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BEHAVIORAL MOMENTUM IN THE TREATMENT OF ESCAPE-MOTIVATED STEREOTYPY

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Descriptive and experimental analyses of stereotypy by a woman with severe mental retardation showed that the behavior was maintained by escape from demands. A sequence of high-probability requests issued immediately prior to a task-related request established a momentum of compliance that increased compliance with task-related demands. Increases in compliance were accompanied by collateral reductions in stereotypic behavior. A mechanism of response covariation, called functional incompatibility, and an animal analogue study for testing the validity of this mechanism are proposed.

DESCRIPTORS: behavioral momentum, functional analysis, basic research, stereotyped behavior, response covariation

Recent research has shown that stereotypic behavior among persons with developmental disabilities can be affected by social contingencies (e.g., Durand & Carr, 1987; Mace, Browder, & Lin, 1987). Most subjects in these studies engaged in high rates of stereotypy when presented with challenging tasks or when the arranged consequence for stereotypy was a brief escape from task-related demands. For such individuals, stereotypic responding appears to be negatively reinforced by the alleviation, attenuation, or postponement of engagement with the task.

Interventions to reduce escape-motivated behavior problems have attacked different aspects of the negative reinforcement process believed to maintain the target response. One approach has been to prevent the target behavior from resulting in alleviation or attenuation of task requirements, thereby placing the response on extinction. Procedurally, this has been accomplished by either guiding compliance with the task (e.g., Parrish, Cataldo, Kolko, Neef, & Egel, 1986) or presenting repeated trials of the task until the subject completes it (Mace et al., 1987; Mace & West, 1986). Another treatment strategy has been to reduce the aversive properties of the task by eliminating some task requirements (e.g., Gaylord-Ross, Weeks, & Lipner, 1980), to select easier tasks (e.g., Weeks & Gaylord-Ross, 1981), or to increase the reinforcement for task completion (e.g., Steege, Wacker, Berg, Cigrand, & Cooper, 1989). A third intervention has been to teach the client to mand trainer assistance for difficult tasks (Durand & Carr, 1987) or to request a break from task engagement (Durand & Kishi, 1987). This strategy is effective presumably because the consequences for the communication response and the problem behavior are of the same class.

Although these analysis-derived interventions for escape-motivated behavior problems have proven effective and appropriate for many cases, there are some situations to which they may not be suited. Consider the example of a large client who engages in high rates of disruptive stereotypy (or other problem behavior) when asked to board a vehicle destined for school or work. Extinguishing the behavior via guided compliance or repeated requests may pose safety and/or practical concerns. Similarly, it may be either impractical or contrary to the client's

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best interests to select an easier task or grant a request to stay at home for the day. Finally, increasing the reinforcement for and during travel, as well as during school or work, may be effective only if the client can first be induced to enter the vehicle.

An alternative intervention that may prove effective in such situations is the high-probability command sequence (Mace et al., 1988). This procedure involves presenting a sequence of commands or requests with which the client is likely to comply at brief intervals immediately preceding the problematic or low-probability command. The sequence increases compliance to the low-probability command by establishing a high rate of reinforcement for compliance contiguous to the low-probability request. Nevin, Mandell, and Atak (1983) used the term *behavioral momentum* to describe the persistence of behavior following a change in reinforcement conditions (e.g., a shift from high-probability to low-probability commands, Mace et al., 1988).

Increasing compliance with task-related demands may have a collateral effect of reducing problem behaviors that are maintained by escape from these demands. Several researchers have found that reinforcing compliance results in covariant reductions in unwanted behaviors such as aggression, self-injury, and crying (e.g., Parrish et al., 1986) without knowledge of the function of these behaviors. Further, performance of task-related activities is functionally incompatible with responses that escape or avoid these same activities. The following study investigated the effectiveness of the high-probability command sequence for reducing disruptive stereotypic behavior that was previously maintained by escape from task-related demands.

METHOD

Subject and Setting

Doris, a 38-year-old woman functioning in the severe range of mental retardation (AAMD criteria), served as the subject for this study. She spoke in three- to five-word phrases and appeared to understand simple requests. Doris engaged in repetitive, stereotypic touching of objects and, occasionally, people. The stereotypy interfered with completion of household tasks and socialization with clients and staff. Occasionally, the touching resulted in physical damage to the home (e.g., broken lamps) and to other clients (e.g., scratching).

