An Approach to Identifying the Conditions Under Which Response Interruption Will Reduce Automatically Reinforced Problem Behavior

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ABSTRACT

Response interruption is a common intervention for problem behavior maintained by automatic reinforcement, but this intervention is challenging for caregivers to implement with consistent fidelity. In the current study, we challenged the integrity of response interruption across two participants by examining carry over into conditions in which the procedure was not implemented, by removing the presence of an interventionist, and by introducing delays to implementation. The results indicated that these challenges severely compromised treatment efficacy. Conditions under which response interruption procedures are likely to be effective and possible strategies to increase the effectiveness of response interruption are discussed.

Keywords: automatic reinforcement, carry-over effects, children, developmental disabilities, problem behavior, response interruption, stimulus control, treatment integrity

Automatic reinforcement describes an operant behavior-environment relation in which the maintaining reinforcers are a direct consequence of the behavior rather than the reinforcers being mediated by another person (Vaughan & Michael, 1982). The concept of automatic reinforcement has been particularly useful in the assessment of problem behavior because some problem behavior has been shown to be insensitive to the reactions of other members of the social environment and appear to be reinforced by the products of the behaviors themselves (Vollmer, 1994). For example, repetitive hand-flapping often occurs among individuals with autism and will persist even in the absence of social interaction. The concept of automatic reinforcement implies that the problem behavior is indeed operant (i.e., maintained by a source of reinforcement), but that the source of reinforcement may be the visual or tactile stimulation hand-flapping produces (Rincover, Cook, Peoples, & Packard, 1979).

Problem behaviors maintained by automatic reinforcement pose several

challenges for practitioners. First, the general term automatic reinforcement does not specify the reinforcer type. Second, once identified, these sources of reinforcement are difficult to directly manipulate and control given automatic sources of reinforcement are rarely accessible to the practitioner. For instance, it is relatively easy for a practitioner to withhold their attention following the occurrence of problem behavior and to deliver attention contingent upon a more desirable behavior, as in a typical treatment for problem behavior maintained by attention (Iwata, Pace, Cowdery, & Miltenberger, 1994), but it is more challenging to withhold the sensory stimulation experienced by a client striking his head. If the reinforcers for problem behavior have not been identified or cannot be manipulated, satisfactory treatment effects may be difficult to produce.

A few interventions for this class of behavior have been shown to be effective. One such treatment, known as response interruption, involves a practitioner or caregiver remaining in close proximity to the client and manually interrupting

the completion of the response (Ahearn, Clark, MacDonald, & Chung, 2007; Fisher, Lindauer, Altmann, & Thompson, 1998; Hanley, Iwata, Thompson, & Lindberg, 2000; Lalli, Livezey, & Kates, 1996; Lerman & Iwata 1996; McCord, Grosser, Iwata, & Powers, 2005; Reid, Parson, Phillips, & Green, 1993; Slifer, Iwata, & Dorsey, 1984; Smith, Russo, & Le, 1999; Tiger, Hanley, & Bessette, 2006). For example, Reid et al. successfully reduced the stereotypic hand mouthing of two individuals with developmental disabilities by having a therapist place his or her hand in front of the participant's mouth, blocking the participant's hand from entering the mouth.

Although response interruption procedures have been successful treatment approaches for problem behavior maintained by automatic reinforcement, most studies have involved near perfect implementation of these procedures (i.e., immediate and constant implementation by a highly trained therapist who remains in close proximity to the participant). This sort of vigilance may be a challenge for implementation in classrooms and

homes. For instance, even under ideal conditions, it may be challenging for a dedicated caregiver to consistently interrupt each instance of problem behavior, especially if the behavior occurs at high-rates.

Two studies to date have directly manipulated the schedule of response interruption to determine the effects of this intermittency; these studies provided mixed results. Lerman and Iwata (1996) found interruption to be effective at reducing the hand mouthing of one participant even when a therapist only interrupted every fourth response (i.e., 3 out of every 4 attempts to hand mouth were permitted). However, Smith et al. (1999) conducted a replication of Lerman and Iwata's procedures and found intermittent response interruption to be ineffective at reducing chronic self-injurious eye-poking for their participant. This procedure actually produced increases in eye poking during some intermittent implementation schedules.

