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A PRELIMINARY EVALUATION OF THE EMERGENCE OF NOVEL MAND FORMS

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Strategies that produce generalized responding are valuable, especially with regard to language acquisition, because relatively little training may result in large behavior changes. Conditions that result in generalized manding were analyzed in the current study. We demonstrated in reversal designs that undesirable or single-word responses were the predominant mand forms of 3 preschool children. Multiple baseline designs with 2 participants and a reversal design with 1 participant were then used to demonstrate the extent to which differential reinforcement of single-word mands (e.g., ''cars'') or framed mands (e.g., ''I want the cars, please'') would result in the emergence of other single-word and framed mands for different items (e.g., mands for music, puppets, or puzzles). Results showed that prompting and differential reinforcement of one or two mand frames resulted in the emergence of other framed mands for all participants.

DESCRIPTORS: differential reinforcement, generalization, language training, mands, preschool children, tacts, verbal behavior

Over 1 million children categorized as having speech and language delays were served by public school special education programs during the 2000–2001 academic year (National Dissemination Center for Children with Disabilities, 2004). Problem behaviors are more prevalent among children with language delays than typically developing children (Willinger et al., 2003). It is therefore not surprising that previous research has shown that many forms of problem behavior serve a communicative (social) function (e.g., Carr & Durand, 1985; Winborn, Wacker, Richman, Asmus, & Geier, 2002). Consequently, strategies have been developed that replace problem behavior that serves a social function with an acceptable alternative (e.g., Carr & Durand; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Wacker et al., 1990). In essence, both the problem and the alternative behavior are controlled by the same establishing operations and consequences, and both may be understood as mands. Skinner (1957) used the term *mand* to describe a verbal operant that is evoked by deprivation or aversive stimuli (e.g., establishing operations) and is reinforced by specific consequences directly related to the response. For example, restricted access to a preferred toy truck is likely to function as an establishing operation for saying ''truck,'' which would be reinforced with the specific consequence of access to the truck.

Single words (e.g., ''truck'') are often suggested as target mands for children with language deficits due to the ease of production in comparison to framed responses (e.g., ''I want the truck, please''; Horner & Day, 1991; Musselwhite & St. Louis, 1988), and several studies have shown that prompting and differential reinforcement of single-word mands result in a reliable increase in these responses (Gobbi, Cipani, Hudson, & Lapenta-Neudeck, 1986; Winborn et al., 2002; Yoder et al., 1995). Targeting single-word responses may be efficient in the initial stages of mand teaching, and

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may be especially important if those mands are being taught as functionally equivalent replacements for problem behavior (Carr & Durand, 1985; Fisher et al., 1993; Horner & Day; Wacker et al., 1990). However, the same strategy may be inefficient in the long term, because it is likely that each new mand would require separate instruction prior to acquisition. Thus, it may be important that mand training, whether as an intervention for a preexisting pattern of socially mediated problem behavior or as a means to preempt the development of this sort of behavior, contain features that allow the development of mands that are not directly trained.

Strategies to promote generalization were first described by Stokes and Baer (1977), who suggested that generalization should be directly assessed and carefully programmed. Although a variety of procedures have been found to be effective for strengthening verbal repertoires (see Warren & Reichle, 1992, for a review), relatively few studies have determined the teaching conditions that will result in generalization. One possible reason for this relative lack of research is that similar responses may have dissimilar controlling variables. For instance, several researchers have shown that mands and other verbal operants (e.g., tacts) are functionally independent (Hall & Sundberg, 1987; LaMarre & Holland, 1985; Sigafoos, Doss, & Reichle, 1989), and that teaching a child to label (i.e., tact) an item will not necessarily result in that child being able to request (i.e., mand) that item when it may be important for the child to do so. In contrast, more recent research (Petursdottir, Carr, & Michael, 2005) has shown that mands and tacts are not necessarily independent. Petursdottir et al. showed that mand training tended to lead to emergent tacting, and tact training resulted in some emergent manding. Although this study suggests that mand training leads to emergent tacting, variables that effect transfer between mands and tacts have not been identified. Thus, an important research area involves understanding the conditions under which generalization between verbal operants (e.g., tacts and mands) will occur or, from an applied perspective, identifying the procedures that can produce generalization between verbal operants.

Wallace, Iwata, and Hanley (2006) recently showed that transfer from tact to mand functions was dependent, at least in part, on the value of the items to be tacted and manded. That is, if the items were shown to be highly preferred, mands for these items occurred and were maintained following tact training. An additional strategy for promoting transfer among verbal operant classes was offered by Skinner (1957), who suggested that the use of a frame might facilitate generalization to untrained responses (e.g., the mand frame, ''I want the —,'' or the tact frame, ''That is a —''). A mand frame may serve to bridge tacts and mands. That is, a mand frame may serve to mediate generalization (Stokes & Baer, 1977) in that the response, ''I want the —, please,'' would be taught in the presence of a strong establishing operation. This frame may thus be evoked in the presence of other similar establishing operations, thus resulting in generalization. For example, a child may be taught to say, ''I want juice, please'' when thirsty and may subsequently use a frame to mand for food when hungry (e.g., ''I want cookies, please''). Such outcomes were suggested by Hart and Risley (1980), who showed that an experimental group who were taught to use compound sentences to access restricted toys used more complex vocabulary and sentence structure that had not been directly taught than the comparison group did.

Simic and Bucher (1980) provided an example of teaching mands within frames when they taught 5 children with mental retardation the partial frame, ''I want a —.'' Their data showed that mand frames were acquired by the participants, but the benefit of generalized manding via framed mands was not

demonstrated. Therefore, further analysis of the conditions in which teaching framed mands results in generalization to untrained mands seems warranted.

In the current study we first determined the predominant mand forms for 3 preschool-aged children who appeared to be at risk for language delays. We then determined the direct and indirect effects of providing differential reinforcement for relatively smaller or larger topographical mand classes. More specifically, once we identified a variety of preferred items and determined that tacting repertoires for these items were intact, we evaluated the extent to which training both single-word mands (e.g., ''truck'') and framed mands (e.g., ''I want the truck, please'') would result in the emergence of novel mands.

GENERAL METHOD

Assessment and Training Overview

A preference assessment (Fisher et al., 1992) was conducted with each participant to identify preferred items that would maximize the motivating conditions of the mand analysis (Wallace et al., 2006). A tact assessment was conducted to ensure that the participants were able to tact each of the items that were to be included in the mand analysis, and tact training was provided when the participant was not able to tact a preferred item. Thus, items that the children preferred and could tact were included in the mand analysis. The initial mand analysis identified the particular response forms that functioned as mands (referred to as the *mand form analysis*). These data were then used as baselines to evaluate the direct and indirect effects of teaching single-word and framed mands (referred to as the *generalization analysis*).

Participants and Setting

Two 4-year-old-boys (Tom and Jason) with nonspecific developmental delays and 1 1.7-year-old typically developing girl (Ana) participated in this study. All 3 children attended a classroom in a full-day inclusive preschool program. They were selected to participate in this study because they made few vocal requests in the classroom, and teachers reported that their communication consisted primarily of gestures, crying, and taking items from children and adults.

The preference assessments and mand form and generalization analyses were conducted in a room (2.3 m by 2.7 m) that contained a child-sized table, two child-sized chairs, five plastic opaque containers, and two bookshelves. The tact assessment and training were conducted in a classroom (12 m by 7 m) that contained a variety of recreational activities.

