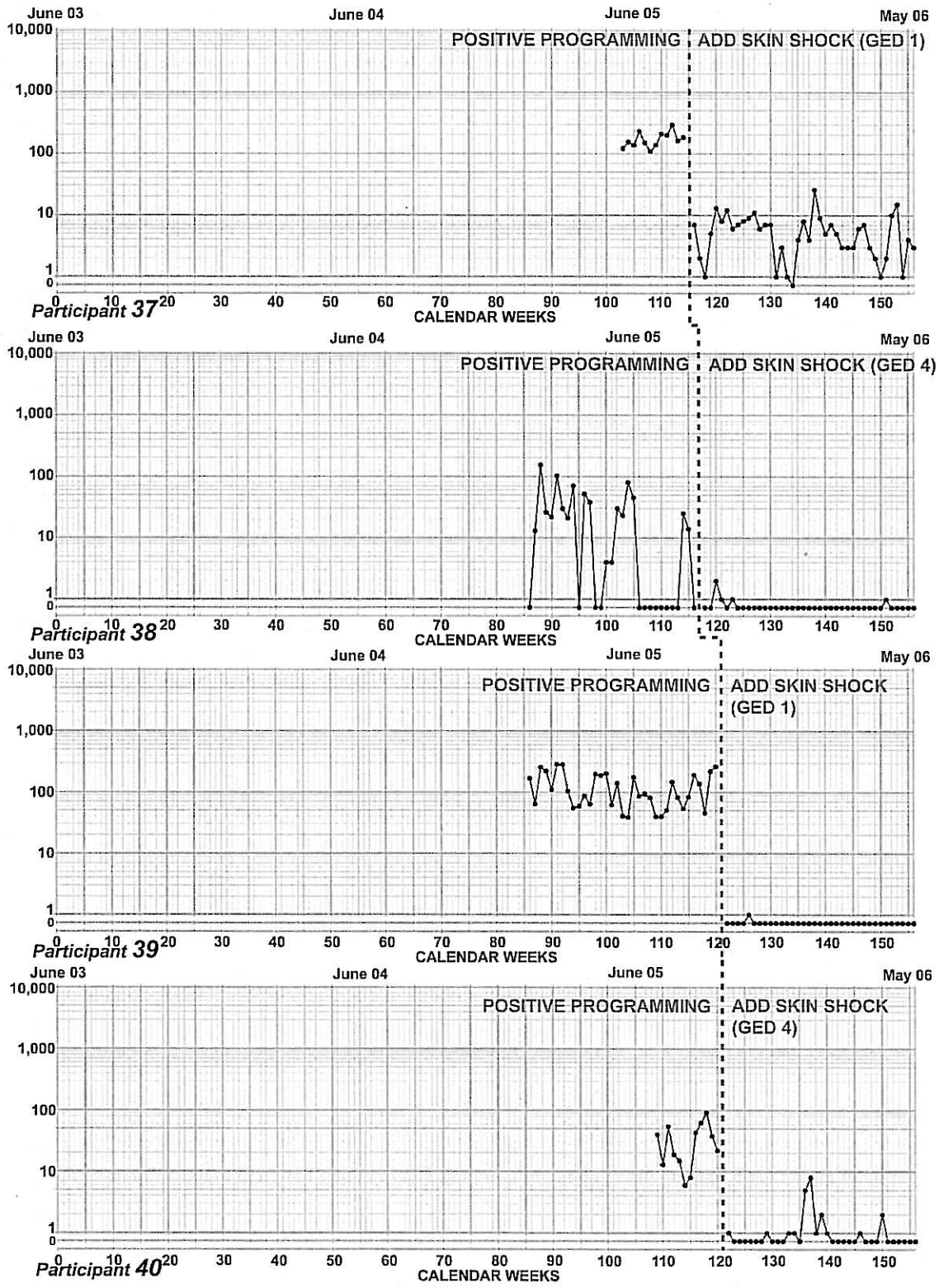

June 03
June 04
June 05
May 06
POSITIVE PROGRAMMING
ADD SKIN SHOCK (GED 1)
10,000
1,000
100
10
1
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CALENDAR WEEKS
Participant 33
Participant 34
Participant 35
Participant 36

Figure 1 (continued).



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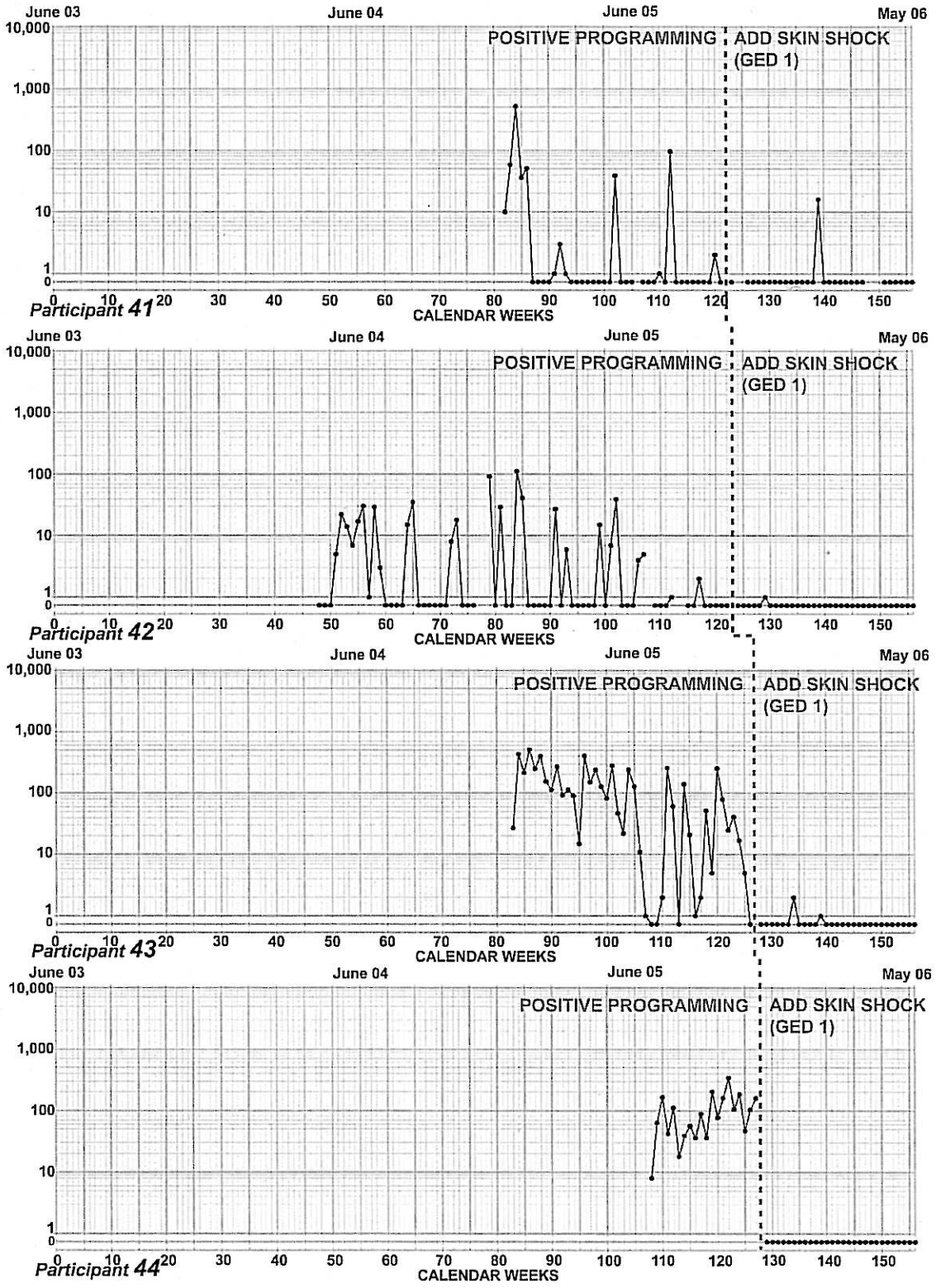

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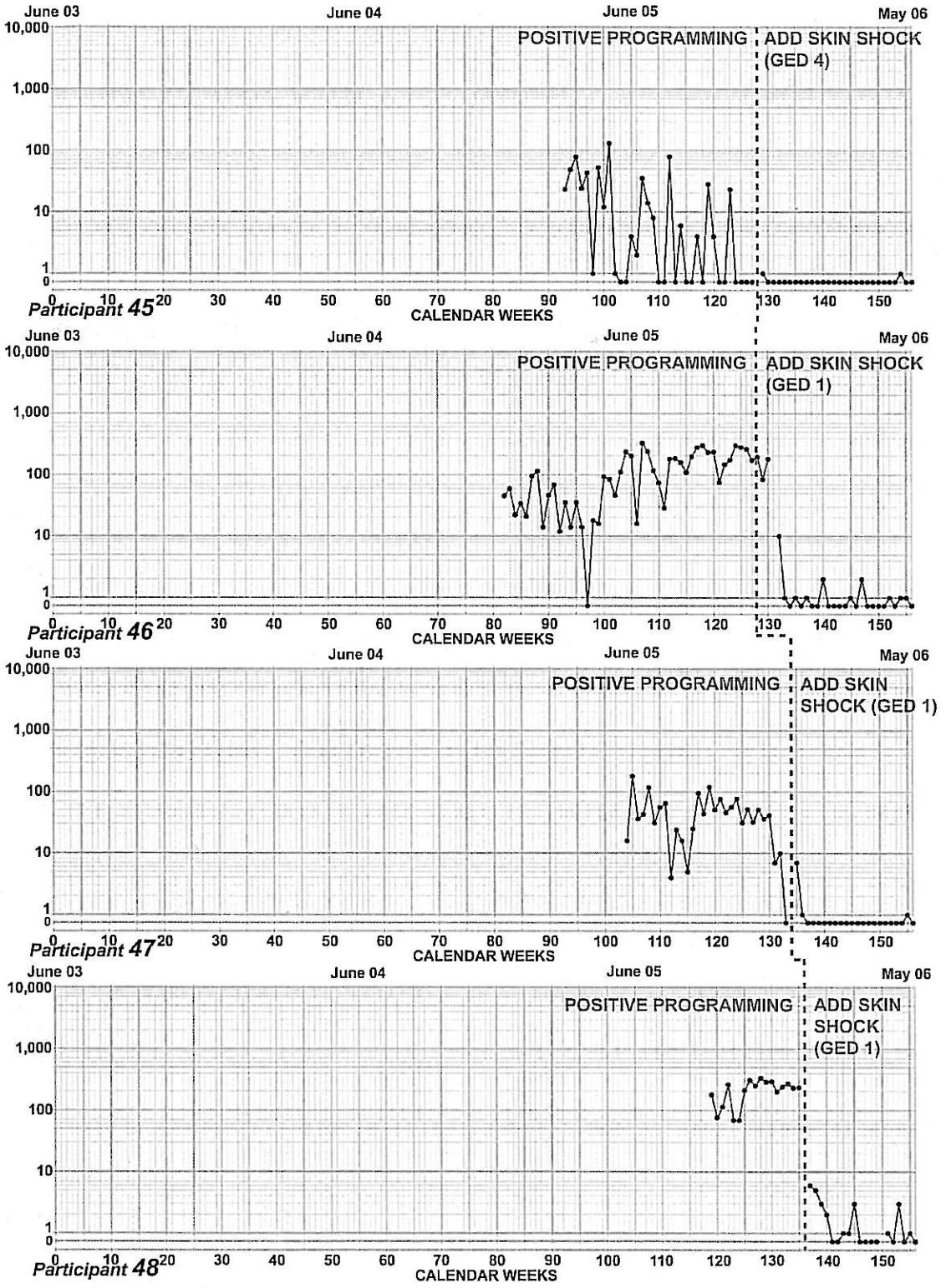

