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EFFECTIVENESS OF FUNCTIONAL COMMUNICATION TRAINING WITH AND WITHOUT EXTINCTION AND PUNISHMENT: A SUMMARY OF 21 INPATIENT CASES

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Functional communication training (FCT) is a frequently used treatment for reducing problem behavior exhibited by individuals with developmental disabilities. Once the operant function of problem behavior is identified by a functional analysis, the client is taught to emit an appropriate communicative response to obtain the reinforcer that is responsible for behavioral maintenance. Studies on FCT have typically used small numbers of participants, have reported primarily on clients for whom FCT was successful, and have varied with respect to their use of other treatment components. The main purposes of the present study were to evaluate the efficacy of FCT for treating severe problem behavior in a relatively large sample of individuals with mental retardation (N = 21) and to determine the contribution of extinction and punishment components to FCT treatment packages. FCT with extinction was effective in reducing problem behavior for the majority of clients and resulted in at least a 90% reduction in problem behavior in nearly half the applications. However, when demand or delay-to-reinforcement fading was added to FCT with extinction, treatment efficacy was reduced in about one half of the applications. FCT with punishment (both with and without fading) resulted in at least a 90% reduction in problem behavior for every case in which it was applied.

DESCRIPTORS: functional communication training, severe behavior problems, mental retardation, punishment, extinction

Functional communication training (FCT) is a frequently used differential reinforcement procedure based on the results of a functional analysis (e.g., Carr & Durand, 1985). FCT involves teaching the client to emit an appropriate communicative response that produces access to the reinforcer that is responsible for maintenance of problem behavior. Since its introduction, a number of studies have demonstrated that FCT can be highly effective in rapidly reducing problem behaviors displayed by individuals with mental retardation (e.g., Carr & Durand, 1985; Day, Horner, & O'Neill, 1994; Lalli, Casey, & Kates, 1995). These replications across clients, settings, and target behaviors support the generality of FCT (Barlow & Hersen, 1984).

One difficulty in interpreting these studies, however, is that FCT has been used in a variety of treatment packages consisting of multiple components, including (a) within-session prompting to occasion the communication response and increase the probability that the client contacts frequent reinforcement (e.g., Day et al., 1994), (b) demand or delay-to-reinforcement fading to reduce the rate of communication to levels more likely to be maintained in the natural environment (e.g., Bird, Dores, Moniz, &

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Robinson, 1989; Fisher et al., 1993), and (c) a changeover delay between communication and problem behavior to minimize the potential of response chaining between problem behavior and communication (e.g., Lalli et al., 1995).

Perhaps more important, studies on FCT vary considerably with respect to the consequences delivered for problem behavior. Procedures including extinction (Day et al., 1994; Fisher et al., 1993; Lalli et al., 1995), extinction with response blocking or brief physical restraint (Carr & Durand, 1985; Durand & Carr, 1991), extinction with redirection (Bird et al., 1989; Steege, Wacker, Berg, Cigrand, & Cooper, 1989), and punishment (Fisher et al., 1993; Wacker et al., 1990) have been used in combination with FCT. Only a few studies, however, have examined the relative contribution of these components when used with FCT (Fisher et al., 1993; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Wacker et al., 1990).

In a component analysis conducted with 2 clients, Wacker et al. (1990) demonstrated that an FCT treatment package was not sufficiently effective when the contingency for problem behavior (either graduated guidance or time-out) was withdrawn for both clients. Fisher et al. (1993) found that FCT used with or without extinction was not as effective in producing clinically acceptable reductions in problem behavior as was FCT with punishment with 4 clients. Shirley et al. (1997) found that in each of 3 clients, independent signing could not be established and problem behavior was not reduced until an extinction component was added to FCT. After having established stable rates of appropriate signing and low rates of problem behavior, however, removal of the extinction component did not disrupt signing or increase problem behavior for 2 of the 3 clients. The results of these studies highlight the need for additional research to identify the contribution of the various treatment components that are typically used in combination with FCT.

The main purposes of the present study were to evaluate the efficacy of FCT for treating problem behavior in a sample of 21 individuals with mental retardation who had been admitted to an inpatient unit and to determine the contribution of extinction and punishment when used in combination with FCT. Although FCT interventions are rarely used without eliminating the consequence for problem behavior (e.g., extinction), FCT without extinction was used with some clients in the present study to better isolate the effects of providing reinforcement only for a communication response.

METHOD

Clients and Setting

The 21 clients included in the present study were treated during admission to an inpatient unit specializing in the treatment of severe behavior disorders (i.e., clients were not recruited for this study). Because the purpose for each client's admission was to develop an intervention for his or her problem behavior, a standardized research protocol was not used to determine the experimental design, length and order of treatment phases, communication response, and so forth. Decisions of this nature were made on an individualized basis depending upon the needs of each case. The inclusion criteria for the current investigation were as follows: (a) A functional analysis showed that the client's problem behaviors were maintained by social reinforcement, and (b) FCT (either with or without extinction or punishment) was evaluated as a treatment for the client's problem behavior.

Clients ranged in age from 2 years 9 months to 16 years 6 months, and all had been diagnosed with mental retardation and a severe behavior disorder (see Table 1 for specific client characteristics). Primary be-

Table 1
Demographic Characteristics of Clients ($N = 21$)

Case	Age	Language age equivalent		MR level	Target behaviors
		Receptive	Expressive		
1	5–10	—	—	Severe-profound	SIB, aggression, disruption
2	8–1	38	—	Mild-moderate	Aggression, disruption, elope
3	11–3	19.5	13.5	Profound	SIB, aggression, disruption
4	16–6	—	—	Severe	SIB, aggression, disruption
5	10–1	27	15	Profound	SIB, aggression, disruption
6	15–2	113	105	Mild	Aggression, disruption
7	9–5	12	10.5	Severe	SIB, aggression, biting
8	5–10	—	—	Profound	Aggression, disruption
9	2–9	6.5	6.5	Severe	SIB, aggression, disruption
10	4–1	15	24	Severe	SIB, aggression, disruption
11	10–6	23	23	Moderate	SIB, aggression, disruption, pica
12	7–3	41.5	40	Mild-moderate	Aggression, disruption, elope
13	12–1	13	13	Severe-profound	SIB, aggression, disruption
14	12–5	67	105	Mild-moderate	Aggression, disruption
15	14–7	17.5	24	Severe-profound	Aggression
16	10–5	12	4	Severe-profound	SIB, aggression, disruption
17	5–11	15	10	Severe	SIB, aggression, disruption
18	8–0	—	10.5	Severe	Aggression, disruption
19	9–1	26	32	Mild	SIB, aggression, disruption
20	5–4	17.5	—	Severe	SIB, aggression, disruption
21	7–1	37	26	Mild-moderate	SIB, aggression, disruption

Note. Dashes indicate that test results on language functioning were not available; age is reported in years and months; receptive and expressive age equivalents are reported in months.

havior problems included self-injury, aggression, and property destruction. Sessions were conducted primarily in padded treatment rooms (3 m by 3 m) and occasionally in bedrooms or on the living unit. Typically, sessions were 10 min in length, and 8 to 12 sessions were conducted per day, 5 days per week.

Response Definitions

Individualized operational definitions for problem behaviors were developed for each client. A total of 67% of clients exhibited self-injury, 100% exhibited aggression, 91% exhibited property destruction, and 19% also exhibited other problem behaviors such as elopement and pica. *Self-injury* included head hitting, hand biting, head banging, self-scratching, ear flicking, and body hitting. *Aggression* included slapping, scratching, kicking, pinching, pushing, head butting, pulling hair, and throwing objects at people. *Property destruction* included banging objects, throwing objects, knocking objects off surfaces, ripping objects, and turning over furniture. *Elopement* included running toward an open door, putting any body part beyond an open door jamb, and attempting to open doors or leave rooms without staff. *Pica* included placing inedible objects into the mouth past the lips. All data are presented as combined problem behaviors per minute unless otherwise noted. *Communication* was individually defined for each client as a specific phrase (e.g., "toys please"), sign, or gesture while orienting toward the therapist (e.g., hand raising), or pointing to or handing a picture communication card to the therapist.