Data Collection, Target Behaviors, and Interobserver Agreement

During the preference assessment and tact assessment, trial-by-trial data were collected on the child's approach toward an item or vocal approximation of the name of the item, respectively. An approach was defined as reaching toward the item with one or both hands. During the tact assessment, a correct response was scored when the child's vocal response approximated the agreed-upon name of the item; an incorrect response was scored when the child did not make a vocal response within 5 s or when the vocal response did not resemble the name of the item. The relevant tacts for each child are listed in Table 1.

During each preference and tact assessment, data were collected using paper and pencil and were summarized as the percentage of trials on which an item was selected (preference assessment) or the number of correct responses over the total number of trials conducted (tact assessment and training). Interobserver agreement was assessed by having two observers simultaneously but independently record selections (preference assessment) and correct or incorrect responses (tact assessment) on a trial-by-trial basis. Agreements were defined as both observers scoring the same response during each

Table 1
Tacts and Item Descriptions

Child	Tacts	Items
Ana	Frog, froggies	Four beanbag frogs and a rubber frog
	Babies, girl, doll, bottle	One 20-in. doll, one 8-in. crying and laughing doll with a bottle and blanket, and one 5-in. musical doll
	Phone, telephone	Six plastic phones with sounds and music button
	Dinosaur, dino	Plastic Lego® dinosaurs and a plastic dinosaur with sounds and a light
	Cars, train, bus	Plastic cars with sounds and lights, a bus and a train
Tom	Cars	Five cars of various colors
	Dress-up	Scarves, necktie, necklaces, a vest, dresses, bracelets, glasses, two hats, a ring, and shoes
	Disney®	Plastic Aladdin® and Pooh Bear® movie characters
	Books	Paperback preschool books such as Tonka Trucks® and a book
	Dinosaurs	Plastic Lego® dinosaurs and a plastic dinosaur with sounds and a light
Jason	Music	Drum, metal triangle, xylophone, clapper, cymbals, and rhythm sticks
	Puppet	Animal hand puppets
	Bears	Colorful plastic stackable bears
	Dinosaurs	Plastic Lego® dinosaurs and a plastic dinosaur with sounds and a light
	Puzzles	Electronic inset puzzle with sounds

trial. Agreement for each session was calculated by dividing the total number of agreements by the total number of agreements and disagreements and multiplying by 100%. Agreement was assessed during at least 50% of preference assessment sessions across all participants and averaged 98% (range, 96% to 100%). Agreement was assessed during at least 75% of tact assessment and training sessions across all participants and averaged 94% (range, 73% to 100%).

The frequency of each participant's undesirable, single-word, and framed responses was recorded during the mand form and generalization analyses. Undesirable responses for Ana were crying, yelling, and two rudimentary signs defined as placing an open palm on her chest and moving it from side to side (similar to the American sign language sign for "please") or extending her arms toward the items while making contact with the fingertips of both hands (similar to the sign for "more"). The undesirable response form for Tom and Jason was pointing, which was defined as extending the index finger in the direction of the item. These responses were considered undesirable because all participants showed evidence of somewhat intact vocal verbal repertoires; thus, these responses may have competed with further development of their vocal verbal repertoires. Because single-word mands, as opposed to undesirable behavior, were found to be the predominant mand form for Jason, undesirable responses are not reported in the generalization analysis. Single-word responses were defined as vocalizations that included an approximation of the name of the target item (e.g., "dinosaurs," "dino," or "want dino") and did not include a mand frame. Framed responses were defined as vocalizations taking the form of "I want [name of the object], please," "May I have [name of the object], please?" or "Can I have [name of the object], please?" Single-word responses were not scored in the same instance a framed response occurred (i.e., single and framed responses were mutually exclusive categories).

During the mand form and the generalization analyses, data on child behavior were collected using handheld computers during continuous 10-s intervals and were summarized as the number of responses per minute. Interobserver agreement was assessed in at least 49% of mand form analysis sessions across all participants and averaged 98% (range, 87% to 100%). Agreement was assessed in at least 22% of the generalization analysis sessions across all participants and averaged 98% (range, 64% to

100%). Exact agreement scores were calculated on an interval-by-interval basis by dividing the number of intervals with agreements by the number of intervals with agreements and disagreements; these fractions were then averaged and multiplied by 100%. An agreement was scored for each interval if both observers recorded the same number of responses.

Preference Assessment and Tact Assessment and Training

The purpose of the preference assessment and the tact assessment and training was to identify five items to be included in the mand analysis. Items to be included met three criteria: (a) When provided with the item following an approach response during the preference assessment, the child engaged with the items for the entire 30-s period in a developmentally appropriate manner (showing the absolute value of an item). (b) The child could tact the items in three consecutive opportunities during the tact assessment or following tact training (showing a minimal tact repertoire with respect to the items). (c) The items were selected over other items on at least some of opportunities (showing the relative value of the item).

Procedure

Preference assessment. Interviews of parents and teachers yielded a list of 10 preferred items for each child. A paired-choice preference assessment (Fisher et al., 1992) was conducted with each participant to identify five items for use during the mand analysis. Each item was paired with every other item once during the assessment. This occurred by placing two bins, each containing different sets of items, on the table simultaneously. The child's approach toward one of the two bins (e.g., a bin containing cars and a bin containing dinosaurs) resulted in 30-s access to that bin. When a child approached two bins simultaneously, the therapist blocked access to the bins, and the bins were presented again. The percentage of trials in which items were selected was calculated by dividing the number of times the child selected an item by the total number of trials in which the item was presented and then multiplying by 100%.

Tact assessment and training. Each child's ability to tact each of the 10 items was assessed by asking the child, "What is this?" in the presence of each item. Following a correct response, the therapist provided social praise (e.g., "That's right!"). Incorrect responses resulted in a brief 2-s time-out from interaction followed by the presentation of the next item. The therapist presented each of the 10 items in a random order, and each item was presented three times (for a total of 30 tact trials per child). If the child did not accurately tact the target items in all three of the opportunities, tact training was conducted.

Tact training was conducted in a manner similar to the tact assessment except that if the child did not respond within 5 s or responded incorrectly, the therapist repeated the question and simultaneously provided a model prompt. For example, the therapist asked, "What is this?" and then immediately stated, "This is a car, say car." If the child imitated the vocalization within 5 s of the model, social praise was provided. On the next trial, the prompt was delayed by 2 s. For example, the therapist said, "What is this?" and waited 2 s, before stating, "This is a car, say car." The model prompt was delayed by increments of 2 s following each correct response (Ault, Gast, & Wolery, 1988). Tact training was terminated when the child independently (i.e., in the absence of a model prompt) responded correctly for three consecutive trials.

Mand Form Analysis

The purpose of the mand form analysis was to identify the response forms that functioned as mands for each child. Five 3-min sessions were conducted daily, 4 to 5 days per week. Each of the 3-min sessions involved one of the five sets of items that the child was able to tact

and had been selected on over 20% of opportunities. The presentation of the items was conducted in random order for Tom. However, to determine if a temporal generalization gradient of novel mand forms would develop (i.e., if untrained mands that were assessed closer in time to directly trained mands would emerge sooner than mands that were assessed later), the order in which the items were presented was held constant for Ana and Jason. Brief breaks were provided between each session such that the total amount of time spent in sessions each day was approximately 20 min for all participants.

Procedure

Noncontingent reinforcement (NCR). During NCR, one of the five sets of items was freely accessible for 3 consecutive minutes. At the end of the 3-min session, the items were returned to the bin and placed out of view. A total of five sessions (i.e., one session per toy set) were conducted consecutively, and only one set of items was presented at a time. The therapist did not respond in any way to the target responses or other behaviors during these sessions. Because Ana rarely experienced periods in which an adult who was in close proximity did not interact with her for minutes at a time, she was also provided with 10 s of attention every 30 s, independent of her behavior. During this condition, the establishing operation for manding for the toy sets was eliminated or at least minimized by providing continuous access to the preferred items. Therefore, this condition served as a control for the effects of differential reinforcement.

