

## A COMPONENT ANALYSIS OF FUNCTIONAL COMMUNICATION TRAINING ACROSS THREE TOPOGRAPHIES OF SEVERE BEHAVIOR PROBLEMS

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We evaluated the separate treatment components of a functional communication training program for 3 severely handicapped persons who each displayed different topographies of aberrant behavior. Following a functional analysis of maintaining conditions for inappropriate behavior (self-injury, stereotypy, aggression), each participant was trained to emit a communicative response that functioned to solicit reinforcement. For 2 participants, consequences (time-out or graduated guidance) for inappropriate behavior were also included. Treatment continued until the participants emitted the communicative response independently and no occurrences of inappropriate behavior were observed for at least two sessions. Following treatment, the separate contributions of the treatment components for communicative responding and for inappropriate behavior were evaluated with a reversal design. The results indicated that both sets of treatment components were necessary for maximal control over aberrant behavior. These results are discussed in relation to the efficiency, history, and control over reinforcement of both appropriate and inappropriate responses.

DESCRIPTORS: severely handicapped, functional analysis, communication training

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From a clinical standpoint, the major advantage of conducting a functional analysis is the selection of an effective treatment. Treatments based on a functional analysis of behavior begin with the development of what Iwata, Pace, Kalsher, Cowdery, and Cataldo (1990) referred to as a "functional match" between the response and the intervention. If, for example, target behavior is maintained by

negative reinforcement, treatment might begin by withholding reinforcement (extinction) for target behavior and providing escape for desired behavior (Steege, Wacker, Berg, Cigrand, & Cooper, 1989). If the desired behavior serves a function that is equivalent to the function of the target behavior (Carr, 1988), and the maintaining contingencies for the original target behavior are prevented or disrupted, effective treatment should occur.

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Durand, Crimmins, Caulfield, and Taylor (1989) and Repp, Felce, and Barton (1988) demonstrated the importance of a functional match between intervention and target behavior by comparing two treatments for the same target behavior. In both cases, the intervention that was matched to the target behavior was more effective. For example, in the Durand et al. (1989) investigation, two groups of matched students with severe developmental disabilities were provided with both praise and time-out (escape) for appropriate behavior following an assessment of the function of their aggression, self-injury, or tantrums. For the students whose problem behavior was maintained by attention, praise was an effective reinforcer for alternative

behavior. Conversely, time-out was an effective reinforcer for the second group of children, whose problem behavior was maintained by negative reinforcement. Thus, treatment based on an analysis of maintaining conditions can be effective.

A wide variety of treatments is currently available, many of which involve multicomponent interventions. Of these treatments, the findings from investigations using functional communication training are especially striking because of the speed with which problem behavior is reduced to zero or near zero levels of occurrence. For example, Carr and Durand (1985) presented data on 4 developmentally disabled children who displayed disruptive behavior in the form of aggression or destruction. The results of Experiment 1 demonstrated that the children displayed disruptive behavior for different reasons (positive or negative reinforcement). When they were taught either to solicit praise or to request assistance in Experiment 2, problem behavior decreased significantly during the first treatment session. Likewise, when Durand and Carr (1987) used a very similar functional communication treatment ("Help me") for stereotypic behavior, immediate reduction of stereotypic behavior occurred during the first treatment session.

There appear to be several reasons for the effectiveness of functional communication training. First, as discussed by Carr and Durand (1985), the results may be a function of the consequences delivered to the children. In other words, if the children are provided with assistance or praise, where appropriate, on a dense schedule of reinforcement, problem behavior may be reduced. However, as also pointed out by Carr and Durand (1985), functional communication training places the children in active roles during treatment by teaching them to control the delivery of reinforcement, rather than teaching them to be passive recipients of consequences delivered by an experimenter on a differential reinforcement of other behavior (DRO) schedule. It may be the case that control over the delivery of reinforcement is as important in functional communication training as the amount or schedule of reinforcement received. This distinction, control

versus schedule, has not been analyzed in previous investigations.

Second, in almost all previous studies, a separate consequence for inappropriate behavior has been incorporated into the treatment package. Carr and Durand (1985), for example, provided extinction for inappropriate behavior, whereas Steege *et al.* (1989) used extinction plus redirection. When consequences such as time-out or graduated guidance have been used for inappropriate behavior (Northup *et al.*, 1989), their separate contribution has not been analyzed. Therefore, it is unclear what role consequences for inappropriate behavior play in functional communication training.

Finally, Carr (1988) suggested that the efficiency of the alternative response may be a major variable in evaluating the effectiveness of functional communication training. Carr defined *efficiency* as involving both the consistency of reinforcement and the delay between the response and the delivery of reinforcement. For example, self-biting that results in reinforcement on a continuous reinforcement schedule (CRF) within 5 s of occurrence is more efficient than a more appropriate response that results in reinforcement on an intermittent schedule after a delay of 30 s or more.

The primary purpose of this investigation was to begin to evaluate functional communication training more systematically through component analyses. The component analyses permitted evaluation of two aspects of functional communication training: (a) the need for an intervention component delivered for inappropriate behavior following initial training and (b) the control of the communicative response over the schedule of reinforcement. The third factor, efficiency, was controlled across conditions by delivering reinforcement immediately (within 5 s) on a CRF schedule during both assessment and treatment. The participants each displayed distinctly different target behavior, as defined by both topography (self-injury, stereotypy, and aggression) and function (tangible, sensory, and escape). Thus, the investigation evaluated functional communication training across different types of behavior to assess the generality of the findings.

