

*EVALUATION OF THE "CONTROL OVER REINFORCEMENT"
COMPONENT IN FUNCTIONAL COMMUNICATION TRAINING*

SUNGWOO KAHNG, BRIAN A. IWATA,
ISER G. DELEON, AND APRIL S. WORSDELL

UNIVERSITY OF FLORIDA

The effectiveness of functional communication training (FCT) as a treatment for behavior disorders has been attributed to a number of variables, one of which is the individual's ability to exert control over the delivery of reinforcement. We evaluated this component of FCT by exposing individuals to conditions in which their behavior either did or did not affect the delivery of reinforcement. Three adults with mental retardation who engaged in self-injurious behavior (SIB) participated. Following a functional analysis of their SIB, the effects of FCT were compared to those of noncontingent reinforcement (NCR) in a multielement design. The amount of reinforcement during both conditions was equated by yoking the schedule of reinforcement during NCR sessions to that in effect during FCT sessions. Results indicated that FCT and NCR were equally effective in reducing the SIB of all participants and suggest that control over reinforcement delivery may not affect the degree to which FCT produces behavioral suppression. However, a different benefit of FCT was evident in the results: More consistent increases in the alternative response were observed during the FCT condition than during the NCR condition.

DESCRIPTORS: extinction, functional analysis, functional communication training, noncontingent reinforcement, self-injurious behavior

One approach to reducing the frequency of problem behavior consists of reinforcing a more socially acceptable alternative response while the aberrant response is extinguished. Collectively, these procedures are known as differential-reinforcement-of-alternative-behavior (DRA) contingencies (see Vollmer & Iwata, 1992, for a review). One variation of DRA procedures has emerged as a popular intervention over the past decade and is described in the literature as func-

tional communication training (FCT; Carr & Durand, 1985). The development of an FCT intervention typically involves two steps (see Durand, 1990; Durand, Berotti, & Weiner, 1993): A functional analysis is first conducted to identify the variable or variables that maintain the problem behavior; subsequently, the individual is taught to emit an alternative response that produces the same reinforcer.

The efficacy of FCT has been demonstrated across a wide range of behavior problems (Belfiore, Browder, & Lin, 1993; Bird, Dores, Moniz, & Robinson, 1989; Jayne, Schloss, Alper, & Menscher, 1994) as well as across settings (Campbell & Lutzker, 1993; Hunt, Alwell, & Goetz, 1988; Smith & Coleman, 1986). Recent data also suggest that FCT may have enduring therapeutic effects. For example, Durand and Carr (1991) treated 3 children with FCT who engaged in destructive behaviors. They reported that treatment effects were maintained after ap-

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Reprints may be obtained from Brian Iwata, Psychology Department, The University of Florida, Gainesville, Florida 32611.

proximately 18 to 24 months from the introduction of their intervention.

The success of FCT has been attributed to a number of variables in addition to extinction and differential reinforcement, one of which is the individual's ability to exert control over the delivery of reinforcement. Carr and Durand (1985) suggested that, by strengthening an alternative response that produces reinforcement, FCT places the individual in active control over reinforcement rather than being the passive recipient. Although few would argue against the general benefits of teaching individuals better ways to control their environments, the extent to which this particular feature of FCT accounts for behavior reduction is unclear and has not been thoroughly evaluated. In a preliminary investigation, Wacker *et al.* (1990) conducted a brief comparison between FCT and differential-reinforcement-of-other-behavior (DRO) contingencies. The DRO conditions were in effect for very brief periods (one to three sessions), small differences were observed in levels of aberrant behavior during the FCT and DRO conditions, and the major difference between the conditions appeared to be levels of the alternative response, which were higher during the FCT condition. Most important, the use of DRO (or any differential reinforcement contingency) as a comparison condition still affords the individual control over the delivery of reinforcement: In a DRO contingency, interresponse time (*not* responding) produces reinforcement; in a DRA (or FCT) contingency, responding produces reinforcement. In either case, the individual's behavior determines whether reinforcement is delivered.

