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Effects of delays to response blocking when used as treatment for problem behavior maintained by automatic reinforcement

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EFFECTS OF DELAYS TO RESPONSE BLOCKING WHEN USED AS TREATMENT FOR PROBLEM BEHAVIOR MAINTAINED BY AUTOMIATIC REINFORCEMENT

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ABSTRACT

Response blocking and response interruption are common interventions for problem behavior maintained by automatic reinforcement in the treatment literature, but these interventions may be extremely challenging for caregivers to implement with fidelity (i.e., immediately blocking each instance). We evaluated the effects of challenges to the procedural integrity of response blocking and interruption procedures upon the maintenance of treatment effects for problem behavior maintained by automatic reinforcement for two young men by measuring aberrant behavior under several conditions including a baseline condition, an immediate response blocking or interruption condition, and delayed response blocking or interruption conditions (e.g., 3-s, 15-s, and 30-s delays). The results indicated that even brief delays to implementing blocking and interruption severely compromised treatment efficacy.

INTRODUCTION

Automatic reinforcement describes an operant behavior-environment relation in which the maintaining reinforcement results as a direct consequence of the behavior rather than reinforcement mediated by another person (i.e., reinforcement is independent of the social environment; Vaughan & Michael, 1982). The concept of automatic reinforcement has been particularly useful in the assessment of variables maintaining problem behavior in that some instances have not appeared to be maintained by the reactions of other members of the social environment, but rather have been 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. Rather than conclude that this behavior is biologically based, the concept of automatic reinforcement maintains the notion that the behavior is indeed operant (i.e., maintained by a source of reinforcement), but the source of reinforcement may be the visual or tactile stimulation hand-flapping produces (Rincover, Cook, Peoples, & Packard, 1979). If this were the case, hand-flapping would represent problem behavior maintained by automatic positive reinforcement because the direct sensory consequence of the behavior itself acts as a reinforcer. Automatic negative reinforcement has also been suspected to maintain aberrant behavior, such as self-injurious scratching resulting in pain attenuation (Iwata, Pace, Dorsey, et al., 1994).

Aberrant behaviors maintained by automatic reinforcement pose several challenges for researchers and practitioners involved in the delivery of treatment (Vollmer, 1994). Since the general term automatic reinforcement does not specify the reinforcer (i.e., only specifies reinforcement is not from a social source), reinforcers for problem behavior maintained by automatic sources are often difficult to identify. Once identified, these sources of reinforcement are difficult to directly manipulate and control given that automatic sources of reinforcement are rarely obtainable by a therapist. For instance, it is relatively easy for a therapist to withhold their attention following the occurrence of problem behavior and deliver attention contingent upon a more desirable behavior (i.e., as would be a potential treatment for problem behavior maintained by attention; Iwata, Pace, Cowdery, & Miltenberger, 1994), but it is more challenging to withhold the sensory stimulation experienced by banging one's head. If the reinforcers for aberrant behavior have not been identified or cannot be manipulated, treatment effects may be difficult to produce.

A few interventions for this class of behavior have received empirical support (Vollmer, 1994). One such treatment approach, known as response blocking or response interruption, involves a therapist or caregiver remaining in close proximity to the client and manually blocking or interrupting the completion of the response (Ahearn, Clark, MacDonald, & Chung, 2007; Fisher, Lindauer, Alterson, & 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, and 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. Fisher et al. also used response blocking as part of their procedures to successfully reduce the property destruction of a 7-year-old boy diagnosed with moderate mental retardation, pervasive developmental disorder, and a speech and language delay. The experimenters baited the therapy room with plastic objects, similar to items the participant reportedly destroyed at home, and immediately removed an item when the participant touched any of these objects.

While response blocking and interruption procedures have been successful treatment approaches for problem behavior maintained by automatic reinforcement, most studies have involved the perfect implementation of these procedures (i.e., immediate, constant implementation) which may be a challenge for classroom and home environments. That is, although such procedures can be implemented with near perfect integrity by highly trained clinicians, it is less likely that typical caregivers (e.g., parents, teachers, and home staff) will have the resources necessary to provide 1-to-1 support to continuously monitor and implement response blocking. If such staff resources are necessary to maintain treatment effects via response blocking, then alternative treatment strategies will need to be developed. However, if the effects of blocking can be maintained when implemented less than perfectly, this strategy may continue to be valuable.