## METHOD

### *Subjects and Settings*

The participants were inpatients on a 14-bed unit for children and young adults with developmental disabilities. Each participant had been referred for a 2-week evaluation of aberrant behavior. As part of the inpatient evaluation, a functional analysis of aberrant behavior was conducted and a treatment program was initiated. All evaluations were conducted by trained therapists, graduate students, and a teacher on the unit and took place in a standard classroom or in a therapy room (Bobby only), which was empty except for a table and chair.

*Bobby.* Bobby, a 7-year-old boy with autism, was nonverbal and did not communicate through signs or gestures. According to his school and medical records, Bobby functioned within the severe to profound range of mental retardation and had a seizure disorder that was poorly controlled. He had no identified problems with his upper limbs or fine motor skills and frequently walked rapidly in an apparently aimless manner.

The primary behavior of concern for Bobby was hand biting, which reportedly occurred several times per hour, often with sufficient force to draw blood. He was also described as being noncompliant and destructive, and he engaged in tantrums and stereotypic behaviors (hand flapping, spinning, eye pressing, string twirling, etc.). Bobby lived with his parents and attended a segregated classroom for students with severe to profound mental retardation. This placement was in jeopardy because of his self-injurious and destructive behavior.

*Barb.* Barb, a 30-year-old woman with a diagnosis of untreated phenylketonuria, was classified in medical records as functioning within the profound range of mental retardation. Barb was nonverbal and did not communicate with signs or gestures; she was ambulatory and had normal fine motor skills. Barb had been taught to press a microswitch to activate battery-operated toys and a radio.

Barb lived in a residential center and attended a day program in which the primary concern was

her almost continuous body rocking, which occurred when she was left alone or was unsupervised. Barb's body rocking interfered with task completion and recreational activities. She was also observed to engage in other stereotypic behaviors, including arm waving, hand flapping, and apparently aimless running. Like Bobby, her day program placement was in jeopardy because of both her stereotypic and her "overactive" behavior.

*Jim.* Jim was a 9-year-old boy who attended a segregated school program for students with severe and profound mental retardation. Although Jim was nonverbal and did not communicate with gestures, he had reportedly received training at school to sign "please" and "eat"; however, we did not observe these responses on the inpatient unit prior to treatment, even with prompting. Jim was reported to be destructive and was taking Mellaril at the time of this investigation; like Bobby and Barb, he was ambulatory and engaged in apparently aimless walking or running. The primary behavior of concern, however, was his aggression, defined as slapping or biting peers and staff. Jim lived in a group home in which his aggression toward peers was considered to be extreme, and his group home placement was in jeopardy.

### *Response Definitions and Materials*

The target behavior for Bobby was hand biting, defined as placing his teeth on one or more fingers and closing his jaws. For Barb, the target behavior was body rocking, defined as repetitive rocking with at least a 45-degree bend at the waist while seated. Jim's target behavior was slapping or biting others, defined as contact between Jim's hand and the face of others, or contact between his teeth and any part of the body of others.

The alternative communicative behavior for Bobby was lightly touching or brushing his chin with one finger; this was the only motor behavior we observed that approximated a manual sign. Because Bobby resisted physical contact and frequently had tantrums when provided with hand-over-hand guidance, this motoric response was selected as his sign for requesting a desired item.

When Bobby emitted this sign, he was provided with a selection of materials and play items. He almost always chose to hold a yellow bowl, which was identified as a possible reinforcer during the functional analysis. Additional, more appropriate reinforcers had not been identified in his school or home settings.

For Barb, a contact switch (15 cm by 15 cm) was attached to a standard tape player that contained a continuous loop tape. Pressing the contact switch activated the repeated message, "I'm tired of rocking; somebody give me something to do," for as long as the switch was engaged. A previous reinforcer assessment, conducted prior to this investigation, indicated that Barb preferred two recreational activities: (a) rocking in a rocking chair and (b) riding an exercise bike. She did not appear to respond to music or battery-operated devices as reinforcers. The rocking chair and exercise bike were placed in front of her during all sessions. When sitting in the rocking chair, Barb maintained contact with the back of the chair and did not bend at her waist. Thus, this was considered to be an appropriate behavior. Barb did not rock when riding the exercise bike.

Both local staff members and the experimenters had previously attempted to teach Barb to sign but had been unsuccessful. Therefore, a microswitch that activated pretaped messages was used in this investigation. In addition, although Barb had been observed to stop body rocking when working, sitting in the rocking chair, or riding an exercise bike, she was never observed to initiate activities. It was hoped that by pressing the switch, she would alert others to present an activity to her.

Jim's teacher and group home staff had been teaching him to use signs, including the "please" sign; therefore, we decided to continue training him to use this sign as part of our treatment program. Jim was reported to engage in aggression randomly but was most prone toward aggression when required to perform tasks, such as picking up toys. Therefore, Jim was required to pick up toys in the classroom, but when he signed "please," he could escape the task for 15 to 30 s. Beginning in the 12th treatment session, he also began to sign "eat,"

which we reinforced by providing a brief break from the task and a small cracker. Jim never picked up toys independently, but required graduated guidance. He was considered compliant if he was not aggressive, even if he resisted the guidance procedure. Beginning with the 10th treatment session, he only rarely resisted picking up toys.

