

*EVALUATING THE EFFECTS OF FUNCTIONAL  
COMMUNICATION TRAINING IN THE PRESENCE AND  
ABSENCE OF ESTABLISHING OPERATIONS*

KIMBERLY A. BROWN, DAVID P. WACKER, K. MARK DERBY,  
STEPHANIE M. PECK, DAVID M. RICHMAN, GARY M. SASSO,  
CLAUDIA L. KNUTSON, AND JAY W. HARDING

THE UNIVERSITY OF IOWA

We conducted functional analyses of aberrant behavior with 4 children with developmental disabilities. We then implemented functional communication training (FCT) by using different mands across two contexts, one in which the establishing operation (EO) that was relevant to the function of aberrant behavior was present and one in which the EO that was relevant to the function of aberrant behavior was absent. The mand used in the EO-present context served the same function as aberrant behavior, and the mand used in the EO-absent context served a different function than the one identified via the functional analysis. In addition, a free-play (control) condition was conducted for all children. Increases in relevant manding were observed in the EO-present context for 3 of the 4 participants. Decreases in aberrant behavior were achieved by the end of the treatment analysis for all 4 participants. Irrelevant mands were rarely observed in the EO-absent context for 3 of the 4 participants. Evaluating the effectiveness of FCT across different contexts allowed a further analysis of manding when the establishing operations were present or absent. The contributions of this study to the understanding of functional equivalence are also discussed.

DESCRIPTORS: functional communication training, establishing operations, manding, functional equivalence

---

Functional communication training (FCT; Carr & Durand, 1985) is one reinforcement-based treatment package that is directly based on the results of a functional analysis. The purpose of FCT is to teach an individual an appropriate alternative re-

Kimberly Brown is now with The Kennedy Krieger Institute, Baltimore, Maryland. Mark Derby is now with Gonzaga University, Spokane, Washington. Stephanie Peck is now with Utah State University, Logan, Utah. David Richman is now with University of Kansas Medical Center, Kansas City, Kansas.

This project was completed as part of the requirements for a PhD degree in school psychology by the first author. This project was supported in part by a grant from the National Institute of Child Health and Human Development. Corey's data have been previously submitted for publication in a book chapter. The authors express their sincere appreciation to the staff and families who participated in this project and to Agnes DeRaad for her editorial assistance.

Correspondence concerning this article should be addressed to Kimberly A. Brown, The Kennedy Krieger Institute, Department of Behavioral Psychology, 707 N. Broadway, Baltimore, Maryland 21205.

sponse (a mand) to obtain reinforcement and to replace aberrant behavior. Many different types of mands have been used successfully in FCT packages, including verbalizations (e.g., Marcus & Vollmer, 1995), manual signs (e.g., Derby et al., 1997), word or picture cards (e.g., Lalli, Casey, & Kates, 1995), gestures (e.g., Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997), and micro-switches (e.g., Peck et al., 1996; Wacker et al., 1990). Numerous studies have supported the successful use of FCT in reducing aberrant behavior (e.g., Day, Horner, & O'Neill, 1994; Durand & Carr, 1991; Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquistio, & LeBlanc, 1998; Kahng, Iwata, DeLeon, & Worsdell, 1997; Wacker et al., 1990).

As research continues on FCT, several questions arise regarding both methodological and conceptual issues. One methodolog-

ical issue that has been systematically addressed is whether FCT is more effective alone or as one component in a treatment package that includes extinction or punishment (e.g., Fisher et al., 1993; Hagopian et al., 1998; Wacker et al., 1990). For example, Wacker et al. implemented FCT treatment packages following functional analyses. FCT packages included reinforcement for appropriate manding and extinction (withholding of reinforcement) or punishment (e.g., timeout, response cost, graduated guidance) for aberrant behavior. Once treatment resulted in reductions in aberrant behavior, a component analysis of the treatment packages was conducted to determine which components were necessary to maintain reductions in aberrant behavior. For all 3 participants, FCT was most effective (i.e., aberrant behavior decreased to low levels, and manding increased) when it was combined with extinction or punishment. Similarly, Fisher et al. evaluated the effectiveness of FCT alone, FCT plus extinction, and FCT plus punishment, and found that FCT plus punishment was the most effective treatment package for reducing aberrant behavior and increasing manding. Hagopian et al. replicated these findings in a summary of 21 cases for which FCT plus punishment was the most effective treatment package in reducing aberrant behavior and increasing manding. Collectively, these studies suggest that FCT treatment packages combined with extinction or punishment components are most effective.

Conceptual questions remain regarding the conditions under which mands successfully replace aberrant behavior during FCT treatments. Suppose an individual with disabilities has a preexisting skill deficit in communication. It might be argued that increasing a repertoire of manding, regardless of function, may result in a concomitant reduction of aberrant behavior. If this is true, then any mand or set of mands could be taught to an individual regardless of the

function of aberrant behavior. However, Carr and Durand (1985) showed that the trained mand should be functionally relevant to the situations that occasion aberrant behavior. They taught a child who engaged in high rates of aberrant behavior during difficult demands to request help (relevant to aberrant behavior) or praise (irrelevant to aberrant behavior) while working on the task and found that the child asked for help much more frequently than praise. This suggests that the reinforcers delivered in treatment should be relevant (i.e., matched to the correct establishing operations and to the function of aberrant behavior) to the context in which behavior occurs. Carr (1988) proposed that a major reason for the effectiveness of FCT was that the mand resulted in the same reinforcers that were previously provided for aberrant behavior. He termed this situation, in which the mands and aberrant behavior are both maintained by the same reinforcer, *functional equivalence*.

Based on the results of previous literature, continued research on FCT is needed to further understand the behavioral processes that contribute to the success of FCT treatment packages. The primary purpose of the current investigation was to use FCT treatment packages to determine if a mand that was matched to the function of aberrant behavior and reinforced only when the relevant establishing operation (EO) was present would result in decreased aberrant behavior and increases in manding. To address this purpose, we first identified the function of aberrant behavior during brief and extended functional analyses. Next, FCT was implemented by using two different mands across two contexts, one in which the EO that was relevant to the function of aberrant behavior was present and one in which the EO was absent. The mand used in the EO-present context served the same function (i.e., resulted in the same class of reinforcement) as aberrant behavior, and the mand used in the

EO-absent context served a different function. Finally, aberrant behavior resulted in extinction or mild punishment in both contexts.

## METHOD

### *Participants*

The participants for this study were 4 individuals who had been referred for assessment and treatment of aberrant behavior. Participants were selected for inclusion in this study if they met the following criteria: (a) Self-injury or aggression was the primary aberrant behavior of concern, (b) aberrant behavior was observed during the assessment sessions, (c) a social function (positive or negative reinforcement) was identified for aberrant behavior, and (d) FCT was selected as the treatment procedure by the clinic team.

Jim was a 7-year-old boy who had been diagnosed with autism, severe mental retardation, and a possible seizure disorder. The behavior of concern was self-injury, which consisted of head banging, head hitting, and hand and arm biting. Jim's mother reported that self-injury occurred at a high frequency and intensity and resulted in tissue damage (i.e., bleeding and bruising). Jim was nonverbal, but he used several manual signs, including "more," "please," and "done." Jim received Haloperidol during this study.

Kelly was a 9-year-old girl who had been diagnosed with mental retardation, level unspecified. The behavior of concern was self-injury, which consisted of head banging, head hitting, hair pulling, and knee banging. Kelly displayed some verbal communication (one- to two-word phrases, such as "please," "help," "mom," "know what?"), although most of her speech was unintelligible to individuals who did not know her. Kelly also used modified signs (including "done") recognized by her care providers and a picture

communication book to communicate with others.

Theresa was a 13-year-old girl who had been diagnosed with severe-profound mental retardation and a possible seizure disorder. The behavior of concern was self-injury, which consisted of head banging and hand biting. Theresa was nonverbal and was being taught to sign "please" and "more" at school. She typically pointed at preferred items or activities as a means of requesting them. Theresa received Imipramine and Carbamazepine during this study.

