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Analysis of Mand Selection across Different Stimulus Conditions

Lisa Winborn-Kemmerer, David P. Wacker, Jay Harding, Eric Boelter, Wendy Berg, and John Lee

The University of Iowa

Abstract

We conducted a three-phase study to evaluate the use of mands and the occurrence of problem behavior for 2 children with developmental disabilities. During Phase 1, a functional analysis identified the variables maintaining problem behavior. During Phase 2, functional communication training was implemented within a concurrent schedules design. The children were reinforced for using either a novel mand (communication card) or other existing mands (vocal speech, manual signs) that were not specifically trained but were observed to be part of the children's existing repertoire. We then conducted an assessment of mands and problem behavior across different stimulus conditions (card absent, card present) within an ABAB design (Phase 3). Results showed that during Phase 2, problem behavior decreased and participants used the card more frequently than they used other existing mands. Phase 3 showed that problem behavior remained low across both stimulus conditions. When the card was absent, the children used other existing mands; when the card was present, they primarily used the card. These results suggested that the presence of a communication card may function as a discriminative stimulus for a specific topography of manding, but that training with the card did not inhibit the use of other mands when the card was absent.

DESCRIPTORS

functional analysis; functional communication training; discriminative stimulus; concurrent schedules; problem behavior; mands

The success of functional communication training (FCT) as a treatment for individuals with developmental disabilities who display severe forms of problem behavior has been documented over the past two decades. Carr and Durand (1985) defined FCT as a reinforcement-based procedure designed to replace problem behavior with an appropriate communicative response (mand) that matched the hypothesized function (positive or negative reinforcement) of problem behavior. FCT consists of two steps: (a) The function of problem behavior is identified via a functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994), and (b) the individual is taught a mand that produces the same reinforcement identified for problem behavior (Durand & Carr, 1985).

Since the publication of Carr and Durand (1985), studies on FCT have focused primarily on the dimensions of reinforcement (e.g., rate, effort, immediacy) provided for using appropriate mands instead of engaging in problem behavior (e.g., Fisher, Thompson, Hagopian, Bowman, & Krug, 2000; Hanley, Iwata, & Thomson, 2001; Horner & Day, 1991; Lerman, Kelley, Van Camp, & Roane, 2002). Much less is known about how to select the particular mand topography (e.g., microswitch, picture, manual sign, or vocal speech) for FCT programs (Winborn,

Wacker, Richman, Asmus, & Geier, 2002; Winborn-Kemmerer, Ringdahl, Wacker, & Kitsukawa, 2009).

Winborn et al. (2002) trained 2 preschool-aged children with developmental disabilities to use both novel and existing mands to gain access to negative reinforcement (escape from demands) and to reduce problem behavior within an FCT program. Following the separate training of each mand, a concurrent schedules design was used to evaluate mand preference. Results indicated that although both mand topographies were displayed independently following training, when they were available concurrently, the existing mand was chosen more often than the novel mand. However, the existing mand was correlated with increased rates of problem behavior. These results suggested that preference for the type of mand topography used during FCT programs may not always result in maximum treatment benefits and that the history of reinforcement associated with specific mand topographies may lead to differential treatment effects.

In a second study, Winborn-Kemmerer and colleagues (2009) used a concurrent schedules design to assess the role of preference for one of two novel mands. One limitation of Winborn et al. (2002) was that the reinforcement history associated with the existing mand may have influenced mand preference. In the Winborn-Kemmerer et al. study, reinforcement history and response effort were controlled for by selecting two novel mands (pressing a microswitch and touching a communication card) that required similar motoric effort. Results showed that following nearly equal training (i.e., number of response-reinforcer pairings) of the two novel mands, a preferred mand emerged when the mands were concurrently available on a fixed ratio schedule of reinforcement. Problem behavior during the mand preference assessment was not observed with either novel mand. These results were similar to Winborn et al. (2002) and further suggested that mand preference was not accounted for by reinforcement history.