### *Observation System and Reliability*

The participants' responding was recorded through a one-way observation window by using a 6-s partial interval recording system. Every 6 s, the observers (2 therapists, 2 teachers, and 3 graduate students) recorded the target or alternative communicative behavior emitted by the participant. In addition, the therapist's use of physical prompts and time in reinforcement were recorded on the data sheets. In all cases, interrater reliability was calculated using an exact interval-by-interval agreement method. An agreement occurred when both observers simultaneously but independently recorded that the same behavior occurred during the same interval. Overall agreement was computed by dividing agreements by agreements plus disagreements and multiplying by 100. Occurrence agreement was computed by dividing agreements of target behavior, alternative communicative responses, and prompted responses by agreements plus disagreements and multiplying by 100. Agreement of time in reinforcement was computed by dividing agreement within exact intervals by agreements plus disagreements and multiplying by 100.

For Bobby, reliability was computed six times during assessment (31% of sessions), four times during training (36% of sessions), and seven times during the component analysis (64% of sessions). Average occurrence reliability was 86%, 90%, and 88%, respectively, with a range of 68% to 100%. Total (occurrence plus nonoccurrence) reliability was comparable, averaging 92% across all sessions. Time in reinforcement agreement was computed eight times during the component analysis (all functional communication training sessions), with an average reliability of 96%.

For Jim, reliability was computed 16 times dur-

ing assessment (100% of sessions), 12 times during training (57% of sessions), 14 times during the component analysis (93% of sessions), and during generalization sessions. Average occurrence reliability was 84%, 88%, 81%, and 76%, with total agreement being over 90% across all sessions. Time in reinforcement was computed 12 times during training and 14 times during the component analysis, with an average agreement of 88% and 91%, respectively.

For Barb, reliability was computed during every session, with an average agreement reliability of 100% during assessment, 93% during training, and 96% during the component analysis. There were no disagreements on time in reinforcement.

### *Design*

The study was conducted in two phases for each participant. During Phase 1 (assessment) a functional analysis was conducted to identify maintaining conditions for the target behavior. For Bobby and Jim, the results of the functional analysis were evaluated within an alternating treatments design. For Barb, the functional analysis was completed within a reversal design. A reversal design was conducted because a recently completed functional analysis of inappropriate behavior by the experimenters revealed that stereotypic behavior occurred primarily during alone conditions but almost never during demand conditions. The reversal design (alone, demand, alone) was conducted to replicate these findings.

Following assessment, a component analysis was conducted within a reversal design as follows: (a) treatment package, in which the participant was trained to communicate using signs (Bobby and Jim) or a microswitch (Barb), (b) removal of contingency (time-out or graduated guidance for Bobby and Jim, respectively) for target behavior, (c) return to treatment package, (d) DRO, in which reinforcement was provided on the same schedule as during treatment, the contingency for inappropriate behavior continued, but communication responses were ignored, and (e) return to treatment package.

### *Procedures*

*Assessment and treatment for Bobby.* The functional analysis was based on the work of Iwata, Dorsey, Slifer, Bauman, and Richman (1982) and Carr and Durand (1985) and consisted of presenting four conditions counterbalanced across days: escape, tangible, alone, and social attention. In all conditions except alone, Bobby received the consequence (attention, tangible, or escape) contingent upon target behavior. During the alone condition, in which Bobby was permitted to engage in free play alone, no consequences occurred for appropriate or inappropriate behavior. During the attention condition, Bobby and a therapist were alone in a room, and the therapist attended to him ("Don't do that") only when he engaged in inappropriate behavior. For the escape condition, Bobby was required to complete various educational tasks (based on his Individual Education Program goals) and was provided with brief escape (15 to 30 s) contingent on inappropriate behavior.

The alone, attention, and escape conditions comprised the initial assessment, with all inappropriate behavior observed during the first two sessions occurring in the escape condition. However, during the alone and escape conditions, in which Bobby was permitted to wander around the room, he always picked up a yellow bowl. For this reason, beginning in the third assessment session, a tangible condition was added in which he received the yellow bowl contingent on biting ("Don't do that; here, play with this"). The bowl was removed from the room during the escape condition, resulting in a substantial decrease in biting. Three to five assessment conditions were provided for each condition, with each session lasting between 6 and 10 min. During all conditions, reinforcement was provided for 15 to 30 s contingent upon the target response.

Treatment was conducted to train the participants to communicate requests during the assessment condition that had resulted in the highest percentage of target behavior. For Bobby, this condition was tangible, and he was trained to sign using a least-to-most-restrictive prompt sequence,

in which he was given a verbal prompt (e.g., "Sign 'please'"), a model, and then physical guidance.

The treatment condition began with Bobby sitting alone at a table. If he signed, he received the yellow bowl and was permitted to wander around the room for 10 to 20 s. At the end of this interval, he was given a verbal request to sign; if he did, he was permitted to keep the bowl for another 15 s. If he did not sign, the bowl was removed, and he was either provided with a physical prompt to sign (primarily during the first two treatment sessions) or placed back in the chair. Similarly, if he bit himself at any time, he was placed back in the chair and the bowl was removed (time-out component). Once Bobby was placed in the chair, opportunities to hold the bowl and to leave the chair were contingent on signing. If he did not sign, he was prompted to do so after 15 to 20 s. Data were recorded on hand biting, signing, prompts by the experimenter, and time in reinforcement. Each treatment session lasted 10 min, with no more than two sessions occurring consecutively.

*Assessment and treatment for Barb.* Assessment conditions were alone and demand, with the alone condition repeated twice. During the alone conditions, she was left at a table with no available activities or materials and all behavior was ignored. During the demand condition, she was required to dust tables, a task that was terminated for 10 to 15 s whenever she engaged in body rocking. Assessment for Barb was completed during a 90-min session, with brief breaks (2 to 5 min) between sessions.