Some exceptions to the perfect implementation of blocking procedures exist in the literature. In one such study, McCord et al. (2005) evaluated the effects of challenges to the procedural integrity of response blocking by manipulating the blocking-initiation criteria during treatment evaluations for three participants who engaged in pica (the ingestion of inedible substances). Specifically, these authors examined the efficacy of response blocking when initiated when inedible items were first touched (early in the response chain) or when the items were brought within .3 m of the mouth (later in the response chain). Pica attempts and successes were more prevalent during conditions when therapists initiated blocking later in the response chain for all participants. These results indicated that response blocking may only be effective if initiated early in the response chain in part because blocking later responses in the chain resulted in poorer integrity. That is, the therapists successfully blocked fewer responses, which allowed intermittent reinforcement of this behavior.

Two studies to date have directly manipulated the procedural integrity of response blocking by varying the proportion of blocked responses but provided mixed results. Lerman and Iwata (1996) found blocking to be effective at reducing the hand mouthing of one participant even when a therapist blocked every fourth response (i.e., 3 out of every 4 attempts to hand mouth was permitted). However, Smith et al. (1999) conducted a replication of Lerman and Iwata’s procedures and found intermittent response blocking to be ineffective at reducing chronic self-injurious eye-poking for their participant. By contrast, this procedure actually produced increases in eye poking during some intermittent-schedule arrangements.

Intermittency is only one challenge likely to be experienced in typical environments for individuals with automatically maintained problem behavior. Not only is it unlikely that a caregiver will be able to block each response, but it is also unlikely that a caregiver will be able to block each response immediately after its occurrence. 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 blocking. Research findings indicate 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 even brief delays (i.e., 10 s or 20 s) may compromise suppressive effects (Goodall, 1984). The effects of these delays to blocking have not yet been evaluated and are the focus of the current study.

The purpose of the current study was to evaluate the effects of challenges to the procedural integrity of response blocking and response-interruption procedures upon the maintenance of treatment effects. For the current research, we measured aberrant behavior under several conditions. First, we measured responses in a baseline condition with no programmed consequences for problem behavior. Next, we evaluated levels of problem behavior under a series of response blocking and interruption conditions, including an immediate response blocking and interruption condition and delayed response-interruption conditions (e.g., 3-s, 15-s, 30-s delays).

METHOD

Participants and Setting

Two young men, referred by caregivers for the assessment and treatment of problem behavior, participated. Kevin was a 12-year-old young man with multiple diagnoses including autism spectrum disorder, 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. We conducted Kevin's sessions in a therapy room at an on-campus psychology clinic that was equipped with a video camera that allowed observation from an adjacent media room. Ryder was a 19-year-old man diagnosed with autism spectrum disorder who engaged in repetitive hair twirling towards others in his classroom. 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 (i.e., blocked or interrupted attempts during response interruption phases) and scored each response using a frequency 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 (7.62 cm) from the original location; any of the above resulted in a new instance scored. 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 to include blocked or 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 compared 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 their data's inclusion in this study.

The mean agreement score for the frequency of skin picking was 90.9% (range, 65% to 100%) throughout all functional-analysis sessions and 91.1% (range, 47% to 100%) throughout all treatment-evaluation sessions for Kevin. The mean agreement score for the frequency of hair twirling was 94.9% (range, 91% to 98%) throughout all functional-analysis sessions and 95.8% (range, 81% to 100%) throughout all treatment-evaluation sessions for Ryder.

Procedures

Preference Assessments. We conducted a paired-choice preference assessment as described by Fisher, Piazza, Bowman, Hagopian, Owens, and Slevin (1992) with each participant. We identified leisure items used in this 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).

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 middle-ranked leisure item (identified via the aforementioned preference assessment); 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. The therapist remained present during this condition to control for possible effects of the presence of a therapist during future treatment conditions (i.e., as opposed to conducting an alone condition without a therapist present). During the *toy-play* condition, the participant had free access to high-ranked 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 establishing operation (via non-contingent reinforcement) and the reinforcement contingency tested in each of the previously described test conditions.

At the completion of Kevin's functional analysis, we verified an automatic function 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 covertly (i.e., 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 verify his behavior persisted in the absence of social consequences and to mitigate other social sources of reinforcement that may have served to maintain this behavior.