Noncontingent reinforcement (NCR) has also been shown to reduce problem behaviors maintained by positive as well as by negative reinforcement (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Vollmer, Marcus, & Ringdahl, 1995). However, be-

cause NCR schedules involve time-based delivery of reinforcement independent of behavior, at no time does the individual's behavior influence the delivery of reinforcement. We examined the extent to which control over reinforcement contributes to behavior reduction during treatment with FCT by arranging conditions in which the individual's behavior either did (FCT) or did not (NCR) determine the delivery of reinforcement. Superior results obtained during FCT would support a conclusion that control over reinforcement may be an important component of FCT, whereas equivalent outcomes during FCT and NCR would suggest that control over reinforcement is unnecessary for producing behavioral suppression.

METHOD

Participants and Setting

Three adults living in a state residential facility for persons with developmental disabilities participated. All were referred to a specialized day program for assessment and treatment of their self-injurious behavior (SIB). Todd was a 50-year-old man who had been diagnosed with profound mental retardation and tuberous sclerosis. His SIB consisted of head banging, and he wore a protective helmet throughout the day to prevent injury from seizures as well as from SIB. He had no expressive language skills but responded to a few simple requests. He was ambulatory and blind in his right eye. Lynn was a 29-year-old woman who had been diagnosed with severe mental retardation and whose SIB consisted of hand mouthing. She had a limited vocal repertoire but responded to a variety of requests. She was ambulatory and had no sensory impairments. Bob was a 45-year-old man who had been diagnosed with severe mental retardation and whose SIB consisted of eye poking. He had limited expressive language skills but good receptive

language skills. He was ambulatory and had no sensory impairments.

The study was conducted at a day program located on the grounds of the residential facility. Therapy rooms contained chairs, tables, and other furnishings, as well as materials that varied according to the conditions of the study. Sessions lasted 10 to 15 min and were conducted two to four times per day, usually 5 days per week.

Response Measurement and Reliability

Todd's head banging was defined as forceful contact of his head against walls or furniture. His alternative response during FCT training was raising an arm, initially defined as lifting his hand above the level of his shoulder. However, after Session 23 during the treatment phase of the study, the definition of arm raising was changed to lifting his hand above the level of his chest. Lynn's hand mouthing was defined as insertion of her hand into her mouth past the plane of the upper and lower lips. Her alternative response was saying "hi." Bob's eye poking was defined as insertion of his finger into his eye socket. His alternative response was signing "finished." Prompted communications were those produced by a participant with assistance from an experimenter; independent communications were those produced without assistance.

Frequencies of SIB and the alternative response were recorded using hand-held computers (Assistant, Model AST102) during continuous 10-s intervals. Data were summarized as number of responses per minute of SIB and of the alternative response by dividing the number of responses by the total session time. In addition, data were collected on experimenters' implementation of assessment and treatment procedures (e.g., delivery of instructions, prompting, and consequences).

A second observer simultaneously but independently collected data during 32.7% of

Todd's sessions, 40.3% of Lynn's sessions, and 27.5% of Bob's sessions. Agreement percentages were calculated based on interval-by-interval comparisons of observers' records, in which the smaller number of responses in each interval was divided by the larger number of responses. These proportions were summed across all intervals and divided by the total number of intervals in the session to obtain the percentage agreement between the observers. Mean agreement scores for Todd, Lynn, and Bob, respectively, were as follows: SIB during the functional analysis: 99.6%, 93.7%, and 96.6%; SIB during baseline and treatment sessions: 99.1%, 89.0%, and 92.1%; the alternative response during baseline and treatment sessions: 99.7%, 96.9%, and 99.6%.

Experimental Sequence and Design

A functional analysis was conducted initially to identify the variables that maintained participants' SIB. A multielement design was used during this assessment. Subsequently, two simultaneous baselines were implemented for each participant; one was conducted by the experimenter who later implemented the FCT procedure, and the other was conducted by the experimenter who later implemented the NCR procedure. To further enhance discrimination between the two conditions, sessions were conducted in different rooms. The effects of FCT and NCR were compared in a multielement design, which was introduced according to a multiple baseline across subjects design.

Functional Analysis

Participants were exposed to four assessment conditions (alone, attention, play, demand) based on procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994).

