The Analysis of Verbal Behavior 2008, **24,** 69–85

Discrete Trial Instruction vs. Mand Training for Teaching Children With Autism to Make Requests

Heather K. Jennett, Kennedy Krieger Institute
Sandra L. Harris and Lara Delmolino
Rutgers, The State University of New Jersey

The present study compared the effects of discrete trial instruction (DTI) and mand training on the acquisition of independent requests in 6 children with autism. Two multiple-probe designs across participants were conducted with 3 participants receiving mand training followed by DTI and the other 3 receiving DTI followed by mand training. Eye contact and challenging behaviors were also assessed across conditions. Results indicate that 5 of 6 participants made more independent requests and acquired requesting faster in the mand training condition, had slightly better eye contact in the DTI condition, and fewer challenging behaviors in the mand training condition. Overall, the results indicate that mand training is a more efficient method for teaching children with autism to make requests.
Key words: Mand training, motivating operations, discrete trial instruction, autism

One of the primary deficits in autism is a deficit in language and communication skills (APA, 2000). One particular difficulty for children with autism is making their needs and wants known, or manding. This is a skill that develops early in typically developing children, but children with autism often use other ways to get their needs met, including engaging in problem behaviors. Traditionally, behavior analytic methods for teaching language and communicative skills to children with autism have relied on discrete trial instruction (DTI; Koegel, Russo, & Rincover, 1977). However, in recent applied behavior analytic literature, there has been an increased focus on Skinner's verbal operants (Skinner, 1957) for teaching language to children with autism. For example, a set of teaching procedures which relies on the arrangement of motivating operations (MOs) has been developed by researchers such as Sundberg and Partington (1998). This procedure, known as mand training, focuses on altering the MO in order to evoke verbal behavior that is under its control. Laraway, Snycerski, Michael, and Poling (2003) have described MOs as stimuli that alter the value of an object or event as a reinforcer (or punisher) and simultaneously alter the frequency of a behavior that has been followed by that reinforcer.

Correspondence information: Heather Jennett, Kennedy Krieger Institute, Department of Behavior Psychology, 707 N. Broadway, Baltimore, MD 21205; e-mail: jennett@kennedykrieger.org

Sundberg and his colleagues have advocated for mand training as an essential feature of early stages of a language training program for children with autism (Sundberg & Partington, 1998) because the mand gives the child some control over the environment and increases the value of language as a form of social behavior (Sundberg & Michael, 2001). In addition, mands may be more likely to be used spontaneously because of the motivational factor and are therefore, in theory, more likely to occur under a variety of environmental conditions (Sundberg & Michael, 2001). Aside from these functional reasons, an analysis of the language of infants suggests that mands are the first type of language to develop (Drash & Tudor, 1993).

Despite the recent popularity of this strategy and its supposed clinical utility, there is little research regarding this approach to teaching language in autism, particularly in comparison with more traditional teaching procedures such as DTI. In one study, Drash, High, and Tudor (1999) investigated shaping a mand repertoire as the first step in language training in three nonverbal participants. A motivating operation was contrived, the item was held out of reach, and the participant was asked if he wanted the item. At first any vocalization was reinforced, this was followed by differential reinforcement for certain imitated sounds, and ultimately successive approximations to specific responses were reinforced. Since these items were visible and the sounds or words were prompted, they were under the multiple

control of a nonverbal stimulus (as tacts) and the experimenter's verbal behavior (as echoics). Thus, beginning mand training was also echoic and tact training. Overall, the three participants acquired mand and echoic repertoires and two of the participants began to acquire a tact repertoire. Additionally, as manding increased, inappropriate behavior and nonresponding decreased.

The Drash et al. (1999) study represents a good first step, but more research is needed. Based on their findings, the authors discuss the value of initiating a language training program with mand training rather than the traditional imitative model (such as DTI), however, they do not provide control data using an imitation model as the first procedure. Another drawback of the study was that the mands were always prompted (e.g., participant is asked "What do you want?") and thus it is unclear whether the stimulus control for the response was a motivating operation or a discriminative stimulus or both. Despite these limitations, this study provided initial evidence of the clinical significance of mand training.

Further, a few studies have investigated aspects of language acquisition under the different conditions of DTI and more naturalistic teaching methods, such as incidental teaching (e.g., McGee, Krantz, & McClannahan, 1985) and the Natural Language Paradigm (NLP; Koegel, O'Dell, & Koegel, 1987). Like mand training, both incidental teaching and NLP arrange the environment based on the motivation of the child. Although there may be minor procedural differences, the main difference between these latter procedures and mand training is the conceptual basis. Investigations comparing DTI with incidental teaching have focused on language skills such as answering yes/no questions (Neef, Walters, & Egel, 1984), preposition use (McGee et al., 1985), and use of color adjectives (Miranda-Linne & Melin, 1992). The results of these studies suggest that there may be little difference in acquisition or retention between the two teaching procedures (McGee et al., 1985) but that DTI may enhance quicker initial acquisition (Miranda-Linne & Melin, 1992). Additionally, DTI has been found to be more time efficient (Miranda-Linne & Lenin, 1992) but incidental teaching promotes better generalization of skills (McGee et al., 1985; Miranda-Linne & Lenin, 1992; Neef et al., 1984). Research comparing DTI with the NLP suggests that the NLP results in increased language (Koegel, Koegel, & Surratt, 1992; Koegel et al., 1987), increased spontaneous language (Koegel et al. 1987), and increased speech intelligibility (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998). Furthermore, these comparisons yielded results showing increased generalization across people and settings (Koegel et al., 1987) as well as reduced disruptive behavior during teaching (Koegel et al., 1992) when taught using the NLP.

Thus, many of previous studies comparing naturalistic teaching procedures with DTI have found some advantage for the naturalistic procedure. However, despite the remarkable results, there is a paucity of research in this area. Particularly lacking is research focusing on the application of Skinner's analysis of verbal behavior to teaching language to children with autism. Although mand training may resemble the NLP and incidental teaching in practice, neither teaching procedure is conceptualized based on Skinner's analysis. However, because mand training procedures are similar to these other naturalistic procedures, the results can be expected to be the similar. Despite this, there are no published studies comparing mand training with DTI to date.

The purpose of the present study is to compare DTI with mand training for teaching children with autism to request items. Proponents of using Skinner's analysis of verbal behavior suggest that mand training should be the first step in a language program (Sundberg & Partington, 1998). Although Drash and colleagues (1999) claimed that their results supported the superiority of mand training for language development over the traditional imitation model, they did not directly compare these methods. The present study investigated this suggestion by initiating a language training program through mand training with half of the participants, followed by language training in a discrete trial model. The other half of the participants began their language training program through DTI, which was followed by mand training. Therefore, this study not only compares the effects of the two different teaching procedures for each participant but also investigates the effects of initiating a language program with each of the teaching models.