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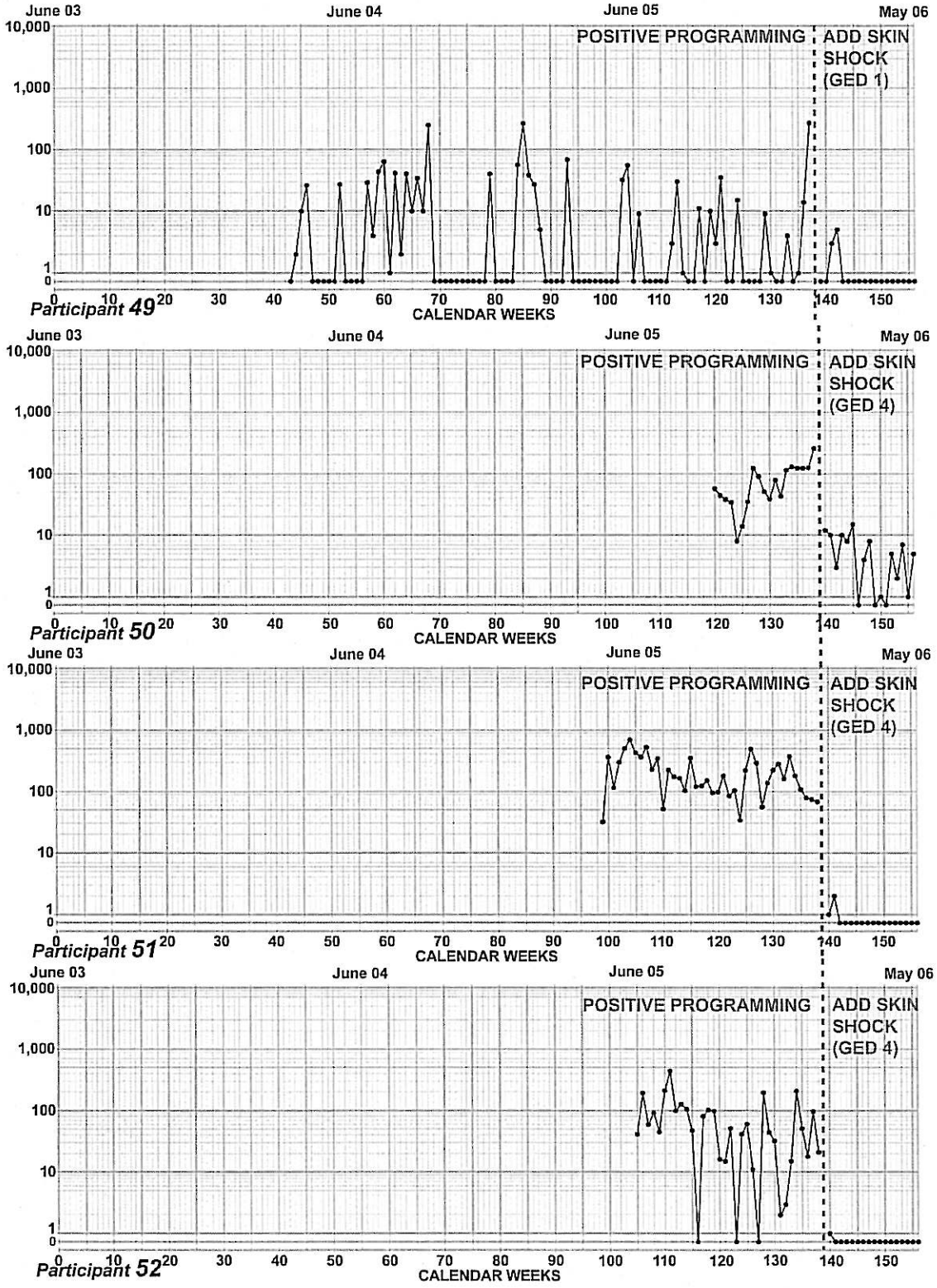

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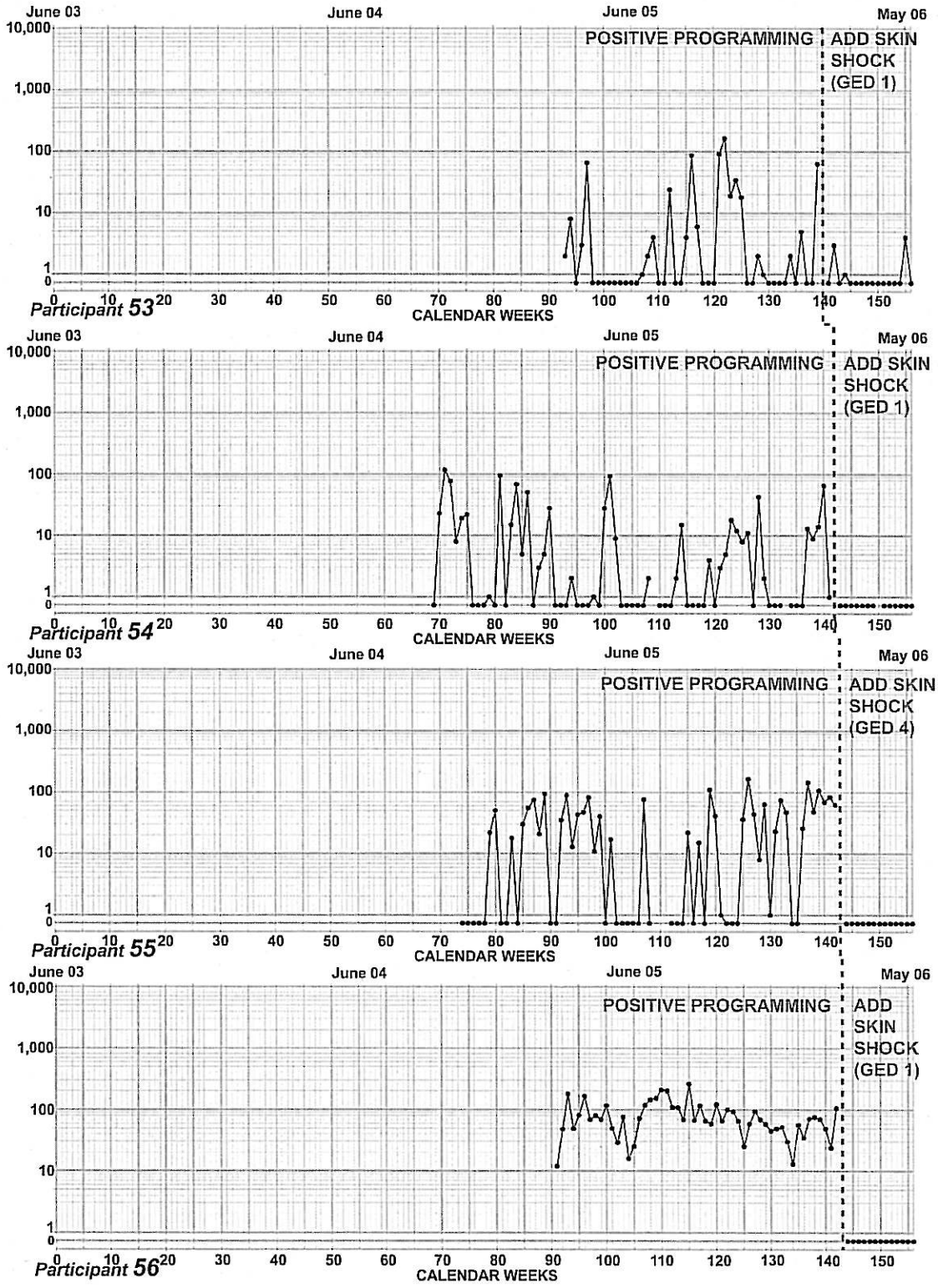

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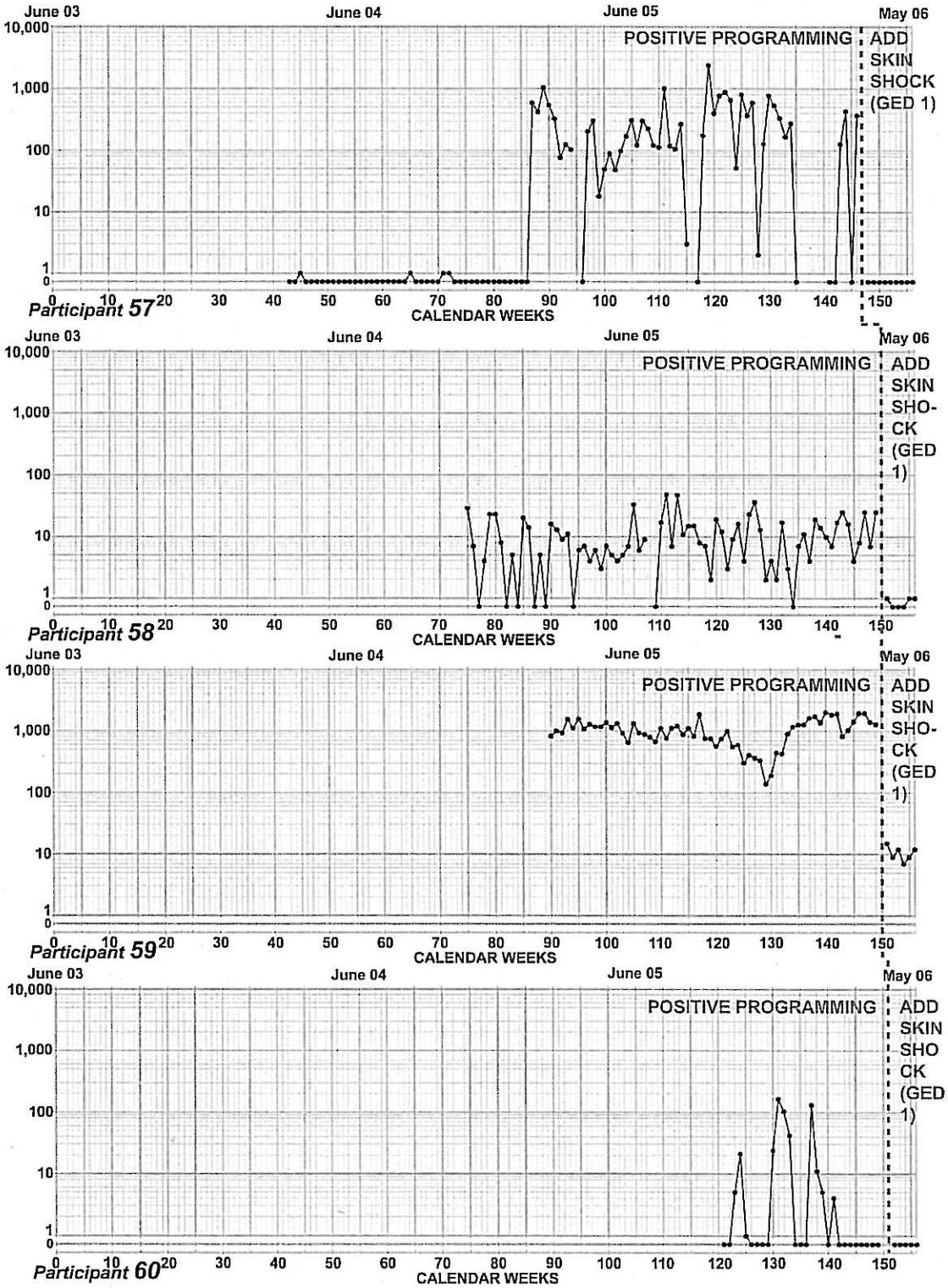

Figure 1(continued).

Trends during baseline

Table 2 summarizes the trends seen during the baseline (positive programming) phase. In 40 participants (68% of the 59 cases where there was sufficient information to characterize the trend), the frequency was either increasing (accelerating) or flat when CSS was introduced. In the remaining 19 cases, even though the behavior was decreasing in frequency (decelerating), CSS was introduced because the behavior was too dangerous to be allowed to occur at the frequency it was showing.

Table 2

Trends of aggressive behavior during baseline

Description	Total	Participant numbers
Acceleration	23	2, 6, 8, 10, 11, 16, 19, 25, 26-29, 33, 37, 40, 44, 46, 48, 50, 55, 57-59
Flat	17	4, 7, 13, 14, 18, 20, 22-24, 34-36, 39, 42, 47, 49, 54
Deceleration	19	1, 3, 5, 9, 12, 15, 21, 30-32, 38, 41, 43, 45, 51-53, 56, 60
Insufficient Information	1	17

Decelerative effect of CSS on aggressive behaviors

To analyze CSS's decelerative effect, we examined: (1) the initial change in frequency associated with the introduction of CSS; (2) the overall chart patterns found during the treatment phase; (3) the overall decelerative effect seen when all baseline data is compared with all treatment data; and (4) the changes in trends from baseline to treatment.

Initial effect on frequency

In almost every chart in Figure 1, the GED is shown to produce two separable effects. It causes an immediate decrease in frequency (jump down) right after it is introduced, and this is followed by some other trend over the succeeding weeks.[2] We chose to measure these immediate jump downs by plotting the trend (celeration) lines for both the baseline and treatment data, and measuring the vertical distance between the end of the baseline celeration line and the beginning of the treatment celeration line. If there was more than one trend during baseline or treatment, we used the last trend in the baseline data and the initial trend in the treatment data.

Figure 2 is an example of how this was done. The size of the jump down at the time of CSS introduction is the same up/down distance as the distance between 1 and 85 on the vertical scale of the multiply/divide chart in Figure 2. Therefore the jump would be characterized as a "÷ 85" (read "divide 85") jump down which means that the frequency divided by a factor of 85. Table 3 shows the jump down that occurred immediately after CSS introduction for each participant. It shows that median jump down was ÷27, meaning that the weekly frequency made an immediate decrease by a factor of 27.

[2]This observation was first brought to our attention by the late O.R. Lindsley, who also developed the precision teaching technology on which we have based much of our charting scheme and data analysis.