During treatment, Barb was seated alone at a table, with the rocking chair and exercise bike placed on the opposite side of the table in front of her. Whenever she pressed the switch, she was permitted to leave the chair and to participate in either recreational activity for up to 30 s. If she was engaged in body rocking in the chair, she was not permitted to leave. She was never observed to engage in body rocking during reinforcement. Treatment was completed during a 30-min period.

*Assessment and treatment for Jim.* Four as-

essment conditions were used for Jim: no contingency, social attention, escape, and DRO. The attention and escape conditions were conducted in the same manner as described for Bobby, except that the task used for Jim in the escape condition was picking up toys. During the no-contingency condition, a therapist maintained close contact with Jim as he wandered around the classroom but otherwise ignored him. During the DRO condition, the therapist provided positive attention (e.g., "nice playing") contingent on the absence of inappropriate behavior during free play in the classroom.

Jim was reported to bite and strike out at staff randomly, even when receiving praise. For this reason, we added the DRO condition to determine whether differences in behavior occurred when he received positive attention versus social disapproval (attention condition). The no-contingency condition replaced the alone condition because his target behavior was aggression rather than self-injury.

During treatment, 10 toys were placed around the classroom, and Jim was required to pick them up with physical guidance. When he signed, he was permitted to escape the activity and to wander around the room or eat a cracker for 15 to 30 s. If he signed "please" or "eat" when approached to pick up more toys, he was permitted to continue in reinforcement for another 10 to 30 s. If he did not sign independently (following a verbal prompt), he was returned to the activity. If he hit or bit the therapist, he was immediately provided with hand-over-hand guidance to pick up a toy (graduated guidance). All treatment sessions occurred for 10 min, with no more than two sessions conducted consecutively.

*Component analysis.* For Bobby and Jim, the first condition (functional communication training [FCT] only) involved the removal of the contingency (time-out or graduated guidance) for inappropriate behavior. Instead, when Bobby or Jim emitted the target behavior, they were simply ignored. Four sessions of this FCT-only condition were completed, with each session continuing for 10 min. Following the completion of the FCT-only condition, the entire treatment package was rein-

stated for two sessions, followed by a DRO condition. During the DRO condition, the contingency for inappropriate behavior continued but signing was ignored. However, the schedule and amount of reinforcement were based on the previous two treatment sessions. On a recording form, an observer marked exactly when and for how long reinforcement was received during the final two sessions of the previous FCT condition. During the DRO condition, the same schedule of reinforcement was presented at the same times as during the final two treatment sessions, except if inappropriate behavior was occurring. If inappropriate behavior was occurring, the therapist simply delayed reinforcement until the next 6-s interval. Thus, the DRO condition specifically evaluated the control function of communication because the same schedule of reinforcement was provided. The DRO condition continued for two (Jim) or three sessions (Bobby), each 10 min in duration, over a 2-day period. Following the DRO condition, the entire treatment package was again reinstated for two (Bobby) or six (Jim) sessions.

For Barb, the only contingency for body rocking was extinction. Therefore, the first condition following treatment was the DRO condition, which continued for two 10-min sessions. The micro-switch continued to be present but did not activate the pretaped message; instead, Barb was provided with the same schedule of reinforcement as during treatment. This was followed by two sessions of FCT plus extinction, one session of DRO, and one session of FCT. The component analysis was completed in one afternoon.

*Generalization across therapists.* A partial generalization analysis was conducted for Jim with 2 therapists who had not been involved previously in his treatment. Following the component analysis, each therapist (a teacher and a staff psychologist on the inpatient unit) worked independently with Jim to pick up toys. Both therapists were familiar with the treatment package, having served as reliability observers during treatment, and were given no further instruction but to implement the treatment.

## RESULTS

The results for Bobby are presented in Figure 1. During assessment, Bobby engaged in no hand biting during the alone or attention conditions. He initially engaged in a high frequency of hand biting during the escape condition, but this frequency decreased substantially during the third session when the yellow bowl was no longer available. Instead, hand biting increased substantially during the tangible condition when the bowl was provided contingent on hand biting, leading us to conclude that hand biting was maintained primarily by positive reinforcement (yellow bowl).

Following assessment, when hand biting resulted in time-out (removal of bowl) and signing resulted in the presentation of the yellow bowl, hand biting decreased rapidly and never occurred during treatment in more than 5% of the intervals. Bobby also quickly learned to sign independently and received no physical prompts to sign during the final three sessions. During the final four sessions, he signed independently in at least 25% of the intervals.

During the FCT-only condition, in which time-out was removed from the treatment package, control over hand biting and signing quickly decreased. Signing decreased from 30% to 16% across sessions, and hand biting increased from 0% to 18%. The slope of both behaviors is also striking, demonstrating an inverse relationship. It is important to consider that hand biting was ignored and signing continued to result in reinforcement on a CRF schedule. Nevertheless, signing decreased and hand biting increased.