Alone. The individual was in the room in which neither an experimenter nor leisure materials were present. The purpose of this

condition was to determine whether SIB persisted in the absence of social contingencies, which would suggest that SIB was maintained by nonsocial (automatic) reinforcement.

Attention. The participant and experimenter were in a room that contained various leisure materials. The experimenter directed the individual toward the materials at the beginning of the session but otherwise ignored the individual. Whenever SIB occurred, the experimenter approached the individual and provided brief social attention (e.g., “Don’t do that; you’ll hurt yourself”). This condition was conducted to determine whether SIB was maintained by positive reinforcement in the form of attention.

Demand. The individual and an experimenter were in a room (usually seated at a table) with task materials selected from the individual’s habilitation or education program. Learning trials were presented approximately every 30 s (fixed-time [FT] 30-s schedule) using a three-step graduated prompting procedure (verbal instruction, demonstration, physical guidance). Praise was delivered following compliance, and prompts were presented at 5-s intervals if compliance did not occur. If SIB occurred, the experimenter ceased all interaction with and turned away from the individual until the next trial began. The purpose of this condition was to determine whether SIB was maintained by negative reinforcement in the form of escape from demands.

Play. The individual and an experimenter were in a room containing a variety of leisure materials. The therapist provided attention on an FT 30-s schedule in the form of praise, pats on the back, or delivery of a leisure item. This condition served as the control.

Treatment Conditions

Baseline. Following the functional analysis, two baselines were implemented for each

individual by two experimenters in different settings. Todd’s and Bob’s baselines were similar to the demand condition of the functional analysis. During Todd’s sessions, the experimenter presented instructions on a continuous basis and terminated the sequence for 30 s whenever SIB occurred. During Bob’s sessions, instructions were presented on an FT 30-s schedule, and SIB resulted in an escape for the remainder of the 30-s interval. For both individuals, compliance resulted in praise from the experimenter. Lynn’s baselines were identical to the attention condition of the functional analysis. Upon each occurrence of SIB, the experimenter delivered attention to Lynn for approximately 5 s (e.g., “Don’t do that; you’ll hurt yourself” or “You shouldn’t stick your finger in your mouth”).

Functional communication training. Alternative responses were selected for each individual based on informal observations indicating that the responses occurred at least occasionally. During FCT sessions, these responses were prompted and strengthened using the reinforcer previously found to maintain SIB, while SIB was placed on extinction. Todd was physically prompted to raise his arm immediately following the presentation of an instruction. A time-delay procedure (Touchette, 1971) was used to increase independent responding. The delay between the presentation of an instruction and the prompt was gradually increased based on the absence of SIB. Todd continued to require periodic prompting throughout the FCT condition. Occurrences of arm raising (prompted or unprompted) resulted in a 30-s escape from the task. Head banging resulted in presentation of the next trial. Lynn was verbally prompted to say “hi” on an FT schedule based on the mean interresponse time (IRT) of hand mouthing during the previous three baseline sessions. A time-delay procedure was used to increase independent vocalizations, with the delay to

prompting gradually increased based on the mean IRT of the previous three sessions, until all verbal prompts were eliminated. Emitting the alternative response (prompted or unprompted) resulted in approximately 5 s of attention (e.g., “How are you today?” “What did you do this weekend?”). Occurrences of SIB were ignored. Bob was verbally prompted to sign “finished” immediately following the presentation of an instruction, and a time-delay procedure was implemented in a manner similar to that used for Todd. Signing “finished” (prompted or unprompted) resulted in escape from the task for the remainder of the 30-s interval. Eye poking produced no differential consequences.