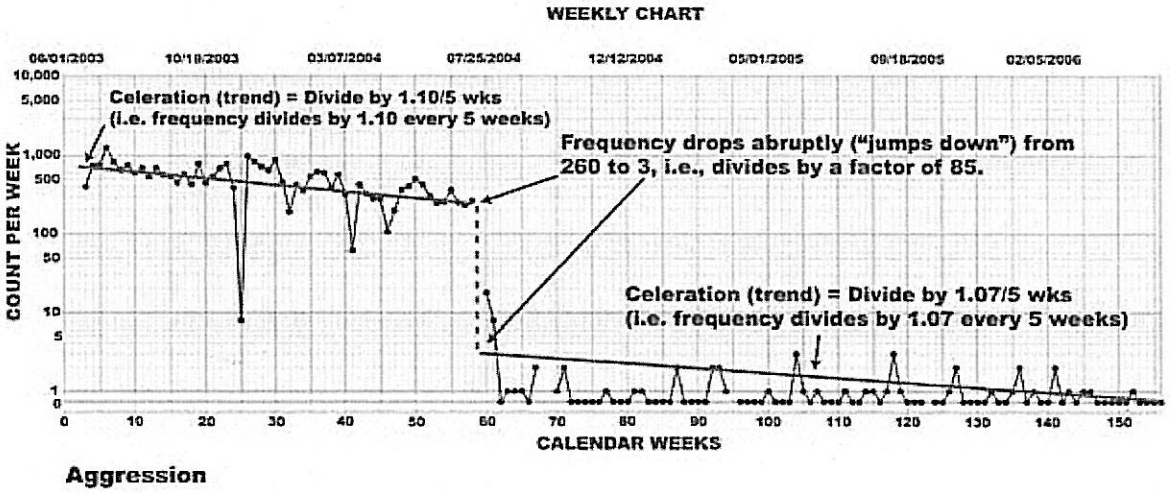

Figure 2. Sample weekly chart showing calculation of frequency jump down

Overall chart patterns during treatment phase

We classified each of the charts in Figure 1 into five categories, according to the extent of the initial jump down (i.e., whether frequency dropped to zero or not) and the trend of the data after that point. The result of this classification is shown in Table 4 which also shows the percent of cases that fall into each category.

In 48 cases (80% of the participants), aggressive behaviors were reduced immediately to a zero or near-zero level and remained at that level for whatever time remained in the 3-year period. In 5 cases (8.3%) the frequency jumped down and then showed a deceleration, but had not yet reached zero within the remainder of the 3-year period. Therefore, in 53 cases (88.3%), the behavior either jumped down to zero or near-zero immediately, or jumped down and then decelerated toward zero. In the remaining 7 cases (categories 3-5), although several different trends were seen after the initial jump down, the level of aggression during the treatment phase was substantially lower than during baseline (see next section, below) and reflected clinically meaningful improvement.

Overall decrease in frequency from baseline to treatment

For each participant, we calculated the overall mean weekly frequency of aggressive behaviors across the entire baseline phase, the overall mean weekly frequency across the entire treatment phase, and the respective standard deviations. We then calculated improvement for each participant in terms of both the percent and the factor by which the baseline mean weekly frequency had been reduced. These data are shown in Table 5.

The results are further summarized in Tables 6 and 7, and Figure 3. In Table 6, total frequency, number of weeks, standard deviation, mean per week, median per week, and range are presented for the baseline and treatment phases. In Table 7, the number of participants who achieved various percent reductions from baseline are presented. Percent reduction was calculated using the entire baseline and entire treatment means. Table 7 shows that for 30 (50%) of the participants, aggressive behaviors were reduced by 100%, and that for 57 (95%), aggressive behaviors were reduced by 92% or more.

Table 3

Frequency jump downs occurring immediately after CSS introduction (organized by magnitude)

Frequency jump down Immediately after CSS Introduction	Participant Number	Frequency jump down Immediately after CSS Introduction (continued)	Participant Number (continued)
÷800	57	÷26	8
÷500	12	÷21	17
÷150	32	÷20	4
÷120	46	÷20	34
÷110	44	÷19	2
÷110	51	÷18	21
÷100	28	÷16	19
÷100	33	÷16	38
÷90	59	÷15	35
÷85	18	÷15	36
÷80	6	÷15	50
÷80	48	÷15	53
÷60	56	÷12	39
÷56	15	÷11	3
÷52	29	÷11	25
÷50	22	÷10	49
÷49	26	÷9	1
÷45	31	÷9	58
÷44	10	÷7	20
÷42	13	÷7	42
÷40	11	÷6	7
÷40	30	÷6	45
÷40	55	÷5	54
÷36	37	÷4	24
÷30	14	÷3	41
÷30	40	÷3	43
÷30	47	÷1.6	23
÷30	60	÷1.5	5
÷29	52	÷1.5	9
÷28	16	÷1.5	27

Median = ÷27

Table 4

Summary of frequency patterns during treatment phase

	Pattern Shown by Frequency During Treatment Phase	Number of Cases	Percent of Cases	Charts
1	Jump down to zero or near-zero level; then maintenance at that level	48	80	1-4, 7-15, 17-23, 25, 26, 29, 31-35, 38-47, 49, 51-58, 60[a]
2	Jump down to non-zero level; then a deceleration	5	8.3	5, 37, 48, 50, 59
3	Jump down to non-zero level; then maintenance at that level.	3	5	24, 28, 30
4	Jumps down to non-zero level; then acceleration	1	1.7	6
5	Jumps down to non-zero level; then alternating accelerations and deceleration(s)	3	5	27, 36, 16
	Totals	60	100	

[a] Although this classification of this data series for participant 60 as a flat celeration at a zero frequency is based on only five data points, examination of the next 6 weeks of data (which are outside of the 3-year period covered in these graphs) showed that the behavior maintained at 0 during those weeks, confirming the present classification.

Table 5

Comparison of all Baseline Weeks with All Treatment Weeks

Participants	Mean Weekly Frequency During Entire Baseline Period	SD During Entire Baseline Period	Mean Weekly Frequency During Entire Treatment Period	SD During Entire Treatment Period	Percent Reduction from Baseline (means)	Reduction from Baseline (Divide by Factor)
1	48.14	39.64	0.21	0.58	100	229
2	17.03	37.41	0.02	0.13	100	852
3	68.61	111.47	0.11	0.42	100	69
4	5.1	20.72	0.07	0.49	99	73
5	17.56	22.07	0.59	1.45	97	30
6	222.77	155.7	4.67	3.61	98	48
7	12.4	26.1	0.18	0.58	99	69
8	90.79	155.13	0.09	0.35	100	1009
9	26.79	37.59	0.08	0.34	100	335
10	34.4	66.22	0.02	0.13	100	1720
11	19.32	33.72	0.02	0.2	100	966
12	167.61	227.11	0.05	0.27	100	3352
13	53.43	57.88	0.21	0.67	100	254
14	19.83	38.83	0.14	0.52	99	142

Table 5 (Continued).

Comparison of all Baseline Weeks with All Treatment Weeks

Participants	Mean Weekly Frequency During Entire Baseline Period	SD During Entire Baseline Period	Mean Weekly Frequency During Entire Treatment Period	SD During Entire Treatment Period	Percent Reduction from Baseline (means)	Reduction from Baseline (Divide by Factor)
15	220.94	156.59	0.77	1.01	100	287
16	73.1	61.63	8.74	9.36	88	8
17	3	6.71	0.04	0.19	99	75
18	239.51	106.68	1.36	3.34	99	176
19	77.08	205.5	0	0	100	77
20	26.68	60.87	0.1	0.62	100	267
21	80.63	96.71	0.84	1.39	99	96
22	33.83	56.33	0.1	0.35	100	338
23	5.42	14.53	0.18	1.04	97	30
24	11.53	10.45	2.51	3.05	78	5
25	24.59	59.68	0.14	0.66	99	176
26	25.72	39.85	0.05	0.22	100	514
27	102	64.96	12.15	12.73	88	8
28	204.27	121.44	1.78	2.45	99	115
29	94.7	94.97	0.76	1.22	99	125
30	140.58	64.59	2.17	3.12	98	65
31	60.7	61.11	0.04	0.2	100	1518
32	136.42	71.57	0.34	0.87	100	401
33	208.14	207.03	0.04	0.2	100	5204
34	85.36	69.81	0.04	0.2	100	2134
35	4.7	15.01	0.06	0.24	99	78
36	94.96	33.65	7.77	7.75	92	12
37	174.42	53.23	5.98	4.8	97	29
38	24.26	35.59	0.13	0.41	99	187
39	125.46	76.98	0.03	0.17	100	4182
40	34.25	25.58	0.69	1.6	98	47
41	20.87	83	0.55	2.74	97	38
42	8.31	18.69	0.03	0.17	100	277
43	122.75	133.78	0.1	0.41	100	1228
44	101.95	80.75	0	0	100	102
45	17.6	29.06	0.07	0.26	100	242
46	121.37	95.28	0.84	2.01	99	144
47	47.93	39.35	0.41	1.5	99	117
48	213.06	85.11	1.37	1.81	99	156
49	16.73	47.02	0.44	1.34	97	38
50	79.89	58.98	5.35	4.61	93	15
51	215.9	155.64	0.18	0.53	100	1204
52	76.56	87.73	0.06	0.24	100	1268
53	12.81	31.28	0.5	1.21	96	26
54	12.47	24.84	0	0	100	13

Table 5 (Continued).

Comparison of all Baseline Weeks with All Treatment Weeks

Participants	Mean Weekly Frequency During Entire Baseline Period	SD During Entire Baseline Period	Mean Weekly Frequency During Entire Treatment Period	SD During Entire Treatment Period	Percent Reduction from Baseline (means)	Reduction from Baseline (Divide by Factor)
55	30.33	38.12	0	0	100	30
56	81.19	49.95	0	0	100	81
57	172.94	324.67	0	0	100	173
58	11.19	10.29	0.5	0.55	96	22
59	1027.51	467.22	10.67	2.88	99	96
60	16.87	40.89	0	0	100	17
	Median = 57.07	**Median = 59.33**	**Median = 0.14**	**Median = 0.54**	**Median = 99.5**	**Median = 121**

Note: When the treatment weekly mean was equal to zero, the number 1 was substituted in order to calculate the factor by which the treatment mean was reduced. This was the case for participants 19, 44, 54, 55, 56, 57, and 60.

Table 6

Descriptive Statistics of all Participants during Baseline and treatment

	Baseline	Treatment
Total Frequency of Aggressive Behaviors	220,873	3,764
Number of Participant-Weeks	2,489	3,196
Mean per Week	88.74	1.18
Standard Deviation	203.67	3.79
Median per Week	17	0
Range	0 - 2367	0 - 62

Table 7

Percent of participants achieving certain percentage reductions

Percent Reduction	Number of Participants	Cumulative Number at or above this Percent Reduction	Cumulative Percent at or above this Percent Reduction
100	30	30	50.0
99	15	45	75.0
98	3	48	80.0
97	5	53	88.3

Table 7 (Continued).

Percent of participants achieving certain percentage reductions

Percent Reduction	Number of Participants	Cumulative Number at or above this Percent Reduction	Cumulative Percent at or above this Percent Reduction
96	2	55	91.7
95			
94			
93	1	56	93.3
92	1	57	95.0
91			
90			
88	2	59	98.3
78	1	60	100.0

The frequency distributions for the mean weekly frequency of baseline and treatment are presented in Figure 3. The baseline portion shows that of the 11 intervals, at least one student had a mean weekly frequency that fell within 10 of the intervals. By contrast, the treatment portion shows that all 60 students had a mean weekly frequency that fell within the first interval (a mean weekly frequency of 0-25).

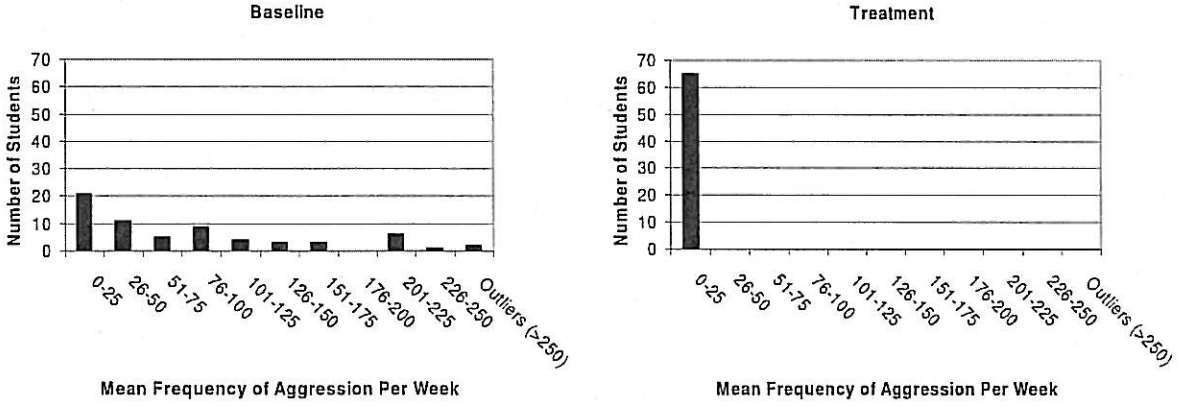

Figure 3. Frequency distribution of the weekly means.

Results of paired sample t-test and effect size

Using a paired sample *t*-test, we compared the means of aggression during baseline with the means of aggression during treatment. The difference between the means was found to be significant, $t(59)=5.01$, $p < .001$. In order to assess the magnitude of the effect, we utilized Cohen's *d* with the original standard deviation values. The effect was found to be large, $d = .91$.

Comparison of percentage reduction found in this study with those found in treatment outcome reviews

We compared the percentage reduction that we found in the present study with those reported in two treatment outcome reviews: (1) one by Cataldo (1991), who evaluated published studies (1965-1989) in which punishment was used to treat problem behaviors; and (2) one by Carr et al. (1999) who evaluated published studies (1995-1996) in which Positive Behavior Support procedures were use used to treat problem behaviors. The results, including the methods for calculating percentage reduction are shown in Table 8.

