

*ANALYZING THE MULTIPLE FUNCTIONS OF
STEREOTYPICAL BEHAVIOR FOR STUDENTS WITH AUTISM:
IMPLICATIONS FOR ASSESSMENT AND TREATMENT*

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We studied behavioral functions associated with stereotypical responses for students with autism. In Study 1, analogue functional analyses (attention, demand, no-attention, and recreation conditions) were conducted for 5 students. Results suggested that stereotypy was multiply determined or occurred across all assessment conditions. For 2 students, stereotypy was associated with positive and negative reinforcement and the absence of environmental stimulation. For 2 other students, stereotypy occurred at high levels across all experimental conditions. For the 5th student, stereotypy was associated with negative reinforcement and the absence of environmental stimulation. In Study 2, the stereotypy of 1 student was further analyzed on a function-by-function basis. Within a concurrent-schedules procedure, alternative responses were taught to the student using functional communication training. The results of Study 2 showed that similar topographies of stereotypy, based on qualitatively different reinforcers, were reduced only when differential reinforcement contingencies for alternative forms of communication were implemented for specific response–reinforcer relations. Our results suggest that the causes of stereotypy for students with autism are complex and that the presumed association between response topography and behavioral function may be less important than previously realized.

DESCRIPTORS: stereotypy, autism, response–reinforcer relations

Since the syndrome of autism was first described in the 1940s, the presence of stereotypical movements has been a central behavioral feature of the disorder (Kanner, 1943). Stereotypy is typically characterized by repetitive movements that do not appear to serve an adaptive function (Baumeister &

Forehand, 1973; Berkson & Davenport, 1962). The occurrence of stereotypy has been associated with impaired learning (e.g., Lovaas, Koegel, Simmons, & Long, 1973) and social development (e.g., Koegel, Firestone, Kramme, & Dunlap, 1974). Although a number of theories have been postulated about the conditions associated with stereotypy, a complete understanding of the causes of stereotypy still awaits explication.

Apart from psychodynamic and mentalistic explanations for stereotypy that have

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largely been discredited (Schreibman, 1988), theories derived from the natural sciences have focused on the functions stereotypy might serve. That is, researchers have begun to focus on the specific consequences that might maintain stereotypy. Behavior-analytic research and theory suggest that stereotypical responding functions to provide sensory input to an individual, either because of too little or too much environmental input (Lovaas, Newsom, & Hickman, 1987). Although these efforts are a beginning to understanding the psychological nature of stereotypy, this approach may not fully account for the complexity of the events that determine these responses.

Contemporary discussions of the causes of stereotypy have focused on the etiology of these behaviors in terms of behavior–environment relations (Guess & Carr, 1991; Kennedy, *in press*). This perspective predicts that stereotypical responding may be maintained by a number of specific reinforcement processes. For example, stereotypy may be more likely to occur in the absence of preferred activities as a form of reinforcer substitution. On the other hand, stereotypy may also serve as a form of social interaction that mediates the behavior of others to gain access to or remove particular types of stimulation (e.g., gaining social attention from others). It is possible that stereotypy is maintained not only by positive or negative perceptual reinforcers but also by positive or negative reinforcers that are socially mediated (e.g., increased attention or decreased demands, respectively).

As a reflection of this evolving conceptualization, recent studies of stereotypy have attempted to determine if such behavior may occur for specific social reasons. Studies have identified stereotypy as functioning to avoid or escape particular situations (Durand & Carr, 1987; Mace & Belfiore, 1990). For example, Mace and Belfiore analyzed a woman's repetitive touching and found that it

functioned to avoid or escape instructional requests. Such demonstrations have expanded the field's understanding of repetitive behaviors by showing that stereotypy can be negatively reinforced by reducing social interactions. These findings suggest that a functional account of stereotypy needs to incorporate a greater array of events that may serve as positive or negative reinforcers for stereotypy.

