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# Analysis of Multiple Manding Topographies during Functional Communication Training

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## Abstract

We evaluated the effects of reinforcing multiple manding topographies during functional communication training (FCT) to decrease problem behavior for three preschool-age children. During Phase 1, a functional analysis identified conditions that maintained problem behavior for each child. During Phase 2, the children's parents taught them to request positive reinforcers (attention or toys) via vocal manding, manual signing, or touching a picture/word card with or without a microswitch recording device. A non-concurrent multiple-baseline design across children was used to evaluate FCT outcomes. Results showed that problem behavior decreased for all three children. Results also indicated that the children initially used multiple manding topographies but displayed a preference for vocal manding over time.

### Descriptors

functional analysis; functional communication training; mand preference; problem behavior

Functional communication training (FCT) is a treatment procedure in which an individual is taught to produce an appropriate communicative response (mand) as an alternative to problem behavior as a means of gaining reinforcement (Carr & Durand, 1985). In this procedure, the function of the problem behavior is identified via a functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). The individual is then taught to emit a mand that matches the function of the problem behavior. If reinforcement is provided for manding and withheld for problem behavior, the occurrence of problem behavior may be reduced.

A number of investigations have demonstrated the effectiveness of FCT for reducing the problem behavior of individuals with developmental disabilities (Day, Horner, & O'Neill, 1994; Derby et al., 1997; Durand & Carr, 1991; Fisher, Kuhn, & Thompson, 1998; Kahng, Hendrickson, & Vu, 2000; Kelley, Lerman, & Van Camp, 2002; Northup et al., 1994; Wacker et al., 1990). Furthermore, researchers have demonstrated the durability of these positive effects over time and across settings. Durand and Carr (1991) and Derby et al. (1997) reported decreases in problem behavior following FCT that were maintained for over 1 year for some participants. Wacker et al. (1998) reported similar positive outcomes for a group of 28 young children (6 years of age or younger) with developmental disabilities who displayed severe problem behavior. In Wacker et al. (1998), FCT procedures were conducted by the children's parents in their homes and resulted in an average decrease in destructive behavior (e.g., self-injury, aggression) of 87% across children. The immediate and long-term benefits of having

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parents conduct FCT in home settings was replicated by Wacker et al. (2005) with a second cohort of 26 young children who displayed an average decrease of 85% in destructive behavior between baseline and final treatment sessions. In addition, results suggested that the effects of FCT generalized across persons, settings, and tasks.

In the studies conducted by Wacker and colleagues (1998, 2005), it was observed that young children with relatively mild developmental delays and some vocal language ability nevertheless displayed difficulty in emitting a vocal mand independently. These children often engaged in destructive behavior such as aggression and property destruction instead of using appropriate communication. Investigators in these studies provided the children with augmentative communication strategies (e.g., word/picture cards, microswitch recording devices) to reduce the amount of effort related to manding for reinforcement and to provide the children with a clear visual cue (i.e., discriminative stimulus) that reinforcement was available for manding (Wacker, Berg, & Harding, 2002). However, the analyses conducted in these investigations did not separate the occurrence of different topographies of manding. Therefore, it was unclear regarding what type of mand or combination of mands the children displayed.

Although the effectiveness of FCT has been demonstrated, less is known about the effects of mand preference on treatment effectiveness. Peck et al. (1996) and Richman, Wacker, and Winborn (2001) evaluated mand responding via concurrent operants arrangements in which two mands each resulted in reinforcement. Peck et al. altered both the amount and the quality of mand reinforcement to bias responding toward the selection of a specific mand. Results showed that mand selection was a function of reinforcement contingencies rather than preference. Richman et al. (2001) evaluated a young child's allocation between signing "please" and handing his mother a communication card. Both mands resulted in access to tangible reinforcement, but results showed that the participant's manding was allocated almost exclusively to signing. In this case, mand selection appeared to be a function of relative response effort. Both Peck et al. and Richman et al. demonstrated that mand selection during FCT was related to dimensions of reinforcement rather than to preference.