Several contrasts between DTI and naturalistic procedures have been described in the literature (e.g., Delprato, 2001). In the present

Table 1
Participant Characteristics[a]

Participant	CA	PPVT—III AE	SIB—R AE	
			Overall	S–C domain
Maggie	4–3	> 1–9	2–5	1–7
Marcus	5–11	2–10	3–4	2–5
Oliver	4–2	2–7	4–4	3–6
Peter	3–0	2–8	1–11	1–8
Christian	5–8	>1–9	4–0	2–5
Ryan	3–7	1–10	2–3	1–7

[a] reported in yrs–mos AE = age equivalent; S–C = social–communication

study, all of these contrasts remained except for the element of specific versus nonspecific reinforcement. That is, in both teaching procedures, the participants received specific, functional rewards for a correct response and the items used in each procedure were items that were highly preferred by each individual participant. Therefore, this study investigated the role of the motivating operation rather than the role of reinforcement. To do this, it was important to keep the opportunities for reinforcement constant across teaching procedures, but it was expected that the value of the item as a reinforcer would differ depending on whether the procedure follows the motivating operation (as in mand training) or whether an item that has been found to be preferred functions as a reinforcer for its request when it is chosen by the instructor (as in DTI).

METHOD

Participants

Six participants with previous diagnoses of Autistic Disorder and Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS) were recruited from a waiting list of children to receive services from the Douglass Developmental Disabilities Center, a specialized program for autism. Each child selected for participation was requesting at a rate of less than one per minute during a 20-min screening session. The six participants included five boys and one girl between the ages of 3 and 6.

During the intake procedure, the Peabody Picture Vocabulary Test—Third Edition (PPVT—III; Dunn & Dunn, 1997) was administered to obtain a standardized measure of each participant's language ability; and the Scales of Independent Behavior—Revised (SIB—R; Bruininks, Woodcock, Weatherman, & Hill, 1996), an adaptive behavior scale with a primary focus on the participant's social and communicative behaviors, was administered to the parent of each participant as a checklist. Table 1 describes participant characteristics including chronological age and age equivalent scores for the PPVT—III and SIB—R. The participants were matched as well as possible by their age equivalent score on the PPVT—III and each member of the matched pair was assigned to one of the two conditions (DTI first or mand training first). Assignment to a condition was random but also depended upon which participant was ready to schedule training first.

Stimulus Materials

The stimulus materials consisted of toys and activities that were made up of two parts and that needed both parts to be functional, such as paper and crayons. A standard pool of 24 items was established for the purpose of the study and all items selected were popular toys and activities for young children. From this pool, two sets of materials were created: Set A consisted of one member of each pair and Set B was the other member. For the discrete trial condition, the participant was taught to request items from Set A and for the mand training condition, to request items from Set B. For example, if the pair of objects was paper (A) and crayons (B), requesting the paper was taught during

Table 2
Sample List of Items

Set A	Set B
Cassette tape	Tape player
Mitt	Softball
View-Master®	Pictures
Racecars	Car launcher
Markers	Paper
Bubbles	Blower
Lite Brite®	Pegs
Computer	Game
Juice	Straw
Play-Doh®	Fun Factory®

DTI and requesting the crayons was taught during mand training. A preference assessment, based on the procedures of Fisher and colleagues (1992), was conducted for each participant to determine his or her top 10 preferences from the standard pool. Items were selected for each participant if they were chosen at least 60% of the time relative to the other items being assessed. If 10 pairs of items were not obtained from the standard pool of items, an additional set of items was created containing items specific to the interest of that participant, as reported by the participant's parent or observed by the primary investigator. See Table 2 for a sample list of items used.

After each participant's items were chosen, an assessment was conducted to determine whether the participant could tact the items. If the participant could tact items in his or her set, a different label was given to the item. For example, for a participant who was able to tact "Thomas the train" as "Thomas," the item was labeled as "train." For participants who were observed to use more complex language, a more complex label was given to the item (e.g., "Thomas" became "Thomas the train"). This was done to ensure that all participants were starting at comparable levels with their vocabulary and to reduce the chance that a participant who was able to tact more items prior to training would acquire the skill faster than a participant who was unable to tact any items. Labels for each member of the pair were of equal difficulty, in terms of number of syllables, so that the language requirements for each participant in the two conditions would be comparable.

Experimental Design

The effects of both DTI and mand training were investigated through two concurrent multiple probe designs (Horner & Baer, 1978) across participants. In order to control for order effects, half of the participants (Maggie, Marcus, Oliver) were trained through mand training first followed by DTI, and the other half (Peter, Christian, and Ryan) were trained through DTI followed by mand training.

Procedures

Each participant received 1:1 instruction during daily sessions consisting of either mand training or DTI. All sessions were 20 min in length and no more than two sessions were conducted on a single day; typically, 8-10 sessions were conducted per week. All sessions were conducted by the first author in a small clinic room containing a table, chairs, and adequate floor space. Procedures are described in detail below and differences between the procedures are summarized in Table 3.

Mand Training

During mand training, all of the stimulus materials from Set A (nontarget items) were placed around the room and were all within reach of the participant, who was permitted to freely walk around throughout the session. The participant initiated a trial by indicating interest in an object by approaching it, reaching for it, pointing or using language to request it. All of the Set B items were kept in an opaque container, which was in view but out of the reach of the participant. Correct responses were reinforced with 30 s access to the pair of items. At the conclusion of the reinforcement period, each member of the pair was replaced to its original position so that the participant could initiate a subsequent trial. Trials were continued until 20 min had expired.

Baseline. Once the participant indicated interest in an item in the room, the instructor presented the target item (Set B) from the pair and briefly played with them together before giving the initial item back to the participant. The instructor held back the second part without prompting for up to 5 s. If the participant made a correct response, he or she was given access to the item for up to 30 s. If the partici-

Table 3
Procedural Differences Between DTI and Mand Training

	DTI	Mand training
Instructional Materials	Selected by Instructor	Selected by Child
Environmental Arrangements	Child sits at table across from instructor	Child moves around the room with instructor nearby
Controlling Variable	Discriminative Stimulus ("What do you want?")	Motivating Operation
Prompt Fading	Progressive time delay across sessions	Progressive time delay within sessions
Mastery Criteria	80% correct across 2 consecutive sessions	1 mand per minute across 2 consecutive sessions

pant did not correctly respond after 5 s but was still indicating interest in the item (e.g., pointing, grabbing, otherwise vocalizing), he or she was also given access to the item but this was not considered a correct response. This was done to approximate how parents may have been reinforcing their child's mands in the natural environment and also to pair the instructor with reinforcement from the beginning of the study, as is recommended by Sundberg & Partington (1998).

Training. The mand training procedures were set up and initiated exactly like the baseline assessment, however, the instructor held onto the target item and modeled the response (e.g., "I want crayon."). Successive approximations of the response were followed by social praise and access to the item for 30 s. If the participant made an error or did not respond after 5 s but was still indicating interest in the item, a second prompt was provided. As long as the participant was indicating interest in the item, prompts were continued approximately every 5 to 10 s. After the participant responded correctly to the instructor's model for a specific item at least 2 times within a session, the prompt was faded during subsequent trials with that item. If the participant did not respond independently and was still indicating interest in the item, a model was provided after approximately 5 s.