Treatment Evaluation (Kevin). Because Kevin's skin picking was directed towards multiple areas of his body, it was not possible to proactively block instances of skin picking without disrupting every hand movement (i.e., appropriate or inappropriate). Therefore, we evaluated response interruption in lieu of response blocking. We evaluated the effects of immediate and delayed response interruption upon Kevin's skin picking in ignore and alone contexts.

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 conducted *interruption* sessions similarly to those of baseline except the therapist sat directly to the side of Kevin (ignore context) or just outside the session room door (alone context) and manually disrupted the occurrence of a skin pick by placing Kevin's hands in his lap for 1 s. During sessions of the alone context, observers notified the therapist when a skin pick occurred so she may enter the room and implement the disruption procedure. We manipulated the latency between the onset of the skin pick and the implementation of the interruption procedure as the independent variable in this study; 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 disrupted 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 evaluated the effects of these delays to implementing response interruption in a combination of reversal and multiple-baseline-across-contexts designs.

Treatment Evaluation (Ryder). We evaluated proactive response blocking in Ryder's case because the therapist was able to discriminate target hand movements from other appropriate hand movements (i.e., Ryder always directed his twirling to the therapist's head). We evaluated the effects of response blocking on Ryder's hair twirling in two empty classrooms at his school. During baseline sessions in each classroom, the therapist sat next to Ryder and did not provide any programmed consequences for hair twirling. During *blocking* sessions, the therapist immediately blocked any reach towards her head and placed Ryder's hands in his lap for 1 s. During *delayed-blocking* 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 programmed delays of 0 s (immediate blocking), 3 s, 15 s, and 30 s in Ryder's evaluation and evaluated these delays in a combination reversal and multiple-baseline-across-classrooms designs.

RESULTS

Kevin

We present the results of Kevin's functional analysis in Figure 1. We saw ambiguous results during the initial multi-element comparison with generally low levels of skin picking across conditions (*Ms* = 0.5 skin picks per min during ignore, 0.3 during attention, 0.5 during toy-play, and 0.3 during escape conditions). 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 (i.e., it may have been higher under covert conditions). 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 (white circles; *M* = 1.1 skin picks per min) and alone condition (gray circles; *M* = 7.7 skin picks per min), 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.

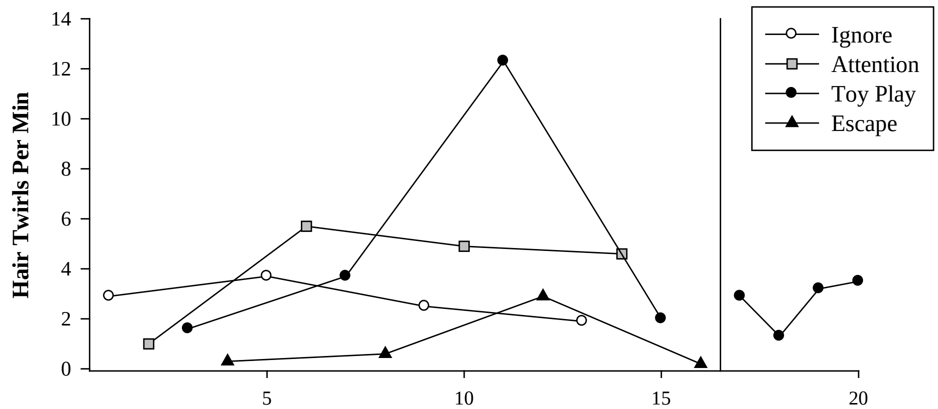

Figure 1. Results of Kevin's functional analysis. Skin picks per min during ignore, attention, toy-play, and escape conditions of Kevin's initial multi-element functional analysis and additional alone and ignore comparison