Winborn, Wacker, Richman, Asmus, and Geier (2002) compared the use of novel and existing mands by two young children who received FCT for problem behavior. After a functional analysis identified the maintaining conditions for problem behavior, the children were trained under distinct stimulus conditions to use either existing mands (e.g., vocal response) or novel mands (e.g., communication card) to obtain reinforcement. In a final phase, the children were reinforced for either manding response. Results showed that both children were more likely to use an existing mand than a novel mand, however, the existing mand was associated with higher percentages of problem behavior than the novel mand.

The purpose of the current investigation was to extend Winborn et al. (2002) by examining whether preference for a distinct topography of manding--vocalizing, manual signing, or touching a communication card--would emerge during FCT when dimensions of reinforcement were unchanged. Preference, in this study, would be indicated by a relatively higher display of a distinct mand topography over other topographies. We conducted FCT using distinct mand topographies from the beginning of treatment to evaluate whether (a) preference for a distinct topography of manding emerged over time, (b) preference was related to existing mands (vocalizing) or novel mands (augmentative communication), (c) problem behavior was correlated with either existing or novel mands, and (d) learning novel mands inhibited the display of existing mands.

# Method

## Participants and Settings

The children in this investigation were three young boys who participated in a federally funded research project (Wacker, Berg, & Harding, 2000). Al, age 3, was diagnosed with expressive and receptive language delays. Problem behavior included aggression (hitting, kicking) and property destruction (throwing objects). Lou, age 2 years 11 months, was diagnosed with developmental delays and disruptive behavior disorder. Problem behavior included aggression (hitting, kicking) and property destruction (throwing objects). Kit, age 1 year 10 months, had not been given a diagnosis at the time of the investigation. He displayed self-injurious behavior (head banging, hand biting), aggression (head butting, hitting), and property destruction (throwing toys). Vocal communication for all three children typically consisted of single words or two-word phrases (e.g., “All done”). Kit also used some manual signs (e.g., signing “please”).

All assessment and treatment procedures were conducted in the living room of the children’s homes. The children’s mothers served as therapists with coaching from the first author during all procedures. All sessions were videotaped for subsequent data collection and analysis.

## Response Definitions

A 6-s partial-interval recording system was used to measure child behavior. *Destructive behavior* was defined as self-injury, aggression, and property destruction. *Disruptive behavior* was defined as crying, screaming, and task refusal. For the purpose of this investigation, intervals of destructive and disruptive behaviors were combined and recorded as problem behavior. *Manding* was defined as an appropriate request to obtain parent attention or a specific toy. *Independent manding* was defined as making a request in the absence of a specific prompt directing the child what to say or do. *Prompted manding* was defined as the child’s making a request within two 6-s intervals of a specific prompt (e.g., “Say, please,” “Touch the card”). During assessment and treatment, we recorded any appropriate *vocal mand* (e.g., saying “Mommy”), *signing mand* (e.g., manually signing “more”), or *touching a microswitch or picture/word card*.

## Interobserver Agreement

Trained data collectors independently scored the occurrence of child behavior using a 6-s partial-interval recording system. A symbol for each of the responses described in the previous paragraph was listed in each 6-s cell of a data recording sheet. Data collectors coded the behavior by watching video recordings of all sessions that were synchronized with a tape recording of 6-s intervals and marking the occurrence of any behaviors at the end of each interval. Interobserver agreement on the occurrence of all behavior was calculated based on exact interval-by-interval comparisons in which the number of agreements was divided by the number of agreements plus disagreements and multiplied by 100. Interobserver agreement for child behaviors was assessed for 30% of each session. Interobserver agreement averaged 96% (range = 86% to 100%) for problem behavior and 97% (range = 88% to 100%) for independent manding. Interobserver agreement was also calculated for individual topographies of independent manding and averaged 95% (range = 81% to 100%) for vocal manding, 89% (range = 83% to 95%) for touching a microswitch, 100% for manual signing, and 100% for touching a picture/word card.