Differential reinforcement of undesirable, single-word, or framed mands (DRA). The DRA condition was similar to the NCR condition except that the items were placed on the table but out of the child's reach, and access to the items was provided for 30 s following any target response. That is, to increase the rate of the target response that functioned as the participant's predominant mand, undesirable, single-word, or framed responses resulted in brief (e.g., 30-s) access to the bin of items.

Experimental Design

A reversal design was used to identify the response forms maintained by access to the target items (i.e., mands). For Ana, this analysis began with the DRA condition due to significant changes in the definition of her undesirable responses that occurred in previous (unreported) observations during NCR and DRA sessions.

Generalization Analysis

Procedure

The purpose of the generalization analysis was to determine if differential reinforcement of single-word and framed mands would result in generalization to single-word or framed mands with no explicit training. The NCR and DRA conditions from the mand form analysis served as baselines for all 3 children for the generalization analysis.

Differential reinforcement of single-word and framed responses (DRSF). This condition was implemented with Ana and Tom only because their mand form analysis showed that undesirable mands were their predominant mand forms. Thus, the DRSF condition restricted the contingency class that received reinforcement to single-word and framed responses. In other words, this condition was similar to the original DRA condition described above, except that access to the visible item was not provided if the child engaged in an undesirable response. A model of the single-word mand was provided after the initial 30 s had expired following the presentation of the item or when the child had not emitted a single-word or framed response for 5 s following removal of the items. Prompt delays were then used to eliminate the vocal model prompts. One second was added to the 5-s delay following a correct response and 1 s was subtracted from the delay following an undesirable response. When vocal model prompts had been eliminated for three

consecutive sessions (i.e., independent responding occurred), vocal mand models were not provided in subsequent sessions.

Differential reinforcement of framed responses (DRF). Differential reinforcement of framed responses was implemented when Ana and Tom reliably engaged in single-word mands on one of the baselines that had previously been exposed to the DRA or DRSF conditions, and the indirect effects of that behavior change were incomplete (e.g., undesirable behavior persisted on the remaining baselines). DRF was implemented with Jason to increase the developmental appropriateness of his manding repertoire. This condition was similar to the DRSF condition, except that a framed mand model was provided after the initial 30 s had expired, and access to the preferred item was provided only following framed responses (i.e., undesirable responses and single-word mands were placed on extinction). Prompting, prompt delays, and mand models were arranged as described above.

Experimental Design

The direct effects of the restricted differential reinforcement contingencies were demonstrated in multiple baseline designs across behaviors for Ana and Tom and in a reversal design with Jason. Although multiple baselines were used to observe the indirect effects of the restricted differential reinforcement procedures for all participants, experimental control over the indirect effects of the differential reinforcement contingencies was shown only with Jason in a reversal design.

Results and Discussion

Preference Assessment and Tact Assessment and Training

Items included in the mand analysis met three criteria described above. Results obtained from the preference assessment are shown in Figure 1 as the percentage of trials in which each item was selected. In general, preference assessment data show a descending slope, thus indicating that some items were more preferred than the other items included in the assessment.

Results obtained from the tact assessment and training are shown above the bars on Figure 1. Ana tacted four of the items (telephones, dinosaurs, frogs, and babies) on all three trials and appropriately interacted with these materials during the preference assessment (data available from the second author); therefore, these items were included in her mand analysis. Ana did not engage with the pens appropriately, so they were not included in the mand analysis. She tacted cars in at least one of three trials; therefore, cars were selected for inclusion as her fifth toy set. Thirteen trials were required to teach Ana to tact cars on three consecutive opportunities (data not shown). Tom tacted cars, dinosaurs, and books in at least one of the three trials and appropriately engaged with these materials during the preference assessment; therefore, these items were included in his mand analysis. Three, 11, and 15 trials were required to teach Tom to tact cars, dinosaurs, and books, respectively, on three consecutive opportunities (data not shown). Tom appropriately engaged with the Disney® and dress-up toys; therefore these items were also included as the fourth and fifth toy sets. Fifteen and 18 trials were required to teach Tom to tact Disney® and dress-up, respectively, on three consecutive opportunities (data not shown). Jason tacted puppets, bears, puzzles, and dinosaurs on all three trials and appropriately engaged with these materials during the preference assessment; therefore, these items were included in his mand analysis. Jason did not engage with the necklaces or books appropriately; therefore, music was selected for inclusion as his fifth toy set. Six trials were required to teach him to tact this item on three consecutive opportunities (data not shown).

Mand Form Analysis

The results of the mand form analysis for Ana are shown in Figure 2. The mean rate of

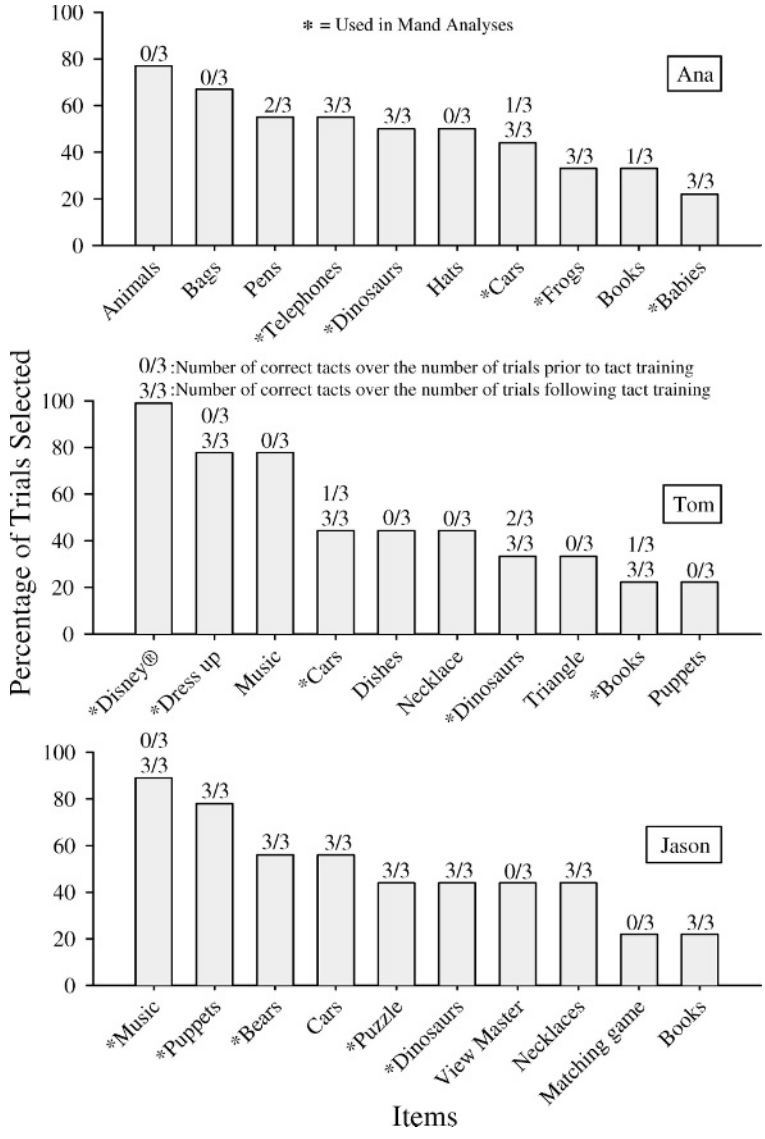

Figure 1. Percentage of trials in which items were selected during the stimulus preference assessment for Ana (top), Tom (middle), and Jason (bottom).

undesirable responses was highest during the first DRA condition ($M = 0.9$) across all items (i.e., cars, dinosaurs, frogs, babies, and phones). Single-word responses were also observed during DRA ($M = 0.4$ across all items), but to a much lesser extent than undesirable responses. During the NCR condition, no undesirable responses occurred, but single-word responses occurred intermittently across all five items ($M = 0.3$). The rate of undesirable responses increased during the return to DRA ($M = 0.8$ across all items), and single-word responses persisted at similar, albeit highly variable, rates ($M = 0.7$ across all items). Framed responses were not observed in any condition with Ana.