We present the results of Kevin's treatment analysis in Figure 2 with data for the ignore context shown in the top panel and data for the alone context in the bottom panel. Initially, we evaluated the effects of immediate response-interruption upon skin picking in the ignore context where Kevin engaged in 1.1 skin picks per min during baseline. Skin picking decreased immediately when we implemented response interruption immediately following each instance of skin picking (M = 0.1). We then removed response interruption, and skin picking increased to a mean of 1.3 rpm. We returned to the immediate response-interruption condition and skin picking decreased to a mean of 0.07 rpm which equates to a 94% reduction of skin picking relative to baseline. We then evaluated the effects of delaying the latency to response interruption implementation by returning to the baseline conditions *(M* = 1.0 skin picks per min) followed by the 3-s delayed response interruption condition. This condition resulted in low levels of skin picking (M = 0.05*)* similar to those of the immediate-interruption condition. We then returned to baseline again (M = 0.5) and evaluated the effects of the 30-s delayed-interruption condition. This condition also resulted in low levels of skin picking (M = 0.1), similar to the immediate interruption condition. We then replicated the effects of the 30-s delay condition in a reversal design by returning to baseline (*M* = 0.4) and again implementing the 30-s delayed-interruption condition, during which skin picking decreased to and maintained at near-zero levels (*M* =0.05).

We then evaluated the effects of the 30-s delay in the alone context. Kevin skin picked at variable but substantially higher rates during the baseline of the alone context (*M* = 5.2). We implemented the 30-s delayed-interruption condition in which 30 s following the occurrence of a skin pick, the therapist entered the room and implemented the disruption procedure. This resulted in an immediate suppression which gradually returned to near baseline levels (*M* = 2.5). Due to the ineffectiveness of delayed interruption in this second context, we evaluated the effects of immediate interruption, in which immediately following the onset of a skin pick, the therapist entered the room and implemented the interruption procedure. Skin picking decreased to a mean rate of 0.2 rpm (a 96% reduction from baseline). We returned to 30-s delayed response interruption sessions and again saw an increase in skin picking to near baseline levels (*M* = 3.1 rpm). We reinstated immediate response interruption and saw a rapid and sustained decrease of skin picking (*M* = 0.07 rpm; a 99% reduction compared to baseline).