## Experimental Design

The investigation was conducted in two phases. During Phase 1, a functional analysis (Iwata et al., 1982/1994) was conducted within a multielement design to identify the maintaining

conditions for problem behavior. A positive reinforcement test condition that showed elevated problem behavior during the functional analysis was identified for each participant and served as a baseline measure of problem behavior and manding. During Phase 2, FCT probes were conducted during weekly to monthly home visits to evaluate the occurrence of problem behavior and manding within a nonconcurrent multiple-baseline design across participants. The extent to which parents were satisfied with the FCT program was assessed via a treatment acceptability questionnaire (Treatment Acceptability Rating Form–Revised [TARF-R]; Reimers & Wacker, 1988) at the end of treatment.

## Procedures

**Phase 1: Functional analysis—**During the functional analysis, four assessment conditions were conducted to identify maintaining conditions for problem behavior. For Kit and Lou, reinforcement contingencies were provided only for the occurrence of destructive behavior (e.g., self-injury, aggression). For Al, reinforcement contingencies were also provided for disruptive behavior because of relatively low frequencies of destructive behavior. Manding did not result in reinforcement.

During the free-play condition, the child had access to toys and the parent's noncontingent attention. During the tangible condition, the child was initially allowed to play with a preferred toy that was identified during a previously conducted preference assessment using a group presentation method (Windsor, Piché, & Locke, 1994). After a brief period of play, the preferred toy was removed and the child was given a less preferred toy. If the child engaged in problem behavior, the preferred toy was returned for 20 s. During the demand condition, the parent used a least-to-most restrictive prompt hierarchy to guide the child in completing a task (e.g., placing blocks into a shape sorter). If the child engaged in problem behavior, the task was removed for 20 s. During the attention condition, the parent diverted her attention from the child (e.g., read a magazine). If the child engaged in problem behavior, the parent provided attention in the form of reprimands (e.g., "Stop doing that") and redirection to toy play for 20 s. All sessions were 5 min in duration.

For the purpose of this investigation, one behavioral function was selected for FCT and videotaped for follow-up evaluation. Kit's functional analysis results indicated a clear attention function, but results for Al and Lou suggested more than one function for problem behavior. Both Al and Lou's parents reported that they could manage their child's behavior during demands, and preferred to work on communication strategies that enabled their child to request preferred items and activities appropriately. The tangible condition (Al, Lou) and the attention condition (Kit) of the functional analysis were used as baseline measures of manding and problem behavior during FCT. The first author provided suggestions for managing problem behavior under other conditions during the course of the investigation but parent implementation was not recorded for subsequent analysis.

**Phase 2: Functional communication training—**The objective of FCT was to teach the children to use appropriate communication as an alternative to engaging in problem behavior to obtain reinforcement (toys or attention). Given the children's vocal speech limitations, we provided the parents with a microswitch recording device and/or picture/word cards as augmentative communication strategies. Thus, if the children had difficulty emitting the target mand vocally, they could touch the microswitch or card to obtain reinforcement. For Al and Lou, a "more" picture/word card was attached to the touch plate of the microswitch. The microswitch was programmed to play the message "more please" when touched. The microswitch and cards also served as visual discriminative stimuli that reinforcement was available for manding.

Parents were asked to practice FCT using the augmentative communication strategies for 10 to 15 min per day at a time that was convenient and free of interruptions so that they could focus their full attention on working with their child. The first author provided written instructions on conducting the program, procedural demonstrations, and prescriptive feedback during FCT treatment probe sessions. Weekly treatment probes were conducted by the investigators for approximately 3 weeks for Al, 8 weeks for Kit, and 12 weeks for Lou. Subsequent treatment probes were conducted during monthly visits. During these visits, the first author showed the parents graphic data displays of their child's progress, addressed parent questions, and videotaped the parents conducting two or three FCT sessions.