Data Collection and Reliability

Trained observers recorded the target responses on laptop computers from behind a one-way mirror for sessions conducted in

treatment rooms. When sessions were conducted in other settings, such as the living unit, observers were seated off to the side of the room (for a few cases, data were recorded using paper and pencil). During an average of 50% of sessions (range, 30% to 99% across clients), an independent observer collected reliability data. Exact interval-by-interval agreement coefficients were calculated for each behavior in each session in which reliability data were collected by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. An agreement was defined as a 10-s interval wherein both observers recorded the same number of occurrences of the target behavior. When data were collected using paper and pencil and sessions were over 30 min in duration, 10-min intervals were used. Agreement coefficients averaged 97.1% (range, 88.5% to 100%) for self-injury, 97.6% (range, 90.0% to 100%) for aggression, 96.6% (range, 88.3% to 99.6%) for property destruction, 99.0% (range, 93.1% to 100%) for other problem behaviors, and 97.5% (range, 88.2% to 100%) for communication.

The percentage reduction of problem behavior obtained with each treatment was determined using the average rate of combined problem behaviors during the initial baseline phase and the last five data points from each treatment phase. This method of evaluating treatment effects has been used previously in treatment outcome reviews involving single-case studies (Carr, Taylor, Carlson, & Robinson, 1991; Cataldo, 1991; Iwata et al., 1994).

Procedure

Functional analysis. A functional analysis based on the procedures developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) was conducted with each client. Typically, a multielement design was used in which two to four test conditions (demand, attention, alone, or tangible) and a control condition (play) were used. In the demand condition, the client was presented with a series of academic or vocational tasks using a three-step prompting procedure consisting of sequential verbal, gestural, and physical prompts. Developmentally appropriate tasks were selected for each participant based on caregiver interview. Contingent on compliance (i.e., correct task completion after either the verbal or gestural prompt), the therapist provided praise and physical attention. Contingent on problem behavior, the therapist removed the demand materials and did not interact with the client for 30 s. In the attention condition, the client was given toys and was told to play quietly. The therapist presented social attention, typically in the form of a mild verbal reprimand (e.g., "don't do that, you'll hurt yourself") contingent on each problem behavior. In the alone condition, the client was placed in the treatment room alone without materials. The alone condition was not conducted with clients for whom self-injury was not a target behavior or with those clients for whom the analysis was not conducted in a session room. In the tangible condition, the client was allowed access to preferred toys or food items for 1 to 2 min prior to the start of the session. During the session, the therapist was seated in a chair holding the preferred objects. The therapist did not interact with the client during the session but provided the objects to the client for 30 s contingent on problem behavior. For all test conditions, the same consequence was delivered for all targeted topographies of problem behavior. In the play condition, the client was provided with preferred toys. The therapist played with the client and provided positive verbal and interactive attention every 30 s contingent on the first 5-s period in which no problem behavior occurred. The conditions were modified slightly in some cases; how-

ever, the procedures used with all clients were similar to those described here.

The functional analysis results for each case were graphically depicted, and an interpretation of the operant function was made by the client's case manager using visual inspection. General guidelines used for interpretation included an examination of response rates in test conditions relative to the control condition, magnitude of differentiation from the control condition, trends across sessions, and stability in responding. Other information, such as parental report and behavioral observations in the natural environment, were considered.

To provide support for the validity of the functional analysis interpretations, two independent raters later examined each functional analysis using structured criteria developed for the interpretation of functional analysis data (Hagopian et al., 1997). These criteria have been shown to have high levels of concurrent validity with expert consensus in identifying operant function (exact agreement was 94%). Using these criteria, comparisons were made between each of the test conditions and the play condition. The range in which most of the play points lie was defined by drawing upper and lower criterion lines that approximate ± 1 *SD* from the mean of the play condition. The number of points in each test condition that fell outside this range were then counted. Specific rules were applied for decisions regarding automatic reinforcement, or in cases with trends in the data, low magnitude of effects, or low-rate behavior. The reader is referred to Hagopian et al. for a detailed description of the criteria as well as data on their reliability and validity.

Communication training. After the reinforcers that were responsible for behavioral maintenance had been identified based on the functional analysis, an errorless backward-chaining procedure was used to train the client to emit a communication response to obtain that reinforcer. The client and two therapists were in a session room (one therapist delivered the reinforcer and the other provided prompts to the client). Communication training sessions were conducted under stimulus conditions similar to those present during baseline and treatment sessions (e.g., similar session room, toys, demand materials). Problem behaviors were blocked during all communication training sessions (e.g., the therapist would briefly place his or her arm between the client's hand and head to block head hitting if it began to occur). For the majority of clients, each session consisted of 10 trials.

The type of communication response (verbal, gestural, or picture exchange) was individually selected for each client based on recommendations of the client's speech therapist. The communication response was separated into three discrete sequential steps. For a picture exchange response, for example, the steps were: Step A, move hand toward the picture; Step B, pick up the picture; and Step C, give the picture to the therapist. During every phase of training, regardless of whether the client completed the final response independently or was guided, the therapist delivered the reinforcer upon completion of the final step. In the initial session, the trainer used the minimal amount of hand-over-hand guidance necessary to guide the client through each step in the sequence. Next, minimal hand-over-hand guidance was used to prompt the client through all the steps except the final one in the sequence (Step C above). If the client did not complete the final step independently within 5 s, then hand-over-hand guidance was used to complete the final step. In the next phase of training, the client was guided to complete only the first step (Step A) in the sequence and was given 5 s to complete each of the subsequent steps independently before additional prompting was provided. The criterion to move to the

subsequent phase was that the client completed the steps targeted during that phase independently on at least 80% of trials during one 10-trial session. This backward-chaining procedure continued until the client independently performed all the steps in the sequence for at least 80% of trials during two successive sessions.

For communication responses that functioned to produce escape from demands, communication training was conducted in the context of a low-preference demand activity (e.g., picking up blocks, doing a repetitive task) under stimulus conditions similar to those present in baseline and treatment (e.g., seated next to a therapist at a table with demand materials). For verbal clients, the therapist verbally prompted the client to state the target communication response (e.g., "If you want to take a break, say, 'break please' "). Gradually, the verbal prompts were faded using a time-delay procedure. This was continued until the client independently engaged in the target communication response for at least 80% of trials during two successive 10-trial sessions.

Evaluation of FCT-Based Treatments

The order of FCT-based treatments (FCT, FCT with extinction, and FCT with punishment) was based on the principle of progressing from a less to a more restrictive intervention until an adequate treatment effect was achieved. In every case, either FCT without extinction or FCT with extinction was evaluated (for some clients, both were evaluated). The decision about whether to evaluate either FCT or FCT with extinction (or both) was determined for each case on an individualized basis. In most cases, FCT with punishment was not evaluated until either or both FCT or FCT with extinction were used and failed to produce clinically acceptable reductions in problem behavior. However, in two cases, FCT with extinction and FCT with punishment were evaluated concurrently using a multielement design.

Baseline. Baseline consisted of the functional analysis conditions in which the reinforcer that had been identified for behavioral maintenance was provided contingent on problem behavior. That is, if the functional analysis indicated that an individual's problem behavior was maintained by escape from demands, then this condition (using the same demands as in the functional analysis) was used as the baseline against which the effects of FCT were compared. For the majority of cases, a new baseline was established after the functional analysis was completed. In a minority of cases, the data from the functional analysis condition were used as the initial baseline. During all baseline sessions, including reversals, the target communication response was ignored.