The current study sought to build on these previous findings by analyzing whether the stereotypical behaviors of students with autism may be multiply determined by a range of behavioral functions. Previous studies have shown that individual topographies of self-injury and aggression can be maintained by positive and negative reinforcers (Day, Horner, & O'Neill, 1994; Haring & Kennedy, 1990; Smith, Iwata, Vollmer, & Zarcone, 1993). For example, Day *et al.*'s results showed that the problem behaviors of 3 individuals with developmental disabilities were maintained by access to tangible objects (positive reinforcement) and escape or avoidance of difficult tasks (negative reinforcement). Such findings are of interest in understanding stereotypy because they suggest that individual topographies of behavior can serve more than one function. If stereotypy could also be multiply determined, such a finding would have important theoretical and applied implications.

In an effort to expand the possible roles that environmental stimulation may play in causing stereotypical responding, we conducted two studies. In Study 1, we used analogue functional analyses to test specific hypotheses regarding the causes of stereotypical responding. In Study 2, a follow-up analysis was conducted that sequentially altered specific behavior–environment relations to further understand the nature of events associated with the maintenance of stereotypical responding.

GENERAL METHOD

Students and Settings

Participants were 5 students with autism. Each student had been diagnosed with autism by two different individuals using criteria outlined in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV;* American Psychiatric Association, 1994). Students attended age-appropriate public school placements that ranged from full-time general education participation to a self-contained special education classroom. Students were identified for participation in the study by teachers who stated that a student's stereotypy interfered with learning. Sessions were conducted in one room at each student's school that allowed uninterrupted observations and minimal distractions. Rooms varied from 3 m by 3 m to 8 m by 8 m, with tables and chairs present.

Brad was a 17-year-old boy who spoke in two- to three-word utterances and could follow two-step requests. James was a 10-year-old boy who spoke in two- to three-word utterances and could follow two- to three-step requests. Julie was a 12-year-old girl who spoke in short sentences and could follow three-step verbal requests and written task analyses. Rita was a 13-year-old girl who manually signed for basic needs and required physical prompting through most requests. Tom was a 9-year-old boy who gestured and manually signed and could follow one-step requests. All participants were classified by local education agencies as having severe to profound disabilities.

Responses, Data Collection, and Interobserver Agreement

Stereotypical responses included hand waving, nose touching, and rocking (Brad); moving or waving the left hand (James); body rocking, head movements, and object manipulation (Julie); hand waving, head movements, object manipulation, and tap-

ping objects (Rita); and head weaving and body rocking (Tom). Data were collected by trained graduate students and doctoral-level personnel using a 15-s partial-interval pencil-and-paper observation strategy, except for Tom's stereotypy (Study 1) and James's alternative communication responses (Study 2) which were recorded on an event basis. Across students an average of 24% sessions (range, 20% to 32%) were scored for interobserver agreement by having a second observer independently record the occurrence of stereotypy. For interval data, occurrence and nonoccurrence agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Occurrence and nonoccurrence means were 93% (range, 86% to 100%) and 89% (range, 85% to 100%), respectively. For event data, agreement was calculated using a point-by-point formula (Kazdin, 1982): total number of agreements divided by agreements plus disagreements multiplied by 100%. Agreement measures produced a mean of 97% (range, 93% to 100%).

STUDY 1: ANALOGUE
FUNCTIONAL ANALYSIS

The initial experiment was designed to assess the possible functions of stereotypy for each student.

Procedure

A multielement design (Sidman, 1960) was used to assess the occurrence of stereotypy across four conditions: (a) attention, (b) demand, (c) no attention, and (d) recreation (see Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). During the attention condition, an instructor (one of the study coauthors) and student sat at a table. The instructor engaged in paperwork while the student was provided with several activities (see recreation condition). If stereotypy occurred, the instructor provided 5 s of social