All FCT treatment probe sessions were 5-min in duration. During each session, the child was allowed to select preferred toys. Prior to conducting the sessions, the parent reminded the child of the various ways to obtain reinforcement. Al and Lou were instructed to say "more," or to touch a microswitch with a "more" picture/word card a ached to the touch plate to obtain additional toys (e.g., blocks, cars). Kit was instructed to say "please," to sign "please," or to touch a "please" picture/word card to access his mother's attention.

Each FCT treatment probe session began with parents providing attention to the children while they played with toys for 20 to 30 s. After a brief period of noncontingent play, the parent prompted the child to mand for reinforcement. For Al and Lou, the parent said, "Tell me if you want more," while presenting the microswitch. If Al or Lou said "more," or touched the microswitch, they were praised and provided with additional preferred toys for 20 to 30 s. If Al or Lou accumulated a sufficient number of toys during the session so that additional toys were not needed, he was prompted to mand for additional time with the toys (e.g., "Tell me 'more' if you want to keep playing"). Parent attention was available throughout the session except during reductive procedures.

For Kit, the parent said, "Tell me 'please' if you want me to keep playing." If Kit said "please," signed "please" or touched the "please" picture/word card, he received attention from his mother for 20 to 30 seconds. During reinforcement, Kit's mother talked to him and assisted Kit in playing with his toys. Toys were available throughout the session except during reductive procedures.

As FCT progressed and the children learned to perform the target mands independently, general prompts to mand (e.g., "What do you say?") were substituted for specific prompts (e.g., "Tell me 'more' if you want to keep playing"). In addition to reinforcing the target mands, parents were instructed to reinforce any other functionally equivalent mands. For example, saying "car, please" instead of "more" was reinforced.

Parents were also taught how to implement reductive procedures during FCT sessions. If the child did not perform the target mands or a functionally equivalent mand following a specific or general prompt, then reinforcement was withheld (i.e., the child did not receive additional toys or attention). If the child engaged in disruptive behavior such as crying or whining, he was ignored. Destructive behavior (e.g., self-injury) was blocked in a neutral fashion (i.e., no reprimands or discussion) and the toys were removed until the child calmed down. The child was then reminded how to communicate appropriately to obtain reinforcement.

## Results

### Phase 1: Functional analysis

Functional analysis results for each participant are displayed in Figure 1. For Al (top panel), problem behavior was elevated during the tangible and demand conditions. Problem behavior also occurred at high levels during the first free-play condition but remained at 0% during

replications of the condition. For Kit (middle panel), problem behavior was elevated nearly exclusively during the attention condition. For Lou (bottom panel), problem behavior was somewhat variable across conditions, but occurred at higher levels during the tangible (*M* = 19%), attention (*M* = 14%), and demand (M = 15%) conditions than during the free-play condition (*M* = 3.3%). These results suggested that a positive reinforcement function was identified for each child.

### Phase 2: Functional communication training

Treatment results for problem behavior are displayed in Figure 2. For Al (top panel), problem behavior averaged 12% across baseline sessions. During FCT, problem behavior immediately decreased to 0% and remained at 0% for the remainder of the treatment probes. For Kit (middle panel), problem behavior averaged 36% across baseline sessions. Problem behavior decreased to 0% after approximately 2 weeks (Session 9) and remained at 0% with the exception of Session 20. For Lou (bottom panel), problem behavior averaged 19% across baseline sessions. However, this mean percentage of problem behavior during baseline was primarily due to elevated levels of problem behavior (58%) during session 5 as problem behavior occurred at much lower levels during sessions 1 though 4.

Problem behavior continued to occur at variable levels for approximately 2 months (Session 20) but eventually decreased to zero or near-zero levels.