Doris resided in a university-affiliated group home with two other clients with severe handicaps. All sessions were conducted in the home's living room, dining room, kitchen, and the subject's bedroom. One or two group-home staff and Doris's housemates were present during most sessions.

Target Behaviors and Measurement

The primary target behavior was stereotypic touching responses (STR), defined as any nonadaptive repetitive contact between the subject's hand or foot and an object or person. Repetitive was defined as behaviors having an interresponse time (IRT) of 15 s or less. Examples of STR topographies included pushing papers, kicking a chair, turning on and off a light switch, pushing a staff person, and kicking a client. The secondary target behavior was compliance with low-probability (low-*p*) requests (e.g., "Please hang up your coat," "Please take your plate to the sink."). The definition of compliance with low-*p* and high-*p* (independent variable) requests and the procedures used to identify these requests empirically were identical to those reported by Mace et al. (1988).

During the experimental analysis and the analysis of the effects of the high-*p* request sequence, compliance to low-*p* and high-*p* requests and occurrences of STR were measured using a continuous count within 10-s interval recording procedure. Rate (per minute) of STR and percentage compliance with high-*p* and low-*p* requests were derived from these measurements. A second independent observer collected data during a minimum of 30% of the sessions, distributed evenly across phases and conditions of the study. Mean total, occurrence, and nonoccurrence agreement calculated on a point-by-point basis was 91.9%, 88.0%, and 88.5% for

STR; 98.7%, 95.0%, and 97.9% for compliance with low-*p* requests; and 100% for compliance to high-*p* requests.

Procedures

Descriptive analysis during natural conditions. Prior to conducting an experimental analysis of STR under analogue conditions, hypotheses regarding possible functions of STR were generated from observations of Doris during uncontrolled natural conditions. Data were collected concurrently on STR and naturally occurring events antecedent and subsequent to STR during seven 60-min sessions using a 10-s partial-interval recording procedure (Mace, Lalli, & Pinter-Lalli, in press). Antecedent events were recorded on a continuous basis, STR was recorded as it occurred, and subsequent events were recorded during the two 10-s intervals immediately following each STR. Because of Doris's needs for close staff supervision, the two antecedent categories observed most frequently were *demand* and *no demand/interaction.* A demand event was defined as the interval beginning with a staff instruction for Doris to perform a household task (e.g., set the table, sweep the floor, wipe the furniture) and ending with completion of the designated task. No demand/interaction was scored when Doris was within 2 m of another person and either person was speaking to the other, or when Doris was in the same room with other clients or staff and no tasks were being performed. The two subsequent event categories observed most often were *social disapproval* and *continue instruction and ignore STR.* Social disapproval was defined as any comment by staff or clients disapproving of Doris's STR. Continue instruction and ignore STR was scored when staff continued the instructional procedure (i.e., prompt hierarchy) and made no verbal reference to STR.

Mean occurrence agreement assessed for one of the seven sessions was 91% or higher for STR and each of the antecedent and subsequent event categories.

Experimental analysis during analogue conditions. Data patterns resulting from the descriptive analysis suggested two plausible hypotheses regarding the function of Doris's STR: (a) STR was positively reinforced by attention in the form of social disapproval and (b) STR was negatively reinforced by intermittent discontinuation of task-related demands. Three analogue experimental conditions were designed to test the validity of these two hypotheses. The experimental procedures and rationale were adapted from Iwata, Dorsey, Slifer, Bauman, and Richman (1982). STR was measured using a continuous count within 10-s interval recording procedure to permit calculation of STR per minute. Sessions were 15 min long and were conducted in various rooms of the group home. One session per analogue condition was conducted daily in a random order and separated by a 20-min free-time period.

During the social disapproval condition, the experimenter performed a work-related task (e.g., paperwork) while Doris was free to engage in an activity. Contingent on an STR, the experimenter provided a disapproving comment (e.g., "Doris, don't touch the lamp.") to Doris on a variable-ratio (VR) 4 schedule. This schedule corresponded roughly to the proportion of stereotypic responses that were followed naturally by social disapproval during the descriptive analysis. The experimenter provided no demands or other forms of attention to Doris during this condition.