Table 8

Percentage Reductions Reported in Present Study and Two Other Treatment Outcome Reviews

Report	Type of Study	No. of Participants/Outcomes[a] Evaluated re Treatment of Aggression	Treatment Methods	Method of Calculating Percentage Reduction	Percent of Participants/Outcomes Achieving a Reduction of 90% or More
Cataldo (1991)	Treatment outcome review of 137 punishment studies, 1965-1989	4 participants	CSS employed with one or more other interventions.	Mean of all baseline data compared with mean of last 3 treatment data	60.0%
Carr et al. (1999)	Treatment outcome review of 109 Positive Behavior Support studies, 1985-1996	90 outcomes	Positive behavioral procedures only	Mean of last 3 baseline data compared with mean of last 3 treatment data	55.5%
Israel et al. (present study)	Treatment of 60 participants using multiple baseline design, 2003-6	60 participants	Positive behavioral procedures plus CSS	Mean of last 3[b] baseline weeks compared with mean of last 3 treatment weeks	100%[c]

[a] Carr (1999) evaluated "outcomes," not participants. If a single subject study used time out, then ignoring and then skin shock in three successive phases, this was counted as 3 outcomes. The Carr report does not provide information as to how many participants were involved in the 90 outcomes in which Positive Behavior Support procedures were employed to treat aggression. [b]For participants 2, 4, 7, 14, 17, 23, 42, 45, and 60 the mean of the last 3 baseline weeks was equal to zero. For those cases, the entire baseline mean was substituted in order to calculate the percent reduction. [c] Actually, when reduction percentage is calculated by comparing end-of-treatment with end-of-baseline, as was done for both the Carr et al. data and the Israel et al. data in Table 8, all 60 participants did 4% better than the normal 90% reduction standard requires. They all achieved a 94% or greater reduction from baseline.

Changes in trends (slope of acceleration or deceleration) before and after CSS introduction

Change effects that occur in data series such as those of Figure 1 can consist not only of jumps (sudden frequency changes) that are seen where trends change, but also of celeration turn downs or celeration turn ups. A celeration turn means that there is an inflection at the end of a trend at which a change in the ongoing acceleration or deceleration takes place. A celeration turn down means that one of three things takes place at the inflection point: (1) the slope of acceleration changes to a different acceleration that is less steep; (2) an acceleration changes into a deceleration; or (3) the slope of a deceleration changes to one that is even steeper. A celeration turn up means that one of these three things takes place at the inflection point: (1) the slope of acceleration changes to a steeper acceleration; (2) a deceleration changes into an acceleration; or (3) the slope of a deceleration changes to one that is less steep.

For 49 of the participants there was no opportunity to examine the celeration turns because their charts show a jump down to zero or near-zero frequencies immediately after CSS introduction. Of the remaining 11, Table 9 describes each participant's treatment data by the jumps and turns that occur. Each major change effect is labeled as to week number, and is characterized by its jump (a "jump up," "jump down" or "no jump") and celeration turn (a "turn up," "turn down," or "no turn."). In each description, the effect that occurred immediately after CSS was inserted is described first. If there were additional major changes after that, each of these is also described and delimited with semicolons.

As can be seen in Table 9, the decelerative power of CSS is evidenced by the jumps and turns that occurred right after CSS was first inserted. All 11 showed jump downs at CSS introduction. And after those jumps, only 1 of the 11 participants showed a celeration turn up, 3 showed no change in trend (i.e., showed no turns) and 7 showed celeration turn downs.

Table 9

Changes in Frequency Jumps and Celeration Turns after CSS Introduction for Participants who did not Show Jump Downs to Zero or Near-zero

Participant #	Change Effect Description
6	Jump Down, Turn Down (wk 49);
16	Jump Down, No Turn (wk 70); No Jump, Turn Down (wk 104); No Jump, Turn Up (wk 117)
24	Jump Down, No Turn (wk 93)
27	Jump Down, Turn Down (wk 95); No Jump, Turn Down (wk. 116, at change from GED-1 to GED-4)
28	Jump Down, Turn Down (wk 96)
30	Jump Down, No Turn (wk 104)
36	Jump Down, Turn Up (wk 109); No Jump, Turn Down (wk 135, during treatment)
37	Jump Down, Turn Down (wk 114)
48	Jump Down, Turn Down (wk 136)
50	Jump Down, Turn Down (wk 139)
59	Jump Down, Turn Down (wk 150)

Comparison of overall improvement of high and low functioning participants

We divided the participants into two groups according to level of cognitive functioning and compared the improvement of the two groups. We used two different methods for classifying each participant as either higher or lower functioning, and analyzed the data separately for each method.

Results when MR diagnosis was used to classify participants. In Table 10, the improvement shown by participants who had been diagnosed with MR is compared with those who were not so diagnosed. For the 28 participants *without* an MR diagnosis, the medians of their individual mean weekly frequencies during baseline and treatment phases were 25.2 and 0.06 respectively. This represents an overall improvement (reduction) by a factor of 25.2 ÷ 0.06 = 420 which is a reduction of 99.8%. For the 32 participants *with* an MR diagnosis, the medians of their individual mean weekly frequencies during baseline and treatment phases were 98.5 and 0.64 respectively. This represents an improvement (reduction) by a factor of 98.5 ÷ 0.64 = 154, which is a reduction of 98.4%. In other words, the non-MR participants showed 420÷154 = 2.7 times more overall improvement (decrease) than did the MR participants. An overall reduction of 100% was achieved by only 38% of the MR group, but by 68% of the non-MR group. A reduction of 95% or greater was achieved by 81% of the MR group, but by 100% of the non-MR group.

Table 10

Improvement of MR and Non-MR Participants

	MR	Non-MR
1. No. of Participants	32	28
2. Median of the Individual Mean Weekly Frequencies (All Baseline Weeks)	98.5	25.2
3. Median of Individual Mean Weekly Frequencies (All Treatment Weeks)	0.64	0.06
4. Overall Reduction from Baseline (Divide-by-Factor) Calculated as Row 2 divided by Row 3	154	420
5. Overall Reduction from Baseline (Percent) Calculated as (Row 2-Row 3)÷Row 2	99.4%	99.8%
6. Percent Achieving 100% Overall Reduction	38%	68%
7. Percent Achieving 95% or Greater Overall Reduction	81%	100%
Superiority of CSS with Non-MR group = 420 ÷ 154 = 2.7 times greater overall reduction from baseline		

We completed a χ^2 analysis with respect to two variables: MR classification (MR vs. No MR) and chart classification from Table 4 (the number of students achieving a zero or near-zero reduction vs. the number in all other classifications). In Table 11, these data are presented. The result of the analysis was significant, χ^2 (1) = 13.13, $p < .001$.

Table 11

Frequency Table of MR and Chart Classification

	MR	No MR	Total
No. classified as achieving zero or near-zero reductions from Table 4.	20	28	48
No. in all other classifications from Table 4.	12	0	12
Total	32	28	60

Results when conversation skill was used to classify participants.

As a second approach, we ignored the participants' diagnoses, and classified them informally as either higher or lower functioning according to whether or not they could carry on a meaningful conversation with a normal adult. Five JRC staff members, who knew the students well and who were unaware of the purpose of the categorizations, made these judgments independently. The final assignment of each student to a group was determined by majority decision.

The results based on this conversational skills standard are presented in Table 12. A total of 38 participants were judged to be high functioning by this standard. They engaged in a median (of the individual mean weekly frequencies) of 28.56 aggressive behaviors during the baseline period and a median (of the individual mean weekly frequencies) of 0.07 aggressive behaviors during the treatment period. This represented an improvement (reduction) by a factor of 408. The 22 participants who were judged to be low functioning by this conversation skills standard displayed a median (of their individual mean weekly frequencies) of 94.83 per week and 1.37 per week, respectively, during baseline and treatment phases. This represented an improvement (reduction) of ÷ 69.9. The high functioning participants showed 5.8 (408 ÷ 69.9) times more overall improvement (decrease) than did the low functioning group.

An overall reduction of 100% was achieved by only 14% of the low functioning group, but by 68% of the high functioning group. A reduction of 95% or greater was achieved by 73% of the low functioning group, but by 100% of the high functioning group.

Need for emergency takedown restraints before and after CSS introduction

We compared the number of emergency takedown restraints that participants underwent during the 30 days immediately prior to CSS introduction with the number they underwent during the 30 days immediately after CSS introduction. Figure 4 shows this data. Figure 4 does not show successive calendar days on its horizontal axis. This axis shows days prior to, and subsequent to, CSS introduction. Irrespective of on what calendar day, during the 3-year period, each takedown restraint occurred, we totaled, across all 60 participants, all emergency takedown restraints that occurred on the 1st day *before* CSS introduction, all that occurred on the 2nd day *before* CSS introduction, etc. The data point immediately to the *left* of the intervention line in Figure 4 represents the total for the 1st day before CSS introduction, the data point that is second to the left from the intervention line is for the 2nd day before CSS intervention, etc. We also totaled all emergency takedown restraints that occurred on the 1st , 2nd , 3rd ,

Table 12

Improvement of Low and High Functioning Participants (Using an Informal Judgment of Conversation Skills to Determine Level of Functioning)

	Low	High
1. No. of Participants	22	38
2. Median of the Individual Mean Weekly Frequencies (All Baseline Weeks)	94.83	28.56
3. Median of the Individual Mean Weekly Frequencies (All Treatment Weeks)	1.37	0.07
4. Overall: Reduction from Baseline (Divide-by-Factor) Calculated as Row 2 divided by Row 3	69.9	408.0
5. Overall: Reduction from Baseline (Percent) Calculated as (Row 2-Row 3)÷Row 2	98.6	99.8
6. Percent Achieving 100% Overall Reduction	14	68
7. Percent Achieving 95% or Greater Overall Reduction	73	100

Superiority of CSS with high functioning group = 408 ÷ 69.9 = 5.8 times greater overall reduction from baseline.

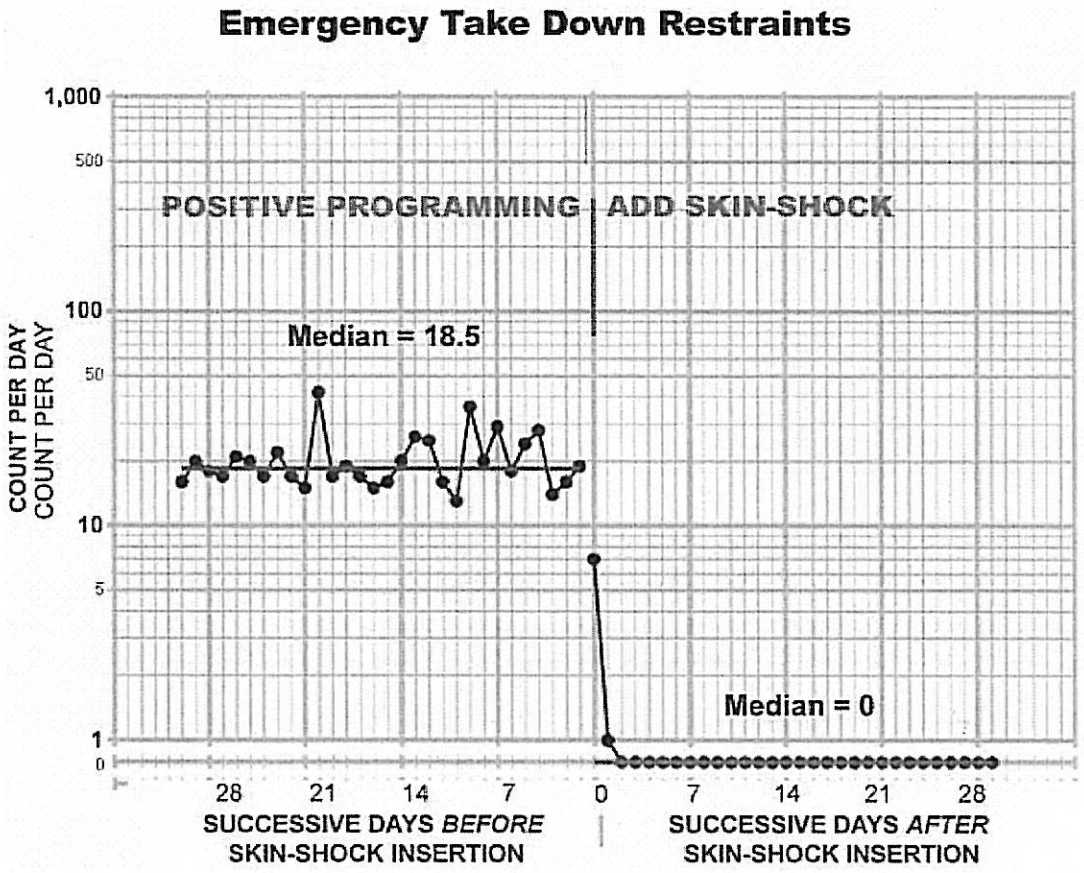

Figure 4. Emergency takedown restraints for the 30 days before and after the introduction of skin-shock.

etc. day *after* CSS introduction and these totals are shown in the first, second, third, etc. data points that appear to the *right* of the intervention line.

The participants, as a group, had a median of 18.5 emergency takedown restraints per day during the last 30 days before CSS introduction and a median of 0 emergency takedown restraints per day during the first 30 days after CSS introduction. Because each takedown restraint involved the joint action of 2-8 staff members, as well as one other staff member whose only role was to observe the restraint, and because each instance was recorded on a restraint form at the time of the restraint, measures to insure interobserver reliability were not deemed necessary.