FCT without extinction. During FCT without extinction, the stimulus conditions and contingencies for problem behavior were the same as in baseline (i.e., problem behaviors produced reinforcement, the same demands, toys, etc.). That is, 30 s of access to escape from demands, 30 s of access to preferred items, and a mild verbal reprimand were provided contingent upon problem behavior in the demand, tangible, and attention conditions, respectively. Whenever the client emitted the target communication response, the therapist immediately provided access to the functional reinforcer for a prespecified period of time. Typically, the therapist provided a 30-s break in the demand condition, 30 s of access to preferred items or one piece of food in the tangible condition, and 15 s of positive social attention in the attention condition. For some clients treated in the demand condition, toys were available during the break. The communication response was not prompted during treatment evaluation sessions, with two exceptions. For these 2 clients, the therapist restated the contingencies for the commu-

nication response every 30 s. There were no differential consequences for problem behavior or appropriate communication during the reinforcement interval (e.g., in the attention condition, the therapist continued to provide attention until the 15-s interval was over, regardless of the occurrence of either problem behavior or additional appropriate communication).

FCT with extinction. During FCT with extinction, the therapist provided the reinforcer on a fixed-ratio (FR) 1 schedule only when the client emitted the target communication response. For all clients, regardless of maintaining variables, extinction consisted of not delivering a consequence for problem behavior (i.e., the therapist continued to do whatever he or she was doing prior to the occurrence of problem behavior). In cases in which response chaining between problem behavior and communication was observed (i.e., the client frequently emitted the communication response immediately after problem behavior), a 3-s changeover delay was implemented to reduce the likelihood of incidental reinforcement of problem behavior (Lalli et al., 1995).

FCT with punishment. During FCT with punishment, the therapist immediately provided the reinforcer whenever the client emitted the target communication response and implemented a punishment procedure contingent on each occurrence of a target behavior. Punishment procedures were implemented for 30 s for all but 3 clients: A 2-min room time-out was used with Case 7, a 60-s basket hold was used with Case 3, and a 60-s chair time-out was used with Case 8. The other punishment procedures used during FCT with punishment were facial screen (Cases 1, 5, 10, and 16), basket hold (Cases 11, 14, 15, 18, 19, and 21), hands down (Case 12), and contingent demands (Case 2).

The punishment procedures were empirically derived using the procedures described by Fisher, Piazza, Bowman, Hagopian, and Langdon (1994) for 7 of the 14 clients for whom punishment was used. Using this methodology, punishers were selected based on parental preference and determined to be effective in reducing problem behavior in a separate formal punisher assessment using either a reversal or a multielement experimental design. The remaining 7 clients were treated prior to our developing the procedures for empirically selecting punishers. In those cases, the punishers were selected for each client based on parental preference and clinical judgment. For 2 of these 7 clients, the punisher was selected based on the identified function of the problem behavior. That is, for 1 client with problem behavior maintained by escape from demands (Case 2), the punisher was the contingent presentation of additional demands. For a client with attention-maintained problem behavior (Case 8), a chair time-out was used. For the majority of clients, the punisher assessment was not initiated until either FCT with or without extinction was evaluated and determined to be insufficient.

Demand Fading and Delay-to-Reinforcement Fading

Demand fading or delay-to-reinforcement fading was conducted on a case-by-case basis. The following criteria were used to determine whether fading was conducted: (a) Problem behavior was reduced to clinically acceptable levels, (b) the client's rate of communication was so high that it made the procedure impractical for most natural settings (e.g., clients who requested to take a break each time a demand was presented), and (c) there was adequate time remaining during the client's inpatient admission to initiate fading.

Demand fading. Demand fading, as described by Fisher et al. (1993), was implemented in cases in which the communication response resulted in escape from de-

mands. Initially, the client could escape from demands each time he or she emitted the communication response. In subsequent sessions, the number of demands issued before communication resulted in escape was gradually increased. Criteria for increasing and decreasing the number of demands required before the client's communication response was reinforced were established on a case-by-case basis. The increments in the fading steps varied across participants and were typically small (e.g., 1, 2, 3, 4, 5 demands, etc.). In general, increases in the number of demands required for reinforcement of communication were made after two consecutive sessions in which the rate of problem behavior was at or below a 90% reduction relative to baseline. Conversely, decreases in the number of demands required for reinforcement of communication were made if the rate of problem behavior was above the 90% reduction level for at least two consecutive sessions. When problem behavior increased during fading, the increments were often made smaller before continuing with fading. If the communication response was emitted before the client completed the required number of demands, the therapist responded, "That's nice asking, but you need to do some more work." If the communication response involved handing the therapist a picture, the picture was made available only after the client completed the required number of demands. In other cases, the client's work requirement was time based (e.g., the client was required to work for 1 min before taking a break), and the length of the work interval was gradually increased.

Delay-to-reinforcement fading. Delay-to-reinforcement fading was conducted when the communication response resulted in access to attention or tangible items. The fading procedure involved increasing the time period between the communication response and the provision of reinforcement (i.e., delay to reinforcement). At the first fading step the client was told, "That's nice asking, but you need to wait," and then the reinforcer was delivered after a delay of 1 to 3 s. If the communication response involved handing a picture to the therapist, the picture was made available only after the client waited the prespecified amount of time. As with demand fading, the increments were small (i.e., 1 s, 3 s, 5 s, 7 s, etc.), and the criterion for increasing the delay-to-reinforcement interval was two consecutive sessions in which the rate of problem behavior was at or below a 90% reduction relative to baseline. Typically, the criterion for decreasing the delay to reinforcement was at least two consecutive sessions in which the rate of problem behavior was above the 90% reduction level.

Design

For each client, a functional analysis was conducted using a multielement or a within-series design (Iwata et al., 1994). A variety of single-subject experimental designs were used to evaluate the effects of the different FCT-based interventions. Information on the specific experimental methods used with each client is presented in the Appendix, including (a) the experimental design; (b) order of phases; (c) number of sessions in each phase; (d) mean rates, standard deviations, and slopes of problem behavior in each phase; and (e) mean rates and standard deviations of the communication response for each treatment condition (e.g., FCT with extinction). A slope of 0 indicates stable responding, negative slopes indicate downward trends, and positive slopes indicate upward trends. Across the 27 applications, one multielement design, two multiple baseline designs, and 24 reversal designs were used, eight of which included at least one multielement phase. For two applications (Cases 10 and 14), functional control of the final treatment package was not demonstrated; the final phase was not replicated because of time constraints.

Table 2
Mean Rate (Per Minute) of Problem Behavior and Standard Deviation for Each Functional Analysis Condition, Interpretation, and Condition in which FCT Was Evaluated

	Functional analysis						
Case	Demand	Attention	Alone	Tangible	Control	Interpretation	FCT condition
1	3.5 (3.4)	0.7 (1.4)	0.7 (1.6)	0.7 (0.9)	0.6 (1.4)	Escape	Demand
2	4.5 (1.2)	16.8 (4.9)	—	1.8 (0.2)	0.2 (0.2)	Attention/escape/ tangible	Demand
3	1.5 (2.0)	0.1 (0.2)	1.4 (2.9)	—	0.6 (1.0)	Escape	Demand
4	1.1 (0.9)	0.1 (0.3)	—	—	0.3 (0.2)	Escape	Demand
5	13.8 (6.2)	5.3 (4.2)	6.4 (5.4)	4.6 (2.6)	2.5 (2.0)	Escape	Demand
6[a]	2.6 (4.6)	0.9 (1.8)	–	—	0 (0.0)	Escape	Demand
7	2.6 (3.0)	0.1 (0.2)	0.1 (0.4)	1.9 (2.9)	0.1 (0.1)	Escape	Demand
8	3.1 (1.1)	12.2 (8.2)	0.2 (0.3)	—	2.0 (1.4)	Attention	Attention
9	—	6.9 (2.3)	3.3 (2.8)	1.2 (0.7)	0.9 (0.6)	Attention	Attention
10	1.6 (0.2)	5.5 (5.8)	0.2 (0.2)	0.8 (0.6)	0.6 (0.6)	Attention/escape	Attention
11	0.5 (0.5)	2.4 (1.4)	0.6 (1.0)	—	0.9 (0.8)	Attention	Attention
12	2.6 (1.1)	2.9 (1.2)	—	—	0.6 (0.4)	Attention/escape	Attention
13	7.1 (10.4)	23.0 (13.9)	9.8 (13.0)	—	9.6 (14.5)	Attention	Attention
14[b]	—	1.8 (0.9)	—	—	1.1 (2.5)	Attention	Attention
15	0.2 (0.4)	5.0 (5.4)	—	—	0.2 (0.3)	Attention	Attention
16	2.0 (2.0)	7.1 (3.3)	—	—	3.1 (1.7)	Attention	Attention
17[c]	3.5 (4.5)	0.2 (0.3)	—	6.6 (6.3)	0.8 (1.3)	Tangible	Tangible
18	3.1 (2.1)	7.0 (6.9)	—	1.4 (1.6)	0.6 (0.8)	Attention/escape	Attention/demand
19	5.6 (4.0)	15.1 (11.6)	3.6 (1.8)	—	0 (0.0)	Attention/escape	Attention/demand
20	6.2 (16.3)	2.4 (3.4)	2.3 (5.0)	2.5 (1.7)	0.2 (0.4)	Attention/escape/ tangible	Attention/demand/ tangible
21	1.5 (1.7)	6.1 (3.8)	—	3.7 (2.7)	0.8 (1.1)	Attention/escape/ tangible	Attention/demand/ tangible