comments to the student and told him or her not to engage in stereotypy. All occurrences of stereotypy produced a similar response from the adult. This condition assessed the degree to which stereotypy was sensitive to positive reinforcement in the form of attention. During the demand condition, an instructor delivered a verbal demand every 15 s. Correct responding was praised and incorrect or no responding resulted in a full physical prompt after 5 s. Any occurrence of stereotypy resulted in cessation of task demands for 30 s. This condition assessed the degree to which stereotypy was sensitive negative reinforcement in the form of escaping or avoiding demands. During the no-attention condition, the student was seated at a table and received no social interaction or activities (this is similar to alone conditions, except an observer was present in the room). The no-attention condition assessed the degree to which stereotypy occurred in the absence of environmental stimulation. During the recreation condition, the student was provided with various activities identified by teachers as being preferred and was praised every 15 s in the absence of stereotypy. The recreation condition served as a control condition designed to minimize the occurrence of stereotypy. Each condition was presented once per day for 5 min (Brad, James, and Tom) or 10 min (Julie and Rita), with a random sequence occurring across each day. Sessions were conducted at the same time each day, 3 to 5 days per week.

Results

Figure 1 shows the results for each student from Study 1. Brad's stereotypy occurred at elevated levels in all conditions, with the exception of the recreation condition. A similar pattern emerged for the stereotypy emitted by James. This pattern of responding is consistent with stereotypy serving multiple operant functions, including positive (atten-

tion) and negative (demand) reinforcement and an unidentified source of stimulation (no attention).

Julie's stereotypy was observed at elevated levels across all experimental conditions throughout Study 1. Her stereotypy occurred at or above 70% of observation intervals for almost all sessions. Rita's stereotypy followed a similar pattern, with occurrence estimated at 90% or greater for the final eight sessions. An interpretation of these data is elaborated on in the Discussion (see below).

Finally, Tom's stereotypy emerged across sessions as occurring primarily during the demand and no-attention conditions. Tom's pattern of responding suggests that his stereotypical behavior functioned primarily to escape or avoid negative reinforcement in the form of instructional demands and also occurred during low levels of environmental stimulation. Although stereotypy did occur during attention and recreation conditions, the high degree of differential responding relative to the other conditions suggests that social attention as a positive reinforcer was not primarily related to the functions of Tom's stereotypy.

We also analyzed the proportional occurrence of different topographies of stereotypy within and across conditions for each student. Data are presented only for conditions in which stereotypy regularly occurred. For Brad, hand waving accounted for 69%, 88%, and 62% of stereotypical responses in the attention, demand, and no-attention conditions, respectively. His nose touching (body rocking) accounted for 13% (18%), 4% (8%), and 15% (23%) of responses in the attention, demand, and no-attention conditions, respectively. James's hand movements (hand waving) accounted for 86% (14%), 71% (29%), and 67% (33%) of responses in the attention, demand, and no-attention conditions, respectively. For both Julie and Rita, each of their stereotypical re-