Control was quickly reestablished when time-out was again added to the treatment package, with signing increasing and hand biting returning to 0% occurrence during the second session. During the DRO plus time-out condition, signing dropped from over 20% occurrence to 5% occurrence in three sessions. Hand biting also increased gradually across all three sessions, even though the same amount of reinforcement was provided. When signing was again added to the treatment package, hand biting was eliminated and signing increased, re-

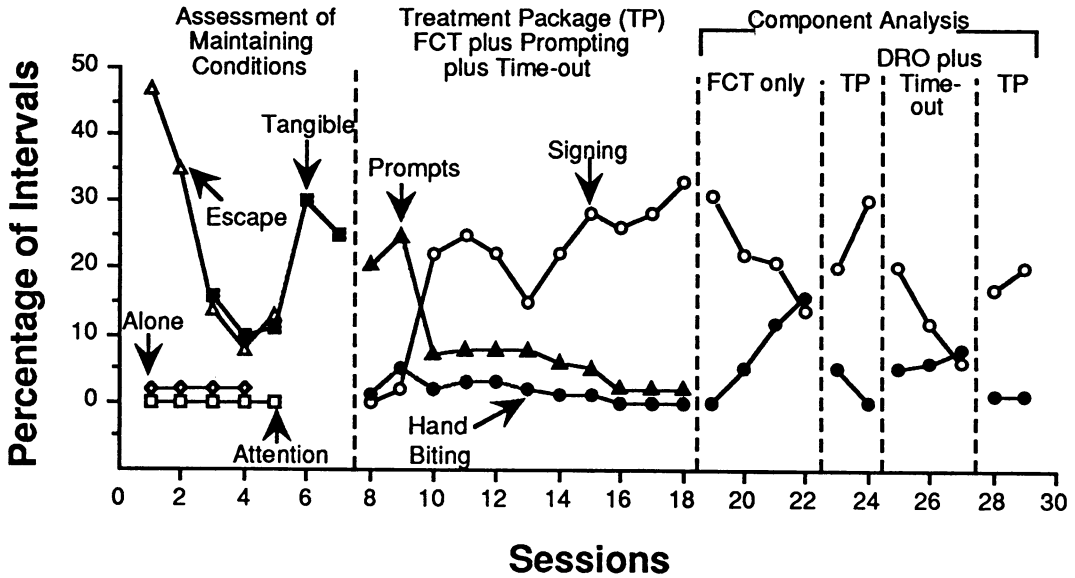


Figure 1. Percentage occurrence of hand biting, independent signing, and prompts across conditions for Bobby.

versing the pattern of behavior observed during the DRO condition. Therefore, only when both FCT and time-out were included in the treatment package was hand biting eliminated consistently (six of the final seven treatment package sessions) and signing maintained.

The results for Barb are presented in Figure 2. During the assessment phase, Barb engaged in almost continuous body rocking during both alone conditions and engaged in almost no body rocking during the demand condition, replicating our previous functional analysis of her behavior.

Barb required virtually no training to press the microswitch, receiving only one physical prompt. She then pressed the switch during both treatment sessions during over 10% of the intervals and engaged in appropriate behavior with at least 80% occurrence. During the first DRO condition, appropriate behavior initially decreased to 70% occurrence but then increased to just over 80% occurrence, with corresponding results for body rocking (decreasing from 28% to 18%). However, pressing the switch decreased substantially to 1% and 2% occurrence, respectively.

When the FCT condition was reinstated, appropriate behavior increased to 95% and 100% occurrence and inappropriate behavior was elimi-

nated. Barb pressed the switch during 12% and 18% of the intervals. When the DRO condition was repeated, appropriate behavior decreased to 88% but pressing the switch continued. Barb pressed the switch several times during the first several minutes and then stopped. Finally, when the FCT condition was reestablished, appropriate behavior increased to 99% and Barb pressed the switch during 15% of the intervals, with responding distributed about evenly across intervals.

The results for Jim are presented in Figure 3 and are very similar to the results achieved for Bobby. During assessment, Jim engaged in aggressive behavior about 13% of the time during the final two demand sessions and never engaged in aggressive behavior during the DRO or no-contingency conditions. He initially emitted some aggressive behavior during the attention condition, but by the final session, no aggressive behavior occurred.

Jim required the most training to sign independently (13 sessions). In the treatment condition, he initially emitted several aggressive behaviors but displayed a downward trend throughout the initial five treatment sessions. This was followed by a temporary but substantial increase in aggressive behavior, followed by zero or near zero occurrence of