If a participant requested only one item across two consecutive sessions, this item was removed from the array for the remainder of the training. This was to prevent the participant from focusing exclusively on one item and to increase the variety of items for which the participant could potentially request. The removed item was replaced by the next highest preferred item according to the participant's preference assessment and was used as a replacement item for the remainder of training. This occurred only one time (for Marcus) throughout training.

If a participant was playing with the nontarget item only and was not indicating interest in its partner target item, the nontarget item was removed from the participant and put back into the array of items after 15 s. The instructor attempted to contrive interest in another set of items. If a participant returned to the same item and was playing inappropriately or engaging in self-stimulatory behavior with the item for more than 2 min, the pair was removed from the remainder of that daily session and returned to the array for the next daily session. This situation occurred only once (for Maggie) throughout training. Finally, if the participant was not indicating interest in any of the items, the instructor played with the pair to contrive interest and continued playing with different pairs of items until the participant indicated interest. Requesting, as taught by mand training, was considered mastered when the participant was requesting at a rate of at least one per minute over two consecutive sessions.

Discrete Trial Instruction

During DTI the participant was seated at a table with the instructor. The instructor determined when to present each stimulus item according to a randomly ordered list. Prior to each training trial the instructor provided the participant with the item from the selected pair that he or she was not being taught to request (i.e., Set B). One trial was conducted on each item before moving onto the next item on the list. Once the list was complete, the instructor repeated the process from the beginning of the list. Trials were conducted until 20 min had expired. Three different lists of the random order of item presentation were created for each participant and the lists were rotated for each session to increase the probability that the items would be taught at equal rates.

Each trial was also interspersed with high-probability tasks at a ratio of 1:2. High-probability tasks varied among participants and such information for individual participants was obtained from their parents or through a brief informal assessment. Because there may or may not have been a motivating operation in effect for the item selected by the instructor for the training trial, there was a possibility of a lower level of reinforcement during DTI. Thus, the purpose of interspersing trials with high-probability items was to ensure a rich overall level of reinforcement in the discrete-trial condition. Compliance resulted in high quality social praise or attention.

Baseline. After being presented with the nontarget item from Set B, the participant was presented with its partner from Set A and asked "What do you want?" No prompts were given. A correct response was followed by access to the pair of materials for up to 30 s. Nonresponses were ignored and the next pair of items was presented. If, after 5 s, the participant was indicating a desire for the target item (Set A), such as by reaching, pointing, grabbing, or vocalizing, the participant was given access to the pair of items but the trial was marked as incorrect. This was done to correspond with the similar procedure in the mand training baseline.

Training. The training procedures were set up like the procedures in the baseline phase such that the participant was initially given the nontarget item from the pair. This was followed by the presentation of the target Set A item from that pair along with the S^D "What do you want?". In contrast to the baseline procedures, initial trials were immediately prompted with a zero time-delay prompt (e.g., "say, 'I want the ____.' "). Once the participant reached the criterion of 80% correct over two consecutive sessions, the prompt was faded to a 2-s time delay, followed by a 5-s time delay after meeting the same criterion. Finally, after achieving a criterion of 80% correct over two consecutive sessions with a 5-s time delay, the prompt was removed and only used during the correction procedure. Correct responses were followed by social praise and access to the requested item for 30 s. Errors or nonresponses were ignored during that trial and a correction trial was implemented during which the response was immediately prompted. Subsequently, the missed trial was re-presented with the appropriate prompt level. After two incorrect trials, the next pair of items was presented and the item was re-introduced as designated by the list. Requesting, as learned through DTI, was considered mastered if the participant attained 80% correct independent responding over two consecutive sessions across ten pairs of items.

Response Requirements

Response requirements were comparable across conditions. Specific requirements were determined by the instructor based on an informal assessment of the participant's verbal repertoire during the initial sessions. Requirements ranged from the name of the item only, to the name of the item with a carrier phrase (e.g., 'want (item name)' or 'I want (item name)'). Maggie, Marcus, and Ryan were taught to request using "I want (item name)." Initially, Oliver was also taught to request using "I want (item name)" but his response requirement was reduced to just the item name after he demonstrated difficulty with acquisition. Peter was taught to request using "want (item name)" and Christian was taught to use only the name.

Dependent Variables

Frequency data were collected on two dependent variables: independent requests and echoic requests. Independent requests were defined as correct responses or approximations of the target word or phrase that occurred without a model from the instructor; echoic requests were defined as correct responses or approximations of the target word that occurred within 5 s of the

instructor's model. Additionally, in order to compare variety in requests between the two teaching conditions, data on the number of different items requested (independent or echoic) during each training session were collected. Data were taken live by the instructor, with a portion of the sessions also coded by a second independent coder for inter-observer agreement.

In addition, eye contact and challenging behaviors were observed as measures of social engagement. Both were coded from videotapes by independent observers. Eye contact was defined as the participant directing his/her gaze toward the instructor's face. Observations of eye contact were coded using a 15-s momentary time sample. Due to technical difficulties or camera obstructions, not all sessions could be coded. In total, 92.2% of DTI sessions (Maggie, 81.3%; Marcus, 76.5%; Oliver, 100%; Peter, 100%; Christian, 97.1%; Ryan, 100%) and 76.9% of mand training sessions (Maggie, 71.4%; Marcus 62.5%; Oliver 75%; Peter, 100%; Christian, 100%; Ryan 81.8%) were coded. Challenging behavior was defined broadly to capture the variety of behaviors exhibited by the participants and included crying, screaming, hitting, throwing materials, running away from the instructional area, noncontextual vocalizations, and self-stimulatory behavior (e.g., tensing the body). Observations of challenging behavior were coded using a 1-min partial interval procedure. As with eye contact, not all sessions could be coded due to technical difficulties. In total, 96.1% of DTI sessions (Maggie, 100%; Marcus, 82.4%; Oliver ,100%; Peter, 100%; Christian, 97.1%; Ryan, 100%) and 90.4% of mand training sessions (Maggie, 100%; Marcus, 75%; Oliver, 83.3%; Peter, 100%; Christian, 100%; Ryan, 91%) were coded.

Inter-Observer Agreement

Inter-observer agreement (IOA) was collected on all variables. The event recording method (IOA = (smaller frequency/larger frequency) x 100) was used for the requesting variables, and agreement data was collected across all participants and all conditions. During acquisition, IOA was assessed for 53.2% of sessions and yielded an average agreement of 93.7%. The interval-by-interval method was used to collect agreement data for both eye contact and challenging behaviors. Data was collected for 37.3% sessions for eye contact and 33.1% of sessions for challenging behaviors and yielded an average of 92.1% and 90.8%, respectively.

Procedural Integrity

In addition, procedural reliability was observed to ensure that the procedures for DTI and mand training sessions were implemented as planned. An independent observer completed a checklist of items specifying the exact procedures that should be followed and rated whether each component was completed properly. This was done for 10% of randomly observed sessions across participants and across training conditions. The average procedural integrity was 97.1% for DTI sessions and 97.7% for mand training. The main procedural component that was not consistently implemented correctly was the time allowed for reinforcement. Specifically, reinforcement periods were occasionally 35–40 s rather than 30 s and typically depended on the participant's behavior at the time.