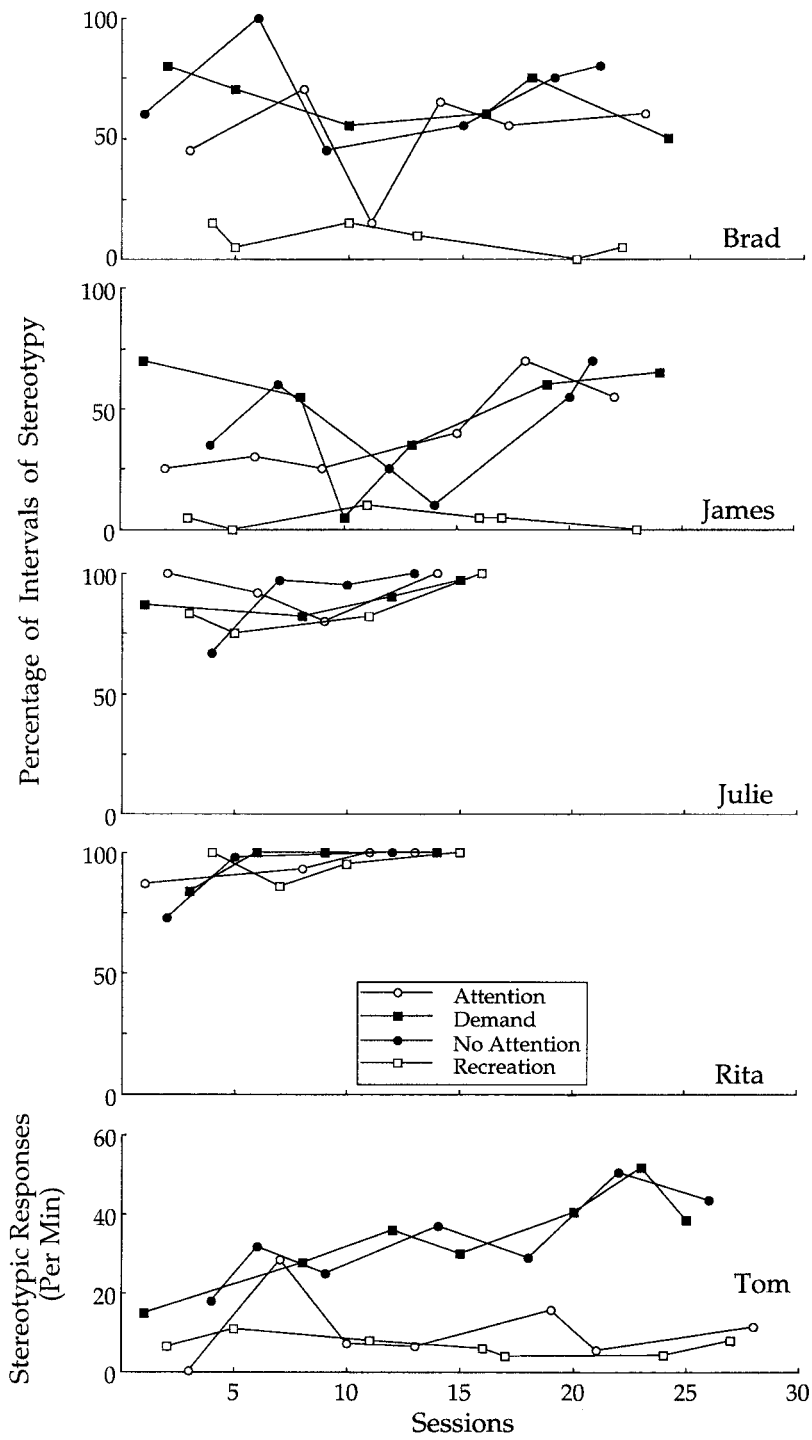


Figure 1. Occurrence of stereotypy across analogue functional analysis conditions (see legend). Data are arrayed as the percentage of intervals of stereotypy for Brad, James, Julie, and Rita. For Tom, data are presented as the number of stereotypical responses per minute.

sponses occurred in almost all observation intervals and, therefore, the proportions were equal across response topographies. Tom's head weaving (body rocking) accounted for 73% (27%) and 81% (19%) of responses in the attention and demand conditions, respectively. These data suggest that the occurrence of differing topographies of stereotypy across conditions was relatively stable.

STUDY 2: FUNCTIONAL COMMUNICATION TRAINING

The second study assessed the degree to which a concurrent-schedules procedure targeting a competing response–reinforcer relation could be established for each behavioral function identified for stereotypy in Study 1. This was done to further assess the degree to which stereotypy was serving distinct and separate functions. James, whose stereotypy was identified as serving multiple functions in Study 1, participated in Study 2.

Procedure

The same responses, settings, measures, and times analyzed in Study 1 were studied in Study 2. A multiple baseline across behavioral functions was used. In addition to the stereotypical behaviors measured in Study 1, three alternative communication responses were measured in Study 2 (described below).