In the demand condition, the experimenter issued a randomly selected low-*p* request to Doris on a fixed-time (FT) 1-min schedule. Compliance with each low-*p* request was praised enthusiastically, and noncompliance was ignored. If an STR occurred within 20 s of the low-*p* request, the experimenter terminated the task by leaving the room until the start of the next FT interval. No attention was provided for STR. The no demand/interaction condition provided attention to Doris without requests to perform household tasks. The experimenter directed a neutral comment to Doris on a variable-time (VT) 2-min schedule (e.g., "It looks like it might rain, Doris.") All STR was ignored. STR during this condition was expected to be low if its function was to produce either

attention or escape from demands (cf. the play condition, Iwata et al., 1982).

High-probability request sequence. Subsequent to the experimental analysis during analogue conditions, the effects of the high-*p* request sequence on STR were assessed during the demand condition, which was associated with the most STR during the analogue conditions. Procedures were identical to the demand condition during the experimental analysis except that (a) STRs no longer produced escape from the task and (b) the high-*p* request sequence was administered. Immediately prior to issuing low-*p* requests on an FT 1-min schedule, the experimenter issued three high-*p* requests at 10-s intervals (e.g., "Give me five," "Give me a hug," and "Hold my hand."). Compliance with high-*p* and low-*p* requests was praised enthusiastically.

Attention control. This condition was designed to differentiate the effects of experimenter attention from those of discriminative stimuli (high-*p* requests) for behavior maintained by high rates of reinforcement (Mace et al., 1988). On an FT 1-min schedule, the experimenter sat or stood within 1 or 2 m of Doris and directed a sequence of three declarative neutral statements (e.g., "My car goes to the garage today.") to the subject in a pleasant manner immediately prior to the low-*p* request. Intervals between each neutral statement and between the third statement and the low-*p* request were 10 s. Compliance with each low-*p* request was enthusiastically praised.

Experimental Design

A multiple schedule design with reversal components was used to assess the effects of the high-*p* request sequence on STR. Two daily sessions were conducted with two different experimenters. In the first phase of the treatment evaluation, Experimenter 1 conducted the demand sessions without the high-*p* sequence and Experimenter 2 conducted the demand sessions with the high-*p* sequence. Session order was determined randomly each day. The second phase reversed the experimenter–condition pairing, and the third phase replicated Phase 1. Both experimenters administered the high-*p* sequence in the final experimental phase. Periodic sessions of the attention control condition were conducted across all four phases of treatment evaluation (see Figure 2).

RESULTS

Figure 1 presents the results of the descriptive analysis. The left panel indicates the percentage of intervals scored STR within two 10-s intervals of the two antecedent event categories. Occurrences of STR were more probable following a demand event (M = 36.2%) than following a no demand/interaction event (M = 23.2%). The right panel shows the percentage of intervals scored as either of the two subsequent event categories within two 10-s intervals following STR. The distribution of subsequent events given the occurrence of STR showed that most STR was either ignored or did not interfere with instruction (M = 83.1%). However, approximately every fifth interval scored STR (on average) was followed by a disapproving comment from staff or other clients. Readers are referred to Mace and Lalli (in press) and Mace et al. (in press) for detailed discussion of the descriptive analysis and computational formulas.

The results of the descriptive analysis suggested two plausible hypotheses regarding the function of Doris's STR: (a) STR was positively reinforced by social disapproval and (b) STR was negatively reinforced by escape from task-related demands. These hypotheses were then tested in the experimental analysis. The upper left panel of Figure 2 presents the rate of STR during the three analogue arrangements. Stereotypic responses occurred most frequently when STR resulted in a discontinuation of task-related instruction, providing support for the negative reinforcement hypothesis (M = 4.5 STR per minute). Percentage compliance with low-*p* requests during the demand condition averaged only 24% (lower left panel of Figure 2). In the absence of task demands, STR occurred substantially less often regardless of whether attention was response independent (no demand/interaction, M = 0.5 STR per minute) or response dependent (social disapproval, M = 1.3 STR per minute).