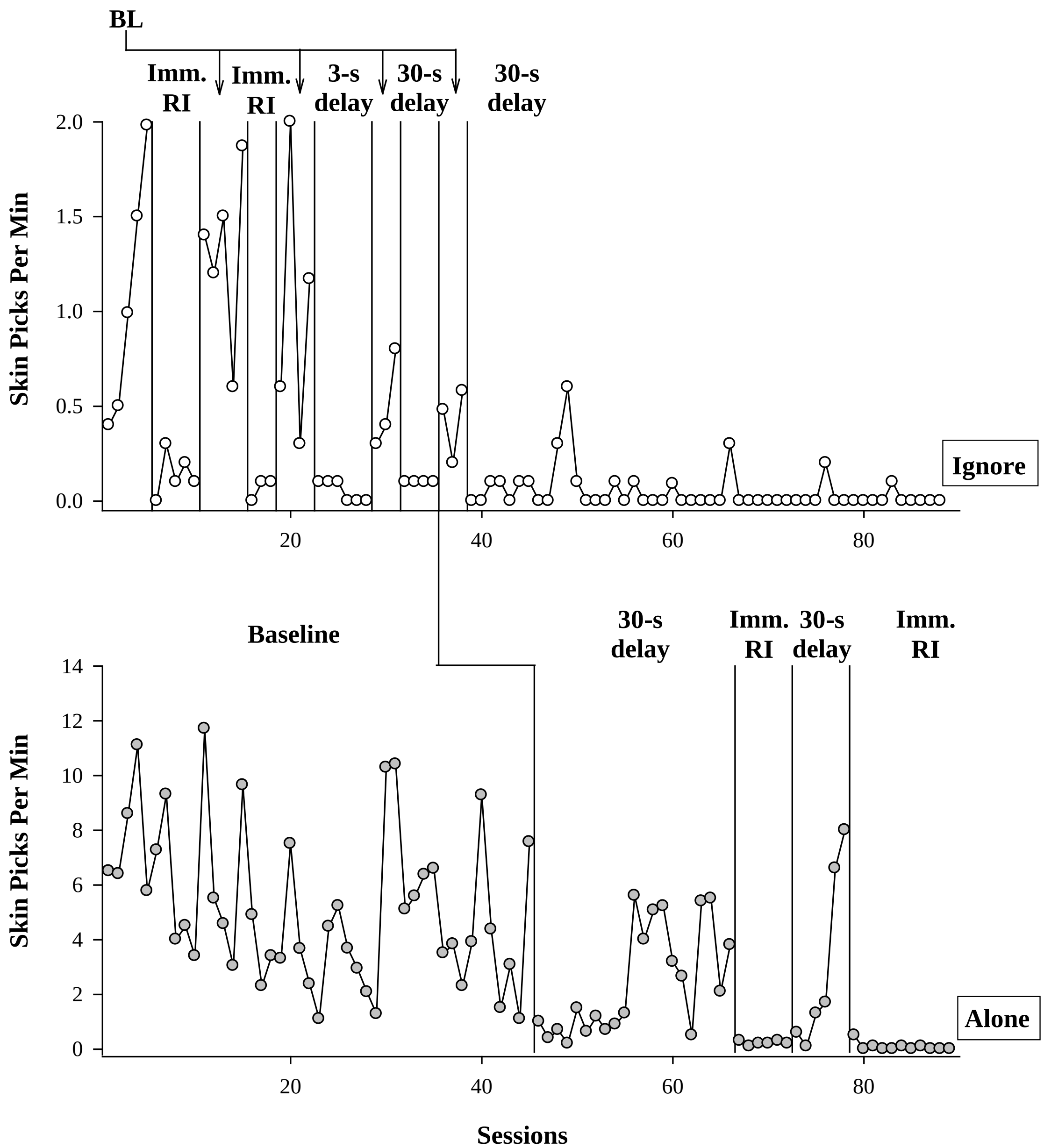

Figure 2. Results of Kevin's treatment analysis. Skin picks per min during baseline, immediate response interruption, 3-s delayed response interruption, and 30-s delayed response interruption conditions in an alone context; and skin pick per min during baseline, immediate response interruption, and 30-s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

Ryder

We present the results of Ryder's functional analysis in Figure 3. In our initial multi-element comparison, Ryder engaged in hair twirling at high levels in the ignore condition (white circles; *M* = 2.8 rpm) but also at high levels in the toy-play condition (black circles; *M* = 4.9 rpm) and in the attention condition (gray squares; *M* = 4.1). 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 a condition in which we delivered attention continuously and hair twirling did not result in any additional attention. We interpreted the persistence of hair twirling during toy-play sessions (*M* = 2.7 rpm) as an indication of sensitivity to the automatic consequences of this behavior; however, sensitivity to attention was also a possibility. To marginalize the effects of attention as a reinforcer for hair twirling, we conducted the remainder of Ryder's treatment evaluation in the context of toy-play sessions similar to those of the functional analysis.

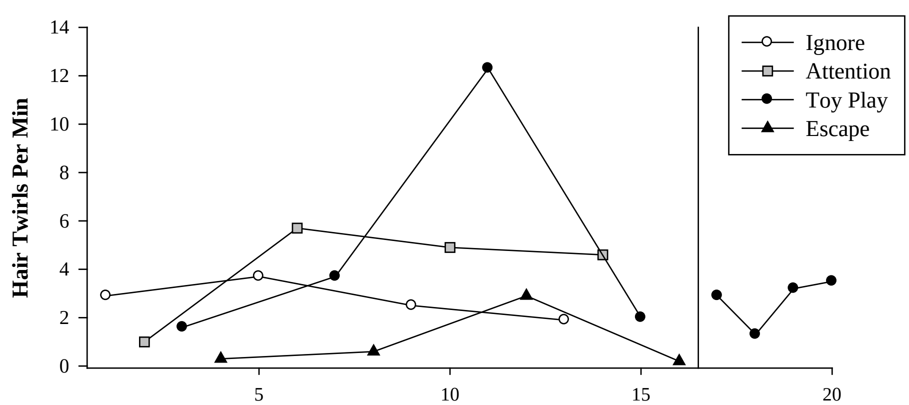

Figure 3. Results of Ryder's functional analysis. Hair twirls per min during ignore, attention, toy-play, and escape conditions of Ryder's initial multi-element functional analysis and a brief series of toy-play sessions.