Corey was a 5-year-old boy who had been diagnosed with pervasive developmental disorder and moderate mental retardation. The behaviors of concern were aggression (i.e., pinching, hitting, biting, hair pulling, and throwing objects at others), active noncompliance (i.e., leaving or attempting to leave the work area), destructive behavior (i.e., throwing and breaking objects), and stereotypy (i.e., spinning objects). Corey was nonverbal and signed "more" to gain access to preferred items.

### *Settings and Therapists*

This study was conducted in three settings: an outpatient clinic (Kelly), an inpatient unit (Jim and Theresa), and participants' homes (Kelly and Corey). Corey's analysis was conducted as part of a grant that conducted in-home assessment and treatment for children who displayed aberrant behaviors. The outpatient and inpatient services personnel conducted sessions in a classroom equipped with a one-way observation mirror, tables and chairs, and a variety of task materials, toys, and activities. In addition, portions of these analyses were conducted in the living room of Kelly's home and in the playroom of Corey's home. Graduate students trained in behavior analysis served as therapists for Jim's and Theresa's assessment and treatment phases. Kelly's mother and Corey's mother and father

served as therapists during the assessment and treatment phases for their analyses. Therapists who worked with the experimenter coached parents on specific procedures for all assessment and treatment conditions.

#### *Response Definitions and Measurement*

*Response definitions.* Two categories of behaviors were recorded for each participant: (a) aberrant behavior (e.g., self-injury, aggression) and (b) manding behavior (i.e., signing, verbalizations, and pointing to word cards). Aberrant behavior for Jim, Theresa, and Kelly was self-injurious behavior. Self-injury observed during this study consisted of head banging (Jim, Theresa, and Kelly), head hitting (Jim and Kelly), hand and arm biting (Jim, Theresa, and Kelly), hair pulling (Kelly), and knee banging (Kelly). Aberrant behavior for Corey consisted of aggression (i.e., biting, pinching, hitting, hair pulling), active noncompliance (i.e., leaving or attempting to leave the work area), destructive behavior (i.e., throwing or breaking objects), and stereotypy (i.e., spinning objects). Mands were selected based on the primary means of communication (sign language, pointing, words) used by each participant. All selected mands were based on responses already in or similar to other gestures in each child's repertoire (e.g., pointing at word cards for Theresa and Corey). Manding was defined as exhibiting a target response without physical guidance to obtain specific reinforcers (attention, tangible items, breaks from demands). Thus, for the purposes of this study, mands could occur spontaneously or after verbal or modeled prompts and be included in the treatment data. Mands that had to be physically prompted were not included. Each participant had two targeted mands: one to gain access to attention or tangible items and one to escape task demands. One of the mands was relevant to the function of aberrant behavior and was

reinforced when the functional EO was present. The other mand was irrelevant to the function of aberrant behavior and was reinforced when the functional EO was absent. The relevant manding responses for each participant in the EO-present contexts were (a) signing "more" (Jim), (b) signing "play" (Kelly), (c) saying "please" (Kelly), (d) touching or pointing to a card that said "break please" (Theresa), and (e) touching or pointing to a card that said "done" (Corey). Irrelevant manding responses for each participant in the EO-absent contexts were (a) signing "done" (Jim and Kelly), (b) touching or pointing to a card that said "I want to play" (Theresa), and (c) signing "more" (Corey).

*Independent variables.* Four categories of independent variables were recorded: (a) attention, (b) task prompts, (c) breaks from tasks, and (d) mand prompts. Attention was defined as any form of verbalization (e.g., reprimands, talking, laughing), gesture (e.g., thumbs up, signing), or physical contact (e.g., pat on the back, hugs) delivered from the therapist to the participant. Task prompts were defined as the presentation of a specific task by the therapist and were recorded as long as the task was present in front of the participant. Task prompts included both verbal requests (e.g., "Pick up this block," "Fold this end of the towel first") and physical guidance (e.g., hand-over-hand guidance) to complete the task. Breaks from demands were recorded when the task was removed contingent on the occurrence of the target behavior. Mand prompts were recorded when the therapist gave the participant a verbal prompt (e.g., "Sign 'please' if you want me to play," "Touch the break card if you want to take a break"), a modeled prompt (therapist demonstrated target response), or a physical prompt (hand-over-hand guidance) to emit the targeted mand.

*Data collection.* Trained observers record-

ed data on participant and therapist responses. Occurrence of these behaviors was recorded concurrently using a 6-s partial-interval recording system during 5- to 10-min sessions. Each behavior was recorded as it occurred, and all observations were conducted via a one-way observation mirror (Jim, Theresa, and Kelly) or via videotape (Jim, Kelly, and Corey).

*Interobserver agreement.* Interobserver agreement checks on aberrant behavior and manding were conducted by a second observer who simultaneously but independently recorded participant and therapist target behaviors. Interobserver agreement checks were conducted on at least 70% of the sessions for each participant (range, 70% to 100%;  $M = 85%$ ). Occurrence agreement was calculated by using a sliding interval rule. An agreement was obtained when either both observers recorded the behavior in the same interval or both recorded the behavior but were off by one 6-s interval (i.e., plus or minus an interval). Occurrence and total exact agreement were calculated on an interval-by-interval basis by dividing agreements by agreements plus disagreements and multiplying by 100%. Occurrence interval agreement for dependent variables averaged 81% for all participants. Average occurrence interval agreement was 81% for Jim (range, 63% to 100%), 80% for Theresa (range, 0% to 100%), 85% for Corey (range, 0% to 100%), and 78% for Kelly (range, 0% to 100%). Low agreements were usually related to low-frequency behaviors that were sometimes missed by one of the observers. Total agreement for participant behavior averaged 92% for Jim (range, 63% to 100%), 98% for Theresa (range, 90% to 100%), 99% for Corey (range, 90% to 100%), and 95% for Kelly (range, 75% to 100%). Total agreement for the independent variables (i.e., delivery of attention, task prompts, breaks from tasks, and mand prompts) was obtained as an integrity measure and was cal-

culated the same as total agreement for participant behavior. Total agreement for independent variables averaged 97% for all participants. Total agreement for independent variables averaged 96% for Jim (range, 90% to 100%), 96% for Theresa (range, 88% to 100%), 99% for Corey (range, 95% to 100%), and 96% for Kelly (range, 82% to 100%).

### *Experimental Design*

*Assessment: Brief and extended functional analyses.* The design for the brief functional analysis was a multielement design with rapidly changing conditions as described by Northup et al. (1991). The assessment consisted of a series of brief (5- to 10-min) assessment conditions, with each condition constituting a distinct environmental situation (e.g., escape from demands or contingent attention). If the target behavior varied between two conditions, one or both conditions were repeated to form a mini-reversal design. A multielement design, as described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), was used for the extended functional analyses.

During the brief and extended functional analyses there were three conditions: free play, positive reinforcement (attention, tangible, or both) contingent on aberrant behavior, and negative reinforcement (escape from demands) contingent on aberrant behavior. Following the brief functional analyses, an assessment of manding with contingency reversals was conducted for Jim and Kelly (standard protocol for brief functional analyses; cf. Northup et al., 1991). The assessment of manding consisted of providing the reinforcers identified in the functional analysis contingent on specific mands. This assessment was conducted within a mini-reversal design, in which the contingent presentation of relevant reinforcers (e.g., attention) for manding was compared to irrele-

vant reinforcers (e.g., escape from demands) for aberrant behavior.

*Treatment: Functional communication training.* FCT was conducted within a multielement (alternating treatments) design across three conditions: EO-present context, EO-absent context, and control context. The EO-present context for each participant was the experimental context identified in the functional analysis that maintained aberrant behavior. The EO-absent context for each participant was the experimental context in the functional analysis in which zero to low rates of aberrant behavior were observed. The control context was identical to the free-play conditions from the functional analyses. The order of conditions was alternated within and across days for each participant.