Low and inconsistent rates of undesirable ($M = 0.3$) and single-word ($M = 0.1$)

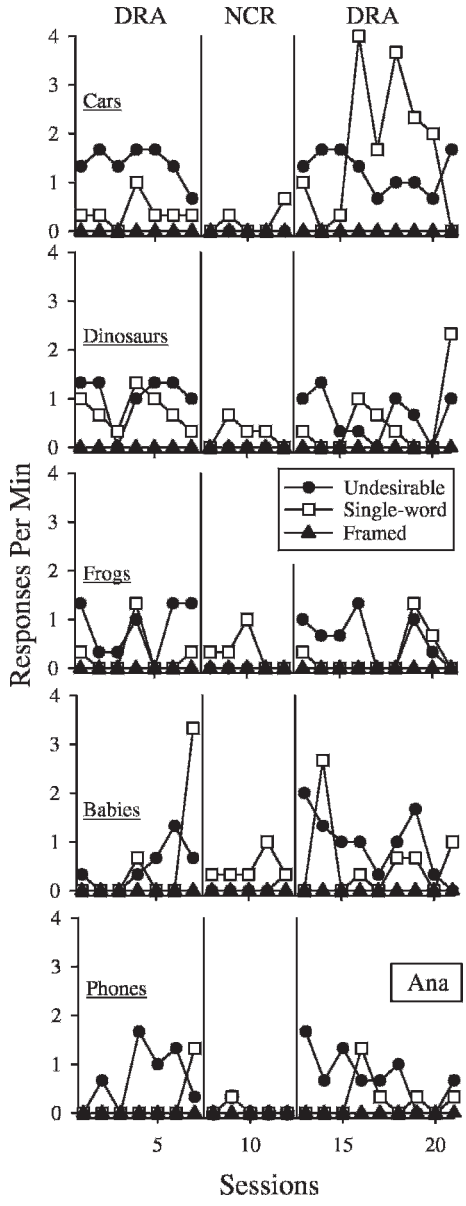

Figure 2. Independent target responses per minute for Ana during the mand form analysis.

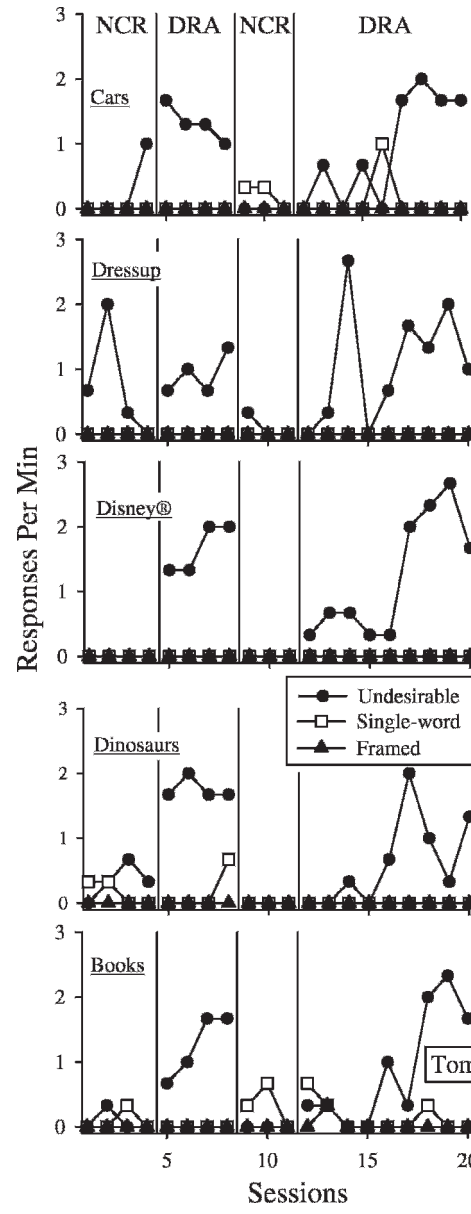

Figure 3. Independent target responses per minute for Tom during the mand form analysis.

responses occurred during the initial NCR condition for Tom across each of the five baselines (i.e., cars, dress-up, Disney®, dinosaurs, and books) (Figure 3). During DRA, high and persistent levels of undesirable responses occurred (M = 1.4), whereas single-word responses occurred during only one of the 20 sessions. During the return to NCR, undesirable responses were zero in 14 of the 15 sessions across the five baselines, and single-word responses occurred at low and intermittent rates (M = 0.1). Upon the return to the DRA condition, undesirable responses increased (M = 1) and single-word (M = 0.1) and framed (M = 0) responses did not.

NCR resulted in either low or zero rates of all target responses across each of the five baselines (i.e., music, puppets, bears, dinosaurs, and puzzles) for Jason (Figure 4). That is, the mean rate of responding for undesirable, single-word, and framed responses was 0, 0.3, and 0 responses per minute, respectively. During the DRA condition, single-word responses occurred consistently in all sessions ($M = 1.7$), undesirable responses occurred at variable rates in just over half of the sessions ($M = 0.8$), and framed responses were not observed. When NCR was reinstated, the rate of undesirable responses continued to be variable ($M = 1.8$), whereas the consistent rate of single-word responses observed during DRA was disrupted ($M = 0.6$). The return to DRA resulted in stable rates of single-word responses across all baselines ($M = 1.9$) and inconsistent, and at times high, rates of undesirable behavior ($M = 1.7$).

The results of the mand form analysis showed that Ana's and Tom's preexisting and predominant mand forms were undesirable responses, given that they appeared to be most sensitive to the changes in the relevant contingencies. By contrast, single-word responses appeared to be most sensitive to the condition changes for Jason and appeared to be his predominant mand form. Although all target responses would have resulted in access to the toy bins during the DRA condition, less desirable mand topographies emerged for each child: rudimentary signs for Ana, pointing for Tom, and uttering single words for Jason. That is, by programming a broad differential reinforcement contingency (i.e., one that provided reinforcement for several categories of responding sequenced on a developmental continuum), the predominant mand form was identified for each child across all item sets. For all participants, the respective mand forms possessed strong generality as similar topographies of manding were observed in the DRA condition across all baselines.