Baseline. Three potential functions identified in Study 1 for stereotypy were incorporated into baseline: attention, demand, and no attention. The same two stereotypical responses, waving and moving the left hand, were analyzed. The attention, demand, and no-attention conditions used the contingencies in Study 1 to establish baseline performances in which stereotypy was maintained by access to attention, by escaping or avoiding demands, or in the absence of environmental stimulation, respectively. Therefore, in the attention condition, stereo-

typy resulted in social attention; in the demand condition, stereotypy produced the removal of task demands; and in the no-attention condition, no programmed contingencies or stimulation occurred. If a topography of behavior consistent with those in the functional communication training (FCT) condition occurred (see below), it was responded to in a manner similar to stereotypy. Attention, demand, and no-attention sessions were conducted in a fixed sequence, 2 to 5 days per week. Each session lasted 5 min and was separated by a 5-min intersession interval.

Functional communication training. An alternative behavior was selected to produce a similar reinforcer for each response–reinforcer relation established in baseline (Carr & Durand, 1985). For attention, demand, and no attention, James was taught to raise his right hand, sign “break,” and sign “more,” respectively, as an alternative response. Consequences for alternative behaviors were the same as stereotypy in the baseline conditions, except that signing “more” resulted in the delivery of preferred tangible stimuli for 15 s. That is, in the attention condition, raising his right hand produced attention; in the demand condition, signing “break” removed task demands; and in the no-attention condition, signing “more” resulted in preferred tangible stimuli.

During training the occurrence of stereotypy produced (a) response interruption, (b) extinction of programmed responses for the stereotypy, (c) partial physical prompting of the alternative response, and (d) presentation of the associated consequence for the alternative response (i.e., the same contingency as established in baseline for stereotypy). Each time the alternative response was emitted, either prompted or unprompted, the associated consequence was implemented.

Results

Figure 2 presents FCT and stereotypy data for James. Data are arrayed as the per-