The remaining portion of Figure 2 presents the

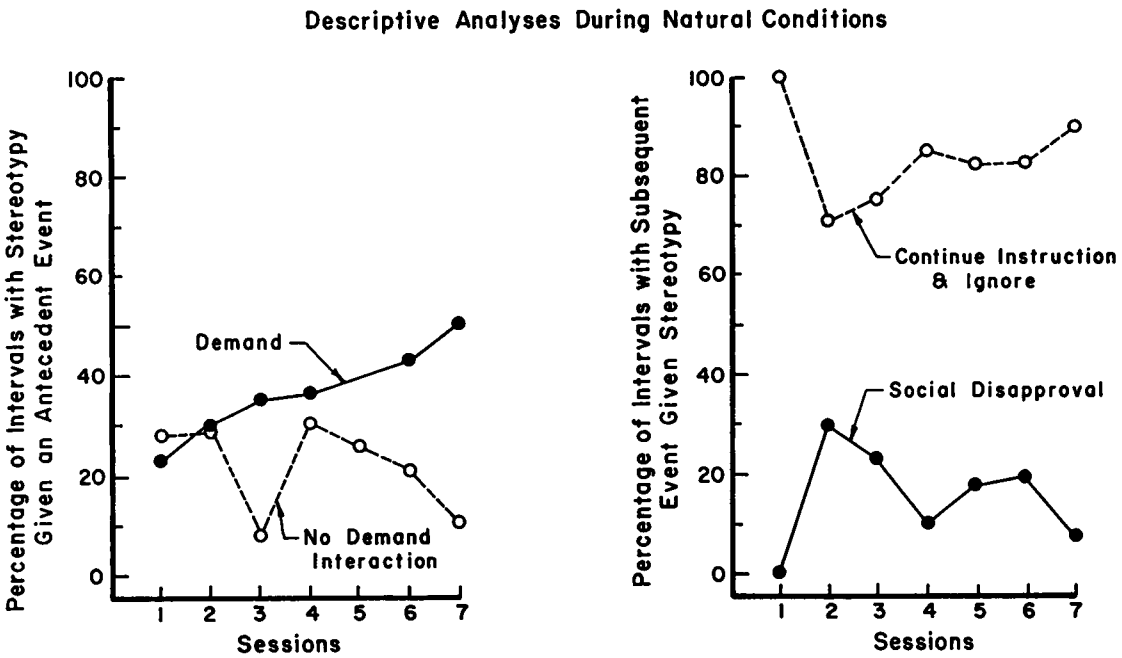

Figure 1. Results of the descriptive analysis of natural conditions. The left panel depicts the percentage of intervals in which stereotypy was observed following two antecedent events: demand and no demand/interaction. The right panel presents the percentage of intervals scored with stereotypy that were followed by two subsequent events: social disapproval and continue instruction/ignore stereotypy.

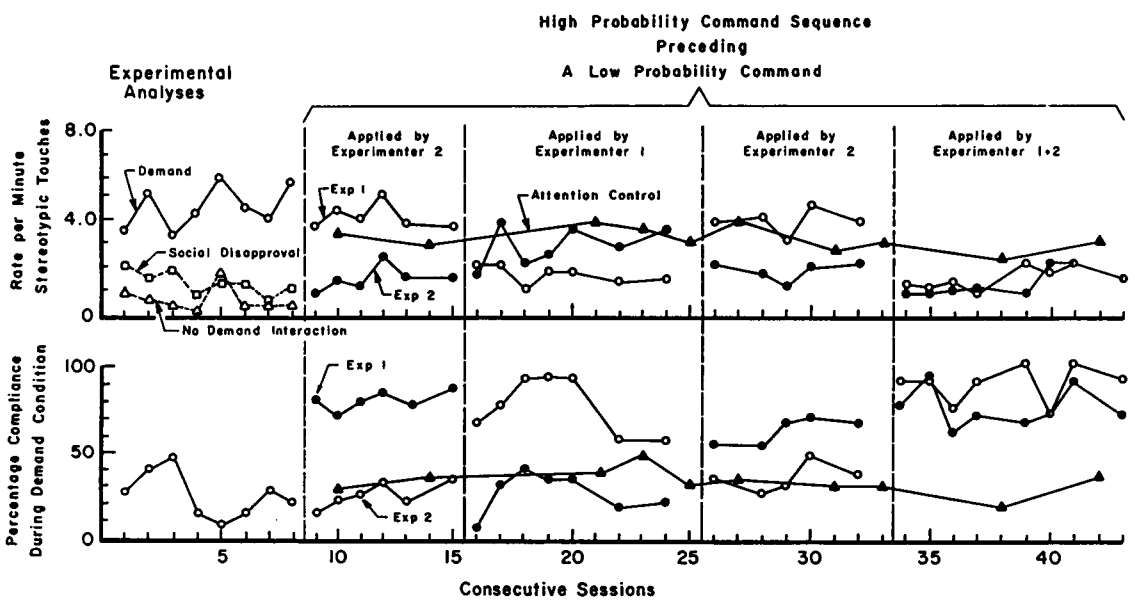

Figure 2. Stereotypic touching responses (STR) per minute (upper portion) and percentage of commands complied with during demand conditions (lower portion). Data are presented for the analysis during analogue conditions (far left panels) and for the analysis of the high-probability command sequence and the attention control condition.