Use of Psychotropic Medication

Forty-eight of the 60 participants (80%) were taking a total of 159 psychotropic medications when they enrolled at JRC. We measured the total number of participants taking psychotropic medications and the number of medications they were taking at the following points in time: (1) when the participants enrolled at JRC (2) when CSS was introduced; and (3) when the participants left JRC, or December 1, 2007 for those who still resided at JRC on that date. Both the date of enrollment and the date of departure (or on December 1, 2007 for those who were still at JRC) were, for some participants, outside of the 3-year window within which the aggression data reported above was obtained. The results are summarized in Table 13. By the date on which CSS was inserted, the number of *participants* taking psychotropic medications had already been reduced by 64.58%. By the date on which the participants departed from JRC (or on December 1, 2007 for those who were still at JRC), the number of participants taking psychotropic medications had been reduced by 93.75%. The total number of psychotropic *medications* that were being taken by participants had been reduced by 74.21% by the time of CSS introduction and by 97.48% by the time the student left JRC (or by December 1, 2007, for those still at JRC).

Table 13

Use of psychotropic medications

	On Date of Enrollment		On Date of CSS Introduction[a]		On Departure Date or 12/1/07, whichever earlier		
	No.	Percent of all 60 participants	No.	Reduction (Percent)	No.	Reduction (Percent)	Reduction (Divide-by-Factor)
Number of participants taking psychotropic medications	48	80.00%	17	64.58%	3	93.75%[b]	48/3 = ÷16
Number of psychotropic medications being taken.	159		41	74.21%	4	97.48%[c]	159/4 = ÷39.8

[a]In those cases in which the GED-1 was used first and was later switched to the GED-4, the date of the GED-1 introduction was used. [b]One participant stopped receiving CSS treatment on 6/25/06, after the end of the 3-year period of this report (the school district removed CSS from his IEP on grounds that it was a methodology, not an IEP objective) and resumed one psychotropic medication on 6/24/07. If this student is not counted, the percentage reduction would be 46/48 = 95.83%. [c] If the student mentioned in table footnote b (who stopped receiving CSS treatment on 6/25/06 and who resumed one psychotropic medication on 6/24/07) is not counted in the calculation, the percentage reduction would be 98.11%.

Comparison of injuries to staff members before and after CSS introduction

We compared the number of injuries that the participants caused to staff members by their aggressive behaviors during baseline with the number they caused during treatment. These were significant injuries that required nursing or other medical attention. For example, during baseline the following injuries were recorded: bites (50), contusions (bruises) (39), strains (18), head injuries (11), sprains (10), lacerations (4), pains (3), abrasions (3), headaches (2), temporomandibular joint problem (1), exposure to blood-born pathogens exposure (1), nasal injury (1), nasal fracture (1), tooth fracture (1), cracked tooth (1). The data is shown in Table 14. Injuries decreased from 146 before CSS introduction to only 7 after. The number of injuries per participant-month, after CSS introduction, decreased by a factor of 25.5, which was a 96% reduction.

Table 14

Aggression-caused injuries to staff members

	No. of Staff Injuries Caused by Participants	No. of Participant -Months	Injuries per Participant -Month
Baseline phase	146	615	0.2274
Treatment phase	7	751	0.0093
Decrease (divide-by-factor)			÷ 25.5
Decrease (percent)			96%

DISCUSSION

This retrospective analysis represents the largest set of data that has been reported on the effects of CSS on aggression. A total of 109.3 person-years (5,685 person-weeks, 39,795 person-days or 955,080 person-hours) of continuously recorded data on aggression are reported. Our results suggest that CSS delivered from the GED, when used as a supplement to a comprehensive behavioral program that involved powerful and consistent reinforcement and educational procedures, was extremely effective in decelerating aggressive behaviors to zero or near-zero levels and in maintaining the behaviors at those levels for periods of up to three years.

The only two treatment outcome reviews that have addressed the treatment of aggressive behaviors are those of Cataldo (1991) and Carr (1999). Unfortunately, although the Cataldo review surveyed 137 studies, only 3 of these studies, involving only 4 participants, dealt with the use of CSS to treat aggression. The low percentage (60%) that reached treatment effectiveness (90% or greater reduction from baseline) found in those studies may have been due to factors such as an inadequately robust CSS stimulus, lack of consistent treatment, and/or insufficiently powerful positive programming procedures.

In the present study, positive behavioral education and treatment, supplemented by CSS, proved to be approximately twice as effective in treating aggression as were the positive behavior support procedures reviewed in the Carr et al. 1999 report. By "twice as effective" we mean that 100% of our participants reached treatment effectiveness (90% or greater reduction from baseline) as compared with only 55.5% who achieved this in the Carr et al. report. Two factors make the superiority of the present results all the more notable. First, the treatment projects reviewed by Carr et al. had been chosen by their authors for submission for publication. Authors of such studies rarely submit failures or negative results for publication. By contrast, in the present study no selection of participants was made. Every single participant whose program was supplemented with CSS during a 3-year period was included with the exception of 7 who were absent from the treatment for such long periods that they did not receive a

consistent treatment program, four other because of logistical difficulties in obtaining consent, and 1 guardian who declined to participate. Second, most of the participants in the present study probably had substantially more severe behaviors than those in the Carr et al. review because they had all previously been rejected, expelled or tried without success in programs that rely solely on positive behavior support procedures (see Israel, Blenkush, von Heyn, & Sands, 2009).

The finding that the positive programming/CSS combination used in the present study almost doubled the effectiveness (in terms of the percentage that reached the 90% or greater reduction standard) that was found in the positive behavior support papers reviewed by Carr et al. is important because many persons and agencies—such as TASH and the Association for Positive Behavior Support—assert that even the most severe problem behaviors can be effectively treated with Positive Behavior Support methods alone (TASH, n.d.; APBS, 2007). Using or choosing a treatment that is 50% less effective than would otherwise be possible might be justified if the aggressive behaviors to be treated are not severe. If the aggression is severe, however, and might result in serious harm to others or to the individual him/herself, choosing a relatively ineffective treatment over one that has proven to be twice as effective raises its own ethical issues.

Because the number of GED applications was always fewer than the number of aggressive behaviors that were tallied, Table 6 can be used to set an outside limit on the number of GED applications that were applied to consequate aggression. Using this data, one can see that no more than 3,764 applications of the GED-1 and GED-4 were made for these 60 participants during the 3 years in question. The median participant received fewer than 0.14 applications per week, which is approximately 1 application every seven weeks. The range was from 0 per week (e.g., participant 29) to 12.15 per week (participant 27). In some cases the number of applications necessary to control the participant's aggression was remarkably low. Participants 19, 44, 54, 55, 56, 57, and 60 did not receive any applications at all after the first week. Participants 2, 10, 11, 31, 33, 34, 39, 42, 45, 52 received only 1 or 2 applications after the first week.

The failure to find significant adaptation in most of the participants is noteworthy. For almost all participants, aggressive behaviors remained at a low level, or continued to decelerate over time, even when the CSS contingency remained in place for periods of up to three years. This finding is significant in light of previous reports of adaptation associated with SIBIS, the skin-shock device that has been used in most CSS studies during the past 17 years (e.g., Ricketts, Goza, & Matese, 1993; Williams, Kirkpatrick-Sanchez, & Iwata, 1993).

A possible limitation of this study was the lack of interobserver reliability. Due to financial considerations, these measures were not obtained. However, it is important to note that those who counted aggressive behaviors completed a significant amount of training and there were various mechanisms within the program to maintain treatment integrity, including live and video monitoring of the staff by trained supervisors. Additionally, the data were collected across environments and represent a complete picture of the total daily behavior frequency of each participant as opposed to session data.
Although gradual removal or fading of the GED was possible for many participants (38%), CSS treatment may, for some individuals with significant developmental disabilities, be prosthetic, i.e., required on a long-term basis—as is the case with eyeglasses, hearing aids, prosthetic limbs, and many drugs—rather than curative. An appropriate prosthetic device or environment enables a behaviorally handicapped individual to behave normally in a normal environment (Lindsley, 1964) and markedly enhances the individual's quality of life.

Our results suggest that CSS was effective not only with lower functioning individuals, such as those with severe or profound retardation and autism, but also with individuals with normal or near-normal cognitive functioning. When presence or absence of an MR diagnosis was used to determine level of functioning, CSS proved to be almost three times more effective in overall reductive power with higher

as compared with lower functioning participants. When, instead, an informal conversation skill standard was used to determine level of functioning, CSS was almost six times more effective in terms of overall reductive power with higher functioning participants than with lower functioning participants The greater effectiveness of CSS with the higher functioning participants was probably due to the fact that for these participants their aggressive behaviors were modified not only by the direct application of contingencies, but also because their superior verbal behaviors enabled their aggression to be affected by rule-governed behavior (Skinner, 1969) as well.

This finding that CSS was more effective with the higher functioning participants may be true of other punishers as well. Foxx and Livesay (1984), for example, found that "higher functioning individuals treated with overcorrection showed longer and better treatment effects than lower functioning individuals"(Foxx, 2003, p.11). A more detailed analysis of the differential effect of CSS on individuals with differing cognitive levels and verbal skills merits future study.

Detection of the superior overall decelerative effect of CSS on the aggression of higher functioning participants was made possible by examining the factor by which the baseline value divided rather than by examining the percentage reduction. For example, in Tables 10 and 12, if one compares only the percentage reduction of the higher versus lower functioning participants, the small differences seen—0.4% when the criterion was presence or absence of an MR diagnosis, and 1.2% when it the standard was an informal assessment of conversational skills—do not reflect the true difference in decelerative power of CSS as between the two groups. Only when we compared the decreases of the two groups by using the reductive factors does the greater improvement for higher functioning participants become clear. Graf and Lindsley (2002) have cautioned researchers against the weaknesses of percent as a measure.

The practice of employing skin-shock with "higher functioning" individuals has been criticized by some. These concerns should be weighed, however, against the fact that some of the higher functioning participants in the present study, unlike many of the lower functioning participants, have been able, with the temporary help of this treatment, to turn their lives around, live independently and become future taxpayers. Many of them function at a level where they can discuss their treatment and reflect on its value to them, something several of them have done at public hearings before Massachusetts legislative committees that have considered bills that would ban the use of skin-shock as a behavioral treatment.

Despite the fact that we administered up to 3,764 GED applications to the participants, the only negative side effect found was an occasional temporary discoloration of the surface of the skin that cleared up within a few minutes or a few days. The most common immediate collateral behavior associated with the application of skin shock was a temporary tensing of the body that some participants showed while the application was applied. Other collateral behaviors were avoidance responses such as attempts to remove the device or grab the transmitter, and temporary emotional behaviors. Future research should be devoted to the prevalence and mitigation of collateral behaviors associated with skin shock.

The absence of negative side effects of CSS treatment with the GED has been confirmed by van Oorsouw, Israel, von Heyn, and Duker (2008), who found either significant improvement or no change in positive verbal and nonverbal utterances, negative verbal and nonverbal utterances, socially appropriate behaviors, and off task behaviors.

The procedures used in this study eliminated the need to use emergency takedown restraint with the participants. The number of such restraints, when totaled across the entire group of 60 participants, dropped from a median of 18.5 per day before CSS introduction to a median of 0 per day after. Each such restraint lasted between 20 and 120 minutes and involved from 2-8 staff members. From the participant's perspective, the elimination of such takedowns avoided the humiliation that can be involved in

undergoing them, and resulted in large savings of time that could now be devoted to classroom learning instead of to being restrained on the floor. Duker and Seys (2000, 1996) have also reported the reduction of restraint as a product of the use of CSS.

By eliminating the need for emergency takedown restraints, CSS treatment enhanced the participants' safety by enabling them to avoid a procedure which, when not carried out properly, can be dangerous. The reported number of deaths in the United States each year due to the use of manual or mechanical restraint has been estimated to be in range between 50 and 125 per year, with some estimates even higher (Conner, 2006). The figure for injuries is probably many times higher.

Our data also shows that the type of behavioral treatment reported here made it unnecessary, in most cases, to continue to use psychotropic medication to control aggression. This fact also enhanced the safety of the participants in this study. Chyka (2000) summarized the number of deaths caused by adverse drug reactions (to psychotropic medications) in 1995 as reported by the US Food and Drug Administrations (FDA). He found that 848 people died as a result of such reactions. This number does not include deaths or other injuries due to human error in medication administration.

It should be noted that these two dangerous procedures—psychotropic drugs and emergency takedown restraint—both of which can be avoided by using the procedures described in this report—are two of the most common procedures that programs normally use to deal with severe aggression.

Anecdotally, we observed other positive side effects. Once the participants' aggression diminished, a cascade of other positive results began to follow naturally. Participants began succeeding, sometimes for the first time, in passing their behavioral contracts. As a result, they began to earn more rewards, advance to residences and classrooms with more privileges, and generally improve their quality of life. Their parents and siblings began to take them home and for outings more often. Many participants were now attending school and learning new skills for the first time in years. Many began to make meaningful plans for finishing public school, obtaining further education, obtaining competitive jobs, and leading a normal, institution-free lives.

Paradoxically CSS, whose application caused some temporary discomfort, had the longer-term effect of improving the participants' self-concept, outlook, safety, and happiness when it was used as a supplement to a powerful positive behavioral program to treat aggression as well as other major problem behaviors. During the treatment phase, many of participants in this report developed optimism for their future where previously there had been none. Faces that appeared to have a permanent scowl when they had first enrolled at JRC, were now relaxed, happy, and smiling. Many who had arrived at JRC with depression found that this was no longer a problem when they were behaving well, earning frequent rewards, and achieving goals. In some cases the participants' improved behaviors even enabled them to lose their previously stigmatizing diagnoses.