Social Validity

Following the completion of the training, each participating child's parent was provided with four randomly obtained videotaped samples of the training as a measure of social validation. Samples included two examples of both training procedures, one from the first half of training and one from the last half. Due to the parents' strong interest in the training methods used, the entire 20-min session was included for each participant, and parents were asked to watch at least 5 min of each session before rating it. They rated each sample on six dimensions using a scale of 1 (not at all) to 5 (very much). The dimensions included engagement, appropriate eye contact, appropriate communication, enjoyment, amount of learning, and whether the parents would use the teaching procedure again in the future.

RESULTS

Requesting Variables

Mand Training Followed by Discrete Trial Instruction

As shown in Figure 1, two of the three participants receiving mand training prior to DTI

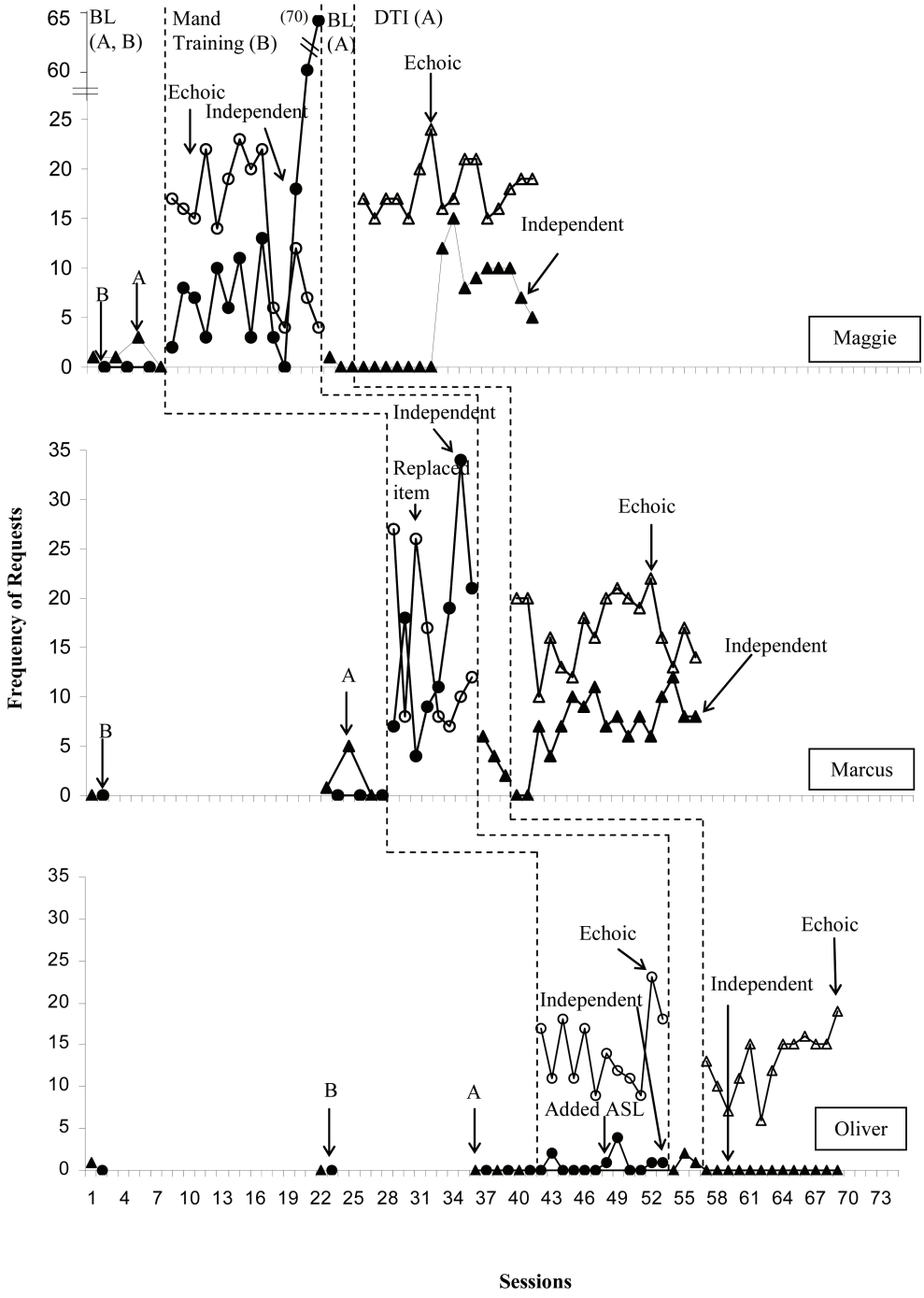

Figure 1. Independent and echoic requests in mand training followed by DTI (BL (A,B) = baseline for set A & B items; BL (A) = baseline for set A items).

(Maggie and Marcus) made more independent requests and required fewer sessions to meet criterion in the mand training condition than in the DTI condition. The third participant (Oliver) made few or no independent requests in either condition.

Maggie and Marcus. Neither Maggie nor Marcus made any independent requests for Set