results of the evaluation of the high-*p* request sequence intervention. Reversal effects were obtained for STR and compliance with low-*p* requests with each introduction and withdrawal of the high-*p* request sequence. Phase means during the baseline demand condition ranged from 2.8 to 4.0 per minute for STR and 22% to 34% for compliance with low-*p* requests. Preceding low-*p* requests with the high-*p* request sequence resulted in substantial increases in compliance, with phase means ranging from 52% to 88% compliance. Collateral reductions in STR were observed with each application of the high-*p* procedure. Mean STR per minute ranged from 1.4 to 1.7, which represented a threefold decrease in STR relative to the first baseline demand condition. During probes of the attention control condition, levels of STR and compliance with low-*p* requests were comparable to those observed in the baseline demand condition. Although no formal maintenance measures were obtained, our anecdotal observations during the 12 months following the study showed that staff use of the high-*p* sequence produced effects on compliance and STR that were consistent with those reported during experimentation.

DISCUSSION

This investigation provides additional evidence that procedures aimed at increasing compliance can produce concomitant reductions in problem behavior (see Cataldo, Ward, Russo, Riordan, & Bennett, 1986; Parrish et al., 1986; Russo, Cataldo, & Cushing, 1981). The novel aspects of this research concern the treatment procedure used to increase compliance with task-related demands and the possible mechanism responsible for response covariation. Nevin et al. (1983) proposed a model to account for the persistence of behavior following a change in reinforcement conditions that occurs in humans (Mace et al., 1990). The persistence or momentum of a specific behavior is a function of the product of response rate and reinforcement rate. Thus, increasing response rate and/or reinforcement rate results in greater behavioral persistence or momentum. By delivering a sequence of high-*p* requests to Doris immediately prior to issuing a low-*p* request to perform a task, the response class "compliance to instructions" occurred and was reinforced at a relatively high rate. As predicted by the behavioral momentum model, compliance with instructions following the high-*p* sequence persisted when Doris was asked to perform a household task (Mace et al., 1988).

Establishing a momentum of compliant behavior not only increased compliance to low-*p* requests but also resulted in marked reductions in escape-motivated stereotypic touching. Speculation regarding the mechanisms responsible for response covariation between compliance and problem behavior has centered around two main points that may be relevant to this investigation (Parrish et al., 1986). First, the behaviors involved in compliance and those constituting aberrant actions may be topographically incompatible such that high rates of compliance could compete physically with high rates of inappropriate behavior. In the present study, STR and task performance could and did co-occur in the same observation interval, although it is possible that some reduction in STR was due to increases in time spent complying with requests.

A second possible mechanism underlying response covariation is related to the inverse interaction between concurrent operants (Parrish et al., 1986). Viewing compliance and problem behavior as operants maintained by concurrent schedules of reinforcement, a change in the consequences for one response is likely to affect the response rate of the concurrent alternative in the opposite direction (e.g., increasing reinforcement for compliance may increase compliance and reduce tantrums). This explanation, advanced by Parrish et al., seems plausible when consideration is given to the function of their subjects' inappropriate behavior. One baseline condition in the Parrish et al. study arranged social disapproving comments for inappropriate behavior, showing that the target behavior was positively reinforced by attention. Because their treatment to increase compliance included social reinforcement and ignoring inappropriate behavior, it seems likely that subjects would allocate more behavior to a concurrently available response (compliance) whose

Table 1
Signaling Stimuli and Response–Reinforcer Relations for Four Experimental Conditions of a Hypothetical Animal Analogue Study to Test the Functional Incompatibility Hypothesis