Intermittency is only one challenge likely to be introduced when implementing response interruption in typical environments. There are likely to be times when (a) an individual who engages in problem behavior maintained by automatic reinforcement will not be closely monitored, or (b) a caregiver will be present, but will be unable to implement response interruption, such as when a parent is cooking a meal or when a teacher is instructing another student. It is possible that the effects of response interruption under some conditions may result in a generalized suppression of problem behavior under other conditions. This effect may be more probable if sufficient common stimuli are programmed across environments. However, it is also possible that implementing response interruption under only some conditions may result in an increase in problem behavior under other conditions, a phenomenon referred to as behavioral contrast (Reynolds, 1961).

Even when present, it is also unlikely that a caregiver will be able to immediately interrupt each instance of problem behavior. For instance, in a typical classroom, a teacher may observe a child hand-flapping from across the room and need to walk over to implement interruption. Research findings indicate that the longer the delay between a response and the delivery of a contingent aversive consequence, the smaller the suppression of the response (Baron, Kaufman, & Fazzini, 1969), and that even brief delays (i.e., 10 s or 20 s) may compromise suppressive effects (Goodall, 1984).

Little is known about the efficacy of response interruption under these challenging conditions and, importantly, if treatment effects can be maintained under these conditions. If near perfect integrity is required, and thus high-levels of staff resources are necessary to maintain treatment effects via response interruption, then alternative treatment strategies will need to be developed. However, if the effects of interruption can be maintained when implemented less than perfectly, response interruption may continue to be valuable. The purpose of the current study was to evaluate two types of challenges to the procedural integrity of response interruption procedures for

problem behavior maintained by automatic reinforcement. We evaluated the carry-over effects of implementing response interruption into non-therapeutic settings and introduced varying delays to the implementation of interruption procedures.

Method

Participants and Setting

Both participants were referred by caregivers for the assessment and treatment of problem behavior. Kevin was a 12-year-old boy with multiple diagnoses including autism spectrum disorder (ASD), cerebral palsy, traumatic brain injury, and a genetic disorder involving deletion of chromosome 6 and duplication of chromosome 3. Kevin engaged in self-injurious skin picking that resulted in numerous open lesions to his arms, legs, and torso. Ryder was a 19-year-old man diagnosed with ASD who engaged in repetitive twirling of others' hair. All diagnoses were made by medical professionals independent of the current study and were reported to us by the child's parent (Kevin) or were determined from his school records (Ryder). We conducted Kevin's sessions in a therapy room at a psychology clinic equipped with a video camera that allowed observation from an adjacent media room. We conducted Ryder's sessions in unused classrooms at his school.

Measurement and Interobserver Agreement

We defined Kevin's self-injurious skin picking as the movement of his fingertips or fingernails with pressure on his skin or clothing or contact of Kevin's hand with the therapist's hand (the latter was included to capture interrupted attempts during response interruption phases). Each response was scored to yield a per observation count. We counted a continuous movement as one instance until Kevin (a) paused for greater than 1 s between picks, (b) switched hands, or (c) changed locations on his body or clothing location a distance greater than 3 in from the original location. We defined Ryder's hair twirling as contact of Ryder's finger(s) to the therapist's head or contact of Ryder's hand to the therapist's hand (again the latter was included to include interrupted responding). We counted continuous movements as one instance of behavior until Ryder (a) paused for greater than 1 s between hair twirls or (b) twirled in a different location on the therapist's head (regardless of distance).

A second observer simultaneously, but independently, recorded target behaviors using hand-held computers during 55% of functional-analysis sessions and 45% of treatment-evaluation sessions for Kevin and during 40% of functional-analysis sessions and 41% of treatment-evaluation sessions for Ryder. We determined interobserver agreement by dividing each session into 10-s intervals and comparing observers' records on an interval-by-interval basis. We provided each interval in exact agreement a score of 1 and all other intervals a proportional agreement score by dividing the smaller score by the larger

score. We then summed the score of each interval, divided the sum by the total number of intervals, and converted this score to a percentage. We trained novice data collectors until their data was at least 85% in agreement with another primary data collector for three consecutive sessions prior to including their data in this study.