Stimulus control may also influence the topography of mand selection. A variety of antecedent stimuli (e.g., eye contact, body orientation of the listener, objects, and other physical stimuli) have been shown to influence the production of a mand (e.g., Halle & Holt, 1991; Kaiser, Alpert, & Warren, 1987). Similarly, during FCT, instruction with a variety of stimuli or specific prompts may set the occasion for particular mands (Derby, Fisher, Piazza, Wilke, & Johnson, 1997).

Fisher, Kuhn, and Thompson (1998) established discriminative control of mand responding using functional and alternative reinforcers during mand training. Following a functional analysis of destructive behavior, an FCT program was implemented in which 2 participants were taught to mand for either a functional reinforcer (attention) or an alternative reinforcer (toys). One participant was taught to sign "hugs" for attention and "games" for toys. A second participant was taught to say "Excuse me, please" for attention and "I want my toys, please" for toys. The discriminative stimulus for both participants was either a picture of the therapist (attention) or a picture of preferred toys. When attention was available, a picture of the therapist was placed in view of the participant. When attention was not available, a picture of preferred toys was in view. Results showed that the pictures, which displayed what type of reinforcer was available for manding, effectively controlled the mand emitted and decreased destructive behavior regardless of which reinforcer was accessible.

In contrast, Gutierrez et al. (2007), found mixed results when training 5 participants to display discriminate manding using picture cards to obtain preferred items. Results for 4 of the participants showed that under the relevant establishing operation, discriminate manding occurred using only the picture cards. For the fifth participant discriminate manding did not occur until two topographically distinct mands (picture card and vocal response) were taught.

These results suggest that the use of two topographically similar mands (picture cards) alone during mand training may not be sufficient to produce discriminate manding.

Collectively, research on teaching mands during FCT indicates that successful mand training has occurred across multiple mand topographies (Drasgow, Halle, & Ostrosky, 1998; Kahng, Hendrickson & Vu, 2000; Peck et al., 1996; Richman, Wacker, & Winborn, 2001; Winborn et al., 2002; Winborn-Kemmerer et al., 2009). In addition, the sequence or the type of target response used following training may be influenced by both mand preference (Richman et al., 2001; Winborn et al., 2002; Winborn-Kemmerer et al., 2009) the stimuli that were present during mand training (Fisher et al., 1998; Halle & Holt, 1991), and the specific topography of mands trained (Gutierrez, et al. 2007).

Given that many individuals exhibit multiple mands within the same response class (Drasgow et al., 1998), the primary research question in the current study was whether mand selection assessed within an FCT program would change in the presence of two distinct stimulus conditions: (a) when a picture card was present, and (b) when a picture card was absent. A second question was whether mand selection would change over the course of treatment.

Method

Participants and Setting

Two children participated in this study. Participants were evaluated in the living room of their homes over a 12-month period as part of a project funded by the National Institute of Child Health and Human Development (NICHD) (Wacker, Berg, & Harding, 2000). The criteria for inclusion in the project were: (a) the child was 6 years old or younger, (b) the child had a diagnosed developmental disability, and (c) the child engaged in severe problem behaviors. One additional criterion was that the child displayed functional mands in his or her repertoire.

Evan was a 3-year-old male diagnosed with Down syndrome. His vocal speech included a variety of words. Annie was a 3-year-old female diagnosed with developmental delays, microcephaly, Chiari-1 syndrome, and ADHD. Annie was non-vocal but displayed multiple manual signs. Both participants displayed aggression, property destruction and tantrum behaviors.

Response Definitions

Problem behavior for Evan was defined as aggression (e.g., hitting, scratching, biting), property destruction (e.g., throwing toys), and tantrums (e.g., screaming, crying, dropping to the floor). *Problem behavior* for Annie consisted of aggression (e.g., hitting, kicking, biting, hair pulling, head butting), property destruction (e.g., throwing objects), and tantrums (e.g., screaming, crying).

Mands were defined as the display of an appropriate communicative response (e.g., manual signing, touching a picture card, or using vocal speech) following either a general vocal prompt (e.g., "If you want Mom to play, just ask"; "What do you want to do?") or following no additional prompts once the establishing operation was in place (e.g., the parent removed attention or provided a task demand) to acquire a functional reinforcer (e.g., access to parent attention, access to a break with preferred toys). Mands were subdivided into *existing mands* (mands that by parent report had been displayed in the child's repertoire) or *novel mands* (mands that by parent report had not been displayed).