Treatment results for independent manding are displayed in Figure 3. All three children displayed some vocal manding (requests for attention or tangible items) during baseline sessions. For Al (top panel), vocal manding averaged 11% during baseline sessions. During treatment, he typically used both the microswitch/picture card and vocal manding to request “more” toys. However, during the last three sessions he used vocal mands nearly exclusively. For Kit (middle panel), vocal manding averaged 9% during baseline sessions. During FCT, he initially used all three forms of manding to request attention, but after four sessions he discontinued use of the card and typically used vocal and manual signing simultaneously. Following Session 21, the card was no longer available, and during the last four sessions, Kit primarily used vocal manding. For Lou (bottom panel), vocal manding averaged 2% during baseline. During FCT, he initially used both the microswitch/picture card and vocal manding. However, after approximately 1 month (Session 16), he used vocal manding more than the card to obtain reinforcement.

The results of the treatment acceptability questionnaire conducted at the end of the study were available for Al and Lou and suggested that their parents were satisfied with the treatment procedures. For example, in response to the question, “How acceptable do you find the treatment to be regarding your concerns about your child?” the parents rated the treatment on a scale of 1 = *not at all acceptable* to 7 = *very acceptable*. Parent ratings on this question were 7 for both Al and Lou. (Note: Complete TARF-R results for each child are available upon request from the first author).

## Discussion

Previous research has demonstrated the efficacy of FCT as a method to reduce problem behavior; however, less is known regarding mand selection during FCT (Winborn et al., 2002). In the current study, we evaluated whether a preference for a distinct topography of manding would emerge during FCT with three participants.

During baseline conditions based on their functional analyses, the children displayed vocal mands in addition to problem behavior. However, during baseline, only problem behavior was reinforced. The occurrence of both appropriate and problem behaviors during the baseline

condition may have indicated a response class hierarchy (e.g., Harding et al., 2001; Lalli, Mace, Wohn, & Livezey, 1995; Richman et al., 2001) in which appropriate behavior (e.g., manding) was not reinforced and the individual learned to display problem behavior.

During FCT, the children were given specific instructions on how to obtain reinforcement via appropriate communication, and problem behavior was placed on extinction. With these conditions in place, problem behavior decreased quickly for Al and Kit and eventually for Lou. On an applied level, this emphasizes the importance of teaching mands that match the function of problem behavior and providing immediate reinforcement for manding.

During FCT, Al and Lou initially used both vocal mands and microswitches and picture/word cards, and Kit used a combination of vocal mands, signing, and a picture/word card. Across sessions, the children showed a preference for vocal mands, or in Kit's case, a combination of vocal mands and signing. Parent reports and baseline data indicated that all three children had existing vocal manding in their repertoires, whereas touching a microswitch/picture card was a novel mand for each child. In this respect, the children's FCT results were similar to those of Winborn et al. (2002) in that the children appeared to develop a preference for existing mand topographies rather than a novel mand. However, in contrast to Winborn et al., the use of existing vocal mands was not related to the continued occurrence of problem behavior for these children. Al displayed no problem behavior throughout treatment and Kit displayed problem behavior only during three sessions of FCT. During the first 4 weeks of FCT, Lou displayed relatively high levels of problem behavior during four sessions. Problem behavior during three of these sessions was correlated with a higher percentage of vocal manding than with use of the microswitch. However, subsequent levels of problem behavior for Lou decreased to zero or near-zero levels during the next 2 months. Thus, the current study extended the results of Winborn et al. by providing evidence for the maintenance of positive treatment effects over time.

There was no evidence that providing reinforcement for using augmentative communication strategies such as signing or using a microswitch/picture card inhibited the children's use of vocal mands. This outcome was consistent with previous studies that evaluated the use of vocal speech when individuals were trained to use alternative communication systems (e.g., Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Weller & Mahoney, 1983).

Providing young children who have developmental delays with a multi-modal approach to communicating basic needs may have multiple benefits. For some children, pointing to a card or using a microswitch may be easier than producing vocal mands. Thus, the initial use of augmentative communication systems may reduce the effort needed to mand. Augmentative strategies may also serve as an instructional component by providing the child with a clear visual cue regarding the appropriate message to access reinforcement (Wacker, Berg, & Harding, 2002). If the mand, in any form, is reinforced sufficiently, it may reduce the occurrence of problem behavior, thus increasing the probability that the child will use appropriate communication rather than problem behavior to access reinforcement. Finally, previous studies as well as the current investigation have shown that augmentative systems are not an obstacle to the performance of vocal language. Results of the current investigation suggest that it may be possible to fade augmentative systems relatively quickly as the child acquires more proficiency with vocal manding.