#### *Procedure*

*Brief and extended functional analyses.* Descriptive information was gathered prior to each evaluation via medical chart reviews and phone interviews with primary care providers to generate hypotheses regarding the function of each participant's aberrant behavior. The specific assessment conditions that were conducted during each evaluation were based on hypotheses of maintaining contingencies developed via the descriptive information. Brief functional analyses were conducted for Jim because a functional analysis had been previously conducted and for Kelly because her evaluation was conducted during an outpatient appointment. Extended functional analyses were conducted for Theresa and Corey because they were part of the standard inpatient and in-home assessment protocols. The specific order of assessment conditions was randomized across participants. The following five conditions were conducted: free play, contingent attention, contingent tangible, contingent attention or tangible, and contingent escape. Tangible items were assessed alone or in con-

junction with attention conditions only when parental report indicated that tangible items were often provided following aberrant behavior. Sessions lasted 5 min for Jim, Kelly, and Corey and 10 min for Theresa (standard protocol on the inpatient unit). Jim's and Kelly's assessments were completed in 1 day, and Corey and Theresa's assessments were conducted across several days.

The free-play condition was conducted with all 4 participants. During this condition, each participant was given noncontingent access to toys and preferred items. The therapist played with the participant and provided him or her with noncontingent attention. During free play, all of the potential reinforcers for aberrant behavior were provided noncontingently (attention, preferred items, escape), and there were no differential consequences for aberrant behavior. Therefore, very low rates of aberrant behavior should occur in this condition.

The contingent attention condition was conducted with Theresa, Kelly, and Corey. During this condition, the participant had access to toys and preferred items and was ignored unless aberrant behavior occurred. Contingent on aberrant behavior, the therapist provided brief (10- to 30-s) social attention in the form of reprimands (e.g., "Don't hit yourself. That will hurt.") or physical contact (e.g., soothing pat on the back). When aberrant behavior stopped, the therapist backed away and again ignored the participant.

The contingent tangible condition was conducted with Corey because his parents reported that they typically provided preferred items after occurrences of mild inappropriate behaviors (e.g., crying). During this condition, a preferred toy was removed from the participant and was provided contingent on aberrant behavior for 10 to 30 s. No attention was provided during this condition.

The contingent attention or tangible con-

dition was conducted with Jim because his mother reported that she typically provided attention and preferred items following occurrences of aberrant behavior. It was conducted in the same manner as the contingent attention condition, but provided both attention and a tangible item (e.g., bubbles, busy box) for 10 to 30 s contingent on aberrant behavior. When aberrant behavior stopped, both attention and tangible items were removed until aberrant behavior occurred again.

The contingent escape condition was conducted with all 4 participants. During this condition, all preferred items and toys were removed and the participant was directed to complete a demanding task, such as picking up toys (Jim), sorting nuts and bolts (Theresa), or color matching (Kelly and Corey). Aberrant behavior resulted in the contingent removal of the task for 10 to 30 s or until aberrant behavior stopped. When aberrant behavior stopped, the task was re-presented.

For the 2 participants who received a brief functional analysis (Jim and Kelly), an assessment of manding was conducted to determine if manding would be a viable treatment option for replacing aberrant behavior. Manding conditions were compared to assessment conditions in which manding did not result in reinforcement. For Jim, two conditions were conducted: contingent attention or tangible for signing "more" and contingent escape for aberrant behavior. During the contingent attention or tangible for signing "more" conditions, signing "more" resulted in access to attention and preferred activities for 10 to 30 s. Aberrant behavior resulted in a brief time-out. This condition was compared to the contingent escape for aberrant behavior condition, in which Jim was provided with a brief (10- to 30-s) break from the demand (i.e., picking up toys) contingent on aberrant behavior. No mand prompts were provided during this condition, and all manding was ignored.

This condition was conducted to observe the occurrence of aberrant behavior and manding in the absence of identified reinforcers. Kelly's manding assessment was identical to Jim's except that manding resulted in attention only.

*Functional communication training.* One EO-present context, one EO-absent context, and a control condition (free play) were conducted for all 4 participants, and were selected based on the results of the functional analyses. Free-play conditions were conducted as previously described. For Jim, the EO-present context was attention or tangible and the EO-absent context was escape. For Kelly, the EO-present context was attention and the EO-absent context was escape. For Theresa, the EO-present context was escape and the EO-absent context was attention. For Corey, the EO-present context was escape and the EO-absent context was tangible. Prior to the beginning of the treatment analysis, the therapist asked the child to display each mand (e.g., "Jim, show me 'more' ") to insure that each child had already acquired both mands.

During treatment within the positive reinforcement contexts (i.e., attention, tangible, and attention or tangible), the participants were instructed to use the target mand to gain access to adult attention or tangible items. At the beginning of each session, the therapist demonstrated which mand was required to obtain reinforcement for that session. Then, the therapist sat near the individual and read a magazine. Verbal mand prompts (general and specific) were provided once per minute until the participant emitted the targeted mand. The therapist provided the participant with attention or tangible items (for 10 to 60 s) contingent on the target mand. All instances of aberrant behavior in attention and attention or tangible contexts resulted in a brief time-out (10 to 30 s or until aberrant behavior stopped) from reinforcement. Following time-out, the par-

ticipant was verbally prompted to use the target mand to receive attention or tangible items. Use of the irrelevant mand in either context was ignored. In the tangible context, attention was provided throughout the sessions, and all occurrences of aberrant behavior were blocked and neutrally redirected (i.e., time-out was not used per parent request).

During the treatment conditions within the escape context, each participant was required to complete a demanding task, including picking up toys (Jim), sorting nuts and bolts (Theresa), color matching (Corey), and academic tasks (Kelly). During the first trial of the escape treatment session for each participant, the target mand was physically prompted and escape was provided to allow each participant to sample the contingency in effect. The participants were required to complete a small number of demands before being allowed to request a break from the task by using the target mand. Thus, spontaneous use of the "done" mand from Kelly and Jim would be ignored until the required amount of work was completed (this situation did not occur), and the break and done cards were not provided for Theresa and Corey until the required amount of work was completed. When the work was completed, the therapist provided a verbal prompt (e.g., "Tell me what you want to do") or no prompts, or the break card (for Theresa and Corey). Use of the target mand resulted in a break from the task for either 30 s (Theresa, Kelly, and Corey) or until aberrant behavior occurred (Jim). All occurrences of aberrant behavior resulted in contingent demands (i.e., a return to the task). For all participants except Corey, attention was provided (in the form of task prompts and praise for compliance) during demands but not on breaks. Corey received attention during both demands and breaks and preferred tangible items during breaks per parent request.

When word cards were used as the targeted mand (Theresa and Corey), only the card that was relevant to the context was available. Thus, in both EO-present and EO-absent sessions for Theresa and in EO-absent sessions for Corey, there was no opportunity to use the irrelevant mand.

## RESULTS

The results of Jim's brief functional analysis are presented in Figure 1. During the brief functional analysis, the highest percentages of aberrant behavior occurred during the contingent attention or tangible condition, suggesting that Jim's aberrant behavior was maintained by positive reinforcement (i.e., access to attention and preferred activities). The assessment of manding indicated that manding occurred only when it resulted in access to attention and preferred items.

The results of Jim's treatment analysis are presented in Figure 2. Jim signed "more" (relevant mand) consistently to obtain attention and preferred items, and never signed "done" (irrelevant mand) in the EO-present context. Jim signed "done" on only one occasion during the first escape session. He occasionally signed "more" in the EO-absent context; however, this occurred exclusively during breaks from demands when he was not receiving attention. Very low percentages of manding were observed in the free-play context.

Figure 2 also displays Jim's percentage of aberrant behavior during sessions in the EO-present context, EO-absent context, and free-play context. A burst of aberrant behavior was observed during sessions in the EO-present and control contexts, but behaviors decreased to 0% over the last three sessions in both contexts. Low percentages (0% to 5%) of aberrant behavior were observed during the EO-absent context sessions.