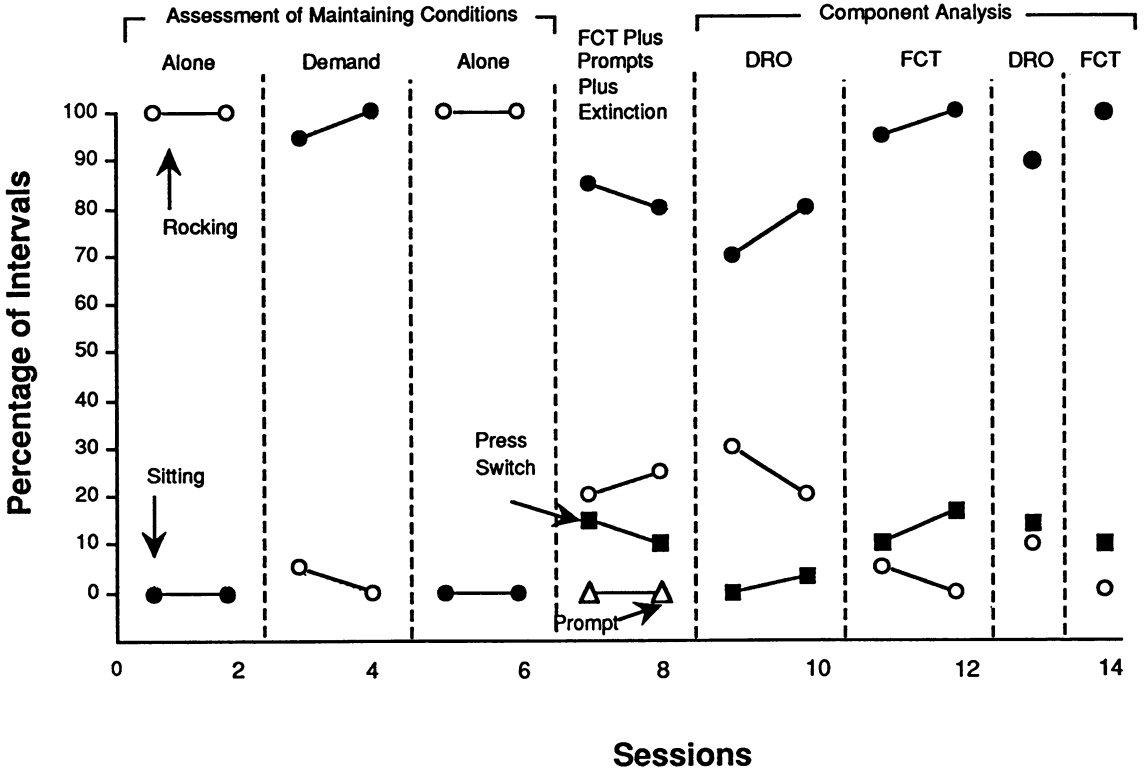


Figure 2. Percentage occurrence of body rocking, independent pressing of the microswitch, and prompts across conditions for Barb.

aggression during the remaining treatment sessions. He emitted no aggressive behaviors during the final two treatment sessions.

As with Bobby, Jim was trained to sign independently, receiving no physical prompts to sign beginning with the 14th treatment session. An inverse relationship appeared to occur between independent signing and aggression across sessions. Jim also increased his percentage of signing across sessions (Figure 3).

Jim's performance during the FCT condition, in which his aggressive behavior was ignored, was almost identical to the performance displayed by Bobby. During the first session, Jim engaged in no aggressive behavior; this was followed by a steady increase in aggression. Unlike Bobby, Jim's signing remained relatively stable. During the third and fourth FCT sessions, Jim frequently bit the therapist, who ignored the biting, and then Jim signed "please" to escape the task. When graduated guid-

ance was returned to the treatment package, aggressive behavior was quickly eliminated by the second session. In addition, a substantial increase in signing occurred and increased across both sessions.

During the DRO plus graduated guidance condition, aggressive behavior reoccurred and, similarly to Bobby, steadily increased, but at frequencies lower than when graduated guidance was removed from the treatment package. However, as was the case for Bobby, the same schedule and amount of reinforcement (as was delivered during the previous treatment condition) were received by Jim during the DRO condition, thus reducing his opportunities for aggression toward the therapist. Even with the maintenance of reinforcement, aggression occurred and increased. In addition, the steadily increasing frequency of signing observed during the previous condition decreased substantially during both sessions.

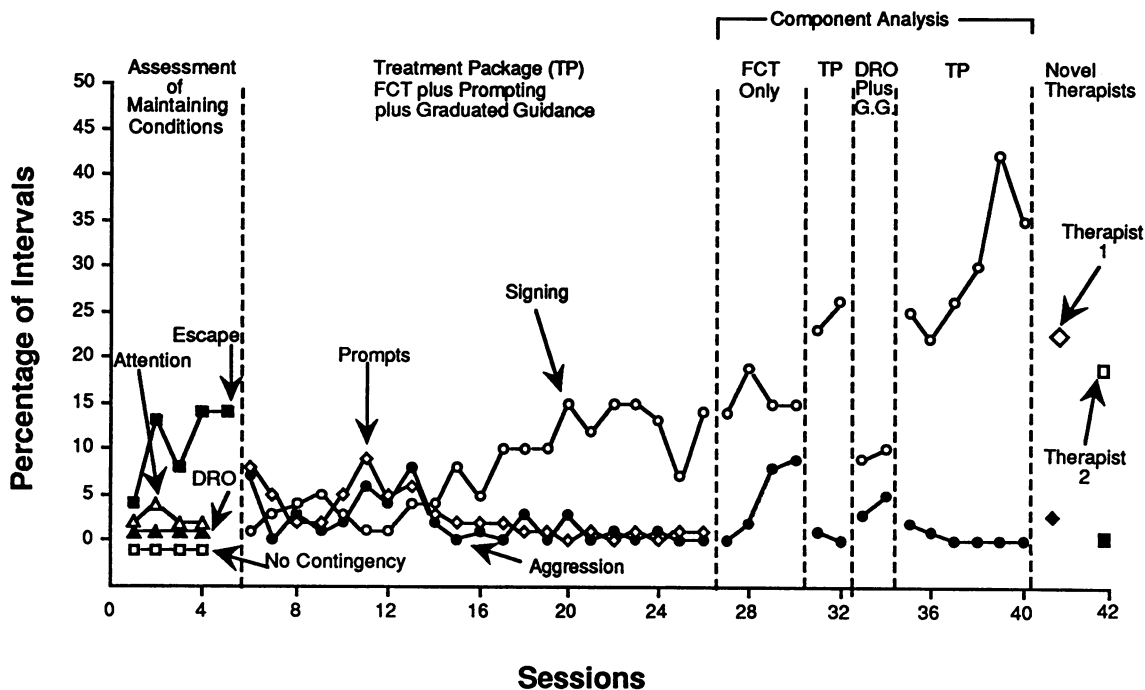


Figure 3. Percentage occurrence of aggression, independent signing, and prompts across conditions for Jim.

When signing was again reinforced as part of the treatment package, control over aggression was quickly reestablished, and aggression did not occur during the final four sessions. Of interest is that Jim's frequency of signing increased substantially over all previous conditions and effectively served as an avoidance response. Jim began to sign "please" and "eat" in combination, signed immediately when new persons entered the room, and was observed to sign independently in other locations of the hospital. As shown in Figure 3, he used signs in the presence of 2 new therapists at a relatively high frequency and was only rarely aggressive.