Noncontingent reinforcement. To control for the amount of reinforcement available in the FCT and NCR conditions, the schedule of reinforcement in a given NCR session was yoked to the reinforcement schedule of the previous FCT session. Thus, NCR sessions always followed FCT sessions but were separated by approximately 30 min. During Todd’s and Bob’s NCR sessions, the experimenter provided escape from the task by presenting an instruction and immediately walking away. The schedule of noncontingent escape was determined by the number of demand trials during which escape occurred in the previous FCT session. For example, if Todd escaped during Trials 5, 10, and 17 of an FCT session by raising his arm, he was permitted to escape the same trials during the subsequent NCR session. During Lynn’s NCR sessions (which were not conducted in a discrete-trial format), the experimenter delivered noncontingent attention on an FT schedule. For example, if Lynn received 30 reinforcers (for saying “hi”) during an FCT session, she received 30 reinforcers (twice per minute) during the subsequent NCR session. Engaging in SIB or the alternative response during NCR ses-

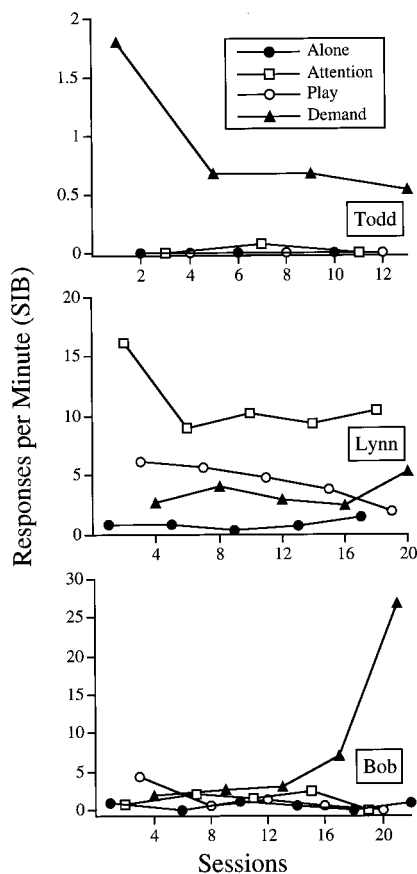


Figure 1. Number of responses per minute of SIB for each participant across functional analysis conditions.

sions resulted in no differential consequences for any of the participants.

RESULTS

Results of the functional analyses are presented in Figure 1. Todd’s SIB occurred almost exclusively during the demand condition, indicating that the behavior was maintained by negative reinforcement in the form of escape from demands. By contrast, Lynn exhibited some SIB in all conditions. However, her SIB was consistently highest during the attention condition, suggesting that her behavior was maintained primarily by positive reinforcement in the form of attention from caregivers. Bob exhibited the highest

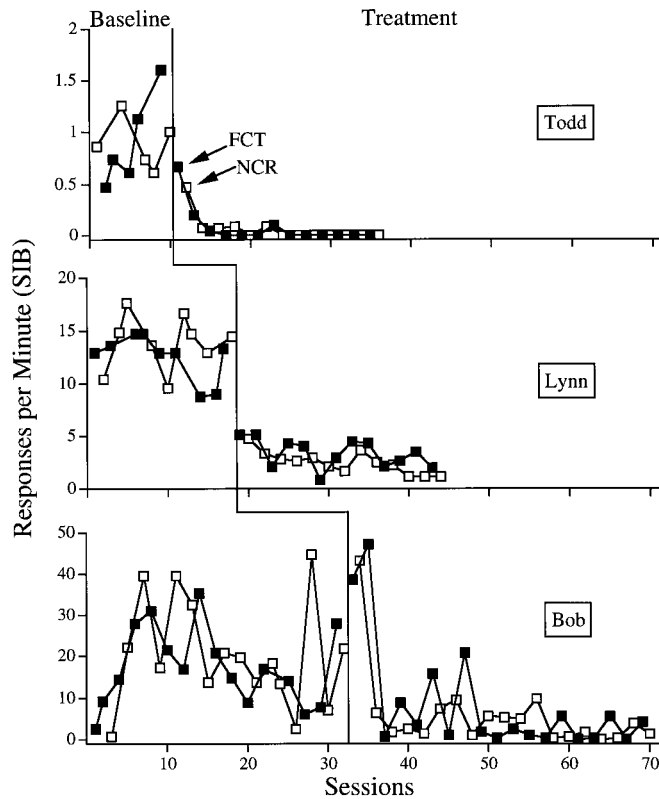


Figure 2. Number of responses per minute of SIB for each participant during baseline and treatment (FCT and NCR) conditions.

levels of SIB in the demand condition, indicating that the behavior was maintained by negative reinforcement in the form of escape from demands. Data from these analyses were used to determine the specific manner in which FCT and NCR would be implemented during treatment conditions.