Selection of the novel mand was based on (a) the child's fine/gross motor skills, and (b) parent preference reported during interviews prior to treatment. For Evan, the novel mand was touching a 5 × 7 in. laminated picture of toys with the word "play." Existing mands for Evan

were saying “play,” “no” or asking for preferred play items that were in view by saying the name of the item or activity (e.g., clothes, bus, music, video), or pointing to the item and saying “that” or “this”. For Annie, the novel mand was touching a 5 × 7 in. laminated picture of toys with the word “play.” Existing mands were manual signs (e.g., “please,” “play,” “mommy,” and “help”).

Data Collection and Inter-observer Agreement

Each session was videotaped and scored independently by two trained data collectors for 30% of the total sessions using a 6-s partial-interval recording system for child behaviors across all three phases. Interobserver agreement (IOA) on occurrence of child behavior was scored by comparing each 6-s interval across observers. An agreement occurred when both observers recorded the same behavior in the same interval. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Occurrence of agreement for Evan ranged from 90% to 100% ($M = 96\%$) and for Annie ranged from 90 % to 100% ($M = 96\%$). Therapist integrity data were recorded for 30% of the sessions during Phase 3 on (a) the type of mand prompt provided, (b) the presence or absence of the card, (c) whether reinforcement was provided for mands, and (d) extinction for problem behavior. IOA was calculated in the same manner as for child behavior. Therapist integrity for Annie and Evan ranged from 93% to 100% ($M = 99\%$). IOA agreement for therapist integrity for both participants was 100%.

Experimental Design

During Phase 1, a functional analysis (Iwata et al., 1982/1994) was conducted within a multi-element design to identify the maintaining variables for problem behavior and to observe the use of existing mands. During Phase 2, FCT was conducted within a concurrent schedules design (Browning, 1967) in which either the existing mand (vocal speech or manual sign) or the novel mand (picture card) was reinforced. During Phase 3, a mand analysis was conducted within a reversal design in which the novel mand was either absent (Condition A) or present (Condition B) during FCT.

Procedures

Phase 1: Functional analysis—Four functional analysis conditions were conducted: (a) free play, (b) contingent attention, (c) contingent escape, and (d) contingent tangible. During the free-play condition, Evan and Annie had continuous access to preferred toys and activities and continuous attention from a parent. No programmed consequences were delivered for problem behavior.

During the attention condition, Evan and Annie had access to several toys. At the start of each session, the parent played with the child for a brief period of time (10 to 15 s). After the brief interaction period, adult attention was withdrawn and the parent sat at a nearby table and read a magazine. Problem behavior resulted in 30 s of parent attention (e.g., vocal reprimands or playing with and talking to the child).

Prior to the start of the tangible condition, Evan and Annie were allowed to play with a preferred toy or activity for a 10 to 15 s period while receiving continuous attention. The preferred activity was identified during free play using a free operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998). The preferred toy was then removed, and attention continued to be delivered. Problem behavior resulted in 30 s of access to the preferred toy.

During the escape condition, Evan was asked to put colored pegs in a pegboard and Annie was asked to stack blocks. These tasks were chosen by the parents. For both participants, problem

behavior resulted in a 30 s break from the task. Task prompts for Evan and Annie consisted of a three-prompt sequence (i.e., vocal, vocal/model, physical guidance).