The results of Kelly's brief functional anal-



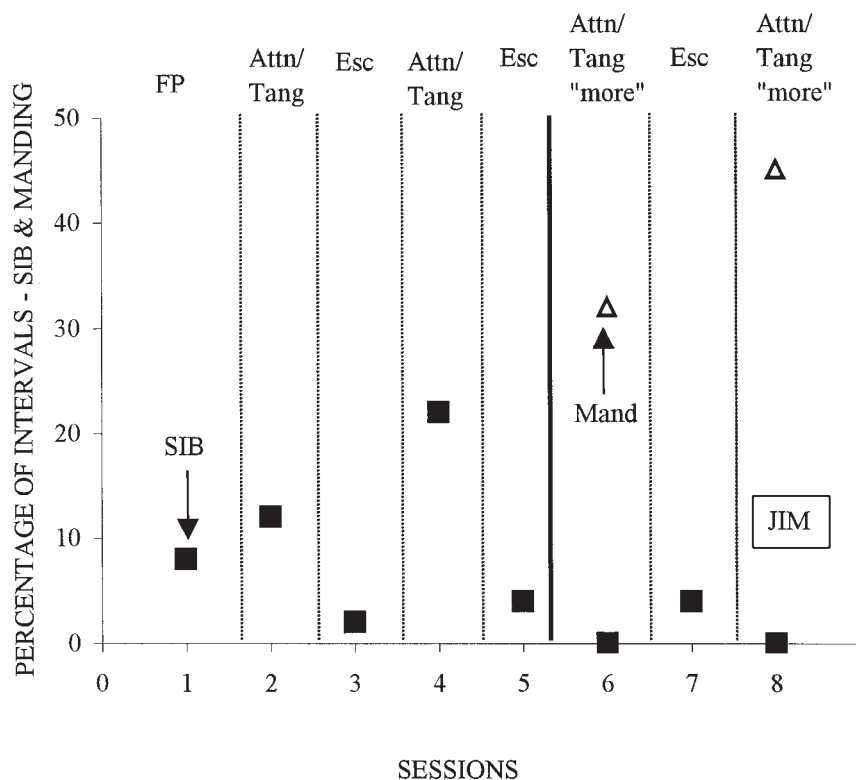


Figure 1. Percentage of aberrant behavior and manding during the brief functional analysis and assessment of manding for Jim. (FP = free play; Attn/Tang = contingent attention and tangible items; Esc = contingent escape; Attn/Tang "more" = contingent attention or tangible items for signing "more")

ysis are presented in Figure 3. During the brief functional analysis, aberrant behavior was observed only in the contingent attention conditions, which suggested that Kelly's aberrant behavior was maintained by positive reinforcement (attention). During the assessment of manding, Kelly's aberrant behavior decreased to 0%, and she used the target mand during 34% of the intervals when manding resulted in attention. Manding did not occur during the escape condition.

The results of Kelly's treatment analysis are presented in Figure 4. Kelly signed or said "play please" (relevant mand) consistently to obtain attention, and never signed "done" (irrelevant mand) in the EO-present context. Kelly signed "done" to receive breaks from demands on a few occasions. She occasionally signed "play please" in the

EO-absent context; however, this occurred exclusively during breaks from demands when she did not have attention. Very low percentages of manding were observed in the free-play context.

Figure 4 also displays Kelly's percentage of aberrant behavior observed during the EO-present context, the EO-absent context, and the control context. Aberrant behaviors were rarely observed during any sessions across all three contexts.

The results of Theresa's functional analysis are presented in Figure 5. Moderate and stable percentages of aberrant behavior were observed during the escape condition, suggesting that Theresa's aberrant behavior was maintained by negative reinforcement (i.e., escape from demands).

The results of Theresa's treatment analysis are presented in Figure 6. Theresa used word

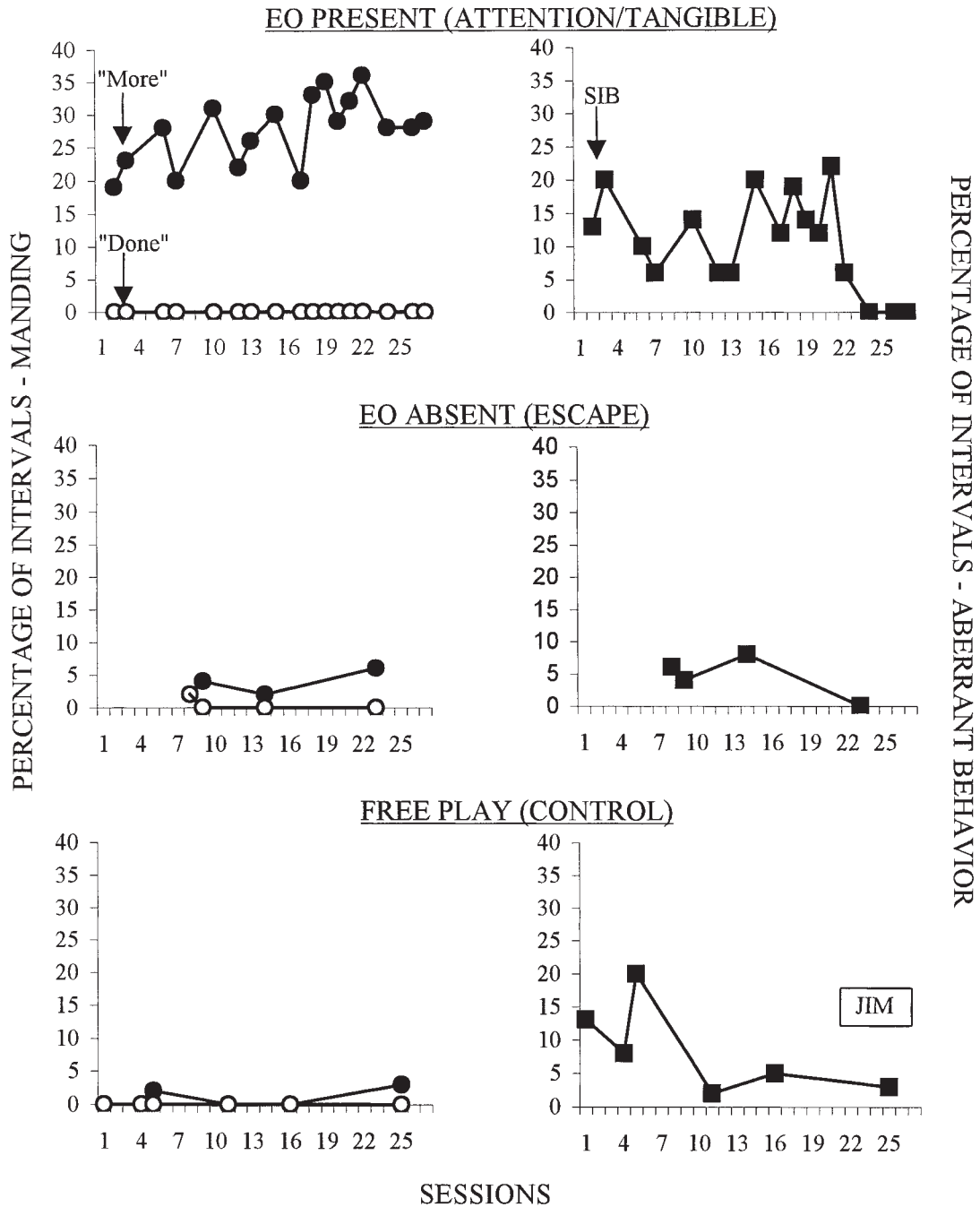


Figure 2. Percentage of manding during the treatment analysis in the EO-present context (top left panel), EO-absent context (middle left panel), and free-play context (bottom left panel), and percentage of aberrant behavior during the treatment analysis in the EO-present context (top right panel), EO-absent context (middle right panel), and free-play context (bottom right panel) for Jim.