The mean agreement score for the frequency of skin picking was 91% (range, 65% to 100%) throughout all functional-analysis sessions and 91% (range, 47% to 100%) throughout all treatment-evaluation sessions for Kevin. The mean agreement score for the frequency of hair twirling was 95% (range, 91% to 98%) throughout all functional-analysis sessions and 96% (range, 81% to 100%) throughout all treatment-evaluation sessions for Ryder.

Procedures

Preference Assessments. We identified leisure items for direct assessment based on results of the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) completed with a parent for Kevin and a teacher for Ryder (Fisher, Piazza, Bowman, & Amari, 1996). We then conducted a paired-item preference assessment as described by Fisher, Piazza, Bowman, Hagopian, Owens, and Slevin (1992) with each participant to identify a preference hierarchy of leisure items that we incorporated into both participants' functional analyses and Ryder's treatment evaluation.

Functional Analysis. Each participant experienced a functional analysis similar to that described by Iwata et al. (1982/1994) to identify variables that occasioned and maintained problem behavior. Each session was 10 min in duration for both participants. During the *attention* condition, the participant had continuous access to a moderately preferred leisure items; the therapist ignored the participant except to deliver a mild reprimand upon the occurrence of problem behavior (e.g., "Don't do that, you might hurt yourself"). This condition tested behavior's sensitivity to social positive reinforcement in the form of attention. During the *escape* condition, the therapist continuously presented academic instructions using a graduated prompting sequence (e.g., vocal, model, and physical guidance), delivered praise following task completion after a vocal or model prompt, and delivered a 30-s break from instructions following an instance of problem behavior. This condition tested behavior's sensitivity to negative reinforcement in the form of escape from challenging tasks. During the *ignore* condition, the therapist was present in the room ignoring all behavior exhibited by the participant. This condition tested behavior's sensitivity to automatic sources of reinforcement. During the *toy-play* condition, the participant had free access to highly preferred leisure items, and the therapist delivered continuous attention without delivering instructions or providing consequences for problem behavior. This condition served as a control by eliminating the reinforcement contingencies tested in each of the previously described test conditions. In order

to minimize the risk of infection due to Kevin's skin picking, we cleaned all open wounds and provided first aide following each session in which his skin picking resulted in any bleeding during this functional analysis and all subsequent treatment sessions.

At the completion of Kevin's functional analysis, we verified skin pickings' sensitivity to automatic reinforcement by conducting an extended number of ignore sessions in which we did not delivery any social consequences for skin picking. We also alternated ignore sessions with sessions of an alone condition to determine if Kevin's skin picking was more likely to occur in the absence of a direct observer. During the *alone* condition, Kevin was alone in the therapy room while the therapist and data collectors observed in another room through the use of video-monitoring equipment. At the completion of Ryder's functional analysis, we conducted a series of toy-play sessions to also verify his behavior persisted in the absence of social consequences.

Treatment Evaluation (Kevin). We evaluated Kevin's skin picking in both ignore and alone contexts during 10-min sessions. The therapist was present in the room with Kevin during ignore sessions; Kevin was alone in the same room during alone sessions (observed through video monitoring). During *baseline* conditions in both contexts, the therapist did not provide any programmed consequences for skin picking. We implemented *response interruption* initially in the ignore context. These sessions were similar to those of baseline except the therapist sat directly to the side of Kevin and immediately, manually disrupted the occurrence of a skin pick by placing Kevin's hands in his lap for 1 s. Response interruption sessions in the alone context operated similarly except that the therapist stood outside the therapy room with her hand on the door and observers vocally notified her through an open cellular-phone line when a skin pick occurred. She then entered the room and implemented the interruption procedure. We manipulated the latency between the onset of the skin pick and the implementation of the interruption procedure across conditions; we programmed these delay latencies to be 0 s (immediate interruption), 3 s, and 30 s across conditions. For instance, during the 0-s condition, immediately upon movement of Kevin's fingers to his clothes or body, the therapist interrupted the occurrence of the behavior and placed Kevin's hands in his lap for 1 s. During the 3-s condition, the therapist waited 3 s following the onset of a skin pick to implement the interruption procedure (the therapist implemented the procedure after the delay interval even if the response was terminated prior to the completion of the interval).