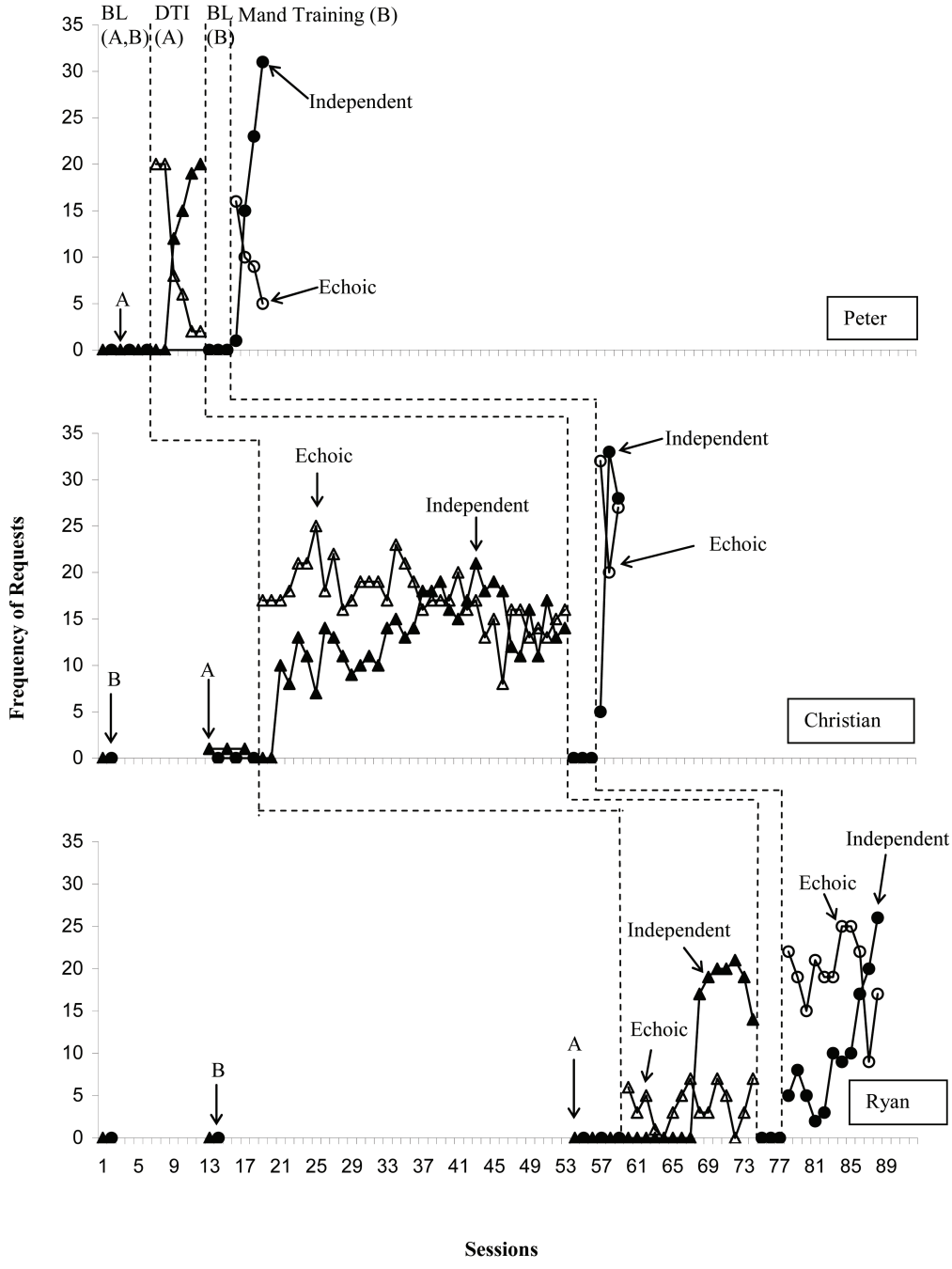

Figure 2. Independent and echoic requests in DTI followed by mand training (BL (B,A) = baseline for set B & A items; BL (B) = baseline for set B items).

B items during the initial mand training baseline. However, Maggie made an average of 1.25 (range 0–3) and Marcus made an average of 1.5 (range 0–5) independent requests for Set A items during the initial DTI baseline. During the mand training phase, Maggie made an average of 15.3 independent requests (range 0–70) and 14.4 echoic requests (range 4–23), although her performance was variable. She required 14 sessions to meet the mastery crite-

rion for mand training. Marcus made an average of 13.7 independent requests (range 4–34) and 14.4 echoic requests (range 7–27) with a significant increasing trend as compared to the mand training baseline. He required 8 sessions of mand training to reach the mastery criterion.

In the subsequent DTI baseline, Maggie made an average of 0.3 independent requests (range 0–1) and Marcus made an average of 4 independent requests (range 2–6) for Set A items. In the DTI condition, Maggie made an average of 5.4 independent requests (range 0–15) and 17.9 echoic requests (range 15–24). She required 7 sessions at the 0-s time delay prompt before reaching criteria for moving to the next prompt level in the teaching procedure. Nine additional sessions were conducted at the 2-s time delay prompt level during which she showed an initial increase, followed by a plateau and then eventually a decrease. Maggie did not meet the criterion for mastery in the DTI condition and made an average of 33.0% independent requests (range 20.8–45.5%) during the 2-s time delay. Marcus made an average of 7.1 independent requests (range 0–12) and 16.9 echoic requests (range 12–22) for Set A items. He required the minimum of two sessions at the 0-s time delay prompt level before reaching the criterion for moving to the next prompt level. Fifteen additional sessions were conducted at a 2-s time delay during which his performance stabilized. Like Maggie, Marcus did not reach the mastery criterion for DTI before his performance stabilized. He made an average of 33.1% of independent requests (range 20–48%) at this prompt level.

Oliver. During the initial baseline conditions Oliver made no independent requests for the Set B items in the mand training baseline and an average of 0.25 independent requests (range 0–1) for the set A items in the DTI baseline. During the mand training condition, Oliver made an average of 0.7 independent requests (range 0–4) and 14.2 echoic requests (range 9–23) for Set B items. Due to limited progress after 6 sessions of mand training, additional prompts were added in the form of American Sign Language (ASL) and the response requirement was modified such that a reduced vocal or sign response would be accepted. Despite this, Oliver showed a negligible change compared to baseline and this condition was discontinued. Three additional DTI baseline sessions were conducted during which Oliver made an average of 1.0 independent request (range 0–2) for Set A items. Twelve sessions of DTI were conducted and included the additional ASL prompts. However, Oliver did not make any independent requests during any of these sessions. All twelve sessions were conducted at the 0-s time delay prompt level and his average percentage correct was 48.5% (range 20.8–68.4%). His percentage correct at this prompt level exhibited some variability and little increase. This condition was also discontinued after 12 sessions.

Discrete Trial Instruction followed by Mand Training

As shown in Figure 2, all participants in this group (Peter, Christian, and Ryan) made more independent requests and required fewer sessions to meet criterion in the mand training condition than in DTI. During the initial baseline conditions, all 3 participants made 0 or near-0 independent requests. In the subsequent DTI condition, Peter made an average of 11 independent requests (range 0–20) and 9.7 echoic requests (range 2–20) across 6 sessions, by the end of which he had met criteria for mastery in this condition. Christian made an average of 13.0 independent requests (range 0–21) and an average of 17.3 echoic requests (range 8–25) during the DTI condition. Two sessions were conducted at the 0-s time delay prompt level followed by 33 sessions at the 2-s time delay prompt level. Although Christian's independent requests showed a slow steady increase, this condition was discontinued at the 2-s time delay prompt level after his performance decreased slightly and he was no longer making progress. Ryan made an average of 8.7 independent requests (range 0–21) and 15.2 echoic requests (range 4–26). Eight sessions were conducted at the 0-s time delay prompt level followed by seven additional sessions at the 2-s time delay prompt level. This condition was discontinued after Ryan's performance stabilized and therefore he did not reach the mastery criteria.