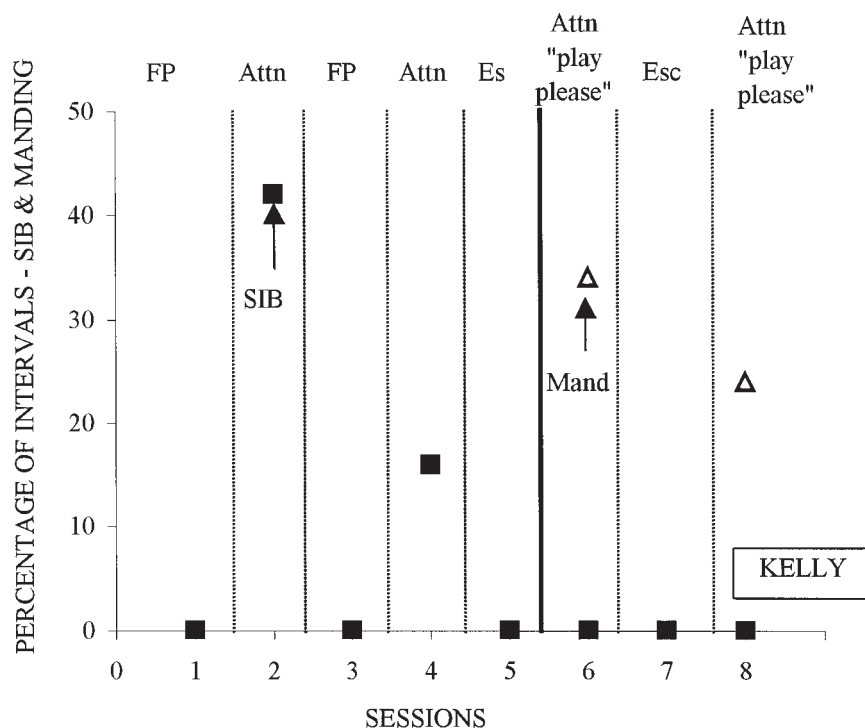


Figure 3. Percentage of aberrant behavior and manding during the brief functional analysis and assessment of manding for Kelly. (FP = free play; Attn = contingent attention; Esc = contingent escape; Attn "play please" = attention contingent on saying "please" or signing "play")

cards to request breaks and attention, and only one card was available per condition. Therefore, one set of manding data are depicted in each panel. Theresa touched the "break please" card consistently to receive a break during the EO-present context sessions, but did not touch the "I want to play" card consistently to gain attention during the EO-absent context sessions. Theresa displayed very low percentages of aberrant behavior (0% to 5%) across all three contexts.

The results of Corey's functional analysis are presented in Figure 7. Low and variable percentages of aberrant behavior were observed across attention, tangible, and free-play conditions. Relatively higher and slightly increasing percentages of aberrant behavior were observed during the escape condition. The level of behavior in the escape condition relative to the level of behavior in the other conditions suggests that Corey's

aberrant behaviors were maintained by negative reinforcement (i.e., escape from demands).

The results of Corey's treatment analysis are presented in Figure 8. Corey used a word card to request breaks from demands and signs to request tangible items. The word card was available only during the EO-present (escape) context; however, Corey could use the sign for tangible items in all contexts. Therefore, manding for breaks from demands is displayed only in the EO-present panel, and manding for tangible items is displayed in all panels. Corey used both the "done" and "more" mands at very similar percentages in the EO-present context. Further analysis of the data indicated that Corey used the "done" mand every time the word card was presented (only three times per session), and that the "more" mand tended to occur intermittently (during demands and

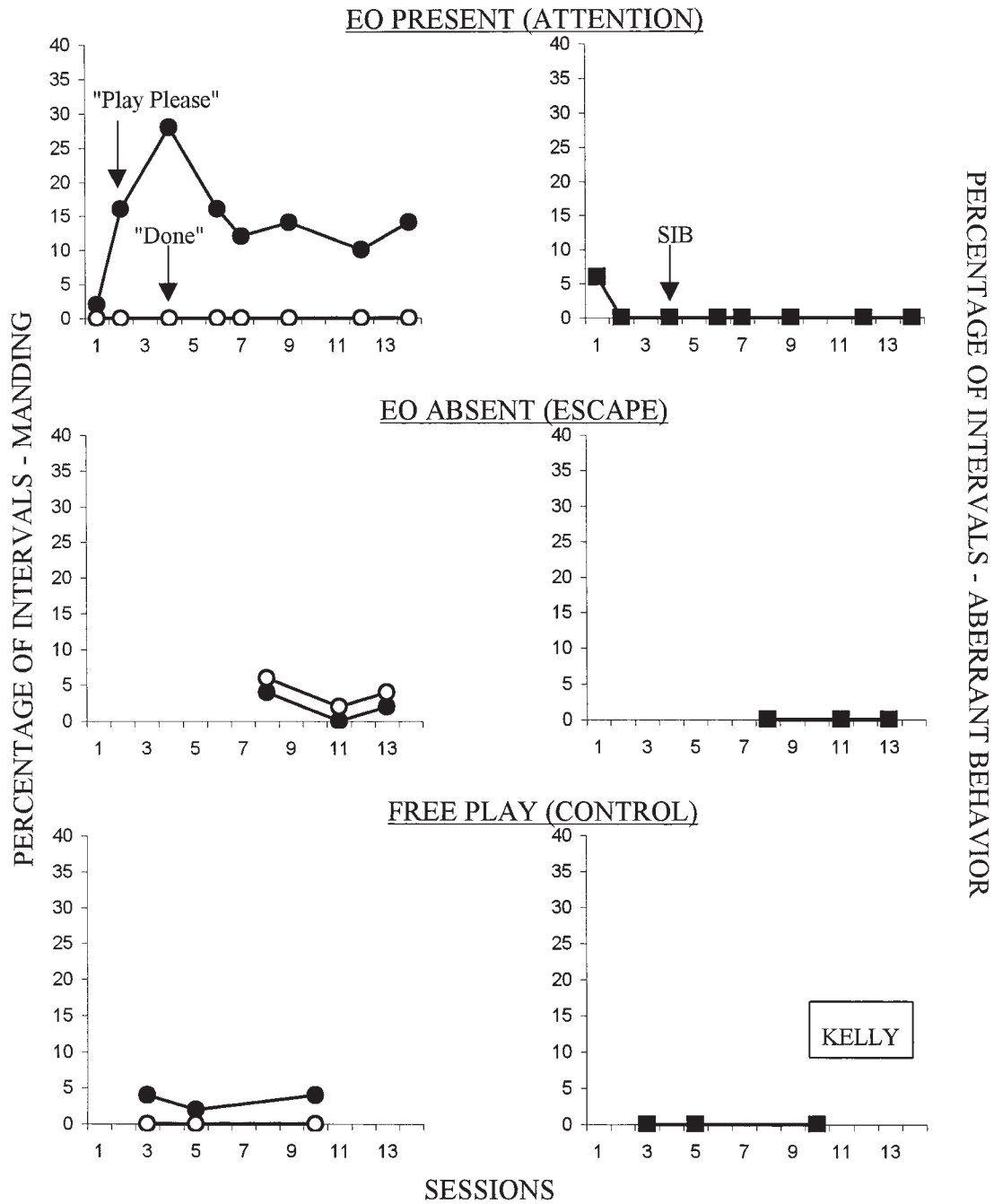


Figure 4. Percentage of manding during the treatment analysis in the EO-present context (top left panel), EO-absent context (middle left panel), and free-play context (bottom left panel), and percentage of aberrant behavior during the treatment analysis in the EO-present context (top right panel), EO-absent context (middle right panel), and free-play context (bottom right panel) for Kelly.