## DISCUSSION

The combined use of functional analysis to identify maintaining contingencies and functional communication training to establish replacement behavior appears to be a powerful approach for treating aberrant behavior. For all 3 participants, the maintaining condition was quickly identified during assessment and the communication response was learned within relatively few treatment trials, rep-

licating the results of previous investigations (Carr & Durand, 1985; Steege *et al.*, 1989). As in the studies by Carr and Durand (1985) and Durand and Carr (1987), the results of treatment were not dependent on particular topographies or functions of behavior; the functional communication treatment program was effective across all behaviors.

An extension of previous investigations was the completion of the component analysis following treatment, with particularly striking results for Bobby and Jim. At the completion of treatment, Bobby and Jim were emitting no or few inappropriate behaviors, but when the contingency for inappropriate behavior was removed, both demonstrated substantial increases in inappropriate behavior, beginning with the second session. In addition, both demonstrated upward trends in inappropriate behavior that were quickly reversed when time-out or graduated guidance was reinstated. These results indicate that, for at least some children who emit inappropriate behavior, treatment cannot rely exclusively on reinforcement for appropriate behavior, at least initially. Instead, a consequence procedure, such as time-out or graduated guidance, also may

be needed but can be faded over time. However, for both children, the consequence for inappropriate behavior was included in the initial treatment package. It is possible that the initial inclusion of these components influences subsequent responding, although this explanation appears doubtful given the reversals in behavior achieved across conditions.

For both participants, inappropriate behavior occurred very infrequently by about the middle of treatment and appeared to be inversely related to the independent display of the communication response. Across treatment sessions, inappropriate behavior occurred with decreasing frequency, with corresponding increases in the number of sessions in which no occurrences were observed and increasingly higher percentages of independent communication responses. These results correspond to Carr's (1988) suggestion that the communication response and the inappropriate behavior are functionally equivalent. In other words, the participants controlled the presentation of reinforcement through signing. By controlling reinforcement through simple motoric responses, there was no need to emit inappropriate behavior. However, a secondary schedule of contingencies was also in effect and was equally necessary for control over behavior. The secondary schedule, controlled by the therapists, involved time-out or graduated guidance.

It makes intuitive sense that both schedules would be needed if the responses are, indeed, functionally equivalent. Neither Bobby nor Jim was observed to use communicative responding to control the environment, but both had histories of achieving reinforcement through aberrant behavior. If signing and aberrant behavior are "blended" into their repertoires, and no contingencies are in effect to suppress the behavior with the longer history, then at least infrequent displays of inappropriate behavior may persist during extinction. Jim, for example, bit the examiner, paused, and he then invariably signed "please" to receive reinforcement. It is possible that if graduated guidance had not been reinstated, he would have been trained inadvertently to emit the following chain: demand-bite-sign-receive reinforcement.

During the DRO condition, when the partici-

pants each received the same amount of reinforcement and on the same schedule as during the final two treatment sessions, control over behavior quickly decreased. These results were especially notable for Bobby and Jim, whose signing decreased substantially and whose inappropriate behavior increased. It was expected that signing would decrease because it was placed on extinction. The increases in inappropriate behavior, although not as great as when the contingencies for inappropriate behavior were removed, were consistent. These data strongly suggest that control over the delivery of reinforcement is a critical component of functional communication training and that functional communication training, as used here, is a distinct schedule of reinforcement.

Carr and Durand (1985) first discussed the issue of control versus amount of reinforcement and concluded that the active participation of individuals in treatment was important. We have taken their conclusion one step further: Control is a separate variable from amount of reinforcement and, at least with respect to Bobby and Jim, was a necessary component for the elimination of inappropriate behavior. For both participants, when signing was again reinforced following the DRO condition, no occurrences of inappropriate behavior were displayed within two and three sessions, respectively. In addition, for Jim, continued increases in signing occurred across subsequent sessions and aggression remained at zero.

On an anecdotal basis, it was also noted that changes occurred in affect for all 3 participants during the final return to treatment condition. All 3 participants interacted more positively with the therapists, smiled more frequently, and appeared to be less agitated. Although these are anecdotal findings, they are potentially important measures of collateral social behavior and should be measured in future investigations, perhaps by using rating scales similar to the one developed by Durand and Lanci (1989b).

In evaluating functional communication training, the use of communication as a metaphor (Durand & Lanci, 1989a) is an interesting and frequently helpful construct, particularly when

explaining the rationale of the approach to parents and direct service staff. From a behavioral standpoint, we agree with Carr and Durand (1985) and Carr (1988) that at least two components of functional communication training are different from typical differential-reinforcement-of-alternative-behavior (DRA) procedures. First, as discussed by Carr and Durand (1985), the schedule of reinforcement is controlled by the participant, making this more of a self-control procedure. In many ways, it is similar to a say-then-do approach, except that it involves say (sign)-then-you-do. Wacker, Wiggins, Fowler, and Berg (1988) used a similar approach with profoundly and multiply handicapped children, who were taught to use microswitches that activated pretaped messages to solicit positive reinforcers (attention, drinks, etc.). We see very little difference between functional communication training and the procedures used by Wacker *et al.* (1988); both approaches trained motoric behaviors that solicited reinforcement. We agree with Carr and Durand (1985) that the primary variable is the active participation of the clients during treatment, which we refer to as the control function of functional communication training.