In the subsequent mand training baseline, none of the participants made any independent requests for Set B items. During the mand training condition, Peter made an average of 17.5 independent requests (range 1–31) and an

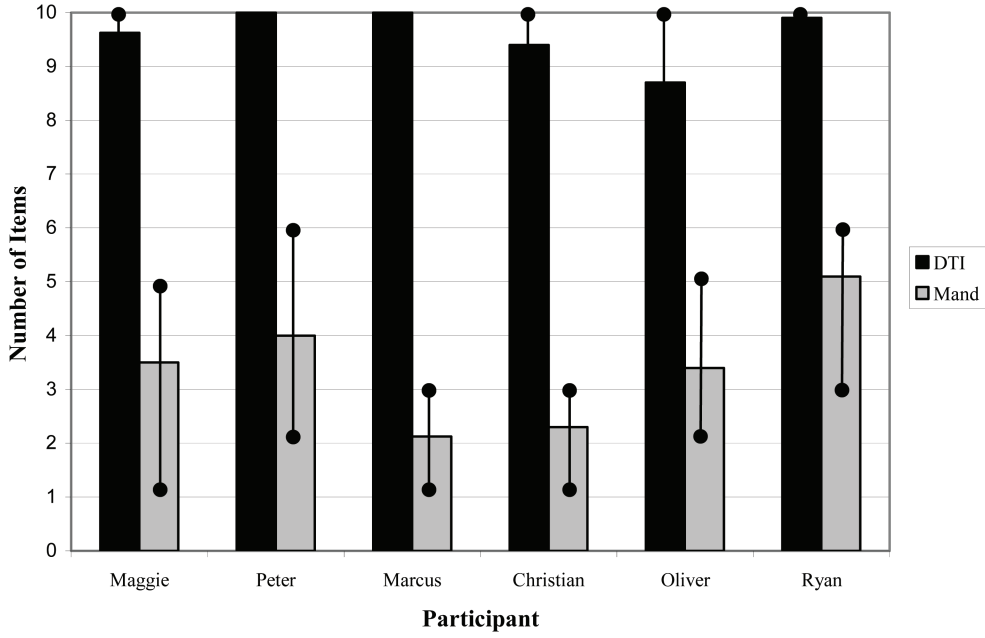

Figure 3. Average number of items taught for each participant in DTI and mand training.

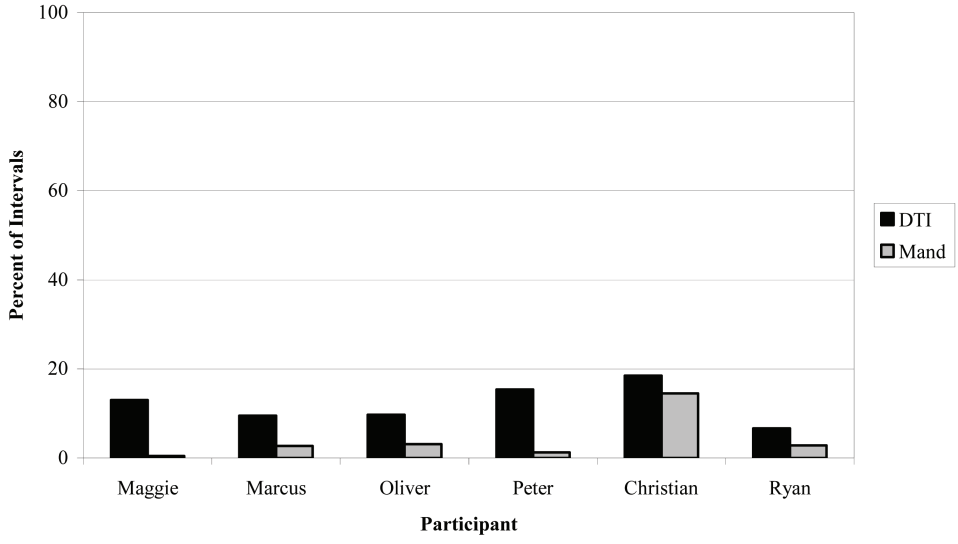

Figure 4. Percent of intervals with eye contact during DTI and mand training.

average of 10 echoic requests (range 5 – 16). He required 4 sessions to meet the mastery criterion. For Christian, 3 sessions of mand training were conducted during which he made an average of 22 independent requests (range 5–33) and an average of 26.3 echoic requests (range 20–32) for Set B items. Ryan made an average of 10.5 independent requests (range 2–26) and an average of 20.6 echoic requests (range 15–25) for Set B items and 11 sessions were required before he met mastery criterion.

Number of Items

All 6 participants requested more items in the DTI condition than in the mand training

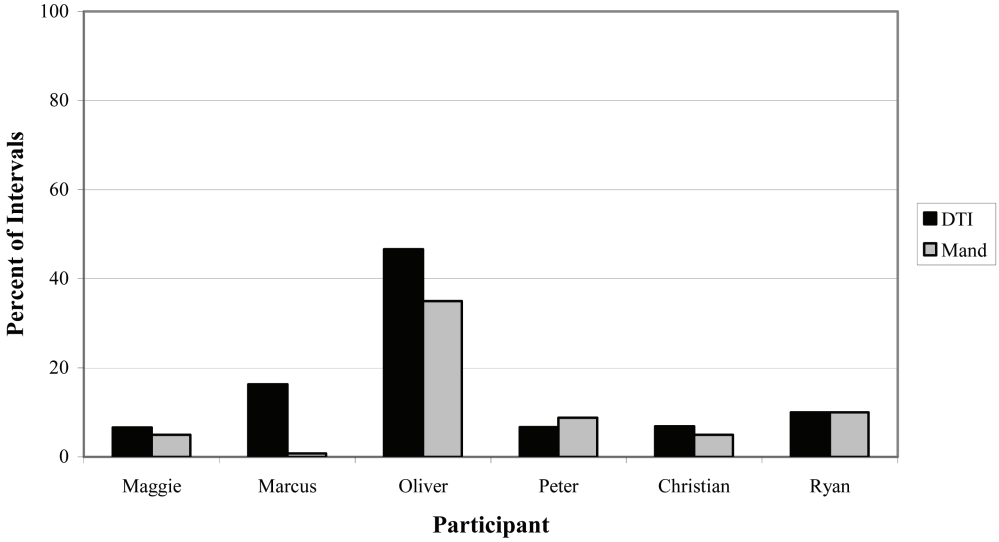

Figure 5. Percent of intervals with challenging behaviors during DTI and mand training.

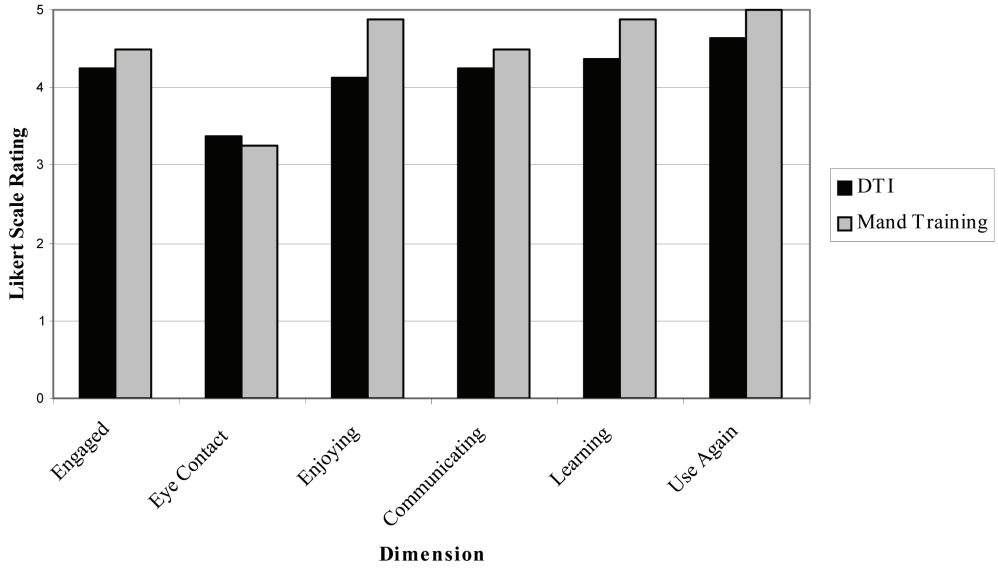

Figure 6. Social validity ratings from parents of participating children for DTI and mand training.

condition. On average, a participant learned to request 9.6 items per DTI session and 3.4 items per mand training session. In DTI, all the participants had the opportunity to request all 10 items in at least half of the sessions. In contrast, the maximum number of items a participant learned to request in a mand training session was 6. Figure 3 shows the average number and range of items learned per session for each participant.