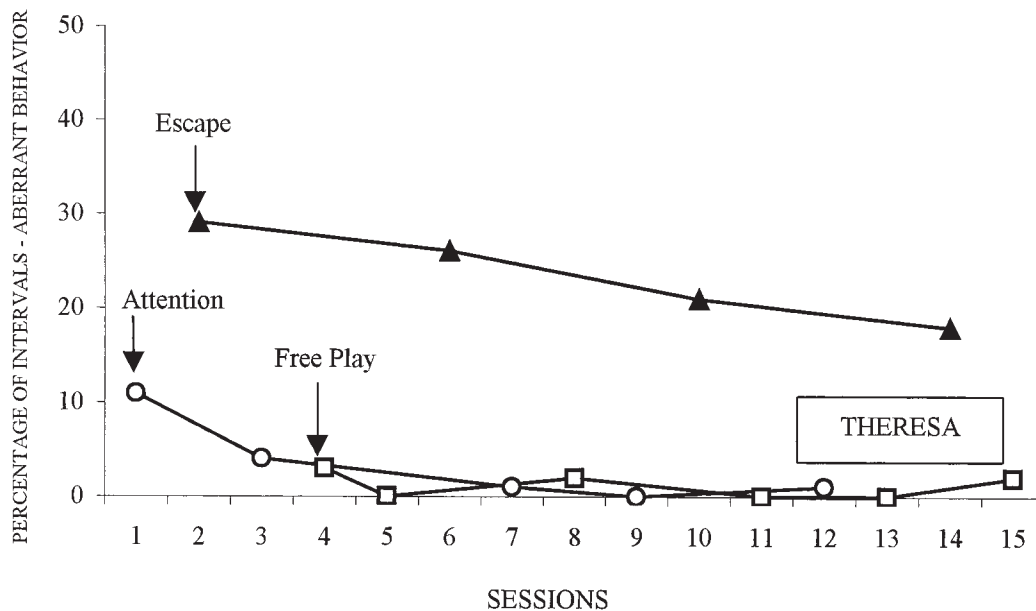


Figure 5. Percentage of aberrant behavior during the functional analysis for Theresa.

breaks) throughout the EO-present context sessions. Corey's use of the "more" sign was moderate and variable during tangible sessions, suggesting that signing may have been maintained by access to tangible items. Very low percentages of manding were observed during the control context.

Figure 8 also displays the percentage of aberrant behavior during sessions in the EO-present context, EO-absent context, and free-play context. An initial burst of aberrant behavior was observed during sessions in the EO-present context, but behaviors decreased to 10% or less over the last four sessions. Very low percentages of aberrant behavior were observed during the EO-absent and control contexts.

In summary, the brief and extended functional analyses identified at least one operant function for all 4 participants' aberrant behaviors. Contingency reversals during the brief functional analyses identified FCT as a potential treatment for 2 participants. Results of the treatment analyses indicated that 3 of the 4 participants displayed the relevant mand (i.e., matched the function of aberrant

behavior) when the functional EO was present more frequently than the irrelevant mand when the functional EO was absent. In addition, aberrant behavior decreased to low levels for all participants across all contexts. The 4th participant (Corey) manded for both escape and tangible items in the EO-present context and manded for tangible items in the EO-absent context.

## DISCUSSION

For 3 of the 4 participants, the mand that matched the function of aberrant behavior was the primary mand observed and maintained throughout the treatment analyses. The relevant mands occurred most often in the EO-present condition, and the irrelevant mands rarely occurred in the EO-present condition for 2 of the 3 participants (Jim, Kelly, and Corey) who had the opportunity to display both mands in the EO-present condition. Near-zero levels of both relevant and irrelevant mands were observed in the EO-absent condition for the 2 participants (Jim and Kelly) who had the opportunity to

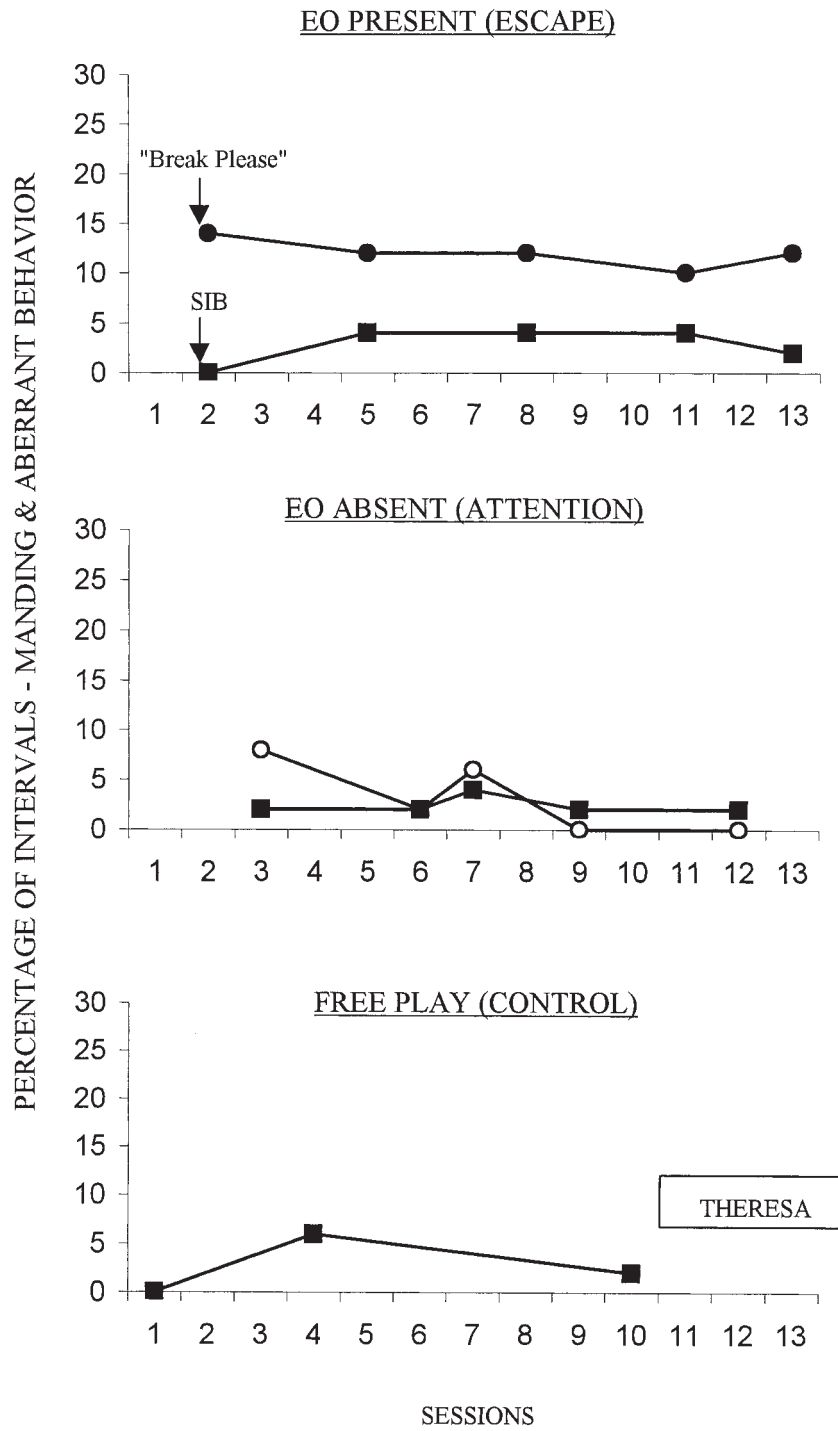


Figure 6. Percentage of manding and aberrant behavior during the treatment analysis in the EO-present context (top panel) and EO-absent context (middle panel) and percentage of aberrant behavior during the treatment analysis in the free-play context (bottom panel) for Theresa.