The beneficial effects of supplementary CSS treatment were so clear that some participants in this study *asked* to be able to go on GED treatment because they could see how much the quality of life had improved for other participants who had already started the treatment. It is not an exaggeration to state that for many of these participants supplementary CSS treatment helped them to turn their lives around and orient them in a positive direction. Future research should be directed to examining these anecdotally noted effects in a scientific fashion.

These observations are consistent with the reports that the effectiveness of CSS in reducing problem behaviors tends to be associated with a wealth of positive side effects (Linscheid et al., 1990; Matson & Taras, 1989) and that the positive side effects tend to far outnumber any negative side effects associated with CSS (Salvy et al., 2004; Linscheid, Pejeau, Cohen, & Footo-Lenz, 1994; Linsheid et al., 1990; Matson & Taras, 1989; Carr & Lovaas, 1983). Future studies should seek to quantify these positive changes.

If an individual's repertoire is too filled with aggressive or other inappropriate behaviors, it can be difficult if not impossible to teach that person much in the way of new skills. In that respect, effective use of aversives functions for some participants as a "gateway" to the use of positive programming in that it enables such programming to occur for the first time. As Johnston (2006) has noted, decreasing strong problematic behaviors in an individual's repertoire can open the way for less frequent, but desirable behaviors to emerge, be rewarded, and become stronger.

Every surgical, dental, or medical treatment involves discomfort, risks, or costs on the one hand, and expected benefits on the other. For most persons, a reasonable approach is to weigh the discomfort/risks/costs against the potential benefits in deciding whether to undergo or approve the treatment. The data presented here help to illustrate one aspect of the benefits – the immediate or rapid elimination of an intractable behavior problem that, in most cases, had resulted in years of ineffective treatment that included numerous psychotropic medications and physical restraints.

There exists a very small population of individuals who engage in severe problem behaviors that do not respond to typical forms of intervention. Although some individuals may prove to have aggression so severe that it will not respond to the procedures described in this study, the fact is that every single participant in the present study did respond well and benefit from this treatment. Hopefully behavioral psychologists may some day develop totally positive treatments for severe aggression. Until then, our data suggest that CSS, delivered by the GED and accompanied by a consistent program of educational growth and comprehensive behavior programming, can be very helpful in producing clinically important reductions in aggressive behaviors across a broad spectrum of individuals.

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Author Note

We dedicate this paper to the loving memory of Dr. Patricia M. Rivera and her remarkable dedication, patience, and commitment to individuals with severe problem behaviors and their families.

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We thank Hank Pennypacker, Christie Perrone, and Glenda Crookes for their helpful comments and suggestions regarding this paper, and Steve Graf for his comments and assistance in the chart analysis. We also are grateful to Sarah Burt for her assistance in preparing the charts.

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Appendix

The Frequency of Aggressive Behaviors During CSS Introduction Week for each Participant.

Participant	Frequency of Aggression During CSS Introduction Week
1	9
2	10
3	25
4	0
5	1
6	182
7	3
8	77
9	13
10	69
11	3
12	0
13	16
14	1
15	170
16	27
17	19
18	98
19	30
20	3
21	3
22	219
23	0
24	5
25	1
26	0
27	44 (15)
28	223
29	21 (0)
30	94
31	1
32	48
33	1
34	2
35	3
36	50
37	200
38	0
39	23
40	17
41	0
42	0
43	36
44	19
45	0
46	60
47	7

Appendix (Continued)

The Frequency of Aggressive Behaviors During CSS Introduction Week for each Participant.

Participant	Frequency of Aggression During CSS Introduction Week
48	33
49	2
50	43
51	68
52	24
53	3
54	5
55	39
56	16
57	962
58	27
59	241
60	0

Note: Participants 27 and 29, who were switched from GED-1 to GED-4, have two CSS introduction weeks. The frequency of aggressive behaviors in the second CSS introduction week (when GED-1 was switched to GED-4) is presented in parentheses.

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Behavioral Interventions
Behav. Intervent. 18: 1–21 (2003)
Published online in Wiley InterScience (www.interscience.wiley.com). **DOI:** 10.1002/bin.127

THE TREATMENT OF DANGEROUS BEHAVIOR

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Individuals who display dangerous behavior towards others have historically been under-treated and under-researched. This paper discusses three published case studies wherein adult males were effectively treated for severe aggression towards others, the environment, and, in two cases, self-injury. All were diagnosed as having mental retardation and two also had a psychiatric diagnosis. All had experienced years of failed attempts to control their aggression through large pharmacological interventions and restricting their freedom of movement via restrictive environments. The use of comprehensive multifaceted behavioral programs involving punishment resulted in dramatic and long lasting reductions in aggression, the elimination or great reduction of drug use, and major lifestyle improvements. The conceptual, clinical, political, legal, philosophical, and ethical considerations that arose during the development and implementation of the programs are discussed as well as scientific issues related to achieving long term maintenance. An early published case study (Martin & Foxx, 1973) is discussed first because it illustrates how an informal functional analysis was used to design a very simple and effective non-punishment treatment program for a woman who displayed dangerous aggression. Copyright © 2003 John Wiley & Sons, Ltd.

INTRODUCTION

Although there is a rich behavioral literature on the treatment of self-destructive behavior, dangerous destructive behavior towards others has remained under-treated and under-researched (Foxx, Zukotynski, & Williams, 1994). The major reason why appears to relate to who is at risk. Self-destructive individuals only pose a danger to themselves whereas everyone, including the interventionist, is a potential victim when individuals aggress towards others (Foxx et al., 1994). Thus, although the clinical, political, philosophical, legal, and ethical issues related to destructive behavior towards others should be less complicated and more straightforward given that the issue of concern is the rights of others to be protected from danger, few advocate for the use of proven effective behavioral treatment (Foxx, 1996). Instead, the typical course of action is a highly restrictive environment or massive pharmacological intervention.

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Yet, it is clear that aggressive behavior can be treated successfully by comprehensive, behavioral programs (Foxx, 1991, 1996; NIH, 1991). Furthermore, comprehensive behavioral programs that include punishment have been demonstrated to be effective with both attention and escape/avoidance motivated aggressive behavior (Cataldo, 1991; Foxx, 1991), which is important given that advocates of positive-only programs have produced no comparable data when the target behaviors are escape/avoidance motivated.

This paper has several goals. The first is to provide several clear examples of effective behavioral interventions for individuals displaying dangerous behavior towards others. A second is to discuss these effective treatments within the current political and professional climate in developmental disabilities. A third is to demonstrate that less formal functional assessment will suffice for severe cases when a treatment program is comprehensive, multifaceted and targeted towards insuring maintenance of the treatment effects. The final goal is to discuss some of the issues related to long term maintenance of punishment effects.

Four of my previously published cases will be presented (Foxx, Bittle, & Faw, 1989; Foxx, Foxx, Jones, & Kiely, 1980; Foxx, McMorrow, Bittle, & Bechtel, 1986; Foxx et al., 1994; Martin & Foxx, 1973). In two cases (Foxx et al., 1980; Martin & Foxx, 1973) the individuals used aggression to gain access to attention and in two aggression gained escape (Foxx et al., 1986b; Foxx et al., 1994). Three individuals also displayed self-injury and aggression towards property.

Three cases were multifaceted treatment programs involving punishment (Foxx et al., 1980, 1986b, 1989, 1994) and will be discussed in detail. An earlier study (Martin & Foxx, 1973) will be discussed first, because it represents an early example of the treatment of aggression based on an informal functional analysis.

GAIL (1973)

Almost 30 years ago, Martin and Foxx (1973) demonstrated that aggressive attacks on residential staff by a 22-year-old woman with moderate mental retardation could be controlled by the victims' reactions to the attacks.

Gail had been institutionalized for five years. Her institutional admission resulted from an episode of extreme aggressive and destructive behavior directed at her parents, herself, and various household furniture. Gail was regarded as an intractable case because no intervention or within-institution transfer had been successful in diminishing her aggression.

Her most frequent form of aggression was attacks toward residential staff. To a much lesser extent she would attack other residents who could not defend themselves, thereby requiring intervention, i.e. attention by staff. Our functional analysis suggested

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that Gail's attacks were being inadvertently socially reinforced by her victims (staff) when they responded to an attack or intervened to aid a resident under attack.

A social reinforcement interpretation of aggressive behavior suggested that aggressive responses can be reinforced by the victim's behavior. Some possible victim related 'social reinforcers for aggression' include signs of inflicted pain, injury and distress (e.g. Feshback, 1964), as well as lectures, concern or defensive responses. Simply put, the victim's 'reasonable' response to socially reinforced aggression insured future attack.

Socially reinforced aggressive behavior can be a major problem in situations where staffing is minimal, their primary responsibility is custodial and staff attention is problem oriented. Where there are few social reinforcers available, the attention associated with any intervention effort may be the aggressor's primary source of human interaction. For the attention-deprived individual, direct attacks on staff offer the most immediate and concentrated attention.

With Gail, we sought to demonstrate that the reactions of an attacked staff member, i.e. the victim, could control her aggressive behavior. The experimental design was ABA with a social reinforcement condition in which the victim (this author) socially responded to each attack counterbalanced between two extinction conditions in which I ignored attacks. One to five 15 min sessions were scheduled daily in Gail's seclusion room. The room contained a toilet, a bed and bedding. A session began when I sat next to Gail on her bed. At the end of each session I left the room. I said nothing to Gail at the beginning or end of a session.

Withdrawal of Social Reinforcement by Victim (Sessions 1–95)

Social reinforcement was withheld and I attempted to ignore all instances of aggressive behavior. Self-aggressive acts and assaults on objects, e.g. the sheets of her bed, provided no threat. Aggression directed at me was also ignored as much as possible but my ability to do so depended on the type of attack. For example, slaps were relatively easy to ignore since they were directed usually at an arm or the upper surface of the thigh. Kicks and bites were more difficult to ignore and sometimes required an avoidance response. To do so, I attempted to avoid an attack (e.g. pull my hand from near Gail's mouth) as casually as possible so as to limit the reinforcing effect of the avoidance response. In session 51 my coauthor Martin substituted as the victim, and in session 52 a female staff member did so.

Social Reinforcement by Victim for Aggression (Sessions 96–140)

In this condition I responded to any aggression either by delivering a benevolent lecture, e.g. 'Gail, how can you behave that way?', and tenderly touching her arm, or

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perspective proactive, skill-building communication strategies become paramount, whereas crisis management and reactive strategies have no relevance.

The successful application of these strategies to dangerous forms of aggressive behaviors that were reinforced by positive or negative reinforcement is illustrated in the following three peer reviewed, previously published cases.

Paul (1980)

Foxx et al. (1980) successfully treated Paul, a 23-year-old, dually diagnosed, institutionalized man, for aggression, self-injury, and property destruction. All previous treatments, including drugs, prolonged restraint, and various behavioral procedures, had been ineffective. Our informal functional analyses revealed that Paul's aggression was primarily attention seeking.

Paul's Vineland SQ was 31.75 with an equivalent age assignment of 7 years, 4 months. Attempts to obtain accurate measures of his intellectual capabilities were unsuccessful because of his aggression and frequent hallucinatory-type verbalizations during testing. Paul's violent outbursts resulted in injury to himself and others, and extensive property damage. For example, prior to his institutionalization, Paul became violent during a family excursion and destroyed thousands of dollars worth of items in a souvenir shop. He lived on a special locked unit for aggressive males containing only male staff.

The standard methods of attempting to control Paul's aggression had been separate or combined use of strait jackets, a restraint chair located in a small closet-like isolation room, and daily dosages and PRN injections of Thorazine. None was effective in decreasing his aggression. For example, Paul destroyed several custom-made, heavily reinforced canvas strait jackets. On one occasion the unit was flooded when he ripped two water fountains from the wall. During his aggressive acts, he often injured staff. His two forms of self-injury consisted of biting his hands or banging his forehead violently against walls. The scar tissue on his head had thickened from repeated head-bangings to a point where it was extremely difficult to suture new wounds. The year before treatment, Paul's head and/or hands had been sutured 12 times and he had received up to 2000 mg of Thorazine daily. During the last five months of that year, he also received over 3300 mg of PRN Thorazine injections. Paul enjoyed the attention that his aggression provided, since he often demanded injections and suturing and would smile during their delivery. Paul's problematic behavior also included threatening others, screaming, and talking to walls or himself in the third person.

The general rationale of the treatment program was to create a highly reinforcing environment and use nonexclusionary timeout (Foxx & Shapiro, 1978). Thus, Paul's aggressive–destructive behavior produced a 24-hour period of social isolation during

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which he remained in the reinforcing environment (a locked unit), but was restricted from all social interactions, scheduled reinforcing activities, and any naturally occurring reinforcing events (such as an unexpected visit from his parents). Thus the isolation was designed to consist of numerous timeout intervals, and each interval would vary in duration and unpleasantness as a function of the reinforcing events from which Paul was being excluded. Although the isolation included intervals in which timeout was not in effect, it kept Paul in a state of readiness to experience timeout whenever a reinforcement opportunity occurred, e.g. when others on the unit received reinforcement. During isolation, Paul wore a white hospital gown that served as a signal (discriminative stimulus) to everyone that he should not receive any attention. To guard against inadvertent attention, all employees were briefed and received written instructions, and a large 'reminder' sign was posted at the unit entrance.