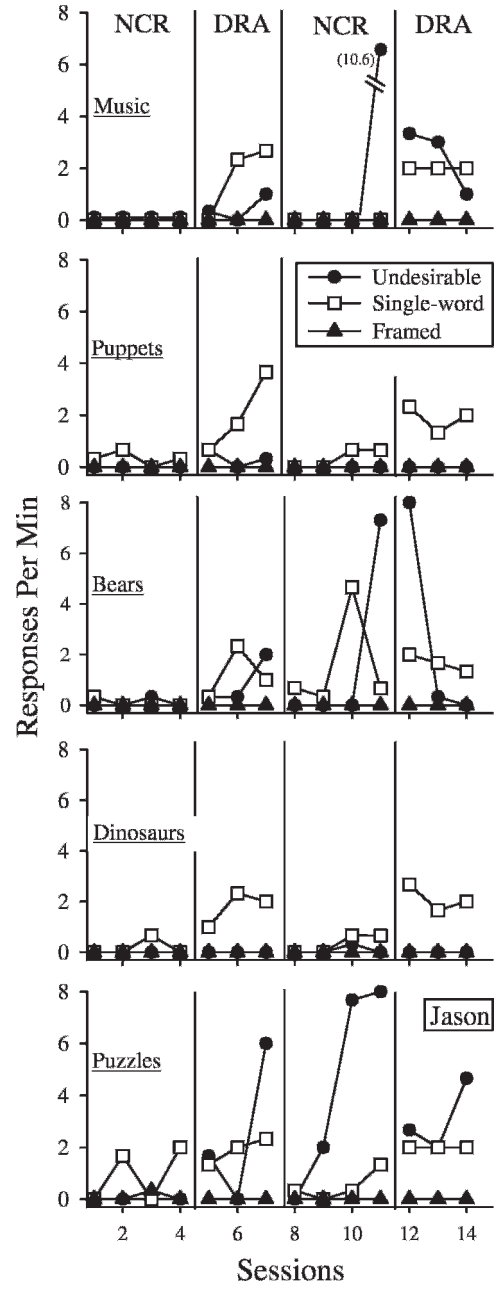

Figure 4. Independent target responses per minute for Jason during the mand form analysis.

Although reliable patterns of one of the topographical classes were evident from the mand form analysis for each child, there was some variability in the data that deserves comment. The establishing operation for

manding as well as the relevant differential reinforcement were absent from the NCR condition. Therefore, target responses that occurred in the NCR condition likely did not function as mands. In addition, when access to the bin was provided for 30 s during the DRA condition following a target response, the relevant mand contingency was temporarily absent from this condition as well. Therefore, a change in the rate of topographical classes of behavior across conditions was the critical indicator of the predominant mand form; the mere occurrence of behavior in either condition did not necessarily support or negate the possibility of that particular topography functioning as a mand. Due to the free-operant (as opposed to trial-based) nature of this assessment, there were many opportunities for the target responses to be emitted under conditions in which tact-like controlling variables were present. For instance, when Ana was playing with the babies she often looked towards the experimenter and said "babies" while extending the baby towards the experimenter. Although responses like this did not result in any generalized reinforcer, their occurrence seemed to be controlled by the presence of the object and perhaps a history of social reinforcement under similar conditions.

The persistence of Ana's and Tom's undesirable mand forms suggests that the ability to tact items may not have been sufficient to occasion single-word mands for the same items in the presence of specific establishing operations. The results for Ana and Tom are consistent with those of Hall and Sundberg (1987), who found that generalization from tact to mand contingencies failed to occur following the manipulation of establishing operations for already-learned tacts. The opposite was true with Jason, for whom a tact repertoire, taught immediately prior to the mand form analysis, was sufficient for occasioning single-word mands. Wallace et al. (2006) suggested that transfer from tact to mand repertories may be facilitated by the inclusion of highly preferred items during tact training. Several of the items included for Tom and Jason were highly preferred, yet transfer from tact to mands occurred only for Jason.

There were, however, differences in the contingencies between this and the Wallace et al. (2006) study. Specifically, the contingency in the Wallace et al. investigation was restricted to one target class. It is possible that the broad differential reinforcement contingency arranged in the current study, which provided reinforcement for undesirable behavior as well as vocal mands, prohibited the emission of single-word responses for Tom and Ana. In addition to assessing or teaching mands under properly motivating conditions, the data from our mand form analysis suggest that restricting the class of topographies that receive reinforcement (i.e., programming extinction for less desirable topographical classes) may be necessary to transfer control from tacts to mands.

Therefore, the contingency classes were systematically narrowed in the mand generalization analysis. That is, fewer topographies of behavior resulted in access to the toy bins. For example, initially Ana was provided with access to the cars when she engaged in an undesirable, single-word, or framed mand. These three responses were part of the same contingency class in that they functioned as mands to access the cars. In the mand generalization analysis, this contingency class was narrowed and included only single-word and framed responses (e.g., DRSF). The contingency class was narrowed further in the DRF condition in that only framed mands resulted in access to the cars. These changes were implemented to increase the complexity and social desirability of the mands and to determine the extent to which the development of the more complex forms of manding would result in transfer to untrained stimuli.

Generalization Analysis

Figure 5 shows Ana's rates of undesirable, single-word, and framed mands across sessions

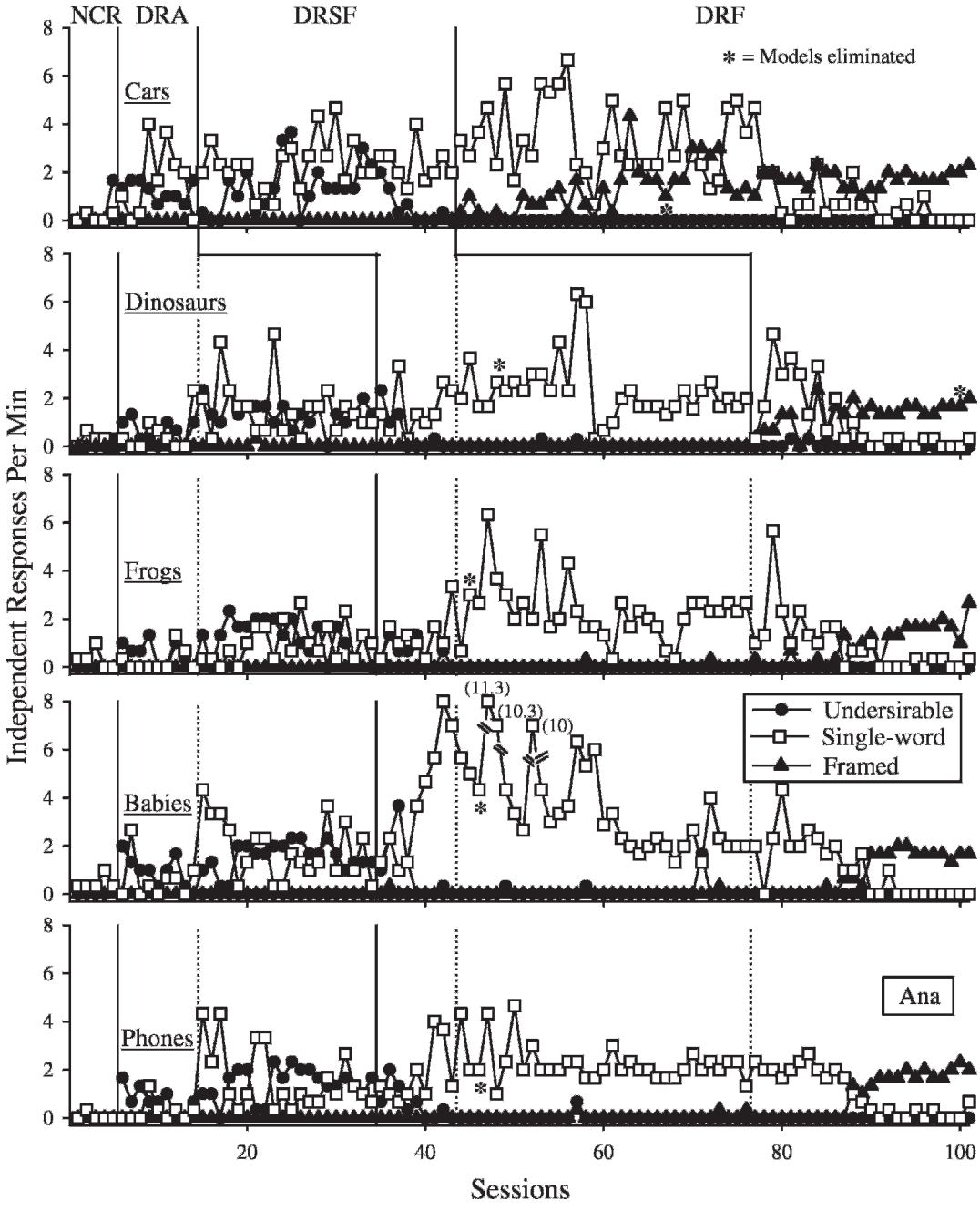

Figure 5. Independent target responses per minute for Ana during the generalization analysis.