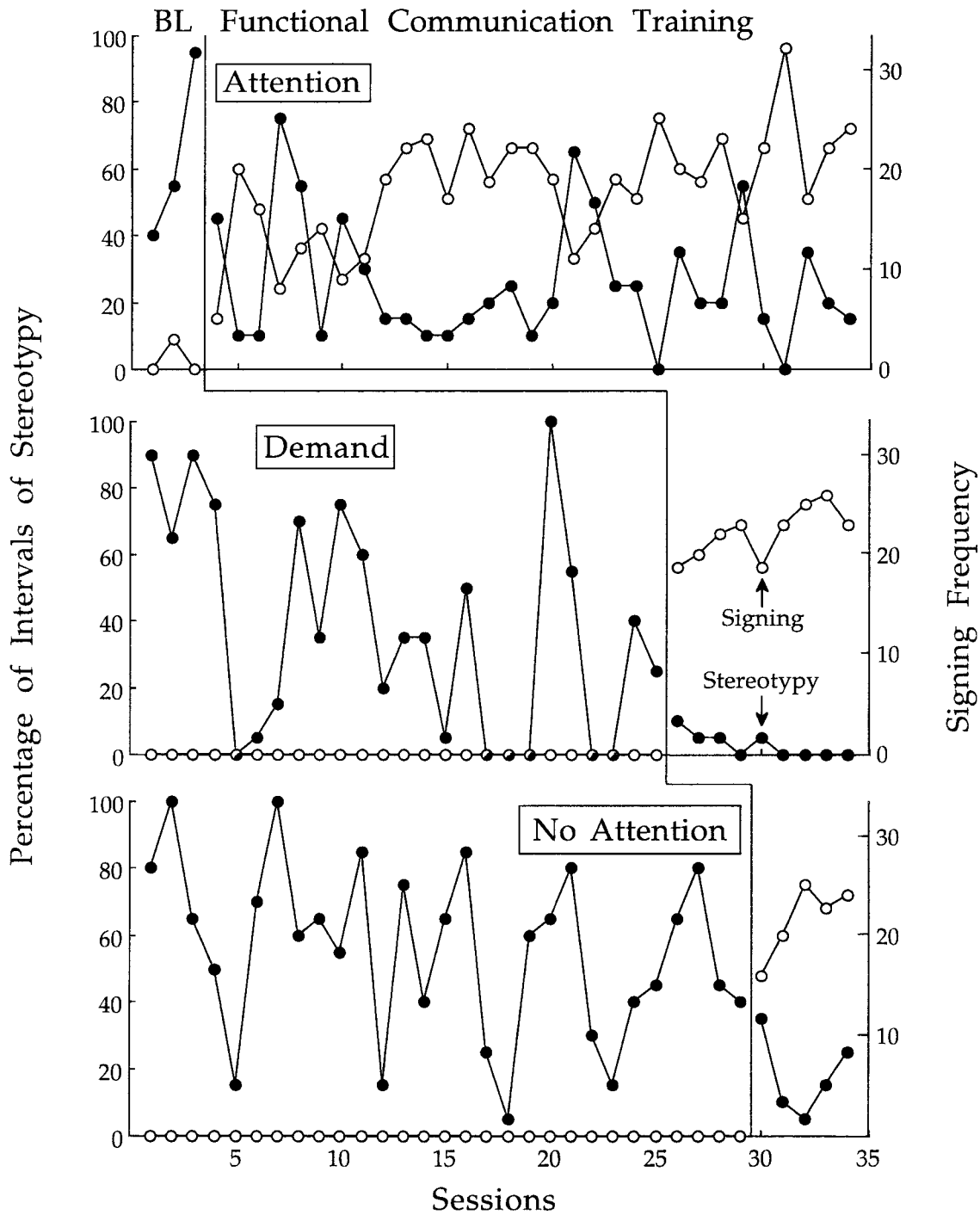


Figure 2. Occurrence of stereotypy for James across attention, demand, and no-attention conditions. Data are arrayed as the percentage of intervals of stereotypy on the left y axis and number of signs per session on the right y axis.

Table 1
Percentage Occurrence of Stereotypical Responses
Across Experimental Conditions in Study 2 for
James

Condition	Hand movements	Hand waving
Attention: baseline	67	33
Attention: FCT	56	44
Demand: baseline	63	37
Demand: FCT	61	39
No attention: baseline	77	23
No attention: FCT	81	19

centage of intervals of stereotypy across attention, demand, and no-attention conditions. In the attention condition, baseline occurrences of stereotypy were high in baseline and decreased following the introduction of FCT. James's communication responses showed an inverse pattern to that for stereotypy in the attention condition. During baseline in the demand condition, James's stereotypy was highly variable. However, when FCT was introduced stereotypy decreased and requests for breaks increased. As in the demand condition, highly variable levels of stereotypy were observed in the no-attention baseline, with decreases in stereotypy and increases in FCT responses following introduction of treatment. Table 1 presents data on different topographies of stereotypy for James. The topographies of stereotypy that occurred across conditions and phases were relatively stable. These data further demonstrate that James's stereotypy was multiply determined and that function-specific alternative responses could decrease stereotypy on a function-by-function basis.

GENERAL DISCUSSION

In Study 1, the stereotyped responses of students with autism were associated with a range of behavioral functions that were not predicted by or associated with the topography of the response. For Brad and James, stereotypy served to escape or avoid instruc-

tional situations (negative reinforcement), produced adult attention (positive reinforcement), and occurred in the absence of environmental stimulation (presumed positive or negative perceptual reinforcement). For Julie and Rita, stereotypy was elevated across all conditions that were assessed. For Tom, stereotypy was related to specific negative reinforcer functions and the absence of environmental stimulation. In Study 2, when FCT training was implemented separately for each function identified in Study 1 for James's stereotypy, reductions in stereotypy occurred on a function-by-function basis even though the topography of stereotypy did not vary across conditions.