Limitations of the current study should be considered when interpreting the results. First, reductions in non-vocal manding varied across participants. Some children might continue to benefit from visual cues that signal both how and when to access reinforcement. Second, it was unclear whether preference for vocal manding would have been maintained over time. For Al and Kit, this preference was limited to several sessions at the end of the investigation.

In summary, this study showed that problem behavior during FCT did not appear to be correlated with either existing vocal mands or novel mands, and that manding eventually replaced problem behavior as a means of gaining reinforcement. Results also suggested that a preference for an existing vocal manding topography emerged during FCT when multiple manding topographies were available concurrently for reinforcement. Future investigations might further evaluate the stability of mand preference across varied stimulus conditions to determine the utility of using augmentative communication strategies with young children who display limited vocal manding and severe problem behavior.

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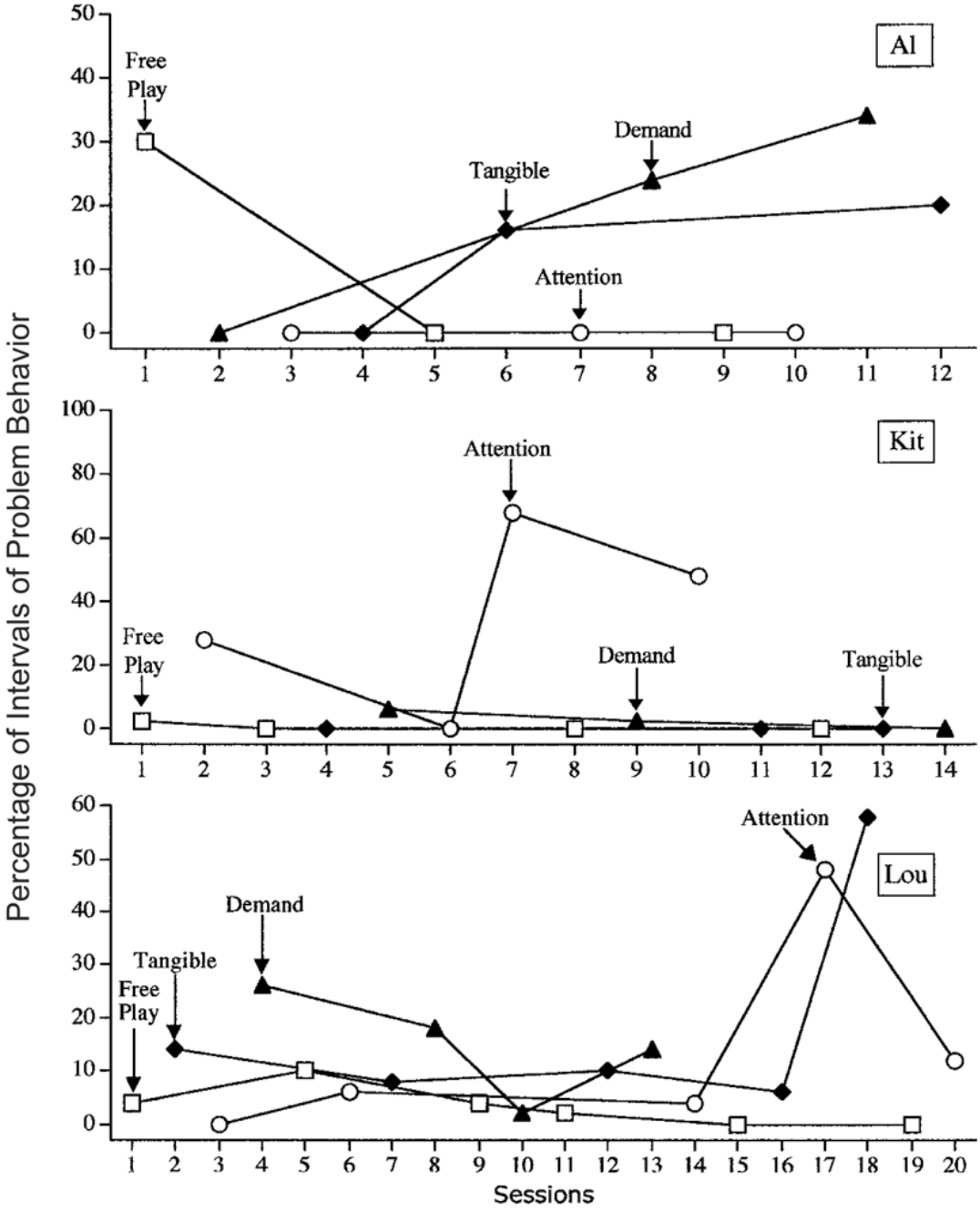