Phase 2: FCT—The functional analysis for Evan identified escape from demands as the reinforcer for problem behavior. FCT involved teaching Evan to complete a work task (e.g., putting pegs into a pegboard) and to touch a card that said “play” or to vocally say “play” to receive a break from work with access to preferred toys. A total of fifteen 5-min FCT sessions were conducted with Evan over 4 months during Phase 2. At the beginning of each FCT session, Evan’s mother interacted with him and allowed him to play with preferred toys. After approximately 20 s, Evan’s mother said, “It’s time to work. I need you to put in the peg.” If Evan complied with the task request, he was praised for finishing his work, the task was removed, and he was prompted to mand. A three prompt sequence for mands (vocal prompt, vocal/model prompt, full or partial physical assistance) was used to teach the mands. Initially, Evan’s mother used specific vocal mand prompts (e.g., “Evan, if you want to play, you need to touch the card or tell me ‘play’”). The order of specific vocal prompts was counterbalanced. For example, if Evan’s mother vocally prompted him to “touch the card or say ‘play’” during the first mand opportunity, during the next trial, she vocally prompted him to “say ‘play’ or touch the card.” After Session 23, only general vocal prompts were used (e.g., “If you want to play, you need to ask” or “What do you want to do?”). If Evan completed the task and manded appropriately (e.g., touched the card, said “play,” or used other existing vocal mands that indicated he wanted to play with a specific toy or activity), he was provided with a break from the task with a preferred toy or activity for 30 s. If Evan did not comply or engaged in problem behavior (e.g., threw the pegs), his mother blocked the behavior in a neutral fashion (without discussion) and continued to prompt him using the three-prompt sequence to complete the task. If Evan engaged in problem behavior during his break, all preferred toys were removed and he was immediately told to complete another task (i.e., “Put one peg in the board”). Task requests continued until Evan completed the task without throwing the pegs or needing physical assistance to put a peg in the board. This sequence was repeated for a 5-min period.

The functional analysis for Annie identified attention and escape from demands as reinforcers for problem behavior. For the purposes of this study, we focused on the attention function, which was the function Annie’s mother selected for treatment. During FCT, Annie was asked to touch the play card or sign “play,” or to use any other existing functional signs (e.g., mom, help, or please). A total of eleven 5-min FCT sessions were conducted over 2 months with Annie during Phase 2. At the beginning of each session, Annie was provided with approximately 20 s of attention and access to preferred toys. After this brief period of attention and play, Annie’s mother removed her attention and told Annie, “I’m going to read; if you want me to play, you need to touch the card or sign ‘play’”). The same mand prompt sequence described for Evan was used for Annie, and the order in which mands were vocally prompted was counterbalanced. If Annie asked appropriately, her mother immediately praised Annie for using her communication and then played with her for 30 s. If Annie engaged in problem behavior, her behavior was neutrally blocked (without discussion) and her mother removed all access to preferred toys and turned away from Annie for 20 s or until she stopped engaging in problem behavior. Her mother then prompted her to mand and the sequence was repeated.

For both children, the criteria for completion of Phase 2 were (a) a minimum of three consecutive sessions with problem behavior below 20%, and (b) a minimum of three consecutive sessions in which mands were emitted 80% or more of the time during each 5-min session when given the opportunity to mand. During each session, the participants were provided with four to six opportunities to mand. An opportunity to mand for Evan was defined as the completion of a task or a vocal prompt to mand. An opportunity to mand for Annie was defined as the removal of attention or a vocal prompt to mand. During a 5-min session, if the

participant was given four opportunities to mand and manding occurred during three of the four opportunities, then 75% was recorded for mands.

Phase 3: Mand Analysis—Following FCT, the effects of the play card were evaluated within a reversal design. The play card was either absent (Condition A) or present (Condition B). For both Evan and Annie, the procedures for the first condition (A = FCT No Card) were identical to the procedures used in Phase 2 except that the play card was not available. The procedures for the second condition (B = FCT Card) were identical to Phase 2. All sessions were 5 min in duration, and each condition of Phase 3 continued until a stable trend in manding and problem behavior was observed.

Results

Figure 1 displays the results of the functional analysis (Phase 1) for Evan (top left panel) and Annie (bottom left panel). The highest levels of problem behavior for Evan were observed during the escape condition. The percentage of intervals of problem behavior during the escape condition ranged from 0% to 36% ($M = 16\%$). Evan displayed some existing mands (e.g., vocally said, “play,” “no” or named toys such as “clothes, bus, music, video,” that he wished to play with) during the escape condition, of the functional analysis, but these occurred at low frequencies and were not reinforced.

The results of the functional analysis for Annie identified both positive (access to attention) and negative (escape from demands) reinforcement maintaining problem behavior. During the attention condition, problem behavior ranged from 18% to 46% ($M = 29\%$). Annie did not display any existing mands (manual sign) during the functional analysis.