The findings of this investigation expand the possible behavior-environment causes of stereotypy. Along with the occurrence of stereotypy in the absence of environmental stimulation (presumably for perceptual reinforcement), these responses were shown to serve positive and negative reinforcer functions within social contexts. It should be noted that each of the students' behaviors occurred for more than a single behavioral function. For example, the behaviors of Brad and James occurred in three distinct environment-behavior arrangements. This suggests that the stereotypy of people with autism may be more complex than previously demonstrated. Based on current and previous findings, assessments of stereotypy for educational or psychological reasons need to address the possibility that these behaviors occur for multiple reasons, and that those reasons may be environmentally based (see also McEntee & Saunders, 1997; Repp, Singh, Karsh, & Deitz, 1991). Assumptions that stereotypy only serves to produce sensory stimulation, as previously proposed (e.g., Lovaas et al., 1987), may not take into account the complexity of reinforcement that maintains stereotypical responding.

An interesting issue raised by the current findings is the interrelation between response

topography and response function. Perhaps following from the implicit adoption of a self-stimulatory hypothesis, it has often been presumed that the type of stimulation a response produces is associated with the reasons for the occurrence of the behavior. In our studies a range of stereotypical behaviors were shown to serve a range of behavioral functions, with no specific topography predictive of a particular function. This suggests that the form of a response may not necessarily predict the function it serves. For example, waving a hand in front of her face may provide a woman with visual stimulation (i.e., a direct response topography–reinforcer relation); but hand waving may also function to reduce the density or type of instructional demands made on the same person (i.e., an arbitrary response topography–reinforcer relation). Our findings indicate that stereotypical responding comes under the control of both direct response topography–reinforcer relations and arbitrary response topography–reinforcer relations, suggesting that response topography may not accurately predict the functions of stereotypical behavior.

Complicating this observation, however, are other studies that have linked response topography to behavioral function, suggesting that response topography can be an important element in assessing the causes of behavior (Kennedy & Souza, 1995; Lalli, Livezey, & Kates, 1996; Piazza, Hanley, & Fisher, 1996). For example, Kennedy and Souza showed that self-injurious eye poking was associated with the visual stimulation it produced. In such cases the form of the response provides clues to the reasons for the response. Although such an observation runs contrary to the old dictum, “form does not imply function,” in some cases response topography does imply behavioral function.

Future researchers may want to determine the boundary conditions between response form and function. It may be that the great-

er the degree of social mediation present in occasioning reinforcement, the less predictive will be the topography of responding. That is, the greater the degree of control over responding by arbitrary response topography–reinforcer relations, the less important is the topography of the response. In individual cases, response topography may or may not be a predictor of function, but that determination would be difficult, if not impossible, to make using a priori judgments based solely on response topography. Instead, functional assessments testing a range of hypotheses about why stereotypy may be occurring should be conducted. Just because a behavior looks like it serves self-stimulatory purposes does not mean that that is the function of the behavior. What our findings suggest is that, like self-injury or aggression, stereotypy needs to undergo a functional assessment prior to developing intervention (Repp, Felce, & Barton, 1988).

Analyses of reinforcers are inherently problematic for responding in the absence of environmental stimulation or the absence of direct manipulation of events that potentially serve as reinforcers (Ferster, 1967; Goldiamond, 1976; Kennedy, 1994). Since the inception of definitions of negative and positive reinforcement (Catania, 1975; Goldiamond, 1976; Skinner, 1938), a number of conditions have been identified that need to be met in order to designate an event as a reinforcer. Specifically, Catania (1994) notes that (a) a response must be identified, (b) a consequent event must be identified (i.e., it must exist as a physical event), (c) the consequent event must be manipulated in relation to the response, and (d) the response must covary in occurrence as a function of the presence and absence of the consequent stimulus. If these prerequisites are demonstrated, then a response–environment relation can be referred to as reinforcement. In the absence of these prerequisite operations,

causal attributions are premature and may prove to be misleading.