We show the results of Ryder's treatment analysis in Figure 4 with data from Classroom A in the top panel and data for Classroom B in the bottom panel. We began our treatment evaluation in Classroom A following the extended series of toy-play sessions which served as an initial baseline (*M* = 2.7 hair twirls per min). Unlike Kevin's evaluation in which we initiated treatment with perfect integrity (i.e., immediate disruption), we initiated Ryder's evaluation with a 30-s delay to implement the disruption; this treatment did not result in a reduction of hair twirling (*M* = 2.0). We then evaluated briefer delays of 15 s and 3 s that corresponded with increased hair twirling (*Ms* = 4.4 and 6.1, respectively). Next, we evaluated an immediate, proactive-blocking procedure which reduced hair twirling to 0.7 responses per min. We returned to 3-s delayed response blocking and saw an increase in the rate of hair twirling (*M* = 3.4 rpm) even after a history with immediate response blocking. We then reinstated immediate response blocking and hair twirling again decreased to near zero levels (*M* = 0.5; an 82% reduction in hair twirling from the initial baseline).

We then replicated the effects of immediate response blocking in Classroom B where Ryder hair-twirled at high, variable rates (*M* = 6.5) during baseline. When we implemented response blocking without delays, we saw an immediate reduction in twirling (*M* = 0.1; a 98% reduction from baseline).