The results of Phase 2 (FCT treatment) are displayed in the top right panel (Evan) and bottom right panel (Annie) of Figure 1, respectively. The results of Evan’s FCT treatment showed a decrease in problem behavior ($M = 10\%$) from the escape condition of the functional analysis and an increase in mands ($M = 98\%$). Problem behavior decreased initially, then became more variable, and then showed consistent reductions during the final 4 sessions. When Evan was given the opportunity to mand, he more often used the novel mand (touching the card) or simultaneously touched the card and said, “play” thus, combining the use of a novel mand (touching the card) and an existing mand (saying “play”). During sessions 28 and 30 on some occasions he touched the card and said, “play” and on other occasions used other existing vocal mands (saying, “clothes, bus, music, video”) to ask for a break with preferred activities. Although Evan was provided with a break from the task for using both novel and existing mands, he primarily chose to touch the play card and say “play” (range, 67% to 100%, $M = 96\%$) rather than use other existing vocal mands (range, 0% to 33%, $M = 4\%$). The number of response-reinforced trials that occurred for touching the play card and saying “play” was 32 and the number of response-reinforced trials for using other existing vocal mands was 2.

The results of Annie’s FCT treatment showed an immediate decrease in problem behavior ($M = 2\%$) from the attention condition of the functional analysis and an increase in appropriate mands ($M = 100\%$). Unlike Evan, problem behavior remained low and stable during all but one session. Throughout Phase 2, although Annie was provided with attention for using existing manual signs (e.g., please, play, help, play dough) or using novel mands (touching or handing the play card to her mother), she always used the card ($M = 100\%$). The number of response-reinforced trials that occurred for using the “play” card was 56 and the number of response-reinforced trials for manual signing was zero. Therefore, similar to Evan’s results, when the FCT program was implemented, a specific topography of appropriate manding (touching the play card) increased.

The results of Phase 3 (mand analysis) are displayed in Figure 2. Evan's analysis (top panel) showed that when the play card was removed during the first FCT No Card condition, existing vocal mands (e.g., "video, clothes, trucks," etc.) increased immediately to 100% across all 5 sessions and problem behavior although variable, occurred at low percentages (range 0 to 8%; $M = 7\%$). When the play card was presented during the first FCT Card condition, Evan chose to touch the play card and say "play" ($M = 92\%$) rather than use other existing vocal mands ($M = 13\%$), with the exception of Session 8. Problem behavior remained low but variable ($M = 4\%$). When the FCT No Card condition was repeated, Evan chose to use other existing vocal mands ($M = 100\%$) similar to the first No Card condition. When the FCT Card condition was repeated, Evan exclusively chose to touch the play card and say "play" ($M = 100\%$) and problem behavior remained low when compared to baseline levels.

Despite the number of response-reinforced trials during Phase 2 with the play card and saying, "play" (32) versus other existing vocal mands (2), when the card was not available, Evan used other existing vocal mands and problem behavior remained low.

The results of Annie's mand analysis (Phase 3) are displayed in Figure 2. Manual signs were emitted during the first session of the FCT No Card condition ($M = 67\%$), but were not emitted during the next two sessions. An initial increase in problem behavior (14%) also occurred during the first session of the FCT No Card condition but decreased to zero by the third session. Problem behavior remained at near-zero levels ($M = 1\%$) for the rest of the FCT No Card condition even though Annie did not use manual signs and did not obtain access to her mother's attention. Thus, neither manual signs nor problem behaviors were emitted. In the first FCT Card condition, manding (touching the play card) occurred during 100% of the opportunities during all sessions and problem behavior remained low. Although Annie could use manual signs or touch the play card to gain access to her mother's attention, she used the play card. The FCT No Card condition was repeated and, in contrast to the first FCT No Card condition, manual signing occurred during each session (range, 50% to 100%; $M = 81\%$), and problem behavior remained low. The FCT Card condition was repeated, and although Annie used both manual signs and the play card to gain reinforcement, she continued to use the play card more often ($M = 68\%$) than her manual signs ($M = 33\%$). In addition, her use of manual signs showed a decreasing trend across sessions. No problem behavior occurred during the six sessions. Finally, the FCT No Card condition was repeated, and when given the opportunity to mand for attention, Annie always signed ($M = 100\%$) and problem behavior remained low.