for the five baselines of different sets of toys (e.g., cars, dinosaurs, frogs, baby, and phones). It should be noted that the initial NCR and DRA data presented in Figure 5 are also shown in Figure 2 and are presented here as a baseline for the generalization analysis. Differential reinforcement was provided for single-word and framed mands only (DRSF) on the cars baseline. During DRSF, the mean rate of single-word mand models provided per session was

0.1. The mean rate of single-word mands increased slightly to 2.4 compared to the mean rate of 1.6 during DRA. In addition, there appeared to be an indirect effect of the DRSF contingency on the other four baselines. That is, during DRA (Sessions 6 to 14), the mean rates of single-word manding for dinosaurs, frogs, babies, and phones were 0.5, 0.3, 0.6, and 0.3, respectively. However, following implementation of the DRSF contingency for cars, single-word manding increased for dinosaurs, frogs, babies, and phones to 1.6, 1.0, 1.7, and 1.5, respectively. In addition, undesirable responses increased from a mean rate of 0.8 in the DRA condition to 1.3 throughout all four baselines even when these behaviors were placed on extinction in the cars baseline. Single-word mand models were provided throughout this phase on the cars baseline because vocal models had not been eliminated for three consecutive sessions; thus, independent responding throughout the session had not occurred.

Because the indirect effects of the DRSF contingency were observed across all four baselines, DRSF was introduced simultaneously across the remaining four baselines to strengthen the single-word mands and eliminate undesirable mands via extinction. The mean rate of single-word mand models provided per session was 0.6, 0.8, 0.4, 0.6 for dinosaurs, frogs, babies, and phones, respectively. When DRSF was implemented across all baselines (Sessions 35 to 43), undesirable manding decreased to near zero ($M = 0.6$). Next, the differential reinforcement contingency was narrowed to include only framed responses on the cars baseline. During this phase, framed mand models were provided at a rate of 0.5 per session. In addition, on the other four baselines (e.g., dinosaurs, frogs, babies, and phones), independent single-word manding occurred for three consecutive sessions; thus, single-word mand models were eliminated (asterisks in Figure 5). The DRF contingency resulted in a gradual increase in framed mands ($M = 1.3$), yet single-word mands (mands outside frames) persisted at a mean rate of 3.4. The asterisk below Session 67 denotes that framed mand models were eliminated at this point. Instances of framed mands were also observed on the frogs, babies, and phones baselines. Because the generalization of framed mands was incomplete, DRF was then implemented on the next baseline (dinosaurs). Framed mand models were provided at a rate of 0.5 per session. Following the implementation of the DRF contingency, an immediate increase in framed mands ($M = 1.4$) occurred on this baseline. The asterisk above Session 100 denotes the point at which mand models were eliminated. Two other important changes in responding occurred when the DRF contingency was implemented on the second baseline: (a) The rate of single-word mands decreased on all five baselines ($M = 1.1$), and (b) there was an increase in the rate of framed mands that occurred on the three baselines in which the contingency had not been narrowed ($M = 0.7$).

In summary, Ana's data show both direct and indirect effects of narrowing the contingency class on mand forms. The direct effects of the DRSF condition were subtle (a slight rate increase in single-word mands was observed), and the direct effects of the DRF contingencies were delayed (seven sessions occurred before consistent rates of framed mands were observed). However, the indirect effects of restricting the contingency to single-word and framed mands were robust in that single-word mands also occurred at high levels across the four baselines in which the contingency remained unchanged. The indirect effects of the DRF contingency were subtle until it was implemented on the second baseline. In other words, once two of the five baselines involved a contingency in which reinforcement was provided only for framed mands, framed mands were observed on all baselines and single-word

mands decreased to near zero, even though they continued to be reinforced in the majority of the baselines.

A limitation of Ana's data is that functional control over most of the direct and indirect effects was not demonstrated. The direct effects of the DRF contingency were replicated in a multiple baseline design, but the direct effects of the DRSF contingency were not replicated because of the apparent indirect effects of this contingency. Nevertheless, Ana's data provide some evidence that a more socially desirable and complex mand repertoire may result from restricting contingency classes in a limited number of situations.

Figure 6 shows Tom's rates of undesirable, single-word, and framed mands across sessions for the five baselines (e.g., cars, dress-up, Disney®, books, and dinosaurs) that included different sets of toys. As with Ana, the NCR and DRA data were obtained from the initial mand analysis. When the DRSF contingency was implemented on the cars baseline, undesirable manding initially increased but then decreased to baseline levels (M = 1.8), and single-word manding increased slightly (M = 0.8). Single-word mand models were provided at a rate of 0.4 per session. The asterisk above Session 20 denotes that mand models were eliminated for the cars baseline. Unlike the effect observed with Ana, the indirect effects of the DRSF contingency were minimal. Some single-word manding occurred on the books baseline (M = 0.5; Sessions 13 to 22), but otherwise, undesirable manding persisted for dress-up, Disney®, and dinosaurs (M = 1.2). The DRF condition was then implemented on the first baseline (cars), and a gradual increase in framed manding was observed on the cars baseline (M = 1.6) along with a slight decrease in undesirable responses (M = 1.2) and single-word mands (M = 0.5). Framed mand models were provided at a rate of 0.7 per session and were eliminated beginning with Session 31. Although undesirable manding (M = 1.1) persisted on the other four baselines (i.e., dress-up, Disney®, books, and dinosaurs), instances of framed mands also were observed on all four baselines. DRSF was then implemented on the second baseline (dress-up). Single-word mand prompts were provided at a rate of 0.7 per session and were eliminated beginning with Session 41. Although single-word mands increased on the second baseline (M = 0.5; Sessions 36 to 43), single words were not observed in those baselines in which the original DRA contingency was operating (M = 0.2). Therefore, DRF was implemented on the second (dress-up) baseline (Sessions 44 to 52). Framed mand models were provided at a rate of 0.3 per session and were eliminated beginning with Session 49. Direct effects were observed in that framed mands (M = 1.3) for dress-up began to occur consistently. We also observed indirect effects in that framed mands occurred on the books (M = 1.0) and dinosaurs (M = 0.5) baselines in which the original contingency remained unchanged. DRF was implemented on this third baseline (Disney®), and framed mands (M = 1.6) were acquired for these toys. Framed mand models were provided at a rate of 0.1 per session and were eliminated beginning with Session 59.