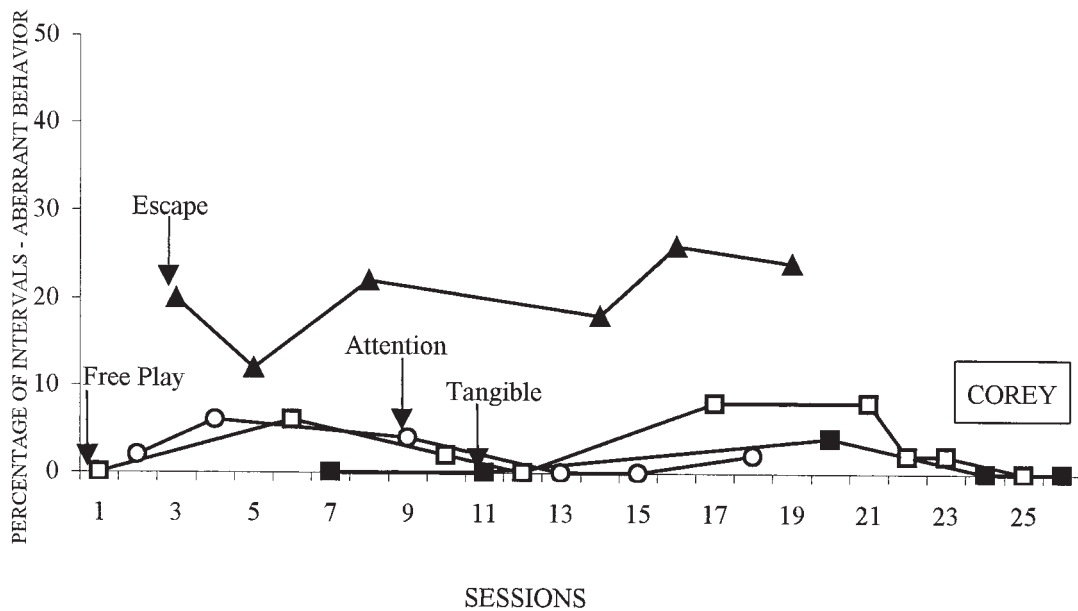


Figure 7. Percentage of aberrant behavior during the functional analysis for Corey.

display both mands in the EO-absent condition. In addition, aberrant behavior occurred most often in the EO-present condition for all 4 participants, and appears to have been replaced either immediately (Kelly and Theresa) or over time (Jim and Corey) with the relevant mand. Thus, these data provide preliminary support for the hypothesis that both mands and aberrant behavior served similar functions and that both were responsive to the EOs and consequences in place during treatment. It is important to note that manding and aberrant behavior were evaluated within irrelevant contexts (EO-absent and free-play contexts) as well as relevant contexts, which permitted a more systematic evaluation of the role of establishing operations in FCT treatment packages. As shown in the results of 3 participants, both mands and aberrant behavior varied as a function of the EO, the contingencies following behavior, or both. The current results also indicate that additional research is needed to identify the procedures that facilitate functional equivalence (Carr, 1988) within FCT treatment packages.

For 3 participants in this study, some combination of establishing operations, differential reinforcement of manding, and mild punishment or extinction for aberrant behavior contributed to the effectiveness of the FCT treatment package. In addition, because the mand that was matched to the function of aberrant behavior was more often displayed relative to the irrelevant mand, a preliminary conclusion based on this result suggests that some mands (e.g., for attention, escape) may not be acquired simply via skills training. One potential interpretation of the results of the current investigation is that relevant mands were displayed more frequently and consistently because the relevant EO was present and the mands provided access to functional reinforcers previously obtained only via aberrant behavior. Similarly, it is also likely that irrelevant mands were displayed at very low levels for 3 of the 4 participants in the EO-absent condition because the relevant EO was absent and the irrelevant mands were not functionally equivalent to the occurrence of aberrant behavior.

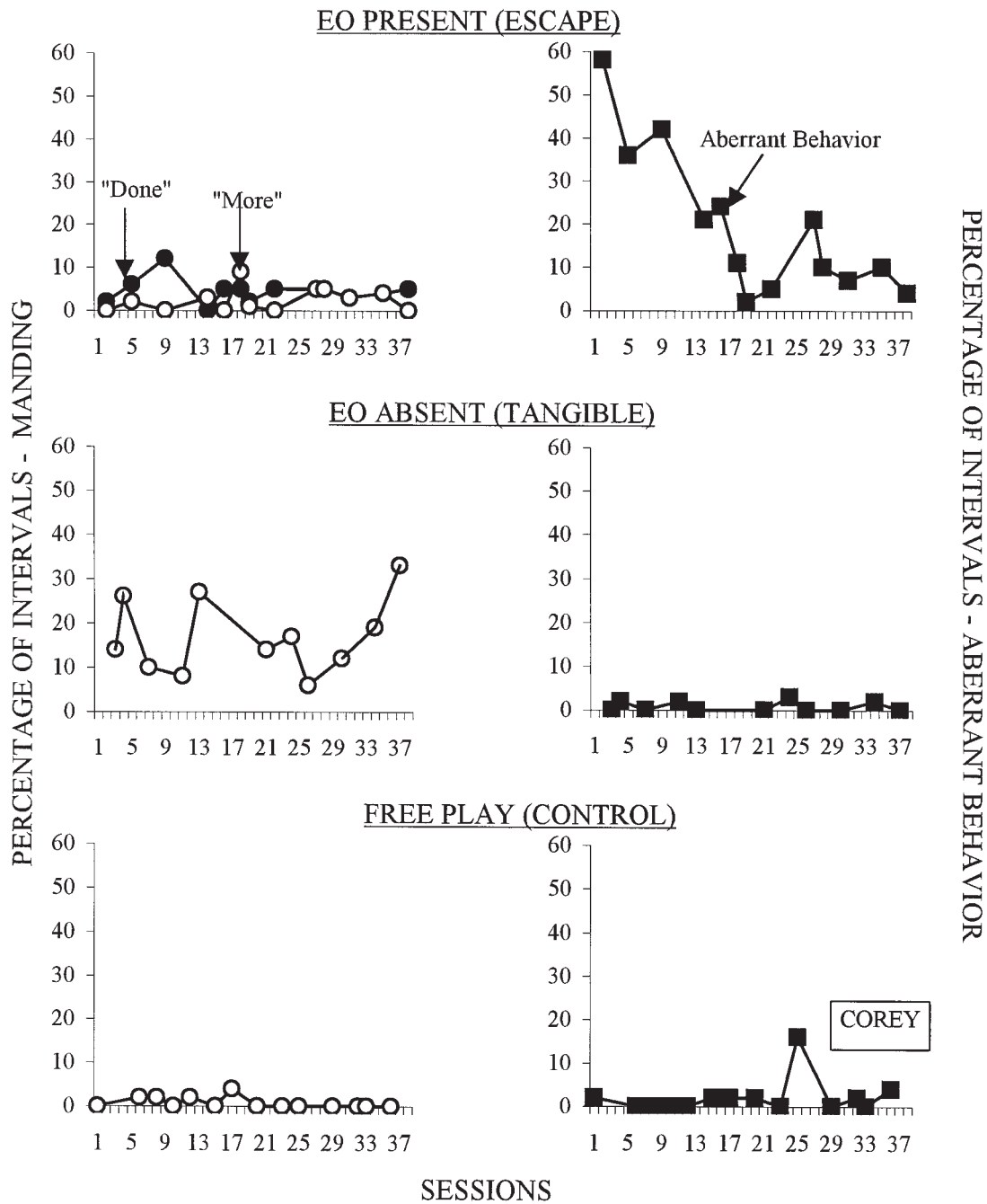


Figure 8. Percentage of manding during the treatment analysis in the EO-present context (top left panel), EO-absent context (middle left panel), and free-play context (bottom left panel), and percentage of aberrant behavior during the treatment analysis in the EO-present context (top right panel), EO-absent context (middle right panel), and free-play context (bottom right panel) for Corey.



There are several limitations of this study that suggest some caution when interpreting these data. Theresa's data do not allow us to compare the use of the relevant and irrelevant mands in the EO-present and the EO-absent contexts. However, we can conclude that she displayed the relevant mand ("break please") in the EO-present context (escape), she infrequently displayed the irrelevant mand ("I want to play") in the EO-absent context (attention), and aberrant behavior was low while manding was relatively high in the EO-present context. Similarly, Corey's data do not allow us to compare the use of the relevant and irrelevant mands in the EO-absent context. Corey may have had difficulty discriminating between the use of the mands in the EO-present context (as discussed below), and it is unclear whether he would have had the same difficulty discriminating in the EO-absent context. It may be important to evaluate treatment effectiveness in the presence and absence of EOs to specifically identify the appropriate contexts for different kinds of treatment.