We examined any carry-over effects of implementing response interruption upon a non-treated context by alternating interruption sessions in the ignore context with baseline sessions of the alone context in accordance with a multielement design. This design also allowed for an evaluation of the necessity of having a therapist visually present to implement response

interruption. Finally, we evaluated the effects of introducing delays to implementing response interruption in a combination of reversal and multiple-baseline designs.

Treatment Evaluation (Ryder). We evaluated the effects of response interruption on Ryder’s twirling of others’ hair in two empty classrooms at his school during 10-min sessions. During *baseline* sessions in each classroom, the therapist sat next to Ryder and did not provide any programmed consequences for hair twirling. During *response interruption* sessions, the therapist immediately blocked any reach towards her head and placed Ryder’s hands in his lap for 1 s. During *delay* sessions, the therapist allowed hair twirling to occur for a specified duration prior to interrupting the behavior and placing Ryder’s hand in his lap for 1 s. Similar to Kevin’s analysis, the therapist implemented the interruption procedure following the delay even if the response was terminated prior to the completion of the delay interval. We evaluated carry-over effects of response blocking by alternating treatment sessions in Classroom A with baseline sessions in Classroom B (due to the necessity of a target to engage in hair twirling, we did not conduct an alone evaluation). We programmed delays of 0 s (immediate interruption), 3 s, 15 s, and 30 s in Ryder’s evaluation and evaluated these delays in a combination of reversal and multiple-baseline designs.

Results

Kevin

We saw ambiguous results during the initial functional analysis with generally low levels of skin picking across conditions (Figure 1). We interpreted two possibilities from these data. First, the stimulation provided from the materials and activities present during the social test conditions may have suppressed skin picking. Second, the presence of another individual may have suppressed the occurrence of skin picking. To evaluate these possibilities, we conducted a series of sessions in which neither social consequences nor stimulating activities were available, and we alternated between ignore and alone conditions. The persistence of skin picking in both the ignore condition and alone condition absent of social consequences supports the interpretation of automatic reinforcement of Kevin’s skin picking. The elevated rates of skin picking in the alone sessions relative to the ignore sessions suggested that there was a suppressive effect of the therapist’s presence.

During our initial ignore and alone baselines for evaluating treatments (top and bottom panels of Figure 3, respectively), Kevin engaged in persistent skin picking, although it was higher in the alone context. Skin picking decreased immediately in

Figure 1. Skin picks per min during ignore, attention, toy-play, and escape conditions of Kevin’s initial multi-element functional analysis and additional alone and ignore comparison.

the ignore context when we implemented immediate response interruption. Skin picking continued to occur at variable but high levels in the alone context. We then removed response interruption in the ignore context, and skin picking increased. Skin picking decreased when we returned to immediate response-interruption in the ignore context. There were no consistent increases or decreases in skin picking in the alone context associated with these changes. Therefore, we did not see evidence of either positive or negative carry-over effects in the alone context from implementing treatment in the ignore context.

We then evaluated the effects of increasing the latency to response-interruption by returning to baseline and then implementing the 3-s delay response-interruption condition in the ignore context. This condition resulted in low levels of skin picking similar to those of the 0-s delay condition. We then returned to baseline again, recovered rates of skin picking, and evaluated then observed lower levels of skin picking during the 30-s delayed-interruption condition. These effects of the 30-s delay condition were then replicated.