Figure 2 shows rates of SIB during baseline and treatment sessions. Mean rates of SIB during Todd's baselines were 0.91 and 0.89 responses per minute. When FCT and NCR were implemented, Todd's SIB decreased and did not occur at all during the last six sessions of either condition. Lynn engaged in high rates of hand mouthing during both baseline conditions ($M = 13.9$ and 12.6 responses per minute). Large and immediate decreases in SIB were observed following the introduction of both interventions. Mean rates of SIB during the FCT

and NCR conditions were 3.4 and 2.5 responses per minute, respectively. Bob's SIB was extremely variable during baseline conditions ($M = 20.4$ and 22.5 responses per minute). Following an initial burst of responding when FCT and NCR were implemented, SIB decreased in both treatment conditions, averaging 2.4 responses per minute in the FCT condition and 1.2 per minute in the NCR condition during the last seven sessions.

Rates of independent alternative responses are shown in Figure 3. All participants rarely engaged in the alternative response during baseline sessions. Although Todd exhibited some arm raising during his first FCT session, the behavior was not observed during six subsequent sessions. This seemed to be primarily a function of the response definition used for scoring arm raising. That is,

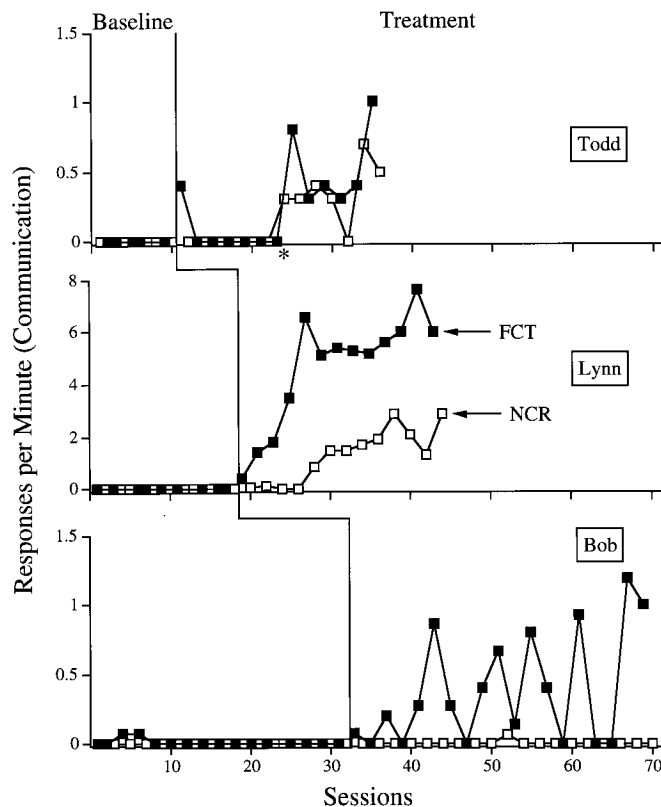


Figure 3. Number of responses per minute of independent alternative responding for each participant during baseline and treatment (FCT and NCR) conditions. The asterisk on Todd's graph (top panel) represents the point at which the definition of arm raising was modified.

although Todd did not raise his arm above shoulder level, he was frequently observed to raise it chest high. Therefore, the definition of arm raising was changed from the former to the latter after Session 23 (the seventh treatment session). Following this change, independent arm raising occurred during both the FCT and the NCR conditions. When FCT was implemented with Lynn, her rate of saying "hi" gradually increased, averaging 5.9 responses per minute during the last nine FCT sessions. She also began to emit the alternative response, although at lower rates, during the NCR condition after she acquired the response in the FCT condition. Bob's rate of signing "finished" gradually increased throughout the FCT condition, although it occurred at variable rates. With the exception of one session (52), Bob

did not emit the alternative response during the NCR condition.