Condition	Signaling stimuli	Response–reinforcer relation
C1	Random-interval Bar 1 light	Bar 1 short-latency, low-*p* food
C2	Synchronized:	
	Random-interval Bar 1 light;	Bar 1 short-latency, low-*p* food
	Random-interval Bar 2 light	Bar 2 short-latency, high-*p* shock postponement
C3	Random-interval tone synchronized onset following DRH:	Bar 1, DRH food
	Bar 1 light;	Bar 1 short-latency, low-*p* food
	Bar 2 light	Bar 2 short-latency, high-*p* shock postponement
C4	Random-interval tone synchronized onset following DRH:	Bar 1, DRH food
	Bar 1 light; change in chamber lighting;	Bar 1 short-latency, low-*p* food plus shock discontinued
	Bar 2 light	Bar 2 short-latency, high-*p* shock postponement

function was similar to the inappropriate behavior. Had their subjects' problem behavior been maintained by other contingencies, social reinforcement for compliance may not have resulted in response covariation. Indeed, Cataldo et al. (1986) found that positive reinforcement of compliance produced collateral reductions in some inappropriate behaviors but not others. It seems possible that these discrepant effects may be related to the different operant functions of the inappropriate behaviors.

Some unique features of this study have prompted us to consider other possible mechanisms of response covariation. The pretreatment functional analysis showed that Doris's STR was an escape response. Thus, positive reinforcement for compliance was juxtaposed with negative reinforcement for escape from demands. With qualitatively different reinforcers available for different concurrent operants, the allocation of responses across available alternatives cannot be expected to be sensitive to small changes in rates of reinforcement (McDowell, 1989). That is, if escape from demands is a very high-quality reinforcer, increasing social reinforcement for compliance may not be sufficient to reduce escape-motivated behavior and increase compliance.

Alternatively, the momentum-based treatment in the present case may have produced behavior that was functionally incompatible with the aberrant response. The momentum of compliance generated by the high-*p* command sequence produced approaches to and engagement with task activity. During task engagement, behavior that avoids or discontinues that activity removes reinforcement derived from that activity and, hence, is unlikely to be reinforced. The momentum treatment may at once establish conditions for compliance with low-*p* commands and also eliminate the establishing conditions for problem behavior that escapes task engagement. Functional incompatibility, in this case, refers to the act of compliance eliminating momentarily the reinforcing value of escape.

The functional incompatibility hypothesis may be tested directly in the following animal analogue study. Table 1 presents the signaling stimuli and response–reinforcer relations for four experimental conditions (C1 to C4) arranged for a rat. In C1, a light above Bar 1 is illuminated at random intervals and responses on Bar 1 within 1 s of the onset of the Bar 1 light (i.e., short latency) result in food with a low probability (i.e., 1 in 10 short-latency responses is reinforced). This condition represents the random presentation of low-*p* requests and the consequences for compliance. The C2 arrangement corresponds to Doris's baseline circumstances in which opportunities for compliance are juxtaposed with escape or avoidance via stereotypy. Bar 1 and Bar 2 lights are presented simultaneously with the consequences for Bar 1 responses identical to C1. The alternative response on Bar 2 results in shock

postponement with a high probability (i.e., 9 in 10 short-latency responses are reinforced). The C3 procedure is analogous to preceding the compliance/stereotypy choice with the high-*p* request treatment. However, in C3 the establishing conditions for escape or avoidance are unaffected by compliance to low-*p* requests. A random-interval tone signals a differential reinforcement of high rate (DRH) contingency on Bar 1. Following completion of the DRH requirements, the Bar 1 and Bar 2 lights are presented simultaneously, signaling the same contingencies as in C2. Finally, the C4 arrangement is identical to C3 except that a short-latency response on Bar 1 following the DRH contingency produces a change in chamber lighting and a correlated discontinuation of shock. In this situation, short-latency Bar 1 responses eliminate the establishing conditions for avoidance responses on Bar 2. If our functional incompatibility hypothesis is valid, short-latency Bar 1 responding should be highest and Bar 2 responding should be lowest in C4. In C3, DRH-induced momentum for Bar 1 and response covariation for Bar 2 should be minimal because the establishing conditions for escape or avoidance are still intact.

Fortunately, clinical applications of the high-*p* sequence to achieve collateral reductions in inappropriate behavior need not await the results of analytic studies of the processes underlying response covariation. However, we are convinced that the specificity and potency of future treatments will be enhanced by such research just as the development of the present intervention has been predicated on advances in basic research.

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