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SIDE EFFECTS OF EXTINCTION: PREVALENCE OF BURSTING AND AGGRESSION DURING THE TREATMENT OF SELF-INJURIOUS BEHAVIOR

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Findings from basic and applied research suggest that treatment with operant extinction may produce adverse side effects; two of these commonly noted are an increase in the frequency of the target response (extinction burst) and an increase in aggression (extinction-induced aggression). Although extinction is often used to treat problem behavior in clinical settings, few applied studies have examined the prevalence of these side effects or their possible attenuation with other operant procedures. An analysis of 41 data sets for individuals who received treatment for self-injurious behavior indicated that extinction bursts or increases in aggression occurred in nearly one half of the cases. The prevalence of bursting and aggression was substantially lower when extinction was implemented as part of a treatment package rather than as the sole intervention.

DESCRIPTORS: extinction, extinction burst, extinction-induced aggression, side effects, behavior disorders, self-injurious behavior

Numerous research findings have shown that operant extinction (i.e., terminating the reinforcement contingency that maintains a response) can produce rapid reductions in problem behavior (e.g., Forehand, 1973; Repp, Felce, & Barton, 1988). The development of methodologies for identifying the maintaining consequences of problem behavior has facilitated the use of extinction as treatment for severe behavior disorders. Moreover, results of studies have demonstrated that extinction can be critical to the success of other treatments, such as differential reinforcement (e.g., Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993; Wacker et al., 1990; Zarcone, Iwata, Smith, Mazaleski, & Lerman, 1994). As a result, an increasing amount of research has focused on developing and refining treatments based on extinction (e.g., Iwata, Pace, Cowdery, & Miltenberger, 1994; Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990; Rincover & Devany, 1982), and such procedures are now commonly used to treat behavior disorders in clinical settings.

Nevertheless, results of basic and applied studies suggest that extinction may be associated with a number of undesirable effects. The two most common side effects described in applied texts and literature reviews are the extinction burst, which is a temporary increase in the frequency, duration, or magnitude of the target response, and extinction-induced aggression, which is an increase in aggression. Although few studies have systematically examined either phenomenon, both side effects have been reported in applied research findings (e.g., France & Hudson, 1990; Goh & Iwata, 1994; Herbert, Pinkston, Cordua, & Jack-

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son, 1973). For this reason, a number of authors have cautioned against using extinction in clinical settings (e.g., LaVigna & Donnellan, 1986).

Treatment with extinction may indeed be contraindicated for use outside laboratory settings if response bursts and extinction-induced aggression occur frequently and increase the risk of physical harm to the individual or to caregivers (e.g., when treating self-injury of large adults). On the other hand, extinction typically is combined with reinforcement or other procedures in applied studies, and several authors have suggested that these alternative procedures (e.g., differential reinforcement of alternative behavior [DRA], antecedent manipulations) may mitigate the undesirable effects of extinction (Kazdin, 1994). However, the extent to which these factors might influence the likelihood of extinction bursts or extinction-induced aggression is unclear because, with one exception (Lerman & Iwata, 1995), the prevalence of these side effects has not been investigated.

Lerman and Iwata (1995) examined 113 published and unpublished treatment cases to determine the prevalence of the extinction burst. Results indicated that extinction bursts occurred less often than previously assumed (they were observed in 24% of the cases), particularly when extinction was combined with other treatment procedures. Only 12% of cases were characterized by bursting when extinction was implemented in conjunction with reinforcement or other procedures, whereas 36% of cases showed evidence of bursting when extinction was implemented alone. However, the generality of these results was somewhat limited because of various methodological differences among the cases. For example, factors that could alter the likelihood of detecting an extinction burst, such as session length and data calculation or presentation methods, varied widely among the cases. Moreover, the prevalence of other side effects, such as increases in aggression, could not be determined because aggression was often the target of treatment, and data on other nontargeted responses were rarely presented.

Further research on the prevalence and characteristics of extinction bursts and extinction-induced aggression is needed to determine whether greater emphasis should be placed on alternatives to extinction in both laboratory and clinical settings. If research findings suggest that these side effects are prevalent when extinction is included in treatment, caregivers probably should continue to reinforce problem behavior while implementing procedures that can be effective in the absence of extinction, such as noncontingent reinforcement (NCR; Fischer, Iwata, & Mazaleski, 1997) and antecedent manipulations (Pace, Ivancic, & Jefferson, 1994; Smith, Iwata, Goh, & Shore, 1995). On the other hand, alternatives to extinction may be unnecessary if these side effects rarely occur or if common treatment components, such as differential reinforcement, attenuate response bursting and extinction-induced aggression. In this study, an analysis similar to that conducted by Lerman and Iwata (1995) was used to determine the prevalence of both extinction bursts and increases in aggression with individuals who had received treatment for self-injurious behavior (SIB).