Because Todd and Lynn both engaged in the alternative response during the NCR condition, when it was never reinforced, a further analysis of their data was conducted by examining within-session patterns of responding. Total frequencies of the alternative response during the NCR condition were calculated on a trial-by-trial basis for Todd's last seven sessions and on a minute-by-minute basis for Lynn's last eight sessions, and are shown in Figure 4. (Note that 14 rather than 15 min are represented for Lynn's sessions due to a timing error in the data-collection program.) These data indicated that Todd emitted the alternative response periodically throughout the NCR sessions, whereas Lynn engaged in high rates of the

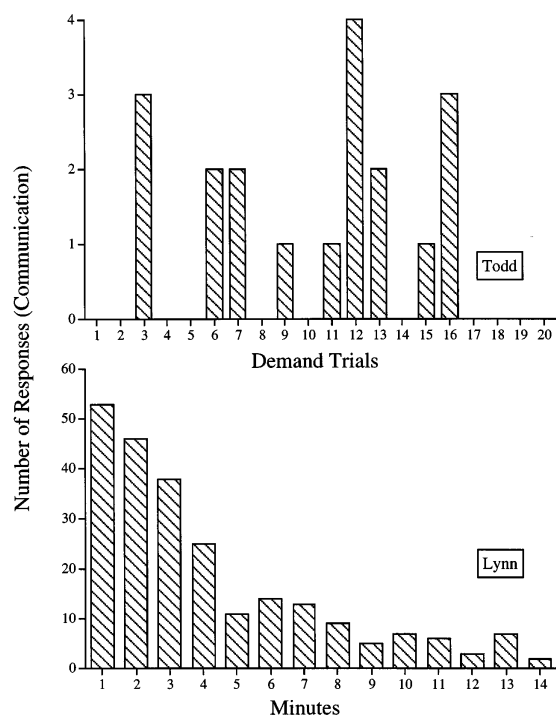


Figure 4. Within-session patterns of alternative responding during the NCR condition. Data represent the total number of responses per trial over the last seven sessions (Todd) or per interval over the last eight sessions (Lynn).

alternative response at the beginning of NCR sessions but displayed very little responding toward the end of sessions.

DISCUSSION

Results of the present study showed that FCT suppressed SIB in 3 individuals. However, similar decreases in SIB were observed for all individuals under a condition of NCR. Thus, SIB was reduced to a similar degree regardless of whether reinforcement was delivered contingent on the occurrence of an alternative response (FCT) or was delivered independent of behavior (NCR). These results suggest that control over the delivery of reinforcement per se is not a critical component of treatment procedures based on FCT.

Behavioral suppression observed during

FCT was most likely a function of the change in consequences for SIB from baseline to treatment. In addition to including reinforcement for appropriate behavior, studies on FCT have included separate contingencies for problem behavior, usually consisting of extinction (Bird *et al.*, 1989; Durand & Carr, 1992). Moreover, results of several studies have indicated that FCT may be ineffective unless extinction, time-out, or some other consequence for inappropriate behavior is included in the FCT intervention (Fisher *et al.*, 1993; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Wacker *et al.*, 1990). Although the separate effects of the reinforcement and extinction components of FCT were not assessed in this study, behavioral suppression (decreases in SIB) preceded behavioral acquisition (increases in the alternative response) for all 3 participants during the FCT condition. In addition, Bob often failed to emit the alternative response during entire sessions in the FCT condition, yet his rate of SIB remained low. These results, when combined with those reported in recent component analyses of FCT (Fisher *et al.*, Shirley *et al.*, Wacker *et al.*), strongly suggest that behavioral suppression during FCT is a product of extinction. The alteration of establishing operations (EO) also may have played a role in the reduction of SIB. That is, during the initial FCT sessions, both prompted and unprompted communicative responses produced reinforcement. This resulted in escape from all demands for Todd and Bob and nearly continuous attention for Lynn. Therefore, it may have been possible that the initial reductions in SIB were due partly to reduced motivation (*i.e.*, EO effects). However, it is unlikely that this occurred beyond the first few FCT sessions because it would have interfered with the emission of the alternative response.