Given that the reductive effects of response interruption did not generalize to the alone context, we then directly evaluated the effects of response interruption in this context beginning with the 30-s delay condition, which resulted in an immediate suppression of skin picking, but skin picking gradually returned to near baseline levels. Due to the ineffectiveness of delayed interruption in this second context, we evaluated the effects of a close approximation to a 0-s delayed interruption, in which immediately following the onset of a skin pick, the therapist entered the room and implemented the interruption procedure. Skin picking decreased and remained low in this condition. We returned to 30-s delayed-interruption sessions and again saw an increase in skin picking to near baseline levels. When we reinstated 0-s delay condition, we saw a rapid and sustained decrease in skin picking.

Ignore and alone contexts were identical except for the presence of the therapist and yet delayed response interruption was effective only when the therapist was present. From these data, it was apparent that the presence of another individual was an important moderator of the effects of delayed response interruption.

Ryder

Ryder engaged in hair twirling at high levels in the ignore, attention, and toy play conditions of the functional analysis (Figure 3). It was possible that this behavior was multiply maintained by both the automatic consequences (e.g., the feel of the therapist's hair) and also social consequences. To clarify this, we evaluated hair twirling in an extended series of toy-play sessions. Presumably, if hair twirling was maintained solely by social sources of reinforcement (most notably attention), we expected the behavior to decrease over repeated exposure to the toy play condition in which we delivered attention continuously and hair twirling did not result in any additional

attention. Hair twirling persisted in this condition, therefore, we interpreted the persistence of hair twirling during toy-play as an indication of sensitivity to the automatic consequences of this behavior.

During our initial baselines, hair twirling persisted in both Classrooms A and B. A 30-s delay to implementing interruption in Classroom A did not result in a reduction of hair twirling. Briefer delays of 15 s and 3 s showed increased hair twirling in the same classroom. An immediate (0-s delay) interruption procedure in Classroom A reduced hair twirling to near zero. A return to 3-s delayed interruption in this classroom resulted in an increase in the rate of hair twirling even after a history with immediate response interruption. The reinstated 0-s delayed interruption procedure decreased hair twirling to near zero levels.

Hair twirling rates were variable in Classroom B, and we did not see systematic changes in hair-twirling rates associated with treatment introduction and removal in classroom A. Thus, we concluded that there was no evidence of either treatment carry over or behavioral contrast. We then replicated the effects of immediate (0-s delayed) response interruption in Classroom B and saw an immediate reduction in twirling.

Discussion

In the present study, we evaluated multiple treatment integrity challenges that are likely to arise when implementing response interruption in typical settings. One such challenge involved the necessity of a continued implementer presence and continued implementation at all times. In both cases, we saw no evidence of the generality of treatment effects across contexts, despite the fact that the evaluative environments were nearly identical (i.e., the contexts differed only by the presence or absence of a therapist in Kevin's case and only by a classroom in the same building with the same therapist present for Ryder). Thus, it appears that the continuous implementation of response interruption is likely necessary for the success of this intervention.

We also evaluated the role of introducing delays to response interruption. Introducing even brief (3-s to 30-s) delays severely compromised the efficacy of response interruption in 2 of the 3 contexts in which it was evaluated. These findings indicate that not only would a staff member need to be continuously assigned to a client to implement this intervention, but also that the implementer would need to maintain constant vigilance to ensure that each instance of problem behavior is immediately interrupted. This raises perhaps the most serious concerns regarding the practical utility of response interruption. The cost of providing a continuous 1-to-1 staff members is likely prohibitive. In addition, the likelihood of staff maintaining perfect integrity seems low. Thus, although effective under ideal conditions, we caution behavior-analytic practitioners against recommending response-interruption procedures in the treatment of automatically reinforced problem behavior and recommend those practitioners that do so (a) carefully

Figure 2. Results of Kevin's treatment analysis. Skin picks per min during baseline, immediate response interruption, 3-s delayed response interruption, and 30-s delayed response interruption conditions in an ignore context; and skin pick per min during baseline, immediate response interruption, and 30-s delayed response interruption conditions in an alone context.

evaluate and plan the staffing required to maintain treatment efficacy and (b) provide training and follow-up support for staff members to maintain high levels of integrity.