METHOD

Participants and Setting

Data records for individuals who had received treatment for SIB in our day program between 1989 and 1997 were examined for potential inclusion in the study. Cases were included if they met the following criteria: (a) Aggression was not targeted for treatment; (b) data on aggression and SIB were collected across all baseline and treatment sessions; (c) treatment was preceded by a

baseline condition in which reinforcement was delivered for SIB, but no programmed consequences were provided for aggression; (d) the transition from baseline to treatment involved extinction (withholding the identified reinforcers that maintained SIB); and (e) procedures implemented in conjunction with extinction included differential reinforcement, NCR, or antecedent manipulations (e.g., stimulus fading). Some participants were exposed to two or more treatments prior to their discharge, in which case the first treatment meeting the above criteria was included in the analysis. If a participant was exposed to treatment with both extinction alone and extinction combined with another procedure, both data sets were included in the analysis if they satisfied the criteria. Forty-one data sets from 30 participants met the criteria for inclusion. Nine of the 41 data sets had been included in the previous analysis (Lerman & Iwata, 1995). Ten participants were exposed to extinction alone, 9 participants were exposed to extinction in conjunction with alternative procedures, and the remaining 11 participants were exposed to both extinction alone and extinction combined with other procedures.

Participants had been diagnosed with moderate to profound mental retardation, and their ages ranged from 5 to 54; however, all but 1 participant was above age 18. Prior to treatment, the maintaining consequences of SIB were identified via functional analyses for all participants (Iwata, Pace, Dorsey, et al., 1994). Results indicated that SIB was maintained by escape from demands (21 cases), access to attention (13 cases), access to materials (four cases), and automatic reinforcement (three cases). Specific treatments were determined by the individual's participation in other ongoing research projects. Sessions for all but 1 participant were conducted in therapy rooms at the day program, which was located on the grounds of a residential facility for individuals with developmental disabilities. For 1 participant, sessions were conducted in an empty classroom at a noncategorical preschool. The therapy rooms contained tables, chairs, and other materials relevant to the individualized treatments.

Response Measurement and Reliability

Topographies of SIB included head and body hitting, eye poking, hand biting, hand mouthing, and body scratching. Topographies of aggression included hitting, pinching, scratching, biting, and kicking others. Observers were undergraduate and graduate students who had prior experience in using the data collection system. Data on SIB were collected using frequency or partial-interval recording, and the data were expressed as responses per minute or percentage of 10-s intervals scored. Data on aggression were collected using frequency recording and were expressed as number of responses per minute.

An *extinction burst* was defined as an increase in responding during any of the first three treatment sessions above that observed during all of the last five baseline sessions or all of baseline if it was briefer than five sessions (Lerman & Iwata, 1995). The occurrence or nonoccurrence of extinction bursts was determined by visually inspecting graphs displaying session-by-session data on SIB. *Extinction-induced aggression* was defined as an increase in aggression during any of the first three treatment sessions above that observed during all of the last five baseline sessions or all of baseline if it was briefer than five sessions. The occurrence or nonoccurrence of extinction-induced aggression was determined by visually inspecting graphs displaying session-by-session data on aggression.

A second observer independently collected data on SIB and aggression during at least 25% of sessions for all participants. Agreement percentages were calculated on an in-