Eye Contact and Challenging Behavior

As shown in Figure 4, all participants had more eye contact during DTI sessions than during mand training sessions. More specifi-

cally, the average percent of intervals with eye contact during DTI ranged from 6.7 % to 18.5 %, whereas the average percent of intervals with eye contact during mand training ranged from 0.5 % of intervals to 14.5 %. As shown in Figure 5, two of the participants (Marcus and Oliver) engaged in more challenging behavior during DTI than during mand training while the other four engaged in approximately equal levels across conditions. Specifically, Marcus engaged in challenging behavior during an average of 16.3% of intervals (range 5–35) during DTI, and an average of 0.8% of intervals (range 0–5) during mand training. The primary topographies of his challenging behaviors were running away from the instructional area and throwing materials. Oliver engaged in challenging behaviors during an average of 46.6% of intervals (range 10–90) during DTI, and during an average of 35% of intervals (range 10–50) during mand training. During DTI and mand training, the primary topographies of Oliver's challenging behaviors were noncontextual vocalizations and crying. He also engaged in tensing during DTI but not during mand training. The other four participants rarely exhibited challenging behaviors but when they did the primary topographies were running away from the instructional area, throwing materials, and crying, and these occurred equally across conditions.

Social Validity

The videotaped samples and social validity rating scales for each participant were sent to all of the participating parents except Oliver's. A clinical decision was made not to send the samples to his parents since he did not make any progress. All of the other parents completed the surveys. Data are reported in Figure 6 and show that parents rated both teaching methods favorably but tended to favor mand training slightly over DTI on all dimensions except eye contact. Specifically, average ratings indicate that parents rated their child's engagement (DTI, x=4.25, mand training, x=4.5), child's enjoyment (DTI, x=4.13, mand training, x=4.88), child's appropriate communication (DTI, x=4.25, mand training, x=4.5), child's learning (DTI, x=4.38, mand training, x=4.88), and their own desire for future use (DTI, x=4.63, mand training, x=5) slightly higher in mand training sessions than in DTI sessions. In contrast, the parents' average ratings of eye contact favored DTI (x=3.38) over mand training (x=3.25).

DISCUSSION

In this study, the effects of DTI and mand training on the acquisition of requests were compared using concurrent multiple probe designs across participants. Each training procedure was implemented as it is typically conducted while controlling for opportunities for reinforcement and preference in order to investigate the role of the motivating operation. The results suggest that, although both mand training and DTI facilitate acquisition of requests in participants with autism, mand training facilitates increased spontaneous requesting and at a faster pace. Five out of the six participants made more independent requests for items when the motivating operation was considered than when preferred items were delivered contingent upon correct requests for which there may or may not have been a motivating operation in effect. In addition to making more requests, these five participants also met the mastery criteria in fewer sessions in the mand training condition than in the DTI condition.

Although five participants showed the pattern described above, perhaps it is best highlighted by Christian's performance. In the discrete trial condition, Christian acquired the skill at a slow and steady pace and after 35 sessions, this condition was discontinued due to the stability of his responding. In contrast, he met mastery criteria for the mand training condition in only three sessions and made an average of nine more independent requests per session than in the DTI condition. Prior to training, Christian did not engage in any vocalizations related to the items; he typically pointed to or grabbed them. It is possible that his rapid increase in responding in the mand training condition was primed by his recent history of reinforcement for vocal responses in the discrete trial condition. However, if reinforcement alone were responsible for the increase in his responding, one would expect to see a similar increase in the discrete-trial condition at some point in the training. This and the fact that a similar pattern of results was obtained for four other participants suggests that the motivating operation was the primary factor in his speed of acquisition. Thus it is hypothesized

that Christian would show a similar pattern of results if the order of training were reversed.

Across both teaching conditions, preference and opportunities for reinforcement were held constant since the same highly preferred stimuli were used in both conditions and consequences for a correct response were specific to the response. However, it can be assumed that the mand training condition involved richer reinforcement because focusing on the motivating operation, by definition, guaranteed that more desirable items were delivered in this condition. In contrast, because there may or may not have been a motivating operation in effect for the items in the DTI condition, it can be assumed that some items may have had less value during their trials and therefore may not always have functioned as reinforcers. Anecdotal observations from the DTI condition indicated that the majority of the participants sometimes indicated interest for other items aside from the one that was selected by the instructor for that trial. A few participants cried or otherwise expressed anger and frustration when trials were conducted with items in which they were not interested at the time or when items for which there was a strong motivation were removed and a new item was presented. In the mand training condition, the participant was able to continue playing with the item for as long as there was a motivating operation.

Another factor likely to facilitate increased responding in a mand training session is that following the motivating operation allows for an increased number of learning opportunities. This is best demonstrated by Peter's performance. Although he showed the pattern of making more requests and requiring fewer sessions to meet criterion in the mand training condition he was the only participant to meet criteria in the DTI condition. He met the prompt-fading criteria in the minimal amount of sessions and was independently requesting at the desired level by the time he was receiving the 5-s time delay prompt. The slope of his acquisition curves across the two conditions is about equal. Peter did as well as could be done in the discrete trial condition but still made more requests and met the mastery criteria faster in the mand training condition. His performance across conditions highlights the difference between a restricted operant and a free operant. The discrete trial condition was a restricted operant such that the pace and the number of learning opportunities were controlled by the instructor. In contrast, the mand training condition represented a free operant condition such that the participant and the motivating operation controlled the pace and the number of learning opportunities. Thus, Peter was possibly able to acquire the skill more quickly in the mand training condition because he was in control of the pace and the number of learning opportunities.

In principle, a free operant setting allows for a greater number of learning opportunities because there is no ceiling on the number of responses made by the learner. While this generally favors increased responding for many learners, it may also allow for a decreased number of learning opportunities for a child whose naturally occurring motivating operation maybe more limited compared with what the pace of an instructor may provide or for a learner with a strong motivating operation for inappropriate behavior, such as self-stimulation or tantrumming. In these situations, the learner may benefit from more structured teaching paced by an instructor or from more creativity by the instructor in contriving other motivating operations or shifting the child's focus.