Another question that warrants discussion pertains to discriminability, not only between mands but also between contexts. Jim and Kelly manded via sign language, and thus both mands were available to them during EO-present and EO-absent contexts. Their data are the best examples of discrimination of the EOs, reinforcement, and punishment contingencies in effect. Theresa manded via word cards, and only one card was available per condition. Thus, she did not have the opportunity to discriminate between which card to use within a session. However, she did have the opportunity to discriminate between manding and aberrant behavior across contexts. Corey used a word card for escape (relevant mand) and a sign for tangible items (irrelevant mand). Thus, he had the opportunity to discriminate between the word card and the sign only during the EO-present context. Corey used

both the word card and the sign in the EO-present context, suggesting that he was not discriminating between the mands during the escape condition. However, his ability to discriminate was likely hampered by the inclusion of tangible items during breaks from the demand. Although aberrant behavior occurred less often during the tangible condition in the functional analysis, tangible items should not have been provided during his breaks from demands. The inclusion of tangible items during breaks may have confounded the results by making the contingencies in the EO-present context less discriminable.

Functional equivalence has been indicated in the effectiveness of FCT (e.g., Carr, 1988; Carr & Durand, 1985; Parrish & Roberts, 1993; Wacker et al., 1990). In this study, the use of mands that were already present or similar to those already present in each child's repertoire should have increased the likelihood of functional equivalence between manding and aberrant behavior. This appears to have been the case for Kelly and Theresa, who quickly switched from engaging in aberrant behavior in the functional analysis to manding in the treatment analysis. However, Jim and Corey continued to engage in moderate rates of aberrant behavior until midway through or towards the end of the treatment analysis. Procedural variables (e.g., the presence of tangible items in the demand sessions for Corey) could identify possible explanations for the differences across children in acquiring functional equivalence. When high rates of aberrant behavior are observed initially in treatment, extinction or punishment procedures are implemented more frequently, thus providing the child with fewer opportunities to contact the reinforcement contingencies that remain in place for manding. In addition, mand prompting could influence the rate at which functional equivalence between the mand and aberrant behavior is acquired. For ex-

ample, a child who displays higher levels of aberrant behavior may require more prompting (verbal, modeled, or physical guidance) initially to display the mand and contact reinforcement. Over time, the prompting could be faded such that the child can request reinforcement independently (without any prompting in place). Prompt fading was not addressed in this study, and the current data do not provide enough information to make a definitive conclusion regarding the establishment of functional equivalence. It may also be true that functional equivalence is not at work when long latencies occur before an inverse relationship is apparent between manding and aberrant behavior. Future studies on FCT and functional equivalence should examine the relationship between independent manding and reductions in aberrant behavior.

In summary, these results replicate previous studies (Derby *et al.*, 1997; Peck *et al.*, 1996; Wacker *et al.*, 1990) in showing that FCT is an effective and often an efficient treatment for aberrant behavior when the treatment is matched to the results of a functional analysis. These results extend previous studies (e.g., Kahng *et al.*, 1997) in showing the effects of EOs on both manding and aberrant behavior, and continue to support the need for conducting FCT with functional reinforcers and in functional contexts. In addition, previous studies (Fisher *et al.*, 1993; Hagopian *et al.*, 1998; Wacker *et al.*, 1990) have shown that the contingencies in place for both manding and aberrant behavior are critical components of the success of FCT. This study extends the list of necessary treatment components in FCT packages to include establishing operations. Further analyses of the behavioral processes at work in FCT treatment packages and systematic criteria for the establishment of functional equivalence are needed. We suggest that each variable be evaluated in isolation to determine the individual contributions of all nec-

essary components of FCT treatment packages.

## REFERENCES

- Carr, E. G. (1988). Functional equivalence as a mechanism of response generalization. In R. H. Horner, G. Dunlap, & R. L. Koegel (Eds.), *Generalization and maintenance: Life-style changes in applied settings* (pp. 221–241). Baltimore: Paul H. Brookes.
- Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis*, *18*, 111–126.
- Day, H. M., Horner, R. H., & O'Neill, R. E. (1994). Multiple functions of problem behaviors: Assessment and intervention. *Journal of Applied Behavior Analysis*, *27*, 279–289.
- Derby, K. M., Wacker, D. P., Berg, W. K., DeRaad, A., Ulrich, S., Asmus, J. M., Harding, J., Prouty, A., Laffey, P., & Stoner, E. A. (1997). The long-term effects of functional communication training in home settings. *Journal of Applied Behavior Analysis*, *30*, 507–530.
- Durand, V. M., & Carr, E. G. (1991). Functional communication training to reduce challenging behavior: Maintenance and application in new settings. *Journal of Applied Behavior Analysis*, *24*, 251–264.
- Fisher, W. W., Piazza, C. C., Cataldo, M., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. *Journal of Applied Behavior Analysis*, *26*, 23–36.
- Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis*, *31*, 211–229.
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, *27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, *2*, 3–20, 1982)
- Kahng, S., Iwata, B. A., DeLeon, I. G., & Worsdell, A. S. (1997). Evaluation of the “control over reinforcement” component in functional communication training. *Journal of Applied Behavior Analysis*, *30*, 267–277.
- Lalli, J. S., Casey, S., & Kates, K. (1995). Reducing escape behavior and increasing task completion with functional communication training, extinction, and response chaining. *Journal of Applied Behavior Analysis*, *28*, 261–268.
- Marcus, B. A., & Vollmer, T. R. (1995). Effects of

- differential negative reinforcement on disruption and compliance. *Journal of Applied Behavior Analysis*, 28, 229–230.
- Northrup, J., Wacker, D. P., Sasso, G. M., Steege, M., Cigrand, K., Cook, J., & DeRaad, A. O. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis*, 24, 509–522.
- Parrish, J. M., & Roberts, M. L. (1993). Interventions based on covariation of desired and inappropriate behavior. In D. P. Wacker & J. Reichle (Eds.), *Communicative alternatives to challenging behavior: Integrating functional assessment and intervention strategies* (pp. 135–173). Baltimore: Paul H. Brookes.
- Peck, S. M., Wacker, D. P., Berg, W. K., Cooper, L. J., Brown, K. A., Richman, D. M., McComas, J. J., Frischmeyer, P., & Millard, T. (1996). Choice-making treatment of young children's severe behavior problems. *Journal of Applied Behavior Analysis*, 29, 263–290.
- Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis*, 30, 93–104.
- Wacker, D. P., Steege, M. W., Northrup, J., Sasso, G. M., Berg, W. K., Reimers, T. M., Cooper, L. J., Cigrand, K., & Donn, L. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis*, 23, 417–429.

Received August 21, 1998

Final acceptance November 3, 1999

Action Editor, James W. Halle

### STUDY QUESTIONS

1. What is meant by the terms *relevant* and *irrelevant* reinforcers and how are they related to the concept of functional equivalence?
2. Describe the methods used for collecting data and for calculating interobserver agreement.
3. The authors indicated that the effects of functional communication training (FCT) were evaluated in a multielement design. Specifically, what independent variables were manipulated during the evaluation of FCT?
4. How were the results of the functional analyses used to determine the “EO-present” and “EO-absent” contexts?
5. Generate a table listing the contingencies in effect for all target behaviors during FCT (EO present) and FCT (EO absent).
6. Summarize the results obtained for aberrant behavior and manding when FCT was implemented during the EO-present and EO-absent conditions.
7. Corey's relevant manding in the EO-present and EO-absent contexts was not expected by the authors. Provide a plausible explanation for these results.
8. Speculate on some reasons why mands may not be acquired solely through skills training.

Questions prepared by April Worsdell and Jana Lindberg, The University of Florida