Note. Dashes indicate a particular condition was not included in the functional analysis; values in parentheses indicate the standard deviation.
[a] Data presented in responses per 30-min session.
[b] Attention was provided for 30 s contingent upon problem behavior.
[c] Food items included in the tangible condition (see text).

The length of each phase during the treatment evaluation was determined based on visual inspection of the data, which involved consideration of the magnitude of change, trend, and stability. The decision-making rules for changing phases were based on the principles of single-case experimental design (e.g., Barlow & Hersen, 1984) and the clinical needs of each case.

RESULTS

Functional Analysis

Means and standard deviations of combined problem behaviors for each condition and the interpretation of each functional analysis using the structured criteria described by Hagopian et al. (1997) for each client are presented in Table 2. The criteria were designed to be used with analyses consisting of 10 points (sessions) per condition. In cases in which there were more than 10 points in a condition, the interpretation was made using the last 10 points of each condition. For Case 6, however, the interpretation was based on the complete functional analysis (consisting of 16 points per condition) because this client exhibited episodic behavior and had numerous sessions with no problem behaviors. For 3 clients, the criteria were modified due to special circumstances. For Case 9, strict application of the criteria

indicated attention and automatic reinforcement functions. However, the moderate levels of problem behavior in the alone condition were not viewed as reflecting an automatic reinforcement function because they appeared to be related to the client's attempts to leave the session room. For Case 14, strict application of the criteria indicated an undifferentiated interpretation due to two high-rate sessions in the play condition. However, there were no problem behaviors exhibited in seven of 10 sessions in the play condition (including the final five sessions), whereas the rates of problem behavior in all attention condition sessions were stable at approximately two per minute. Therefore, the criterion line was adjusted to account for this, and the analysis was interpreted as indicating an attention function only. With Case 21, strict application of the criteria indicated attention and tangible functions. However, the rates of problem behavior in the demand condition during the second half of the analysis were on an upward trend, relative to the first half of the analysis. Therefore, the number of points required for differentiation was changed, and an escape function was also indicated using the adjusted criteria.

The alone condition was not conducted with clients for whom self-injury was not their primary target behavior (Cases 2, 6, 12, 14 through 18, and 21), or when the analysis was conducted on the living unit where the client could not be alone (Case 4). As indicated in Table 2, for some clients with multiply maintained problem behaviors, FCT was not used as a treatment for all conditions. Of the 21 clients, FCT interventions were used for 9 clients with attention-maintained behavior, for 7 with escape-maintained behavior, and for 1 with behavior maintained by access to tangible items. Four additional clients who displayed multiply maintained problem behavior were treated in multiple conditions with FCT interventions (2 with attention- and escape-maintained behavior and 2 with behavior maintained by access to attention, escape, and tangible items).

Thus, the total number of treatment applications was 27 across the 21 clients: 13 applications of FCT interventions in the attention condition, 11 applications in the demand condition, and three applications in the tangible condition. Unless otherwise indicated, the results are described in terms of the number of conditions under which FCT interventions were applied (i.e., applications) rather than the number of clients, because FCT was applied in more than one condition for some clients.

Target Communication Response

The target communication response was emitted at an average rate of 2.0 per minute (range, 0.03 to 6.0) during FCT without extinction, 3.2 per minute (range, 0.4 to 14.5) during FCT with extinction, and 1.5 per minute (range, 0.16 to 4.6) during FCT with punishment. These figures represent mean rates of communication for sessions before delay-to-reinforcement or demand fading was initiated, because fading generally decreased the rate of communication. One client (Case 10) exhibited near-zero rates of the target communication response during FCT without extinction but did engage in independent communicative responding during FCT with extinction. These findings were replicated when FCT without and with extinction phases were reimplemented. Thus, for this particular client, placing problem behavior on extinction was shown to be necessary for the client to emit the target communication response.

FCT Interventions

The percentage change in combined problem behavior for each client is presented in Table 3 and was calculated using the mean of the initial baseline and the last five

Table 3
Percentage Reduction in Problem Behavior During the Final Application of Each FCT Intervention

		FCT intervention			
Case	Condition	FCT	FCT + extinction	FCT + extinction and fading	FCT + punishment
1	Demand	44.19	95.35	53.49	92.03[a]
2	Demand	—	31.25	—	92.92[a]
3	Demand	−101.91	—	—	92.34[a]
4	Demand	−32.77	−2.52	—	—
5	Demand	76.81	91.88	—	99.13[a]
6	Demand	—	87.30	—	—
7	Demand	—	24.81	—	95.80
8	Attention	22.08	—	—	94.12
9	Attention	43.22	98.31	97.46	—
10	Attention	−262.51	88.01	—	99.54
11	Attention	55.66	82.08	—	—
12	Attention	—	61.12	—	96.35[a]
13	Attention	36.41	−19.53	—	—
14	Attention	—	−46.24	—	96.77[a]
15	Attention	—	52.76	—	98.69[a]
16	Attention	86.92	84.50	—	97.09
17	Tangible	—	92.67	98.27	—
18	Attention	—	96.88	97.98	—
18	Demand	—	94.44	87.50	100.00[a]
19	Attention	—	99.51	−7.36	99.02[a]
19	Demand	—	97.67	29.53	98.84[a]
20	Attention	—	99.04	95.92	—
20	Demand	—	99.04	99.52	—
20	Tangible	−159.61	77.25	39.61	—
21	Attention	—	96.84	86.52	99.67[a]
21	Demand	—	56.52	—	98.76[a]
21	Tangible	—	75.96	18.27	99.04[a]

Note. Figures represent percentage reduction from baseline using the last 5 treatment points (except Case 17; see text); negative numbers represent an increase in problem behavior relative to baseline; dashes indicate that a particular FCT intervention was not attempted.

[a] Demand or delay-to-reinforcement fading was conducted during FCT with punishment.

data points of the final treatment phase with or without fading as indicated. The percentage reduction in problem behavior for Case 17 was calculated using four of the last five points, because including the fourth-to-last session (which was aberrantly high; see Figure 1) would not have provided an accurate representation of the treatment effects for this client.