In summary, single-word mands were consistently observed with Tom only when prompting and differential reinforcement were arranged. Thus, in contrast to the results observed with Ana, there did not appear to be a consistent indirect effect of the single-word mand training. Differential reinforcement of framed mands resulted in an increase in the target mand and first-time instances of framed mands for dress-up, Disney®, and dinosaurs, suggesting that direct training of a mand frame may result in the emergence of framed mands for other items. However, consistent rates of untrained framed mands were observed only when the DRF contingency was implemented on the second baseline. Although functional control over the indirect effects was not

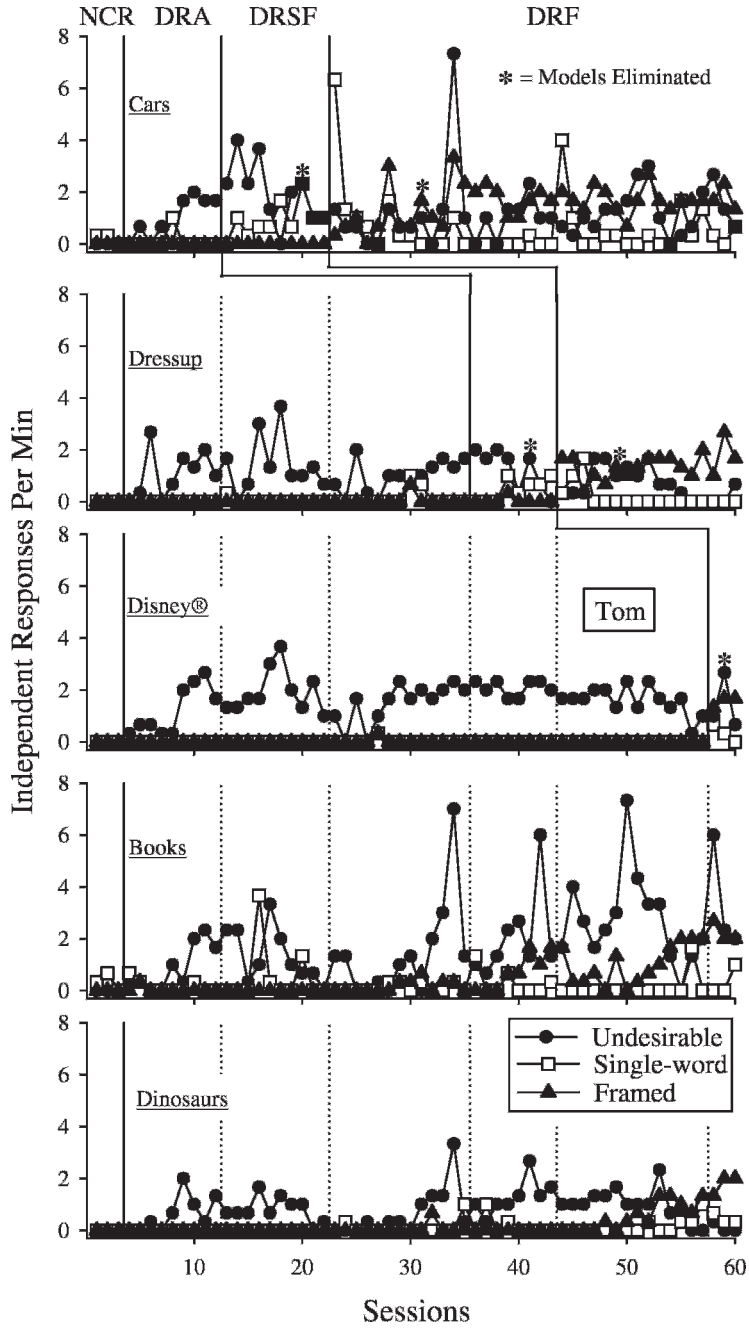

Figure 6. Independent target responses per minute for Tom during the generalization analysis.

demonstrated with Tom, his data are consistent with those observed in Ana's analysis in that indirect effects of the DRF contingency were observed only when two exemplars were exposed to this condition.

Figure 7 shows rates of single-word and framed mands across the five baselines (music, dinosaurs, bears, puppets, and puzzles) for Jason. Although undesirable responses were recorded for Jason, they are not reported

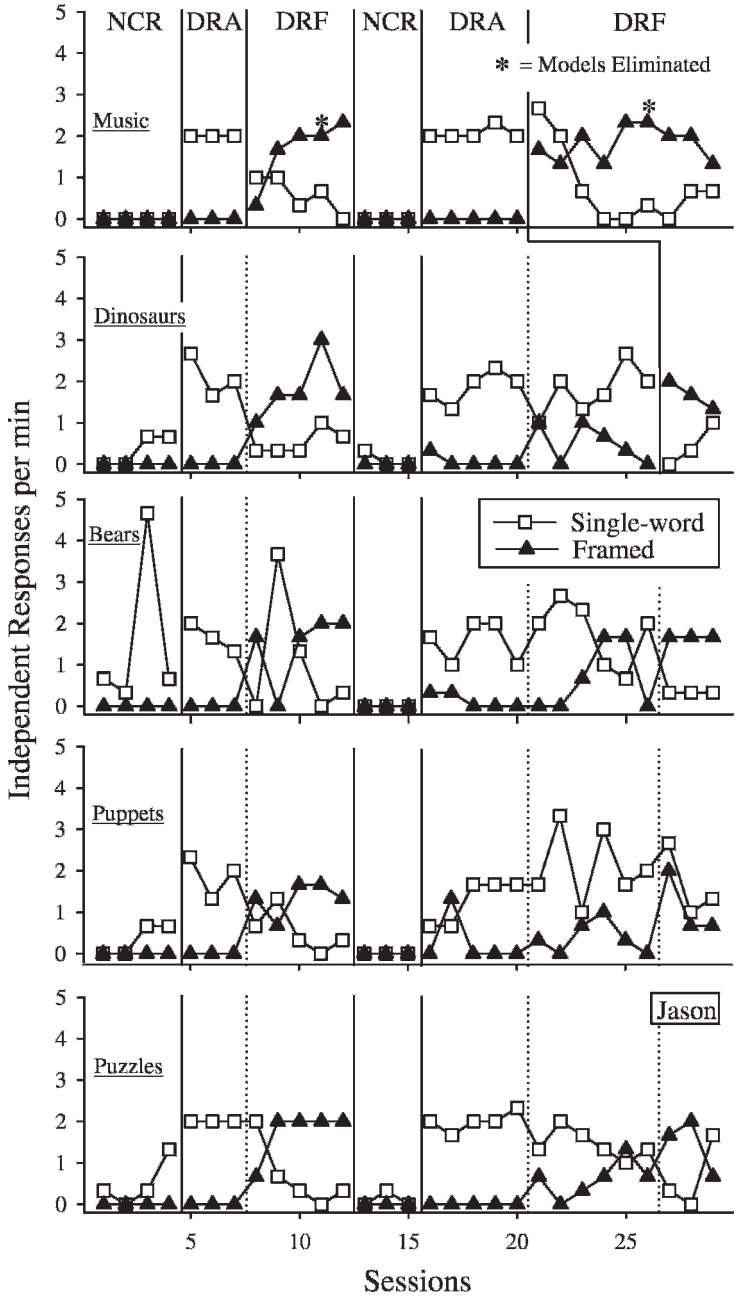

Figure 7. Independent target responses per minute for Jason during the generalization analysis.

because single-word responses were his predominant mand form (i.e., undesirable responses were not sensitive to the programmed contingencies). Because the previous analysis indicated that Jason's predominant mand form was single words, a DRF contingency was initially introduced on the music baseline. As with Tom, the NCR and DRA data were obtained from the initial mand analysis. Framed mand models were provided at a rate of 0.3 per session and were eliminated beginning with Session 11. Framed manding immediately

increased ($M = 1.7$), and single-word manding decreased to near zero ($M = 0.6$). An important outcome was that framed mands occurred in all of the other baselines in which no changes were made to the contingencies ($M = 1.6$ across all baselines). To determine if the generalized change in the complexity of the mand forms was a function of the direct and indirect effects of the DRF contingency, we returned to the NCR condition and reimplemented the same sequence of conditions. Both single-word and framed manding were reduced to zero or near-zero rates across all five baselines during NCR. The return to DRA resulted once again in an immediate increase in single-word mands for all items ($M = 1.7$). Finally, the DRF condition was implemented exclusively on the music baseline (0.2 mand model per session), and once again, framed mands immediately increased ($M = 1.8$) and single-word mands decreased ($M = 0.9$). Framed mand models were eliminated beginning with Session 26. Although smaller in magnitude relative to the initial behavior change, the indirect effects of the DRF contingency were observed as framed manding emerged at higher rates in all four baselines relative to the previous DRA condition ($M = 0.5$). The DRF contingency was then arranged on the second baseline (dinosaurs). Framed mand models were provided at a rate of 0.3 per session. Similar indirect effects of the contingency were observed across the remaining baselines in that framed manding occurred at a mean rate of 1.4.