**Figure 1.**
Percentage of intervals of problem behavior during functional analyses for Al (top panel), Kit (middle panel), and Lou (bottom panel).

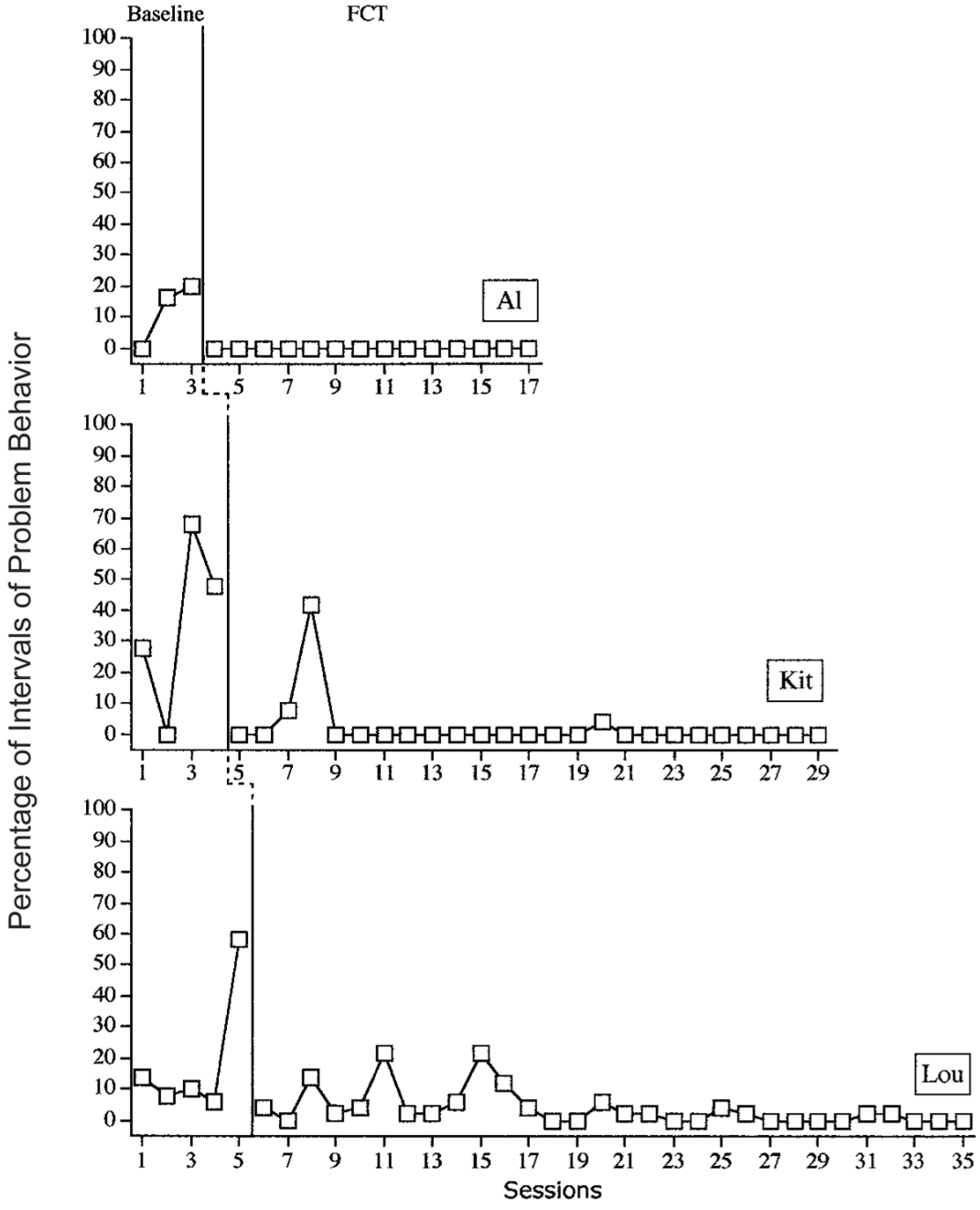


**Figure 2.**
Percentage of intervals of problem behavior for Al (top panel), Kit (middle panel), and Lou (bottom