FCT without extinction. FCT without extinction was applied 11 times across 11 clients: four times in the demand condition, six times in the attention condition, and once in the tangible condition. A 90% reduction in problem behavior was not achieved in any of the applications of FCT without extinction (see Table 3). On average, across applications, a 17.4% increase in the rate of problem behaviors was observed with FCT without extinction (range, 86.9% decrease to 262.5% increase; see Table 3). Consequently, demand fading and delay-to-reinforcement fading were not conducted with any of the clients during FCT without extinction. An increase in problem behavior of at least 50% was observed in three (27.3%) applications of FCT without extinction. Based on a preliminary analysis of these results conducted during the course of the study, FCT without extinction was not

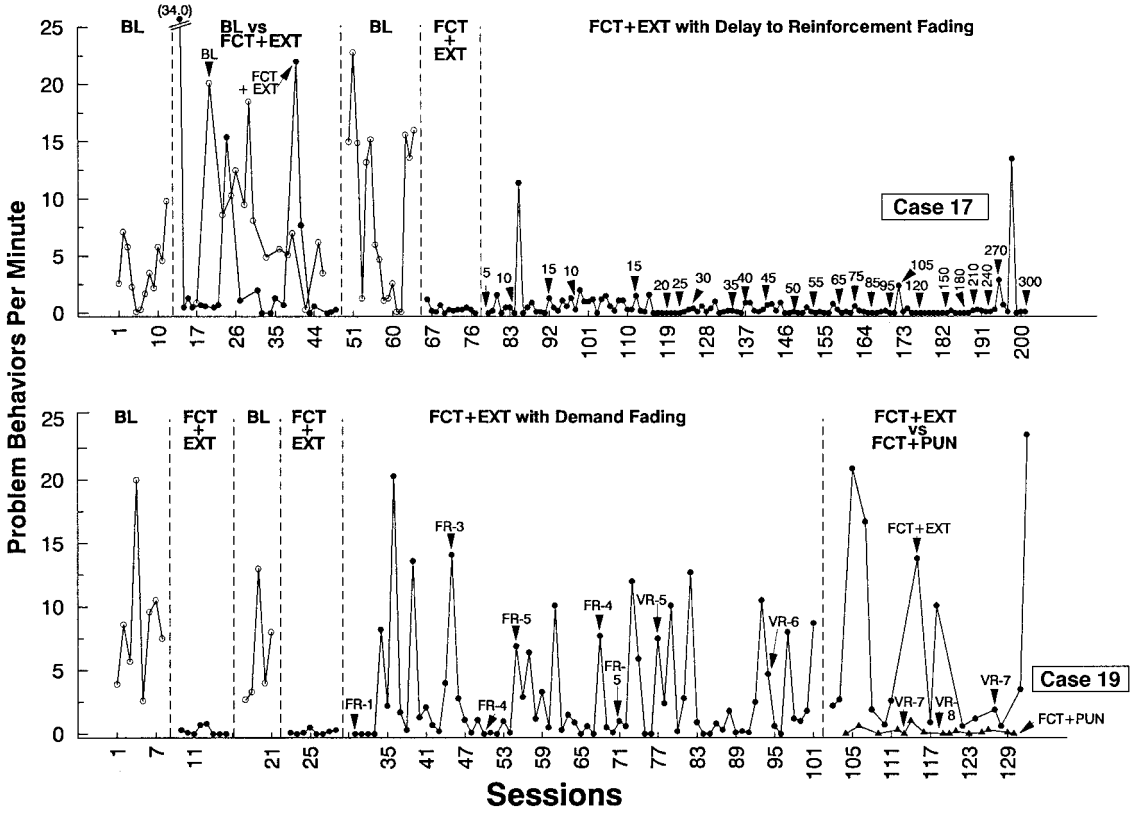

Figure 1. Treatment evaluations for 2 clients in which FCT with extinction (FCT+EXT) was determined to be effective for one case (top panel) and FCT with punishment (FCT+PUN) was effective for the other case (bottom panel). Changes in the delay to reinforcement interval (in seconds) or demand requirements (number of demands) during fading are indicated by arrows.

evaluated with the final 10 clients because of the lack of success.

FCT with extinction. FCT with extinction was applied 25 times across 19 clients: 10 applications in the demand condition, 12 applications in the attention condition, and three applications in the tangible condition. A 90% reduction was achieved in a total of 11 of 25 applications (44%). The average percentage reduction in problem behavior using FCT with extinction was 68.6% across applications (range, 99.5% decrease to 46.2% increase; see Table 3).

The number of sessions in which FCT with extinction was implemented before FCT with punishment was applied averaged 34.2 sessions (range, 7 to 88 sessions across applications). For the application in which a punishment component was added after seven sessions of FCT with extinction (Case 18, demand condition), the rates of problem behavior were essentially unchanged from baseline. The pattern of responding across sessions was similar to baseline and did not resemble an extinction burst.

FCT with extinction and fading. Demand fading or delay-to-reinforcement fading was conducted in 12 of 25 applications of FCT with extinction. In five of 12 applications (41.6%) of FCT with extinction and fading, the 90% reduction in problem behavior achieved before fading was maintained after fading. However, during the other seven applications, fading was associated with increases in problem behavior. Attempts to regain control over the behavior by conduct-

ing additional sessions, reducing the number of demands, or reducing the delay-to-reinforcement interval were not successful in these seven applications. The average reduction in problem behavior for FCT with extinction and fading was 66.4% (range, 99.5% decrease to 7.4% increase; see Table 3).

FCT with punishment. FCT with punishment was applied 17 times across 14 clients: eight applications in the demand condition, eight in the attention condition, and one in the tangible condition. Problem behavior was reduced by at least 90% in 10 of 11 applications (90.1%) of FCT with punishment without demand or delay-to-reinforcement fading (see Table 3). With one application of FCT with punishment in the demand condition (Case 18), a 90% reduction in problem behavior was not achieved until demand fading was implemented. With six applications of FCT with punishment, fading was already under way when FCT with punishment was implemented, so there are no data on these applications without fading. Demand fading or delay-to-reinforcement fading was conducted in 13 of 17 applications (76.5%) of FCT with punishment. In all 13 applications of FCT with punishment and fading, problem behavior remained at or was below the 90% reduction criterion. At least a 90% reduction in problem behavior was achieved for all of the 17 applications of FCT with punishment with and without fading. The average reduction in problem behavior using FCT with punishment was 97.1% (range, 92.0% to 100%; see Table 3).

Demand Fading and Delay-to-Reinforcement Fading

Demand fading or delay-to-reinforcement fading was implemented with 14 of the 21 clients. For clients treated in the demand condition, the number of demands or the amount of time the clients needed to work were gradually increased (M = 10.7 demands, M = 6.0 min). For clients treated in the attention condition the delay to reinforcement was increased to an average of 2.9 min. For clients treated in the tangible condition, the delay-to-reinforcement interval was gradually increased to an average of 3.5 min.

Other Treatments

Treatments not involving FCT were applied with 3 clients following unsuccessful applications of FCT with extinction (FCT with punishment was not attempted with any of these 3 clients). Evaluation of the nature and efficacy of these other procedures is beyond the scope of this paper and will not be reported here.

In sum, FCT combined with either extinction or punishment resulted in at least a 90% reduction in problem behavior in 23 of 27 applications included in the present study. In one application (Case 6), an 87.3% reduction was achieved; however, this was considered to be a successful clinical outcome for FCT with extinction because of marked reductions in the intensity of problem behavior (i.e., the remaining problem behaviors were mild). Therefore, a clinically successful treatment outcome was achieved using FCT either in combination with extinction (seven applications) or punishment (17 applications) in 24 of 27 (85.2%) applications. These successful applications were achieved using FCT with extinction and FCT with punishment for 18 of 21 clients (85.7%). For the remaining 3 clients who were not successfully treated using an FCT intervention, it should be noted that FCT with punishment was not attempted.

Sample Cases

Figure 1 depicts treatment evaluations in which (a) FCT with extinction and FCT with extinction and fading were successful; and (b) FCT with extinction was successful

until demand fading was initiated, at which time problem behavior increased but then was reduced after FCT with punishment was applied. These two sample cases were selected because they represent most types of treatment successes and failures observed in the current study.