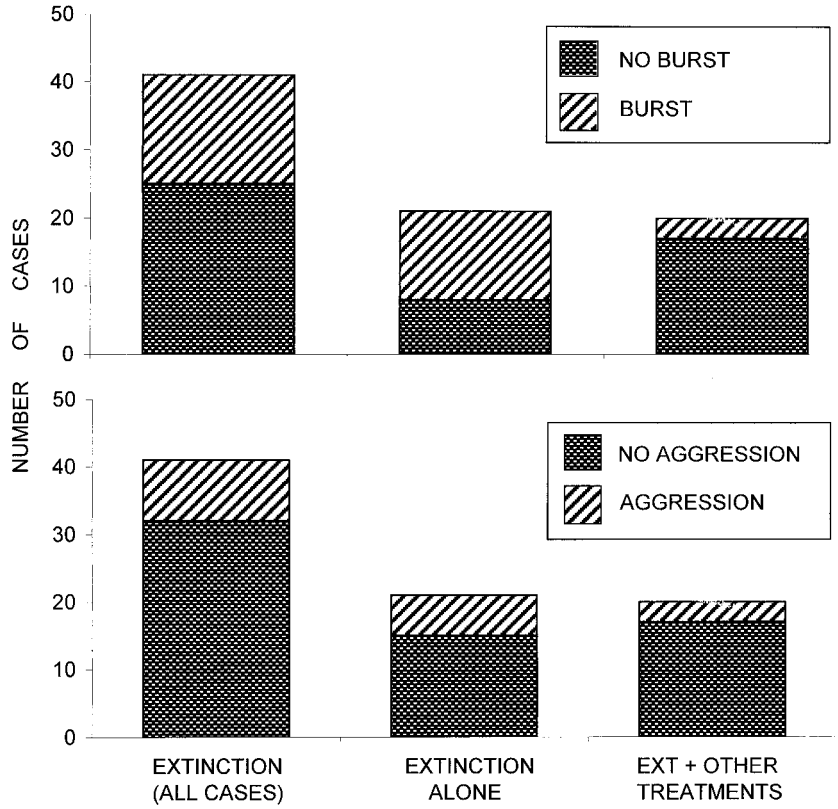

Figure 1. Number of cases showing the occurrence and nonoccurrence of extinction bursts (top panel) or increases in aggression (bottom panel) during treatment overall and with extinction alone versus extinction (EXT) combined with alternative procedures.

terval-by-interval basis. For frequency recording, the smaller number of responses in each 10-s interval was divided by the larger number of responses. These fractions were then summed, divided by the total number of intervals in the session, and multiplied by 100%. For partial-interval recording, percentage of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean interobserver agreement across participants was 95% (range, 81% to 100%) for SIB and 99% (range, 94% to 100%) for aggression. A second observer also examined all of the data sets to make independent determinations about the occurrence and nonoccurrence of the extinction burst and extinction-induced aggression. Percentage agreement was 100% for all of these determinations.

RESULTS

As displayed in Figure 1, overall results for the 41 cases indicated that 16 cases, or 39%, showed response bursting, and nine cases, or 22%, showed increases in aggression (see far left bars of upper and lower panels). Eight cases (19%) were associated with both side effects, eight cases (19%) were associated with the extinction burst only, one case (2%) was associated with increases in aggression only, and 24 cases (58%) showed neither side effect during treatment. Fifteen of the 30 participants, or 50%, showed at least one of the two side effects.

Extinction was combined with differential reinforcement, noncontingent reinforcement, or antecedent manipulations in 20 (49%) of the cases. Results displayed in the top panel of Figure 1 show that a larger number of cases were associated with a burst when extinction was implemented as a single intervention (13 of 21, or 62%) than when it was combined with other treatment components (3 of 20, or 15%). As shown in the bottom panel, extinction-induced aggression also was more likely to occur when extinction was implemented alone (6 of 21 cases, or 29%) than when it was combined with alternative procedures (3 of 20 cases, or 15%).

Overall, the prevalence of the extinction burst was higher for cases in which SIB was maintained by social negative reinforcement (12 of 21 cases, or 57%) than for cases in which SIB was maintained by social positive reinforcement (4 of 17, or 23%).[1] Extinction-induced aggression was equally likely to occur, regardless of whether SIB was maintained by social negative reinforcement or social positive reinforcement (it was observed in approximately 23% of the cases for each). The three cases in which SIB was maintained by automatic reinforcement were not associated with either side effect.

DISCUSSION

An analysis of 41 data sets in which SIB was treated with extinction revealed that about 40% of cases showed at least one of two side effects (i.e., response bursts or increases in aggression) and that almost 20% of the cases showed both phenomena. The overall prevalence of bursting was somewhat higher than that of extinction-induced aggression. Nevertheless, both side effects were less likely when extinction was combined with alternative procedures.