panel) during baseline conditions and functional communication training.

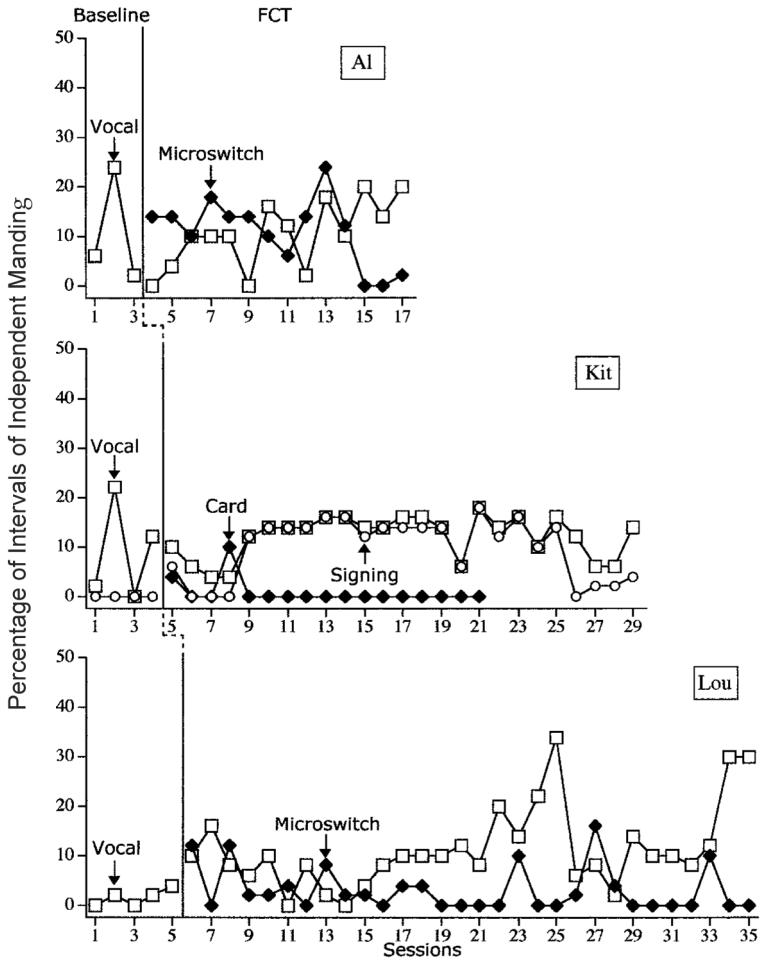


**Figure 3.**
Percentage of intervals of independent manding for Al (top panel), Kit (middle panel), and Lou (bottom panel) during baseline conditions and functional communication training.