For Case 17 (top panel), the tangible condition in the functional analysis was modified to include food items, based on parental report that the client exhibited SIB to gain access to food. Thus, the communication response resulted in access to food items (one small piece was delivered per response). After establishing a baseline, FCT with extinction and baseline were compared using a multielement design. Problem behaviors averaged 8.1 per minute in the baseline condition and 4.1 per minute during FCT with extinction in the multielement phase. The mean during FCT with extinction was elevated because of four high-rate sessions; however, the majority of sessions were low. The rates of the communication response were also variable but occurred at an average of 9.6 responses per minute during FCT with extinction. Following a reversal to baseline, FCT with extinction was reimplemented and problem behavior rates were low in every session. These effects were maintained for the majority of sessions during delay-to-reinforcement fading. The communication response remained high during FCT with extinction (M = 14.5 per minute) but decreased as the delay to reinforcement was gradually increased to 5 min.

The bottom panel of the figure depicts the evaluation of FCT in the demand condition for Case 19. The effects of FCT with extinction (without fading) on reducing problem behavior relative to baseline were replicated using an ABAB design. The communication response resulted in a 30-s break from demands (with toys available). Problem behaviors were reduced to 0.2 per minute during each phase of FCT with extinction, and communication averaged 1.5 per minute and 1.6 per minute for the first and second phases of FCT with extinction, respectively. With the introduction of demand fading, increased variability in problem behavior and communication was observed over multiple sessions. In the final phase, FCT with extinction and fading was compared with FCT with punishment and fading using a multielement design (both treatments included a variable ratio of six demands). During FCT with punishment, a 30-s basket hold procedure was implemented contingent on each target response. FCT with punishment resulted in consistently low rates of problem behavior, whereas problem behaviors remained variable during FCT with extinction. The communication response averaged 0.7 per minute during FCT with extinction and 1.4 per minute during FCT with punishment. Demand fading proceeded more quickly during FCT with punishment, and a variable ratio of eight demands was eventually achieved (i.e., the client was required to complete an average of eight demands before escape was allowed contingent on communication).

DISCUSSION

The results of the current study suggest that FCT, when combined with other operant procedures, was a highly effective treatment for reducing problem behavior exhibited by individuals with mental retardation who had been hospitalized for severe behavior problems. Without the use of punishment or extinction for problem behavior, however, FCT was not effective with any of the clients included in the present study. FCT with extinction was effective in reducing the rate of problem behavior by 90% from baseline levels in 11 of 25 applications. However, the introduction of demand or delay-to-reinforcement fading decreased the effectiveness of FCT with extinction in seven

of 12 applications. FCT with punishment (either with or without fading) produced a 90% or greater reduction in problem behavior each time it was evaluated.

FCT interventions have been conceptualized in terms of a concurrent-operants arrangement (e.g., Fisher et al., 1993; Mace & Roberts, 1993). That is, the client can engage in either the newly acquired communication response or problem behavior to produce the same reinforcer. Under such an arrangement, in which rate and immediacy of reinforcement of the two responses are equivalent, the response that is less effortful (presumably communication) should occur at higher rates than the more effortful response (e.g., Horner & Day, 1991).

In the current study, problem behavior occurred at rates much higher than communication during FCT without extinction. It is possible that these results occurred because the communication response required more effort or had a shorter reinforcement history than problem behavior did (e.g., Freeman & Lattal, 1992; Horner & Day, 1991). In addition, reinforcement of problem behavior may have interfered with the client contacting sufficient reinforcement for communication to establish its relative strength. However, previous studies have found that FCT without extinction can sometimes maintain low levels of problem behavior initially produced through FCT combined with extinction or punishment (Fisher et al., 1993; Shirley et al., 1997).

When FCT is combined with extinction, one operant (communication) results in access to the reinforcer that formerly maintained the other operant (problem behavior), which is now on extinction. Under such an arrangement, one would expect communication to be maintained and the problem behavior to be extinguished over time. During most (22 of 25) applications, FCT with extinction reduced problem behavior. The 90% reduction criterion was achieved in 44% of applications, but was maintained in only about one half of these applications when delay-to-reinforcement and demand fading were introduced. The decreased efficacy of FCT with extinction during delay-to-reinforcement and demand fading was probably directly due to the fact that the communication response no longer resulted in immediate reinforcement. Despite this disadvantage of demand or delay-to-reinforcement fading, this component may be necessary for cases in which the client's rate of communication is so high that it makes the procedure impractical for most natural settings (e.g., a client who requests attention almost continuously).

One possible explanation for the failure of FCT with extinction to suppress problem behavior to acceptable levels during most applications is that the newly trained communication response may have become a member of the same response class as the problem behavior. When a response class is formed, reinforcement of one member of the operant class can maintain other members (Parrish, Cataldo, Kolko, Neef, & Egel, 1986). Thus, if communication and problem behavior formed a response class, then reinforcement of communication may have interfered with extinction of problem behavior (Catania, 1969; Fisher et al., 1993).

A number of studies have shown that FCT with extinction (without the use of other consequences for problem behavior) can effectively reduce severe aggression and SIB (Day et al., 1994; Lalli et al., 1995; Shirley et al., 1997). However, other studies have shown that the effectiveness of FCT is sometimes decreased without contingencies such as graduated guidance or time-out and punishment for problem behavior (Fisher et al., 1993; Wacker et al., 1990). The current results add to this literature by evaluating the effectiveness of FCT with extinction across a relatively large group of participants. However, there were significant procedural differ-

ences between the current investigation and previous studies on FCT with extinction. It is possible that the effectiveness of FCT with extinction may have been enhanced in the current investigation by adding specific procedures (e.g., within-session prompting of communication).

FCT with punishment was effective each time it was applied (with or without fading). This consistent finding may have been due to the fact that clear differential consequences were applied to each target response (reinforcement for communication; punishment for problem behavior). The effects of reinforcement and punishment can be mutually enhanced when implemented concurrently (Azrin & Holz, 1966). That is, providing reinforcement for one response can augment the effects of a punisher applied to another response. Similarly, punishing one response can result in increases in another nonpunished behavior (e.g., Parrish et al., 1986). These effects may be in operation when FCT is used in combination with punishment.

A potential advantage of aggregating data on a particular procedure across a large and defined set of single-case studies (e.g., Derby et al., 1992; Iwata et al., 1994) is that it may enhance the external validity of the findings (Barlow & Hersen, 1984). Despite this and other potential benefits, behavior analysts rarely report aggregated data and are extremely cautious in generalizing the results of group data to individual cases. The literature on FCT consists primarily of reports with small numbers of participants and describes almost exclusively positive treatment outcomes. Treatment failures are less likely to be published in the literature because of the tendency of authors and editors to submit and accept articles reporting positive findings (Cataldo, 1991; Dickerson, 1990). Therefore, this examination of a larger sample of clients for whom FCT treatments were attempted (including successes and failures) may contribute to our understanding of the effectiveness and limitations of FCT.

A potential limitation of the present study is that the subjects represented a clinic-referred sample (all clients were inpatients who could not be successfully treated on an outpatient basis). Therefore, some caution should be taken in generalizing these findings to populations treated in other settings or with less severe problem behavior. Given the severity of problem behavior exhibited by the clients in this study, a successful treatment outcome was defined as a 90% or greater reduction in problem behavior. Using a less strict criterion, particularly with respect to the effectiveness of FCT with extinction and fading, the findings would have been somewhat different.

In the current study, we included clients whose problem behaviors were determined to be multiply controlled. Surprisingly, FCT with extinction was somewhat more effective with the 7 clients with multiply controlled behavior than with the other 14 clients (a 90% reduction was achieved in 54% of applications with multiply controlled behavior vs. 29% of the remaining applications). These findings suggest that FCT with extinction may also be appropriate in cases with multiply controlled behavior; however, this issue requires additional investigation.