Several factors influenced the selection of a 24 hour period of social isolation. First, because the unit had a stable daily routine, Paul's first opportunity for social interactions and activity participation following his isolation would occur in situations quite similar to those in which he had aggressed the day before. This pairing of release from isolation (negative reinforcement of nonaggression) with the opportunity to participate in potentially reinforcing events helped establish these events as conditioned reinforcers for nonaggressive behavior and reduced the likelihood that he would continue to aggress during them. Second, Paul's outbursts often involved certain situations, people, or times, e.g. attacking new employees. However, doing so would result in a forfeiture of reinforcement opportunities for a complete daily cycle. Third, because all three shifts would be involved, a cohesive and consistent staff effort resulted that made the program inescapable and increased the likelihood of generalization across shifts and situations. Finally, the program was easy to monitor because the isolation was scheduled to end at the same time it had begun the previous day.

Paul met several social and intellectual criteria that were essential to the program's success: (i) he had extensive receptive and expressive language skills, e.g. he could participate appropriately in complex conversations; (ii) he enjoyed praise, participating in group activities, and interacting with staff; and (iii) he was capable of mediating time spans, e.g. by talking about past and future events and working for delayed rewards. These criteria ensured that he was capable of understanding the relation between his aggression and social isolation, and that the isolation would constitute timeout.

The success of the program depended on the creation of a highly reinforcing environment. This was accomplished by establishing a token program, reinforcement room, and increasing the number of staff/client interactions and activities. The reinforcement room contained a television, record player, and a variety of games,

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magazines, educational materials, and snacks (Foxx, Bechtel, Bird, Livesay, & Bittle, 1986).

It was critically important to protect Paul and others from his violent outbursts and prevent him from terminating the isolation and receiving attention by aggressing. To do so, a physical intervention procedure, relaxation training (Foxx & Azrin, 1972) was implemented. Whenever Paul became aggressive, two or more staff physically restrained him and then instituted relaxation training. Paul was instructed in a neutral tone of voice to go and lie quietly on his bed. If he failed to comply, he was immediately escorted to the bed and instructed to lie down, and manually guided to a supine position. If he actively resisted, his extremities were held and the staff's manual restraint pressure was decreased as he ceased resisting. Manual restraint was applied as needed whenever he attempted to rise and terminated when he relaxed thereby negatively reinforcing compliance. Once Paul became quiet, he was told he was to lie quietly for 10 minutes, after which point a buzzer would sound. If he became agitated at anytime, the 10 minute period of relaxation training was recycled. After 10 minutes of calmness, the social isolation period began. Paul was told of the conditions surrounding the social isolation.

The program greatly decreased the percentage of days each month in which aggression occurred from a baseline of 90% to 4% one year later. Medical record comparisons in the year before and during the year long program revealed major reductions in (i) the times Paul was sutured following self-injury (from 12 to four), (ii) daily Thorazine dosages (from 2000 to 800 mg), and (iii) PRN Thorazine injections (from nine per month to one every other month).

There were several other gratifying developments. The restraint chair room was converted into a linen closet. Paul's hallucinatory-type verbalizations decreased markedly, although they had not been targeted for treatment. He no longer asked for PRNs or suturing. As he became less threatening, his appropriate interactions increased substantially. Paul's parents received weekly behavioral training and used this training with him during home visits. He participated in the Special Olympics and by year's end attended off-unit educational programs full time.

Although Paul was socially isolated for an extended period, the program was humane. Consider that Paul was given complete freedom to care for his bodily needs and received the same standards of care (i.e. nutritional, medical) as his unit mates. Nothing was withheld except social interactions and activities, and their denial was contingent on his aggressive behaviors. Thus the decision to receive or avoid social isolation was his and he was intellectually capable of making it, because of his history of responding to complex social contingencies and comprehension of time.

Individuals with severe and profound mental handicaps would not benefit from this program because they would be unable to comprehend the relation between their misbehavior and the resulting lengthy, isolation period. They also would be less

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likely to have a sufficient number of social and activity reinforcers to permit many timeouts to occur during the isolation (Foxx & Livesay, 1984). In subsequent clinical applications, I have often been able to reduce the social isolation duration to between six and 12 hours and sometimes to three (see Jack below).

Jack (1986, 1989)

Foxx et al. (1989) described a strategy for systematically discontinuing aversive components in treatment programs in a 52-month follow-up report of a two-phase program for treating the severe, negatively reinforced aggression of Jack, a 20-year-old institutionalized, dually diagnosed, deaf male (Foxx et al., 1986b). Jack had resided in institutions since the age of seven. Jack's attacks on staff and other individuals included pulling out hair causing injuries to the scalp, pinching, and kicking. He also destroyed property. His behavior was so volatile that no one would get close to him. This, of course, limited his opportunities for appropriate social interactions and education. Most disturbing was that he would pull people's hair and eat it. To treat his aggression, custodial methods including psychotropic medications, restraints, and seclusion had been used. He was in cuffs and belts prior to our treatment and received large daily dosages of Thorazine or its equivalent.

Phase I lasted 28 months and included (i) contingent electric shock to punish aggression, (ii) a high density of positive reinforcement to construct a new motivational system for Jack, (iii) brief, intensive compliance training, (iv) transfer of programmatic responsibility from the researchers to direct care staff and Jack's parents, and (v) a relaxation procedure to interrupt the aggressive response chain. Phase II lasted for 32 months and featured (i) replacement of shock with decreasing durations of nonexclusionary time-out (Foxx & Shapiro, 1978) and (ii) a high density of naturally occurring reinforcers. Jack's aggression remained more than 90% reduced from baseline for 5 years. During this period he received no behavior control medication, walked independently to classes and activities, worked on grounds, participated in educational and recreational activities, made regular home visits (over 300 miles away), went on trips to the community with his parents and accompanied them on vacation.

These were important outcomes because prior to the program Jack had received high dosages of behavior control medication (e.g. 1600 mg of Thorazine per day) and had been wearing cuff and belt restraints continuously on the living unit. In the two years before the shock program, Jack received a total of 1 183 000 mg of Thorazine or its equivalent. A social validity questionnaire revealed that he has become more social and less dangerous.

In phase I the goal was to design a treatment regime and training model that would produce durable treatment effects and be maintained by direct-care staff and Jack's

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parents. In phase II the goal was to discontinue shock and yet maintain the treatment effect through the use of a long term maintenance strategy.

Phase I

The training model was as follows. Several individuals who possessed extensive behavioral skills (the primary treatment personnel) worked with me during day long intensive-treatment sessions. After they had become proficient in program implementation and Jack's aggressive behavior had been greatly reduced, the living-unit psychologists were trained. They were then supervised while they implemented the program in the living unit and school. Then, preselected nonprofessionals received training at the living unit and the school. This training involved modeling, demonstrations, and didactic instruction. Finally, the primary treatment personnel remained responsible for Jack's treatment and monitored the program implementation on an ongoing daily basis. Jack's parents were trained to conduct the program during home visits. This model followed the recommendations of Carr and Lovaas (1983) and Foxx, Plaska, and Bittle (1986d).

Several factors ensured that the treatment effects would not be situation specific, including the use of a graded training sequence (i.e. from intensive-compliance training to the regular school and living-unit routines and finally to vocational programming), different trainers (e.g. supervisory personnel, direct-care staff, workshop supervisor), and multiple treatment environments. Functional analyses were conducted on a minute-by-minute basis during the compliance training. This trial-by-trial, day-by-day information was then used to plan future treatment and maintenance efforts. In month 16, Jack was required to relax for 5 minutes whenever he became agitated (Foxx & Azrin, 1972). The relaxation procedure was implemented at or near the beginning of a potentially aggressive episode in order to interrupt aggressive responses at their weakest point in the response chain, create a physiological state incompatible with aggression, and add additional instructional control for calmness.

To encourage relaxation, the staff signed to Jack to sit or lie in a quiet area (e.g. on his bed). If he did not, he was immediately escorted to the area and instructed to relax. When he actively resisted, he was placed in boxing gloves for 30 minutes (see below for the rationale). The relaxation period then resumed. The procedure was repeated if he attempted to leave the area during the 5 minutes. Over time Jack complied with requests to relax and would often leave confrontational situations and seek a quiet area.

The use of shock may have enhanced the reinforcing properties of other stimuli. For instance, social stimuli (e.g. physical contact, praise, interaction, conversation) had little reinforcing effect on Jack's behavior prior to the shock program. Yet, these

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stimuli appeared to acquire considerable reinforcing value as treatment progressed because they may have become conditioned reinforcers when they were paired with the avoidance of shock (see Bucher & Lovaas, 1968). Similarly, negative social stimuli (e.g. negative attention) were probably weakened because they were paired with shock.

Phase II

The shock contingency was discontinued after month 28 because aggression had been reduced long enough for Jack to learn a variety of alternative appropriate behaviors. Nonexclusionary timeout (Foxx & Shapiro, 1978) was then used to maintain the therapeutic effect.

Because most individuals and Jack's parents could not physically manage his aggression, the nonexclusionary timeout/social isolation consisted of Jack wearing boxing gloves. The gloves prevented him from signing (timeout), hair-pulling, and becoming physically unmanageable, yet allowed him to remain in a positively reinforcing environment. During timeout, Jack remained wherever he had aggressed, but he was restricted from all social interactions and scheduled naturally occurring reinforcing events. The overall timeout period was designed to consist of multiple timeout intervals and each varied in duration and effectiveness according to the ongoing reinforcing event at that time (see Paul's program). The gloves also served as a discriminative stimulus that Jack was not to receive attention. Jack was told (signed to) that because of his aggression he would be denied social contact for three hours. He was instructed to avoid others. He was free to move about at will, except when he approached someone or a group activity. In such cases he was either instructed with signs to leave the area or the other(s) walked away. When timeout ended, Jack was returned to regular programming and prompted to complete any task(s) interrupted by his aggression. If his aggression had occurred during an instructional session, he was returned to the situation and given the instruction. Hence, he never escaped a situation by aggressing.

The timeout duration was reduced to one hour during month 41, and to 15 minutes by month 44. Timeout was effective because Jack's living unit had numerous reinforcing activities, a token program, and a reinforcement room that contained a television, a variety of games, educational materials, and snacks (Foxx et al., 1986a). Thus we were able to shift from type I to type II punishment. One factor that may have ensured the enduring effectiveness of the program was Jack's level of functioning. Foxx and Livesay (1984) reported that higher functioning individuals treated with overcorrection procedures showed longer and better treatment effects than lower functioning individuals. Such individuals have well developed expressive language, which permits them more opportunities to obtain reinforcers and positive

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interactions with others. Thus, Jack's programming focused on teaching him new ways of interacting and increasing his positive interactions with other. Jack's case achieved the most desirable long term clinical outcome in a program that included contingent shock because a significant behavioral reduction was maintained in the natural environment with shock discontinued (see Foxx, 1991).

Joe (1994)

Foxx et al. (1994) treated Joe, a 36-year-old institutionalized severely retarded man, for aggression, self-injury, and property destruction. His most common and dangerous form of aggression was biting, which was extremely dangerous because of its intensity and unpredictability. Joe's victims had permanent scarring and physical damage to their fingers and arms (e.g. loss of the end of a finger). His self-biting produced severe lacerations to his limbs.

During 22 years of institutionalization (ages 11 to 32) numerous unsuccessful medical, custodial, and behavioral treatments had been attempted. Similar failures occurred in several group homes, including one that was designed specifically for Joe. In the 28 months prior to the study, Joe aggressed toward himself 12 495 times or 14.7 times per day, toward the environment 3567 times or 4.2 times per day, and toward others 649 times or 0.8 times per day. What is noteworthy about these figures is that Joe's aggression was escape motivated, yet the environment was deliberately designed to produce virtually no demands.

Phase I

A formal functional analysis of antecedent stimuli (e.g. familiar tasks), consequences for appropriate behavior (e.g. continuous encouragement and edible reinforcement), and consequences for aggression (e.g. loud and soft verbal reprimands) revealed that Joe's aggression was primarily escape motivated. The treatment was conducted in a special living unit at a state residential facility.

Our functional analysis clearly revealed that the vast majority of Joe's aggression was triggered by interactional or educational instructions and negatively reinforced by the postponement or termination of these events. This eliminated using positive reinforcement alone as a treatment strategy. There were several reasons why. One, using it alone at the beginning of treatment would be extremely dangerous because there was no way of inhibiting Joe's aggression. Two, positive reinforcement was noncompetitive with the powerful negative reinforcement that he had a long history of obtaining. Consider that merely approaching Joe or saying his name could lead to an attack. Three, the effective use of differential reinforcement programs with an extremely aggressive individual does not simply involve dispensing positive

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reinforcers but also the skillful integration of a variety of strategies and behavioral techniques. Yet, the technology to train such subtle skills does not appear to be readily available (Foxx, 1985a, 1985b, 1996, 2001). Hence, we did not believe that it was possible to adequately train everyone responsible for Joe's treatment to conduct the elaborate and lengthy differential reinforcement programs that some have stated will reduce severe aggression (e.g. LaVigna & Donnellan, 1986) but that have failed in empirical (Paisey, Whitney, Hislop, & Wainczak, 1991) and critical evaluations (Foxx, in press). Four, it did not appear to be feasible to implement such programs on a 24-hour basis. Given these factors, we sought to develop Joe's responsiveness to such positive approaches over time while simultaneously bringing his destructive behavior under control. Because Joe's aggression was primarily negatively reinforced he reacted to any programming attempt as if it represented a demand. Thus, even positive programming efforts increased the likelihood that aggression would escalate and intensify. As a result, a type I punisher was needed to control his aggression.