Jason's results were similar to those observed with Ana and Tom in that indirect effects of the DRF contingency were observed. However, Jason's results were also distinct from Ana's and Tom's because functional control over the direct and indirect effects of restricting the contingency class was demonstrated within a reversal design. Taken together, the results of the generalization analysis show that training one or two framed mands produced an emergence of untrained framed mands even when contingencies supported undesirable mand forms. In addition, these results are consistent with those of Hall and Sundberg (1987) and Sigafoos, Reichle, and Doss (1990), whose data suggested that generalization between tact and mand response classes occurred only after the development of a minimal tact *and* mand repertoire.

GENERAL DISCUSSION

Initial analyses were successful in identifying the specific response topographies that functioned as mands for 3 children. Undesirable responses were the predominant mand forms for 2 children, and single-word mands were the predominant mand form for a 3rd child. Narrowing the contingency class for the 2 participants whose predominant mand form was undesirable resulted in different outcomes. For Ana, the strengthening of one single-word mand resulted in the strengthening of single-word mands for all toy sets in which no changes were made to the prevailing contingencies. For Tom, indirect effects of strengthening one or two single-word mands were not observed. When the contingency class was narrowed on one or two baselines to framed mands, indirect effects were seen with all 3 children in that framed mands emerged on the remaining baselines in the absence of changes to the prevailing contingencies (i.e., any of the target mand forms would have resulted in reinforcement). Although this phenomenon was observed with all 3 children, only Tom's data support the conclusion that generalization is more likely to occur following the acquisition of framed mands than single-word mands.

These data contribute to the literature on vocal language acquisition in two ways. First, although teaching simpler mands (e.g., single words) is common (Gobbi et al., 1986; Winborn et al., 2002; Yoder et al., 1995) and is considered to be best practice by some (Horner & Day, 1991; Musselwhite & St. Louis, 1988),

the current data suggest that training one or a few framed mands after single-word mands have been acquired is likely to result in the emergence of untrained mands (e. g., generalization). These results are somewhat similar to those of Stevens-Long (1974), who evaluated the influence of differential reinforcement on simple and compound sentences and found that training simple sentences resulted in an increase in simple sentences with no effects on compound sentences. Training of compound sentences resulted in an increase of compound sentences and a decrease of simple sentences and, more important, in the production of compound sentences not previously taught. Compound sentences were comprised of two simple sentences combined with the use of the carrier word ''and,'' which possibly served a similar function as the frame ''I want —, please'' in the present study.

The results of the current study, although preliminary, suggest that frames should be targeted during mand training following the initial acquisition of one or two single-word mands. In addition to replicating and extending this relation between single-word and framed mand training, future research may be directed towards understanding if training frames for other verbal operants (e.g., tacts) results in more generative responding.

The second contribution to the literature is that the current results suggest that the development of more complex and socially desirable mand forms may be dependent on extinguishing less complex and less acceptable mand forms. Although single-word mands would have resulted in reinforcement in the DRA condition, their emergence was dependent on extinguishing undesirable mand forms for Ana and Tom. A similar result was obtained for the relation between single-word and framed mands for all participants. Specifically, the initial emergence of framed mands was dependent on extinguishing single-word mands. Perhaps, more interesting is the fact that extinction did not need to be comprehensive. The current data suggest that providing extinction on one or a few baselines for less desirable mand forms might result in the emergence of more complex mand forms across other nontargeted baselines.

The current results also contribute to the literature on generalization between the two most frequently taught functional classes of verbal behavior, tacts and mands. In previous studies, which showed that mands and tacts were functionally independent (Hall & Sundberg, 1987; LaMarre & Holland, 1985; Sigafoos et al., 1989, 1990), the reinforcing value of the consequences for mands was unknown. Similar to Wallace et al. (2006), the data from the present study show that this independence may be context specific. The data from the present study also suggest that functional independence between mands and tacts is dependent on the contingencies for other functionally equivalent responses and on the presence or absence of minimal mand repertoires. That is, although the children were able to tact the items, more complex mands emerged only after prompting and differential reinforcement of a more complex mand and the extinction of less complex mands were programmed. These results also may have differed from previous research because the manded items in the current study were often highly preferred items (Wallace et al.). The reinforcing efficacy of the items was suggested by the results of the preference assessments but was empirically demonstrated by the control exerted by the items in the differential reinforcement condition of the mand form analysis.

Teaching one or two mands in the current study resulted in improvement in multiple mand forms, and the conditions in which this practical outcome occurred were isolated. In addition, the results of Jason's analysis are interesting on a methodological basis in that functional control over generalization was achieved. Although generalization is often a goal

or at least an appreciated side effect of most teaching programs, it is also often the antithesis of functional control and therefore an undesirable outcome from an experimental perspective. The results of Jason's analysis show that generalization and functional control can coexist and suggest an experimental preparation in which both can be demonstrated (see Brigham & Sherman, 1968, or Schumaker & Sherman, 1970, for alternative preparations for showing functional control over generalized performances).

There are three limitations of the current study that deserve consideration. First, it is quite possible that quicker or more thorough transfer would have occurred had we required a more stringent criterion for the tact repertoires of our children. All of the children required tact training for some of the toy sets, and the criterion of three consecutive trials of independent tacting may simply have been too lenient. However, the continued emission of the topographies of responding (Table 1) while the children were engaged with the materials, which occurred throughout both mand analyses, suggests that vocal tact repertoires were strong for these children.

The second limitation pertains to the continued availability of reinforcement for the three mand types across all baselines, which affects our ability to comment on the process of generalization. There is evidence of stimulus generalization in the current data in that mand frames occurred for the first time under different stimulus conditions that did not involve a change in the prevailing context or contingencies. Response generalization (or induction) was apparent in that first instances of different responses occurred on baselines that did not involve a change in the prevailing context or contingencies. Clearly, the first instances of each response should be considered instances of generalization. However, because all first instances of each mand type resulted in reinforcement, the continued emission of these responses was simply a function of reinforcement, and therefore should no longer be considered evidence for generalization. Future studies that evaluate the process of generalized verbal behavior should consider arranging extinction or intermittent reinforcement in the baselines in which the indirect effects of an intervention will be evaluated.

The third limitation is that the use of a free-operant preparation increased the likelihood that nonmand responses, which shared similar topographies with our target mands, obscured our data. An alternative trial-based analysis, in which establishing operations and consequences for each instance of a response can be better controlled, might lead to more easily interpretable data regarding functional classes of verbal behavior. Isolating the conditions under which other verbal operants, such as echoics, tacts, and intraverbals, emerge and transfer function is warranted to increase the efficiency of language programs based on functional verbal classes. Therefore, the implications of arranging free-operant instead of trial-based conditions should be considered in future research on verbal behavior.

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