Although similar procedures were followed for each case, the type of FCT intervention used, length of treatment phase, experimental design employed, and so forth, were selected based on the needs of the case rather than on a formalized research protocol. Moreover, because the current study involved only cases in which FCT was evaluated with and without extinction or punishment, it is not possible to determine what the effects of either extinction or punishment would have been without FCT. In addition, these data represent only treatment evaluation results; generalization and maintenance data were not included.

Finally, sequence effects may have influenced the results, because the three types of FCT interventions (FCT without extinction, FCT with extinction, and FCT with punishment) were evaluated in an order progressing from the least to the most intrusive intervention. In particular, the effects of FCT with punishment may have been enhanced because it usually followed FCT with extinction. However, there were seven instances in which a reversal from FCT with punishment to FCT with extinction was conducted, and three other instances in which these two conditions were compared using a multielement design. In each case, the rates of problem behavior were higher during FCT with extinction than during FCT with punishment, regardless of sequence. Thus, it is unlikely that sequence effects accounted for the differences in effectiveness between FCT with punishment and FCT with extinction.

To summarize, among a defined group of individuals with mental retardation who displayed severe problem behavior that warranted inpatient hospitalization, (a) FCT without extinction was not an effective treatment; (b) FCT with extinction reduced problem behavior in most cases, but produced clinically acceptable outcomes in less than one half of the applications; (c) demand and delay-to-reinforcement fading reduced the effectiveness of FCT with extinction in about one half of the applications; and (d) FCT with punishment was effective in every application, independent of whether demand or delay to reinforcement fading was added to the treatment package. Future investigations might examine how procedural variations may enhance the effectiveness of FCT with extinction (e.g., the modality of communication, the procedures used for training and prompting the communication response, the duration of reinforcement for communication, and the schedule used for fading).

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STUDY QUESTIONS

1. Describe several ways in which functional communication training (FCT) has been varied in terms of (a) procedural differences and (b) contingencies in effect for target responses.

2. What measure was used to determine success for the various FCT interventions and how was it calculated?

3. What method was used to interpret the results obtained from the functional analyses?

4. How was communication taught? What criterion was used to determine that participants had acquired the response?

5. What was the typical sequence for implementing the different FCT-based interventions? What was the rationale for this sequence?

6. Under what circumstances was fading implemented? Briefly describe the demand fading and delay-to-reinforcement fading procedures.
7. What results were obtained when FCT with extinction was followed by demand fading or delay-to-reinforcement fading and to what did the authors attribute these findings?
8. Summarize the results of the aggregate data. What is the major contribution of these results?

Questions prepared by Juliet Conners and Gregory Hanley, The University of Florida

APPENDIX

Experimental Designs and Conditions, Phase Lengths, Mean Responses per Minute and Standard Deviations of Problem Behavior and Communication, and Slope of Problem Behavior per Phase

Case	Design/condition		Condition/number of sessions			
1	ABCACDAD		BL/13	FCT/16	FCTE/19	BL/5
	Demand	Target	3.0 (2.6)	1.6 (1.0)	1.8 (2.5)	3.7 (0.9)
		Slope	−0.1	0	−0.2	0.1
		Commun		1.7 (0.4)	1.8 (0.2)	0.9 (0.5)
2	ABCBCAC		BL/7	FCTE/12	FCTP/8	FCTE/6
	Demand	Target	4.8 (3.2)	1.3 (1.2)	0.3 (0.7)	2.9 (3.4)
		Slope	1.2	0.1	0	1.0
		Commun		1.7 (0.1)	1.9 (0.3)	1.7 (0.1)
3	A(BC)(BD)D		BL/16	FCT/21	FCTP1/23	FCT/27
	Demand	Target	2.1 (1.6)	2.1 (3.2)	0.5 (0.6)	3.3 (3.6)
		Slope	−0.1	0	0	0
		Commun		1.5 (0.5)	1.7 (0.9)	1.7 (0.4)
4	ABCADAEAD		BL/7	FCT/7	FCTE/22	BL/9
	Demand	Target	1.2 (0.4)	4.5 (5.9)	1.7 (1.1)	1.2 (0.5)
		Slope	0.1	−1.9	0	0
		Commun		1.5 (0.7)	1.7 (1.5)	
5	ABCDAD		BL/12	FCT/21	FCTE/15	FCTP/4
	Demand	Target	13.8 (6.2)	4.0 (3.7)	3.4 (4.0)	0.4 (0.2)
		Slope	0.6	0.1	−0.7	−0.2
		Commun		6.0 (5.1)	12.8 (6.8)	6.3 (6.2)
6	ABAB		BL/7	FCTE/8	BL/48	FCTE/47
	Demand	Target	6.3 (9.2)	0 (0)	1.0 (4.8)	1.1 (3.6)
		Slope	−1.5	0	0.1	−0.1
		Commun		2.4 (3.1)		6.0 (7.3)
7	A(AB)(AC)C		BL/182	BL/35	FCTE/30	BL/10
	Demand	Target	22.8 (17.4)	35.3 (24.9)	29.8 (25)	39.7 (22.7)
		Slope	0	−0.9	−1.4	−2.6
		Commun				
8	A(BC)C		BL/27	FCT/24	FCTP/15	FCTP/12
	Attention	Target	14.5 (5.0)	9.0 (5.8)	0.9 (0.9)	0.6 (0.3)
		Slope	0	0	−0.1	0
		Commun		1.8 (0.7)	1.9 (1.0)	2.5 (0.3)
9	ABCAC		BL/11	FCT/20	FCTE/10	BL/3
	Attention	Target	7.1 (2.4)	3.3 (2.2)	1.9 (1.9)	4.7 (1.0)
		Slope	−0.3	0	−0.3	1
		Commun		1.7 (1.1)	3.8 (1.4)	1.7 (1.2)
10	ABCBCD		BL/14	FCT/3	FCTE/18	FCT/3
	Attention	Target	0.5 (11.0)	31.3 (4.1)	4.5 (10.5)	38.1 (13.2)
		Slope	1.1	−0.5	−1.1	13
		Commun		0 (0)	0.3 (0.5)	0 (0)
11	ABCADAEAE		BL/4	FCT/15	FCTE/15	BL/7
	Attention	Target	10.6 (5.3)	3.0 (2.4)	2.3 (1.5)	6.4 (4.6)
		Slope	−1.1	0.2	0	1.2
		Commun		3.8 (2.2)	4.0 (2.1)	

APPENDIX
(Extended)

Condition/number of sessions				
FCTE/26	FCTP/7	BL/3	FCTP/56	
0.5 (0.6) 0.1 Fading	0.5 (0.4) −0.1 Fading	1.5 (0.7) 0.3 1.0 (0.2)	0.3 (0.2) 0 Fading	
FCTP/6	BL/3	FCTP/52		
0.2 (0.4) −0.1 1.8 (0.1)	7.3 (2.6) −1.9	0.3 (0.8) 0 1.6 (0.3)[a]		
FCTP2/40	FCTP2/21			
0.3 (0.5) 0.1 1.8 (0.5)	0.1 (0.1) 0 1.8 (0.2)			
DRAExt/24	BL/5	DRAPun/34	BL/5	DRAExt/70
0.4 (0.5) 0	1.2 (1.0) 0.4	0.5 (0.3) 0	2.2 (1.0) 0.3	0.3 (0.6) 0
BL/8	FCTP/44			
3.0 (2.6) 1	0.1 (0.2) 0 4.6 (3.5)a			
(rate per hour)				
FCTP/8	FCTP/34			
7 (5.4) −1.9	2.4 (2.2) −0.1	(rate per hour)		
FCTE/37				
0.3 (0.5) 0 3.7 (0.8)[a]				
FCTE/42	FCTP/15			
0.6 (1.3) 0 0.4 (0.4)	0.1 (0.1) 0 0.2 (0.1)			
DROExt/6	BL/6	DROPun/9	BL/5	DROPun/35
2.5 (1.9) 0.5 0 (0)	5.5 (3.5) 0.7	0.4 (0.3) 0 0 (0)	8.3 (6.1) 0.5	0.3 (0.6) 0 0 (0)