The results of the mand analysis for Annie showed that when the play card was present (FCT Card condition), Annie more frequently chose to use the card ($M = 81\%$) than to sign ($M = 20\%$). In contrast, when the card was absent (FCT No Card condition), Annie's signing increased ($M = 72\%$) despite the number of reinforced trials during Phase 2 for the play card (56) versus a manual sign (0).

Discussion

The results of Phase 2 showed that when given the choice of using an existing or a novel mand topography to replace problem behavior, both participants demonstrated a clear preference for the novel mand (play card). These results replicate Winborn et al. (2002) and Winborn-Kemmerer et al. (2009). Minimal differences in problem behavior occurred with either existing or novel mands during Phase 3, which in contrast to Winborn et al. (2002), showed that problem behavior occurred more often with existing mands. A second difference between the current study and the results of Winborn et al. (2002) is that the preferred mand was always the novel mand in the current study. Given that the play card was always present during training and that the majority of reinforced trials involved selection of the play card, we hypothesized that

preference was governed by stimulus control; that is, the play card functioned as a discriminative stimulus that prompted the specific mand topography of touching the card.

An incidental effect of FCT was that training with the card appeared to strengthen the use of existing mands for both children even though few reinforced trials occurred during mand training. These results are similar to other studies (Drasgow et al., 1998; Lalli, Mace, Wohn, & Livezey, 1995; Richman et al., 2001) in suggesting that all topographies of mands were members of the same response class. When one topography of mands (in this case touching the card) was reinforced, this also strengthened other existing mand topographies but not problem behavior. This was demonstrated in Phase 3. When the play card was removed, both Evan and Annie used their existing mands (vocal speech and signs) to obtain reinforcement, and problem behavior remained low.

These results have applied implications for optimal treatment outcomes during FCT. First, training individuals to use multiple mands to access the same reinforcers may reduce the probability of individuals using problem behavior to obtain reinforcement when one of the mands is unavailable. Second, training one mand within a mand response class may positively affect the probability of using other mands, even when the other mands are only reinforced intermittently. Third, the presence of the play card appeared to increase the use of the card and to decrease the use of existing mands. Thus, the word card appeared to function as a discriminative stimulus for touching the card.

These findings differ somewhat from other studies (Charlop-Christy et al., 2002; Schwartz, Garfinkle, & Bauer, 1998; Weller & Mahoney, 1983) that showed that the use of picture cards resulted in a concomitant increase in verbal speech. However, the current study also showed that fading of the cards was not needed. When the cards were removed, other existing topographies of manding increased. If a total communication approach is used and multiple mands are reinforced, careful consideration of the topography of mands trained (Gutierrez et al., 2007) and the stimulus conditions under which different topographies of mands are emitted may be needed to predict which mands will be emitted during maintenance.

In conclusion, the current study showed that although both participants demonstrated existing mand topographies within their repertoires, they were more likely to show problem behavior than their appropriate mands prior to FCT. Once FCT was conducted with the novel mand, both children showed a preference for that mand over existing mands. When the play card was absent, other existing mands such as manual signs and vocal speech were used, and problem behavior remained low following FCT training. Thus, although both existing and novel mands were successful in decreasing problem behavior, the presence of the play card became a discriminative stimulus for using the card. Future research might evaluate stimulus control of other mand topographies, such as the effect of a voice output communication device on the use of existing mand topographies and the presence of other discriminative stimuli that may predict which mands will be used during long-term maintenance of FCT programs.

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Figure 1. Percentage of intervals of problem behavior and mands during the functional analysis for Evan (top, left panel) and Annie (bottom left panel) and functional communication training for Evan (top, right panel) and Annie (bottom, right panel).

Figure 2. Percentage of intervals of problem behavior and mands during the mand analysis for Evan (top panel) and Annie (bottom, panel).