In order to implement the overall skill building/communication strategy it was first necessary to find an event that would act as an effective type I punisher for aggressive behavior. Accordingly, the purpose of phase I was to evaluate several procedures hierarchically sequenced according to their aversiveness. The sequence was baseline, DRI, and then DRI combined with an aversive noise, water misting, and contingent electric shock. Because Joe's aggression was primarily negatively reinforced, the evaluations included task demand situations and compliance training (see Foxx et al., 1986b).

Approval to use shock was obtained from Joe's parents and all appropriate parties after they had reviewed a detailed informed consent document (Foxx et al., 1986d) that addressed pertinent ethical, legal, and clinical concerns. Because Joe was part of a Federal lawsuit, the overall program and document were also reviewed by the court's expert consultant, the consultant's experts, and the plaintiff's attorney. Joe's parents witnessed the hierarchical assessment and first three days of shock use.

Contingent shock was viewed as a necessary, but not sufficient, part of the overall treatment effort. Consider that its use to suppress destructive behavior made desirable responses more probable and hence created a window of opportunity for replacing destructive behaviors with new ones. This process was facilitated by arranging for all preexisting and new appropriate behaviors to involve little response effort and result in the same reinforcers as destructive behaviors (e.g. escape). As discussed by Carr, Robinson, and Palumbo (1990), the question is not whether aversive treatments are justified because nonaversive treatments have failed or whether they work at all but rather what is done when an individual is not misbehaving. The use of shock permitted us to avoid crisis management and reactive approaches and opt instead for proactive, skill building communication strategies by creating a situation whereby

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therapists could safely employ these strategies with an extremely dangerous individual.

The hierarchical assessment of reductive procedures revealed that contingent shock was most effective in suppressing aggression. It reduced total aggression by 92% of baseline. Furthermore, Joe's compliance increased substantially in the shock condition. Session duration averaged 34.3 min in the shock condition versus 8.1 min in the baseline (a 423% increase). Joe's outbursts and self-abusive episodes also became shorter and occurred less often over the 19 shock sessions in three days and no destructive behavior occurred during the final eight-hour assessment day. Although Joe attempted to bite several individuals, I was the only casualty when he bit me on the calf on day one of the shock contingency. Joe's on-task performance improved, as did his overall demeanor. Given these outcomes there was unanimous agreement by the treatment team and Joe's parents to incorporate the shock contingency into his program.

Phase II

Program Transfer, Extension, and Maintenance Program Planning. The overall program plan followed Foxx et al. (1986b) and was designed to avoid or minimize problems associated with the use of shock (Foxx, McMorrow, Rendlemen, & Bittle, 1986; Foxx, McHenry, & Bremer, 1996; Foxx, Bremer, Shultz, Valdez, & Johndrow, 1996; Newsom, Favell, & Rincover, 1983), produce durable treatment effects (Foxx et al., 1989), never intermittently reinforce aggression, and enhance generalization across therapists and settings (Foxx, 1990).

Positive Programming Strategies and Procedures. Because phase I demonstrated that shock would control aggression, it was possible in phase II to implement our positive programming strategies of increasing Joe's skills, communication skills, menu of potential reinforcers, self-control and patience, and choice making opportunities, and teaching him behaviors that served the same function as his aggression. Joe was paid tokens for displaying on-task behaviors, independent living, and social skills, and taught to exchange them for preferred activities and events. Over time, Joe participated in a variety of off-unit activities including workshop, occupational, speech, and music therapy classes; swimming, gym classes, social activities, horseback riding, walking on a nature trail, and visiting the canteen.

Results

A comparison of the first treatment month with the month prior to treatment revealed significant decreases in all forms of aggression: overall aggression

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decreased from 35 to 2.5 responses per day (a 93% reduction); aggression toward self from 24 to 1.6 responses per day (a 93% reduction); aggression to others from 2.7 to 0.5 responses per day (an 81% reduction); and aggression to the environment from 8.3 to 0.3 responses per day (a 96% reduction). In treatment month one, contingent shock was applied 60 times but only on 16 of 30 days (53%). In the pre-treatment month, Joe injured himself 2.6 times per day (an injury report and first aid were required each time) whereas only three injuries occurred during month one (a 96% reduction).

The program was in effect for 54 months. The mean daily occurrence of all three types of aggression remained significantly below the pre-treatment month and that the trend continued to be downward. Consider that total aggression averaged 2.1, 1.1, 0.9 and 0.4, respectively, per day during the last 4 years of treatment. No aggression towards others or the environment occurred in months 42 to 54. An important measure of programmatic success was the number of shock free days, which increased across the years from 77% in the first year to 90% by the fourth full year.

A detailed analysis of Joe's aggression by time of day, day, setting and antecedent events in the early stages of treatment revealed some interesting findings. Because the vast majority of Joe's aggression was escape motivated, it was not surprising that aggression occurred the least on weekends. Fifty percent of Joe's aggression occurred in a six-hour period between 8 a.m. and 2 p.m. Because this trend was apparent early in treatment, Joe's daily programmatic schedule was rearranged so that his less preferred tasks and activities were presented in the afternoon. For example, Joe was enrolled in morning gym classes in the middle of month 3. In the next four months, 19.5% of his aggression was displayed during this one-hour class (range 11–23%). After this class was rescheduled to afternoons (month 7), Joe only aggressed in gym class in four of the 11 remaining months and his aggression only averaged 4.3%.

Although aggression occurred in 17 different settings, 68.5% occurred in the six settings that contained the most demands. Nineteen antecedent events were identified as setting the occasion for aggression. The highest percentages of aggression were associated with instructions to perform high demand tasks.

Prior to treatment, Joe's severe aggression required the intervention of three or more staff members. After treatment, only one staff member typically was needed to conduct a structured program with Joe or treat his aggression. During the pretreatment month, emergency restraint was implemented on ten occasions for a total of six hours and 31 minutes, whereas it was not used during treatment. The intensity of aggressive behavior decreased markedly over time. Medical treatment for others has not been needed since I was bitten on treatment day one.

Joe's successful treatment was especially gratifying because his aggression (i) was particularly dangerous and physically damaging, (ii) had been chronic and very

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resistant to a variety of treatments, (iii) had prevented his participation in social and habilitative activities, and (iv) had resulted in the routine use of emergency physical restraint by four to five large men. Joe's aggression was maintained at low levels (i.e. more than 99% reduced from baseline) even though ever increasing demands were placed on him to participate in new activities and environments with new therapists. The majority of his day was spent away from the unit, attending recreational activities and classes, running errands, and visiting the canteen. He received no behavior control medication and made regular home visits and trips to the community with his family.

Conclusion

The long term success achieved in these three cases appears to have been due to numerous factors. One, aggression never produced escape from educational and vocational demands. Two, a history of appropriate responding for positive reinforcement especially with complex social contingencies was established. Hence, as the individual's behavior became increasingly appropriate over time, the density of naturally occurring positive reinforcement correspondingly increased. Three, the complexity and relevance of the tasks that were given were increased. Four, a systematic effort was made to increase self-control and patience. Five, a long-standing problem for Jack and Joe, activity avoidance via aggression, was virtually eliminated by ascertaining and responding to the communicative function of this behavior. Six, the individuals' choice-making opportunities were greatly increased (Foxx et al., 1993). Seven, the stimuli controlling nonproblematic behavior were present throughout the treatment. Eight, the individuals' parents participated in every treatment decision and phase. They served as a valuable resource regarding their child's learning history, reinforcer preferences, and communication skills. Nine, the individuals were taught to request responses that were functionally equivalent to their destructive behaviors but more efficient in generating and securing reinforcers. Ten, the individuals selected to provide the most salient forms of social reinforcement were those who shared a mutual affection with the clients. Eleven, the individuals' destructive and escape and avoidance behaviors were made irrelevant by reducing or eliminating their boredom and frustration and by varying tasks and actively encouraging choice making. Twelve, the maintenance of response suppression was considered by actively programming for maintenance (Foxx, 1990, 1989; Foxx & Dufrense, 1984; Foxx et al., 1989), keeping the treatment and maintenance programs similar (Foxx & Livesay, 1984), and ensuring change agent and programmatic accountability (Foxx et al., 1986b).

These three programs are a step in the development of maintenance strategies for treatment programs in a manner that meets both the individual's right to effective

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treatment (Van Houten et al., 1988) and right to the least restrictive treatment. These rights are met when an individual's treatment is viewed as an evolving process in which clinicians remain committed to achieving the best therapeutic effect over the long term while continually evaluating how much, if any, intrusiveness is necessary. Such a long term approach allowed the time to construct new learning histories for difficult clients that offered them the opportunity to display new as well as dormant appropriate forms of behavior. In this way their full integration into all forms of habilitative programming and an increased range of lifestyle activity can be a realizable goal.

One of the major criticisms of contingent shock treatment procedures is their failure to produce long term suppression (Favell et al., 1982); yet, high intensity shock with infrahumans produces complete suppression (Azrin & Holz, 1966; Johnston, 1972). The issue of maintenance of effect often is confounded by questions concerning stimulus generalization. Maintenance of effect is defined as the change in behavior after a procedure has been terminated rather than the transfer of effect to extra-therapy/treatment settings. Even with this definition, a question of stimulus control arises and this question is essential to understanding why the shock effect may not be maintained in applied research but is in basic research with animals. For animals, maintenance of effect is assessed by repeatedly placing the animal in the chamber where shock had previously been delivered. Clearly, stimulus control is operating. In clinical applications utilizing electric shock, however, the typical procedure is to conduct relatively brief treatment sessions in a restricted setting. Yet, doing so may be creating a multiple schedule. Consider that in setting A, i.e. the treatment setting, a self-injurious or aggressive response produces shock whereas in setting B (i.e. the client's regular environment) the response does not produce shock and may in fact produce reinforcement. On a rather molar level, a two-ply multiple schedule (i.e. punishment versus reinforcement) is created. This is the same type of arrangement that is used in discrimination training paradigms to increase responding in the presence of one stimulus condition and eliminate responding in the presence of another. The stimulus control exerted by the 'treatment setting' certainly is powerful but the stimulus control exerted in the client's regular environment is equally powerful. In other words, the aggressive behavior continues to occur in those environments that shaped and maintained it prior to treatment. To some degree, then, the clinical question of maintenance of effect relates to the degree of generalization from the treatment setting to the clients' regular environment. As a result, we should not expect the maintenance of any clinical gains from the treatment setting to occur in the regular environment unless substantial modifications have been made (Bucher & Lovaas, 1968; Foxx, 1996, 2001). Thus, the question of maintenance of effect pertains only to the duration of clinically achieved effects within the actual treatment setting and the issue of maintenance of effects becomes, in essence, a question of the

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maintenance of stimulus control. In the three studies just discussed, no maintenance problems were encountered because all treatments were either conducted in the client's regular environment from the beginning of treatment, i.e. Paul, or quickly moved there once initial success was achieved in the treatment environment, i.e. Jack and Joe.

Promoting the long term maintenance of therapeutic change has been and remains the most difficult challenge for behavior analysis. A particularly difficult group to treat and achieve long term maintenance success with appears to be individuals who have a long history of dangerous aggression for negative reinforcement. If maintenance is to be successful, it is imperative that they be taught to be more responsive to positive reinforcement. Yet as discussed previously, using positive reinforcement alone at the beginning of treatment would not only be dangerous but also noncompetitive with the powerful negative reinforcement that is available. Furthermore, it does not appear to be currently feasible to implement such programs on a 24-hour basis. This may be why those purporting to use positive approaches alone have had to resort to 'emergency' uses of contingent restraint but '*not as a programmed consequence*' (Lucyshyn, Olson, & Horner, 1999) or missed acknowledging the relation between the introduction of large amounts of Thorazine and reductions in behavior (Berkman & Meyer, 1988; Linscheid & Landau, 1993). A perhaps more honest and superior model is where the clinician must develop individuals' responsiveness to positive approaches over time after first bringing their aggression to safe levels with appropriate reductive and positive procedures.

To advance the treatment of individuals with developmental disabilities who display aggression toward others, lengthy follow-ups must be conducted and disseminated so that maintenance and generalization strategies can be analyzed and evaluated (Foxx et al., 1989). Changing journal publication standards may help ensure this process, e.g. by requiring a minimum follow-up period (e.g. a year or more) before an article can be considered for publication (Foxx, 1985b).

The maintenance of treatment success with dangerous behavior depends on such factors as active programming of a maintenance procedure (Foxx, 1996), the similarity of the treatment and maintenance programs (Foxx & Livesay, 1984), change agent and programmatic accountability (Foxx et al., 1986d), and whether artificial or natural reinforcers are used (Foxx, 1982). These factors were considered in the three cases. The treatment and maintenance programs were similar, kept as uncomplicated as possible, and the maintenance programs were developed before the treatment program ended. The overall density of naturally occurring reinforcement was frequently raised and evaluated. Accountability was ensured by having the senior author retain ultimate programmatic responsibility. Perhaps the most critical factor in the successful treatment of these individuals was providing treatment throughout all of their waking hours (Foxx, 1991, 1996).

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