APPENDIX
(Continued)

Case	Design/condition		Condition/number of sessions			
12	ABABCBC		BL/3	FCTE/12	BL/4	FCTE/5
	Attention	Target	8.2 (1.2)	1.8 (1.6)	15.9 (5.8)	1.5 (1.1)
		Slope	−0.8	0.2	3.9	0.6
		Commun	0 (0)	1.6 (0.5)	0.4 (0.6)	1.5 (0.5)
13	ABCADAEAE		BL/8	FCT/11	FCTE/6	BL/7
	Attention	Target	12.8 (5.1)	9.4 (6.7)	14.4 (11.9)	18.1 (14.0)
		Slope	−0.1	0.1	3.9	−3.1
		Commun		0.7 (0.5)	1 (0.8)	0.7 (0.6)
14	ABCBCBCD		BL/9	FCTE/11	FCTP1/14	FCTE/11
	Attention	Target	1.9 (0.4)	1.0 (1.3)	0.4 (0.7)	2.1 (4.6)
		Slope	0.1	0	0	0.9
		Commun		1.7 (0.3)	1.8 (0.3)	2.0 (0.1)
15	ABABCBC		BL/13	FCTE/5	BL/4	FCTE/54
	Attention	Target	10.0 (6.7)	4.7 (9.4)	13.4 (8.9)	1.6 (3.4)
		Slope	−0.8	−4.4	−5.2	0
		Commun		2.5 (1.4)	0.2 (0.4)	Fading
16	ABCABCDACD		BL/7	FCT/7	FCTE/14	BL/29
	Attention	Target	8.3 (3.6)	4.6 (3.2)	2.2 (2.1)	4.1 (3.8)
		Slope	−0.8	1.2	−0.3	0.3
		Commun		0.3 (0.3)	1.2 (0.5)	
17	A(AB)AB		BL/12	BL/15	FCTE/22	BL/16
	Tangible	Target	3.82 (2.9)	8.1 (5.6)	4.1 (8.7)	9.0 (7.5)
		Slope	0.2	−0.6	−0.3	−0.4
		Commun	3.2 (2.5)	8.1 (5.6)	9.6 (5.9)	2.1 (3.4)
18	ABAB		BL/7	FCTE/5	BL/10	FCTE/29
	Attention	Target	1.0 (10.5)	0.2 (0.2)	1.5 (1.0)	0.3 (0.5)
		Slope	0.8	0	0.2	0
		Commun		2.0 (0.5)		2.0 (0.4)[a]
18	ABCB(BC)		BL/7	FCTE/7	FCTP/12	FCTE/16
	Demand	Target	1.4 (0.8)	0.9 (0.9)	0.2 (0.3)	0.4 (0.6)
		Slope	0.2	0.1	0	0.1
		Commun		1.1 (0.2)	1.2 (0.2)	1.3 (0.2)[a]
19	ABAB(BC)		BL/5	FCTE/3	BL/5	FCTE/50
	Attention	Target	16.3 (1.2)	0 (0)	21.4 (5.3)	2.0 (3.4)
		Slope	−0.4	0	−2.6	0.1
		Commun		3.7 (0.5)	0.2 (0.5)	3.2 (0.2)[a]
19	ABAB(BC)		BL/8	FCTE/8	BL/5	FCTE/80
	Demand	Target	8.6 (5.4)	0.2 (0.3)	6.2 (4.3)	2.7 (4.2)
		Slope	0.4	0	1.1	0
		Commun		1.5 (0.2)	0.1 (0.1)	1.6 (0.1)[a]
20	ABAB		BL/36	FCTE/4	BL/3	FCTE/33
	Attention	Target	8.3 (11.0)	0.3 (0.2)	18.4 (7.9)	0.2 (0.5)
		Slope	0.6	0	−2.2	0
		Commun				

APPENDIX
(Continued) (Extended)

Condition/number of sessions					
FCTP/11	FCTE/7	FCTP/37			
0.8 (0.7) 0 2.3 (0.4)	3.0 (2.0) −0.2 3.0 (0.5)	0.2 (0.3) 0 1.3 (0.6)[a]			
DROExt/8	BL/5	DROPun/7	BL/3	DROPun/25	
11.4 (8.2) 1.3 0.8 (0.9)	11.4 (4.1) 1 0.4 (0.3)	0.4 (0.2) 0 0.5 (0.3)	23.7 (13.0) 12.9	0.3 (0.2) 0 0.2 (0.2)	
FCTP1/12	FCTE/11	FCTP1/88	FCTP2/18		
0.1 (0.3) 0 2.0 (0.2)	1.7 (3.5) 0.4 2.0 (0.2)	0.3 (1.1) 0 1.9 (0.2)[a]	0.6 (0.8) 0 Fading		
FCTP/20	FCTE/8	FCTP/4			
0 (0) 0 Fading	8.3 (12.0) 2.7 Fading	0.1 (0.3) −0.2 Fading			
FCT/23	FCTE/25	FCTP/3	BL/5	FCTE/10	FCTP/21
2.8 (3.1) −0.2 0.9 (0.7)	1.8 (1.4) 0 0.8 (0.6)	0.5 (0.8) −0.7 0.5 (0.8)	6.5 (4.5) 2.7 0.7 (0.6)	0.8 (1.1) 0.2 1.6 (.6)	0.2 (0.2) 0 0.4 (0.6)
FCTE/136					
0.5 (1.5) 0 14.5 (8.9)[a]					
FCTE/16	FCTP/16				
0.8 (1.8) 0 Fading	0.1 (0.2) 0 Fading				
FCTE/7	FCTP/5				
14.8 (6.9) 2 Fading	0.2 (0.1) 0 Fading				
FCTE/16	FCTP/15				
6.5 (7.8) 0 Fading	0.2 (0.3) 0 Fading				

APPENDIX
(Continued)

Case	Design/condition		Condition/number of sessions			
20	ABAB		BL/45	FCTE/11	BL/8	FCTE/20
	Demand	Target	8.4 (13.0)	0.4 (0.8)	3.8 (3.3)	0.1 (0.4)
		Slope	0	0	1.3	0
		Commun				
20	A(AB)CAC		BL/18	FCT/29	BL/12	FCTE/26
	Tangible	Target	2.6 (1.7)	2.1 (3.6)	7.2 (4.6)	0.7 (0.9)
		Slope	0.1	0.2	0	−0.1
		Commun				
21	ABD(MB)		BL/10	FCTE/40	FCTP/23	
	Attention	Target	12.0 (7.0)	0.8 (1.5)	0.1 (0.3)	
		Slope	0	0	0	
		Commun		1.5 (0.3)[a]	Fading	
21	ABD(MB)		BL/22	FCTE/17	FCTP/34	
	Demand	Target	1.6 (1.5)	0.6 (0.9)	0.1 (0.1)	
		Slope	−0.1	0	0	
		Commun		0.3 (0.5)	0.2 (0.2)[a]	
21	ABCD(MB)		BL/5	FCTE/20	FCTP1/8	FCTP2/40
	Tangible	Target	2.1 (0.4)	0.2 (0.3)	0.4 (0.3)	0 (0.1)
		Slope	0.1	0	−0.1	0
		Commun		1.6 (0.4)	0.9 (0.5)	1.4 (0.1)[a]

APPENDIX
(Continued) (Extended)

Condition/number of sessions	
BL/3	FCTE/13
11.4 (4.1)	0.9 (1.1)
2.3	0.1

Note. Values in parentheses indicate the standard deviation; letters in parentheses indicate conditions conducted within a multielement design; FCTE = FCT with extinction; FCTP = FCT with punishment; Target = targeted problem behavior; Slope = slope of targeted problem behavior; Commun = communication response; Fading = demand or delay-to-reinforcement fading was conducted during every session in a particular phase.

[a] Rate of communication was calculated using only sessions before demand or delay-to-reinforcement fading.