Results showed that only a small proportion of cases were characterized by response bursts or increases in aggression when extinction was implemented as a component of a treatment package rather than as the sole intervention (at least one side effect occurred in 20% of the former cases and 62% of the latter). This finding suggests that the occurrence of these side effects may be minimized in clinical settings when extinction is combined with differential reinforcement, NCR, or antecedent manipulations. Although this outcome replicated that obtained by Lerman and Iwata (1995), the overall prevalence of the burst in the current study was somewhat higher than that reported previously (i.e., 39% vs. 24%). One possible reason for this difference was that data on SIB in the current study were collected during relatively brief (10- to 15-min) sessions. Conversely, much of the published data analyzed in the earlier study were collected and summarized across lengthier observation periods (e.g., several hours), which might obscure short-lived extinction bursts. This finding suggests that even fleeting response bursts can be reduced by combining extinction with alternative procedures.

Nevertheless, additional research is needed to identify strategies that might reduce the likelihood of these side effects, which could be problematic in applied settings. Extinction bursts and extinction-induced aggression could be mitigated even further by using certain reinforcement parameters (e.g., rich schedules of reinforcement during differential reinforcement) or specific procedures (e.g., DRA rather than antecedent manipulations), or by combining extinction with more than one alternative procedure (e.g., differential reinforcement plus demand fading). Such factors could not be identified in the current analysis because specific treat-

[1] Prevalence data for cases in which SIB was maintained by access to attention were combined with those for cases in which SIB was maintained by access to materials because of the small proportion of cases having either function.

ment components varied widely among the cases. Although results suggested that bursting was most likely to occur for cases maintained by social negative reinforcement (i.e., escape from demands), the relationship between behavioral function and the prevalence of extinction-related side effects also warrants further investigation. A thorough analysis of this relationship was not possible because some maintaining consequences (e.g., access to materials, automatic reinforcement) were represented by a small number of cases.

Other conclusions presented here must remain tentative for several reasons. First, the effects of alternative procedures on the occurrence and severity of extinction bursts and extinction-induced aggression were not examined on a within-subject basis. For example, it is not possible to determine whether participants who did not show an increase in aggression when extinction was implemented as part of a treatment package would have done so if extinction had been implemented alone. Second, 10 of the 11 participants who received two treatments (extinction alone and extinction combined with alternative procedures) were exposed to the treatment package prior to extinction alone. As such, the prevalence of side effects during extinction alone may have been underestimated because of the participants' prior experience with extinction. Further analysis of the data, however, showed that the prevalence of bursting and aggression for these individuals was similar to that for individuals who received extinction alone as their initial treatment. Third, the generality of these findings may be limited to individuals who receive treatment for SIB rather than for other behavior disorders (e.g., disruption). Fourth, results may not be applicable to other dimensions of extinction bursts that have been reported in the literature, such as increases in the intensity or variability of behavior.

Finally, it is not clear why extinction was associated with increases in aggression. It has been suggested that the withdrawal of reinforcement for responding can be an aversive event, eliciting attack responses similar to those observed when laboratory subjects are exposed to shock, intense heat, or physical blows noncontingent on behavior (Azrin, Hutchinson, & Hake, 1966). Termination of the response–reinforcer relationship while treating SIB might have elicited attack responses similar to those observed in basic studies on extinction-induced aggression. Alternatively, if aggression was a member of the same response class as SIB, extinction might have occasioned aggression by inducing response variability (Goh & Iwata, 1994). Further research on the characteristics and etiology of extinction-induced aggression is needed to better identify strategies that would minimize the occurrence of this side effect in clinical settings, where extinction is a common component of treatments for problem behavior.

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STUDY QUESTIONS

1. What side effects of extinction have been reported, and why is it important to establish the prevalence of these effects?

2. The results of functional analyses for participants in this study indicated that their SIB was maintained by escape from demands, access to attention, access to materials, or automatic reinforcement. Briefly describe how extinction might be implemented for each of these functions.

3. What were the authors' criteria for the occurrence of side effects during extinction? Describe an alternative method for identifying these side effects.

4. What two methods were used for calculating reliability? Why wasn't an interval measure used for all of the data?

5. What was the prevalence of side effects in this study? How did the presence of additional treatment components influence the occurrence of side effects?

6. Side effects appeared to be most common when extinction was applied to behavior maintained by negative reinforcement. What features of the demand context (or of extinction used in such a context) might account for this finding?

7. What behavioral mechanism is most likely responsible for the reduction of extinction-induced responding when differential reinforcement is combined with extinction?

8. The authors suggested that observed increases in aggression may have been either "elicited" or merely were occurrences of behavior that shared functional characteristics with SIB. How might one identify the function of extinction-induced aggression?

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