Although we have concerns regarding recommending response interruption given our current state of knowledge regarding the programming of the procedure, delayed response interruption was effective in maintaining reductions in Kevin's skin picking in the ignore context (although not the alone context in the same therapy room). We view this finding as a source of optimism for the use of delayed response interruption in that at least under certain circumstances, it may be possible to arrange the therapeutic milieu in a manner that promotes the maintenance of treatment effects. We hope these data provide an impetus for applied researchers to develop procedures to enhance the practical utility of response interruption.

There are several possible explanations for the efficacy of delayed response interruption in the ignore context relative to the alone context in Kevin's case. For one, Kevin engaged in excessively higher rates of skin picking in the alone condition relative to the ignore condition. Data from Lerman and Iwata (1996) suggested that response interruption may function as a punishment procedure and that the efficacy of the punisher would be determined by the extent to which the punisher competed with the automatic reinforcers acquired through problem behavior. It may have been that due to the higher rates of problem behavior under alone conditions, there was also a higher level (both in terms of frequency and magnitude) of automatic reinforcement available with which the delayed punisher could not compete.

The presence of the therapist during the ignore condition likely also served a discriminative function, resulting in reductions in skin picking under delayed conditions. That is, the presence of another person acquired suppressive properties either based upon the contingencies arranged in this study or based upon a prior history of punishment for picking in the presence of other individuals and likely accounts for the lower levels of skin picking observed under ignore-baseline conditions relative to alone-baseline conditions. The suppressive effects of another person are surely unique to some idiosyncratic learning history as evidenced by Ryder's data for whom neither the presence of another person nor delayed interruption were sufficient to generate or maintain reductions.

Rather than relying on idiosyncratic learning histories, researchers and practitioners may specifically attempt to develop this type of stimulus control during the early stages of response interruption by pairing a highly salient discriminative stimulus with the perfect implementation of the immediate response interruption procedure and then presenting this stimulus in more typical contexts. For example, Piazza, Hanley, and Fisher (1996) paired a colored card with conditions in which cigarette pica would be punished via a mild reprimand. Following this pairing procedure, the card was introduced into novel environments in which continuous observation and punishment was not plausible; the card continued to suppress behavior in these novel environments.

Strategies that have been effective at increasing the success of delayed reinforcement may also increase the success of delayed punishment. One such strategy may involve gradual

Figure 3. Results of Ryder's functional analysis. Hair twirls per min during ignore, attention, toy-play, and escape conditions of Ryder's initial multi-element functional analysis and a brief series of toy-play sessions.

Figure 4. Results of Ryder's treatment analysis. Hair twirls per min during baseline, 30-s, 15-s 3-s, and 0-s delayed response interruption in Classroom A and baseline and 0-s delayed response interruption in Classroom B.

delay fading (Fisher, Thompson, Hagopian, Bowman, & Krug, 2000). Perhaps initiating delays at briefer values or introducing a delay following only a subset of responses would allow for a better starting point to initiate fading.

Another strategy may be to provide either contingent or noncontingent access to competing or substitutable reinforcers during delay periods (Fisher, Kuhn, & Thompson, 1998; Hagopian, Contrucci Kuhn, Long, & Rush, 2005). In the current study, we provided highly preferred leisure items during all baseline and treatment sessions for Ryder, but these materials did not successfully compete with problem behavior. Identifying successful competing items will likely be a challenge for some forms of automatic reinforcement; nevertheless, Piazza, Adelinis, Hanley, Goh, and Delia (2000) outlined procedures for doing so and showed that continuous access to items that provided presumably similar automatic reinforcement was effective in treating automatically-reinforced problem behavior.

Our recommendations for practitioners based upon the results of the current study are regrettably more cautionary than prescriptive. Problem behavior maintained by automatic reinforcement remains one of the most challenging forms of problem behavior to treat. The current state of our applied literature offers some guidance on how to treat these behaviors under tightly controlled conditions, but additional work by applied researchers is sorely needed by those who would serve individuals presenting with these problem behaviors in their homes and their schools.

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Author Note

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