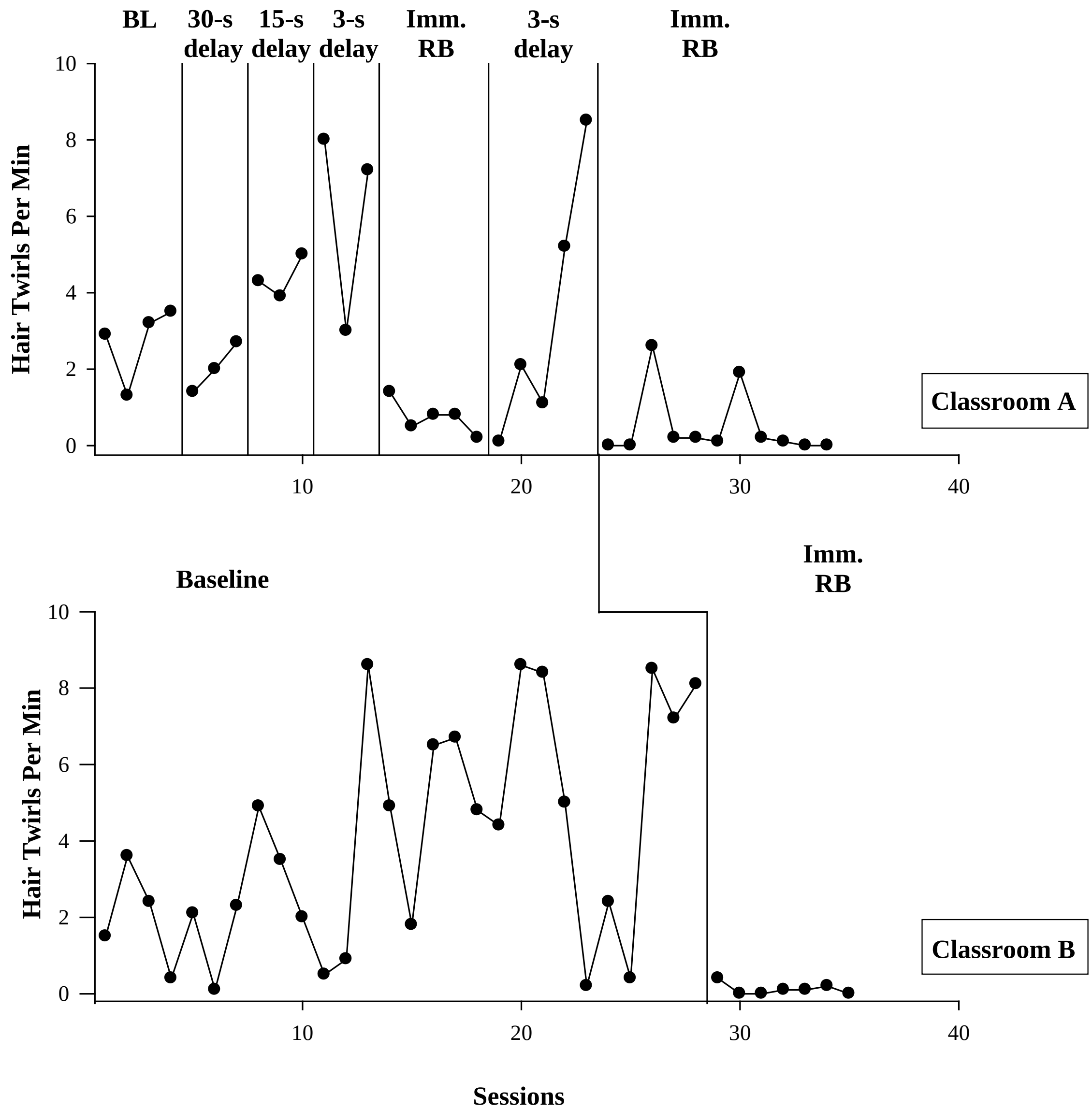

Figure 4. Results of Ryder's treatment analysis. Hair twirls per min during baseline, 3-s delayed response blocking, 15-s delayed response blocking, 30-s delayed response blocking, and immediate response blocking conditions in Classroom A; Hair twirls per min during baseline and immediate response blocking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

DISCUSSION

In the present study, we examined treatment integrity failures in the implementation of response blocking and response interruption by introducing delays from the onset of a behavior to the implementation of response disruption with two young men referred for problem behavior maintained by automatic reinforcement. We evaluated these delays across three experimental contexts and found that delays severely compromised treatment efficacy in two of these three evaluations. Kevin's ignore analysis was the one exception, during which treatment efficacy maintained during 30-s delays to implementation.

Typically, research evaluating the effects of compromised treatment integrity has initiated treatment with near perfect integrity and then gradually introduced challenges to determine the point at which treatment gains dissipate (as did we in Kevin's treatment analysis; see also Kelley, Lerman, & Van Camp, 2002; Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000; Vollmer, Roane Ringdahl, & Marcus, 1999). Although conducting a phase of high-integrity treatment implementation followed by a phase of low-integrity implementation is common, this introduces sequence effects as a potential confound that hiders interpretations of the persistence of these interventions. That is, it may be that exposure to initially high-integrity treatment results in greater persistence of treatment effects when faced with integrity challenges than would be the case if clients' problem behavior was exposed to lesser-integrity treatments from the onset of the intervention; the latter is likely the case when treatments are initiated by indigenous caregivers such as parents and teachers. We addressed this methodological limitation in Ryder's evaluation by initiating treatment at compromised levels (i.e., a 30-s delay) and increased treatment integrity until we observed satisfactory treatment effects. In this case, treatment initiated with less than optimal integrity was not effective at reducing problem behavior; response blocking was only effective when implemented prior to the completion of the target response. These results do not suggest that all maintenance of treatment effects presented in prior literature were due to sequence effects, but rather suggest that varying the order of exposure to high- and low-integrity treatments is likely important in future treatment-integrity research.

The current study differed from the extant response-blocking literature in that we only evaluated the effects of “blocking” with Ryder as our therapist was able to discriminate target behavior from non-target behaviors. When behavior is highly variable in topography, such as picking at multiple locations as in Kevin’s case, it can be difficult to discriminate between target behaviors and non-target movements, such as yawning, resting one’s hand on his or her head, or tapping one’s knee. Rather than suppress all of these behaviors, we instead evaluated response disruption by allowing the behavior to occur briefly. It is possible, or even likely, that allowing even brief exposure to the automatic reinforcement may result in greater persistence of responding than would be the case if all responses could be proactively blocked. The effects of this change may be important to consider in determining treatment strategies as some have questioned the mechanism by which response blocking results in behavioral suppression.

Lerman and Iwata (1996) and Smith et al. (1999) presented data suggesting that response blocking could serve as either an extinction procedure (i.e., to the extent that blocking prevents or attenuates the sensory consequences of the behavior) or a positive punishment procedure (i.e., to the extent that the contingent physical contact is responsible for the reductions in behavior). Therapists in these studies blocked only a subset of responses with the notion that if blocking served as an extinction procedure, intermittent blocking should approximate an intermittent schedule of reinforcement and result in increases in the target behaviors, and if blocking served as a punisher, intermittent blocking should continue to suppress the target behavior. Results were idiosyncratic across both studies, suggesting that either process may be operating in any given case. We observed similar idiosyncratic effects in the current study given that delayed blocking resulted in suppression of skin picking during Kevin's ignore evaluation (consistent with the treatment effects attributed to punishment) but persisted during Kevin's alone evaluation and in Ryder's Classroom-A evaluation (consistent with treatment effects attributed to extinction).