Such concerns are best illustrated when a behavior occurs only in the absence of programmed contingencies (e.g., in alone or no-attention conditions) (see Kennedy, 1994). If responding occurs only in the absence of reinforcement contingencies, there is no basis for specifying a reinforcer function (indeed, it could be argued that the behavior might be respondent rather than operant in such instances). Therefore, although it is intuitively appealing to refer to behavior occurring in such conditions as being maintained by self-stimulation or automatic reinforcement, such claims are premature in the absence of more direct evidence. Because of this observation, we have opted in the current paper to only *describe* the conditions under which such cases occur (i.e., in the absence of environmental stimulation), rather than *infer* a yet-to-be-determined behavioral function (e.g., automatic reinforcement). Although this is a conservative approach, it may prove to be judicious as functional assessments are extended to increasingly complex behaviors.

Undifferentiated high-rate patterns of stereotypy are also difficult to interpret because of the reasons just enumerated (see also Vollmer, Marcus, Ringdahl, & Roane, 1995). It may be that stereotypy served multiple functions for Julie and Rita and that the contingencies in the recreation (control) condition failed to be established or discriminated. Another possibility is that some type of unidentified response–reinforcer relation that was not manipulated in the present analysis successfully competed with the programmed response–reinforcer relations (e.g., proprioceptive or interoceptive stimulation associated with stereotypy). Again, it would be intuitively appealing to state that some private event (e.g., sensory consequences) successfully competed with the manipulation of public events (e.g., demands). Unfortunate-

ly, because access to events produced directly by responses are difficult to identify and manipulate, conclusive statements regarding the causes of Julie's and Rita's stereotypy cannot be reached (cf. Rincover, Cook, Peoples, & Packard, 1979).

Two additional limitations of the current studies should be noted. First, individual topographies of stereotypy were not isolated for independent analysis, which limits interpretations of behavioral function for each specific topography analyzed. However, because contingencies of reinforcement were in effect for each topography of stereotypy and behaviors were demonstrated to covary consistently within and across conditions (indicating a response class of behaviors), it appears unlikely that individual responses were associated with only a single function in cases in which multiple functions were suggested. Another possible limitation of the experiment was the lack of exposure to equal lengths of escape or avoidance and social attention. As shown by Fisher, Piazza, and Chiang (1996), unequal reinforcer durations can lead to different rates of responding. Although there is no indication that unequal stimulus exposures influenced the results of the current investigation, future research on this topic should clarify this possibility.

Despite some interpretative limitations, a number of important conclusions can be drawn from the current investigation. Most notable are the complexity of causes associated with stereotypy and the need to assess a range of environmental events when attempting to determine why a person engages in stereotypy. Stereotypical behavior has been identified as varying considerably in terms of its topography (Berkson, Guter-muth, & Baranek, 1995), periodicity (Newell, Incledon, Bodfish, & Sprague, 1999), rhythmicity (Ross, Yu, & Kropla, 1998), and, following from current and related findings, behavioral functions. Given the diverse set of characteristics that typify stereo-

typical responding, future theoretical and empirical attention should focus on understanding the complexity of stereotypy (noting that this topographical description itself is probably an oversimplification) in terms of social and biological causes that might lead to creating a functional taxonomy of this longstanding but only partially understood behavioral phenomenon.

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STUDY QUESTIONS

1. Describe the types of reinforcement contingencies hypothesized to maintain stereotypic behavior. What general class of contingencies would include perceptual reinforcement?
2. Describe the methods used to measure stereotypic behavior during participants' functional analyses.
3. Construct a table listing the antecedent and consequent events associated with each of the functional analysis conditions. How might these events influence behavior maintained by different sources of reinforcement?
4. Describe the response patterns observed during Brad's and James's functional analyses and the authors' interpretation of these results. What alternative interpretation might accommodate the results?
5. What was the authors' rationale for calculating the proportional occurrence of different topographies of stereotypy, and what did this analysis reveal?
6. What were the consequences for stereotypy and alternative responding during the baseline and FCT phases of Study 2?
7. The authors discussed stereotypy in terms of both direct and arbitrary response–reinforcer

relations. For which type of relation might an analysis of response topography be more relevant?

8. What are some factors that may have accounted for the uniformly high levels of stereotypy observed during Julie's and Rita's functional analyses?

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