Response suppression during NCR may also have been a result of more than one

behavioral process. In this as well as in other applications of NCR, time-based delivery of reinforcement was combined with termination of reinforcement for SIB. Thus, reductions in SIB could have been a function of altering the behavior's establishing operation or a function of extinction. Because the purpose of this study was to use NCR merely as a control procedure, no attempt was made to identify the behavioral mechanisms that accounted for the effectiveness of NCR. Recent data, however, suggest that NCR can be effective in reducing the frequency of behavior problems such as SIB even though the occurrence of SIB continues to produce reinforcement (Fischer, Iwata, & Mazaleski, 1997).

Although our primary interest was the examination of treatment effects on SIB, we also measured occurrences of the alternative responses taught during FCT. Increases in these responses were somewhat gradual and may have reflected either the process of acquisition or a delay to acquisition while SIB was being extinguished. In either case, increases in the alternative responses appear to have been a direct function of the reinforcement component in the FCT (DRA) contingency and provide some support for FCT as a means of response substitution.

A particularly interesting finding was generalization of the alternative response for Todd and Lynn to the NCR condition in the absence of reinforcement. Within-session analysis of their data revealed different patterns of responding by these individuals during the course of most sessions. Lynn typically emitted the alternative response during the first few minutes of the NCR sessions. Toward the end of the session, her rate of responding decreased to a very low level, apparently showing the effects of extinction. By contrast, Todd responded sporadically throughout the NCR sessions, suggesting either adventitious reinforcement during the NCR condition or short-term maintenance

of responding during extinction. Alternatively, although attempts were made to facilitate discrimination between the FCT and NCR conditions (different experimenters and rooms), it is possible that Todd failed to do so.

One limitation of this study may be the fact that the definition of Todd's alternative response was changed midway through the treatment phase. Arm raising was initially defined as lifting the hand above the shoulder. However, it appeared that our definition was too stringent or not easily discriminated by Todd. This may be evident in the fact that he was able to engage in a slightly different form of the response: lifting his hand above his chest. After the change in definition, arm raising was observed to occur in both conditions (FCT and NCR), although we do not know to what extent it actually occurred prior to the definitional change.

Another possible limitation in our findings may have resulted from the use of relatively rich schedules of NCR during brief treatment sessions. Although such conditions are typical in research on treatment evaluation, they may not reveal the potential influence of deprivation in the natural environment. That is, caregivers' delivery of reinforcement in the natural environment may lapse over time and may produce states of deprivation for a client periodically throughout the day. At such times, the ability to recruit reinforcement through the use of a mand seems to be particularly beneficial. For this reason, FCT may ultimately be a more practical intervention than NCR. Thinning a schedule of NCR would require caregivers to monitor and adjust reinforcement rates based on rates of inappropriate behavior. During FCT, the individual's alternative response could be used to determine the schedule of reinforcement, thus making it easier for a therapist to thin the schedule merely by reinforcing occurrences of the alternative response (although another prob-

lem could arise if the individual persisted in responding at high rates). In addition, FCT may lead to better maintenance because there is a more salient cue for the delivery of reinforcement. That is, in FCT, the client cues the therapist, whereas in NCR, the therapist must generate his or her own cue.

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STUDY QUESTIONS

1. Explain why the use of any differential reinforcement procedure (e.g., DRA or DRO), when compared to functional communication training (FCT), does not allow a determination of the extent to which behavior change is a function of individual control over the delivery of reinforcement. What schedules of reinforcement do allow such a determination?
2. What were the results of the functional analyses and in what way were they relevant to the implementation of FCT?
3. Describe the contingencies and the schedules of reinforcement in effect during the FCT and NCR conditions.
4. During the treatment phase of the study, two concurrent baselines were conducted for each participant prior to intervention. Although many multielement treatment comparisons proceed from a single baseline, why is the use of two baselines preferable?
5. Summarize the results obtained during the FCT and NCR conditions with respect to changes in both SIB and the alternative responses.
6. The authors noted that the definition used for recording Todd's arm raising was changed during the study. What set of data might this change have affected?
7. To what did the authors attribute occurrences of the alternative responses exhibited by Todd and Lynn during the NCR condition?
8. Although the present data indicated that control over reinforcement is not a critical component of FCT interventions, the authors nevertheless suggested certain other advantages associated with FCT relative to NCR. What were these advantages?

Questions prepared by Han-Leong Goh and Eileen Roscoe, University of Florida