Overall, the results of our study were most similar to those of Smith et al. (1999) in that challenges to the integrity of response blocking resulted in compromised treatment efficacy. The combined results of our study and those of Smith et al. raise serious concerns regarding the applied utility of response interruption in practice. Although the available literature shows when implemented properly response blocking and interruption can be successful in eliminating problem behavior maintained by automatic reinforcement (e.g., Reid et al., 1993), this treatment is relatively fragile and fails to result in sustained behavioral improvement even under weak challenges (e.g., a 3-s delay to implementation). Increasing the "robustness" of this intervention to withstand these challenges is therefore a crucial area for future research.

One such strategy may be to evaluate the effects of programming for stimulus control by pairing discriminative stimuli with the perfect implementation of the immediate response blocking or interruption procedure. 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. Programming for similar stimulus control during blocking may suppress problem behavior under more challenging conditions. This type of stimulus control may have been active during Kevin's treatment evaluation in that Kevin picked at near zero levels even as we increased delays to the interruption procedure when a therapist was present during ignore conditions, but during otherwise identical alone conditions Kevin continued to skin pick until we implemented the interruption procedure immediately (i.e., the therapist's presence appeared to be a suppressive discriminative stimulus).

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 delay fading. For example, Fisher, Thompson, Hagopian, Bowman, and Krug (2000) taught participants to tolerate delays to reinforcement during functional communication training (FCT) using a delay-fading procedure. Their first participant engaged in destructive behavior maintained by attention, and although teaching an appropriate request for attention (i.e., a hand clap) effectively reduced problem behavior, high rates of appropriate communication required the therapist to provide near continuous attention. In order to make this treatment feasible at home and in school, the authors introduced and gradually increased delays to reinforcement. Specifically, these authors increased delays to reinforcement delivery if problem behavior remained at least 95% below baseline levels for 5 consecutive sessions. Over the course of 22 sessions, these authors successfully increased delays from a 0-s to 30-s delay. For two remaining participants, whose problem behaviors were maintained by access to tangible items, delays to reinforcement were similarly introduced and gradually increased from 1 min to 10 min and 2 min to 10 min, respectively. Incorporating delay-fading procedures may increase the effectiveness of response blocking at maintaining treatment effects under more challenging settings. In the current study, treatment effects were compromised even at 3-s delays for Ryder; perhaps initiating delays at briefer values or introducing a delay following only a subset of responses would allow for a starting point to initiate fading.

Another strategy may be to provide either contingent or non-contingent access to competing or substitutable reinforcers during delay periods. For instance, Fisher, Kuhn, and Thompson (1998) demonstrated the effects of an additional DRA contingency by teaching two individuals to request a preferred leisure item during periods in which a functional reinforcer (i.e. attention) was unavailable; this additional DRA resulted in reductions in destructive behavior during these periods. Hagopian, Contrucci Kuhn, Long, and Rush (2005) provided non-contingent access to leisure items that successfully competed with problem behavior during delayed reinforcement conditions and found more stable reductions of problem behavior when these items were provided. 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.

A final strategy to increase the efficacy of delayed response interruption may be to include a more intense punisher. Fisher et al. (2000) evaluated the effects of an additional punishment procedure (i.e., a 30-s basket-hold time-out contingent upon each occurrence of destructive behavior) when rates of destructive behavior did not decrease under conditions of delayed reinforcement during an FCT evaluation. The additional punishment component not only effectively reduced problem behavior during delayed reinforcement but also resulted in increased appropriate communication. Future research should focus on evaluating the additive benefits of these components at increasing the success of delayed treatments. Similar to the effects of response interruption, the fidelity of an alternative or additional punishment procedure will affect treatment outcomes, and these challenges will be important to evaluate.

Introducing delays is a complex treatment integrity challenge in that not only are delays to a potential punisher introduced, but due to the availability of the automatic reinforcement for each behavior, an intermittent schedule of reinforcement is introduced as well. Thus, the evaluation of delays involves both delay and schedule challenges. While a robust challenge to intervention success, delays such as those examined in this study are analogous to those that will be encountered in the natural environments where treatments such as response blocking are likely to be recommended. Identifying the conditions that promote the success of interventions in the face of these challenges will be essential to the long term outcomes of individuals served by behavior analysts. The current study identified the shortcomings of one behavioral intervention and hopefully will set the occasion for research to remedy this problem.

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