Second, the use of communicative responses, such as signs or pressing microswitches, is an efficient behavior as defined by Carr (1988). Reinforcement occurs on a CRF schedule with a minimum of delay between response and reinforcement. The efficiency of the response may be at least as important as its functional equivalence to the aberrant behavior (Carr, 1988). We would also add a more difficult to measure, but possibly equally important, variable to Carr's definition of efficiency: the motoric effort required of the individual. When the response is not fatiguing (e.g., one-handed signs, simple verbal utterances, or lightly pressing a switch), it is a less demanding response than requiring the participant to actually pick up a toy (which might serve as the replacement behavior in a functional communication program). However, because the participant can avoid task completion in a functional communication program, is it the best approach to long-term treatment? Jim is an excellent example of this potential problem. The demand

for Jim was to pick up toys, but he successfully avoided this task by increasing his signing. When Jim signed 30 or more times, he picked up a maximum of two toys per 10 min, which may not be sufficient in most applied situations.

The approach used by Steege *et al.* (1989) might address this concern. Once inappropriate behavior is reduced to minimal or zero levels and the communication response is occurring both independently and at a high frequency, then the participants should be required to gradually increase their task responding before they sign for reinforcement. Steege *et al.* required the sorting first of five items and then 25 items before the client received reinforcement. A similar approach with Jim might have required him to pick up one item, then two items, and so on, before receiving reinforcement for signing. Future evaluations of the applicability of this approach are needed, especially with respect to ongoing maintenance of both client behavior and use of treatment by staff or parents.

Of potential concern is that the results obtained from the functional analysis do not reflect natural contingencies. With respect to Bobby, for example, a yellow bowl may not exist in the school or home setting. This concern is not particularly problematic to us for two reasons. First, as discussed by Iwata *et al.* (1990), a functional analysis is conducted to narrow the choices of treatment by providing functional matches between the maintaining contingencies and treatment options. Thus, when negative reinforcement is identified as the maintaining contingency, graduated guidance rather than time-out, for example, would be selected for treatment. In other words, the results of functional analyses identify classes of maintaining conditions, not specific reinforcing stimuli. Second, the materials used (including the yellow bowl) and, more importantly, the behaviors observed during the functional analysis were similar to the materials in use and the behaviors observed at school (the same behaviors that led to a referral for evaluation). Therefore, the functional analysis did not set up conditions that caused aberrant behavior but instead was used to identify an already existing class of maintaining conditions.

Future investigators may wish to compare directly the results obtained from functional analyses conducted in controlled settings with those obtained in natural settings to substantiate further the generalizability of the findings. Our preliminary work (Sasso et al., 1989) suggests that there will be good correspondence in the results obtained across settings.

## REFERENCES

- Carr, E. (1988). Functional equivalence as a mechanism of response generalization. In R. Horner, R. Koegel, & G. Dunlap (Eds.), *Generalization and maintenance: Life-style changes in applied settings* (pp. 221-241). Baltimore: Paul H. Brookes.
- Carr, E., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis*, **18**, 111-126.
- Durand, V. M., & Carr, E. (1987). Social influences on self-stimulatory behavior: Analysis and treatment application. *Journal of Applied Behavior Analysis*, **20**, 119-132.
- Durand, V. M., Crimmins, D., Caulfield, M., & Taylor, J. (1989). Reinforcer assessment I: Using problem behavior to select reinforcers. *Journal of the Association for Persons with Severe Handicaps*, **14**(2), 113-126.
- Durand, V. M., & Lanci, A. (1989a, May). Assessing problem behavior: Implications for motivating students with severe behavior problems. In D. Wacker (Chair), *Functional analysis of severe behavior problems: Recent applications and novel approaches*. Symposium conducted at the annual meeting of the Association for Behavior Analysis, Milwaukee, WI.
- Durand, V. M., & Lanci, A. (1989b, May). Functional reinforcer assessment: Task performance and affect. In V. M. Durand (Chair), *Reinforcement redux: Motivation and persons with severe handicaps*. Symposium conducted at the annual meeting of the Association for Behavior Analysis, Milwaukee, WI.
- Iwata, B., Dorsey, M., Slifer, K., Bauman, K., & Richman, G. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities*, **3**, 1-20.
- Iwata, B., Pace, G., Kalsher, M., Cowdery, G., & Cataldo, M. (1990). Experimental analysis and extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis*, **23**, 11-27.
- Northup, J., Wacker, D., Steege, M., Cigrand, K., Sasso, G., & Cook, J. (1989, May). *Outpatient evaluation of self-injurious and aggressive behavior using functional analysis*. Paper presented at the annual meeting of the Association for Behavior Analysis, Milwaukee, WI.
- Repp, A., Felce, D., & Barton, L. (1988). Basing the treatment of stereotypic and self-injurious behaviors on hypotheses of their causes. *Journal of Applied Behavior Analysis*, **21**, 281-289.
- Sasso, G., Reimers, T., Cooper, L., Wacker, D., Steege, M., Berg, W., Allaire, A., & Kelly, L. (1989, May). *Assessing the functional properties of behavior in the classroom*. Paper presented at the annual meeting of the Association for Behavior Analysis, Milwaukee, WI.
- Steege, M., Wacker, D., Berg, W., Cigrand, K., & Cooper, L. (1989). The use of behavioral assessment to prescribe and evaluate treatments for severely handicapped children. *Journal of Applied Behavior Analysis*, **22**, 23-33.
- Wacker, D., Wiggins, B., Fowler, M., & Berg, W. (1988). Training students with profound or multiple handicaps to make requests via microswitches. *Journal of Applied Behavior Analysis*, **21**, 331-343.

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