Although five of the six participants acquired different levels of requesting in both mand training and DTI, Oliver did not acquire the skill in either condition. Initially, the response required of him was "I want (item name)." As with all the participants his response requirement was determined based on an informal assessment of his language abilities during the initial assessment period. During this time he was observed to speak in several-word phrases and some full sentences, thus, he was erroneously assessed to have the ability to produce a full sentence to make requests. However, after six sessions of mand training, Oliver was not making any independent requests. It is notable that he also tended to require about three or four modeled responses in order to emit an echoic request. Sometimes he persisted through these multiple prompts and at other times his focus shifted elsewhere. It was hypothesized that imitation was difficult for him and an informal imitation assessment indicated poor performance with general imitation skills. In a 10-min assessment of gross motor and vocal imitation with dense reinforcement, Oliver was only able to imitate 47% of the tasks. As a result, the response requirement was decreased to the name of the

item and additional prompts were added so that Oliver would have a greater opportunity of contacting reinforcement more quickly. In addition to the typical verbal models provided for all the participants, an American Sign Language (ASL) sign representing the desired items was used following a most-to-least prompting strategy. Thus, Oliver was first physically prompted to emit the sign while the vocal response was modeled simultaneously, then the sign and the vocal response were modeled simultaneously, followed by no prompts. Despite this, independent requesting did not increase and remained at near zero levels.

Although no formal data were taken on engagement with the materials, anecdotally Oliver was observed to be almost continuously engaged with the target stimuli during the baseline period. He also indicated a desire (e.g., by grabbing) to regain access to the materials once they were removed. However, once training had begun, his engagement with the materials and nonvocal mands to regain access to them decreased. His engagement was replaced by challenging behaviors, particularly noncontextual vocalizations and tensing his upper body. Data collected on challenging behaviors indicate that prior to any training, Oliver engaged in challenging behaviors during an average of 12% of intervals during the DTI baseline and during an average of 16% of intervals during the mand training baseline. However, as noted in the results section, this level increased to about 35% during mand training and 47% during DTI and the trend indicated a steady increase throughout training. This increase may have occurred naturally, but another possibility is that the introduction of the demand to imitate language, which was difficult for him, altered the motivating operation away from engaging with the target stimuli and toward engaging in other reinforcing activities (e.g., self-talk, tensing).

In addition to the differential impact of each teaching method on the acquisition of independent requests, this study sought to explore the suggestion that children with autism should receive mand training as the initial intervention (Drash et al, 1999; Shafer, 1994; Sundberg & Partington, 1998). This was accomplished by training half of the participants with mand training followed by DTI and the other half in the reverse order. The results indicate that mand training provides faster acquisition of the skill regardless of the order in which it is implemented, which suggests that this language intervention procedure is a more efficient method for teaching children to request items. Although the results also indicate that acquisition using DTI is slower than with mand training, the design of the current study does not allow us to determine whether performance in one condition has an impact on the speed of the subsequent condition. Future studies using an alternating treatments design might provide more information regarding the speed of acquisition by directly comparing the two conditions and might answer the question as to efficiency.

Finally, this study investigated whether there would be more eye contact and fewer challenging behaviors during mand training than during DTI. With regard to eye contact, the results are counter to the hypothesis that there would be more eye contact during mand training than during DTI. All of the participants in this study had previous experience with DTI and the preacademic skills, such as sitting in a chair and attending to materials that are typically taught with DTI. It is possible that this history and the common practice in DTI of establishing the child's attention prior to issuing an instruction inflated the amount of measured eye contact during DTI. It is also notable that during DTI, the participant was usually sitting across from the instructor during teaching whereas in mand training, the participant could be anywhere in relation to the instructor. Therefore, there may be more opportunities for eye contact in DTI based on its structure. The hypothesis that participants would engage in more eye contact during mand training was based on the belief that the instructor would be paired more with reinforcement during the mand training condition and therefore would be more socially desirable. However, many of the parents who rated the social validity of these sessions, rated mand training slightly lower than DTI for appropriate eye contact and many noted that their children appeared to be looking at the toys more than at the instructor.

With regard to challenging behaviors, the results provide some support for the hypothesis that the participants would engage in fewer challenging behaviors during mand training. Two of the participants fit this pattern while the other four engaged in approximately equal levels of challenging behavior irrespective of the teaching condition that was in place. None of these six participants had major behavior prob-

lems and perhaps the results with children who have more severe problem behavior would be more useful. However, both Marcus and Oliver engaged in challenging behaviors during DTI that interfered significantly with their learning because these behaviors were incompatible with the teaching procedures.

During the mand training condition, most of the participants exhibited challenging behaviors such as leaving the instructional area, possibly because of a shift in the motivating operation. Future studies or applied clinical practice could modify the procedures of this study to expand the range of items and activities that children with autism are being taught to mand. This could possibly reduce the level of challenging behavior during mand training found in the current study even further. However, similar modifications are more difficult to make in a DTI session because the additional behavior is incompatible with the teaching procedure where the instructor is making the decisions of what items to present and teach.

This study also demonstrated clinical significance, as shown through the social validity ratings. In addition, at various points in training, four of the six participants' parents commented that their children were spontaneously requesting more for items or activities at home, something that was not observed prior to the training sessions.

Based on the results of this study, advantages of following the motivating operation include faster acquisition, a greater number of requests per time period, and fewer challenging behaviors. The advantage of the teacher-directed and paced instruction, as set up in the study, is that the learner is being exposed to more stimuli and could potentially learn to request a greater variety of items. In the present study the teaching procedures were implemented as they are typically and the results indicated that in a free operant situation children with autism may focus on only a few items at a time. Therefore, it is possible that the quicker acquisition during the mand training procedure was because the participants were not required to learn to request every item in the set. It may have been easier for the participants to meet the criteria in the mand training condition because it did not specify that a certain number of items needed to be requested correctly, as in the DTI condition. It is possible that in mand training the participants learned to request fewer items more consistently due to increased opportunities to practice but that in DTI they learned to request a greater number of items but inconsistently. Future research should compare the two types of teaching procedures while controlling for the number of items that are being taught.

This study focused on teaching children with autism to request preferred items using multiple prompts and thus represents one of the first steps in mand training as outlined by Sundberg and Partington (1998). That is, the mands being taught were not *pure* mands which are controlled only by an establishing or motivating operation. Rather, they were multiply controlled by the motivating operation, tact prompts (i.e., the presence of the item) and often by echoic prompts (i.e., the modeled response). The requests being taught in the DTI condition were controlled by the discriminative stimulus (i.e., the instruction "What do you want?") but also by tact and echoic prompts. Future studies could also investigate the acquisition of pure mands such that the item being taught is not in the view of the learner but rather hidden so that the true influence of the motivating operation can be investigated.

REFERENCES

American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders* (*Text Revision)*. Washington DC: Author.

Bruininks, R.H., Woodcock, R.W., Weatherman, R.F., & Hill, B.K. (1996). *Scales of Independent Behavior—Revised*. Itasca, IL: The Riverside Publishing Company.

Delprato, D. J. (2001). Comparisons of discrete-trial and normalized behavioral language intervention for young children with autism. *Journal of Autism and Developmental Disorders, 31*, 315–325.

Drash, P.W., High, R.L., & Tudor, R.M. (1999). Using mand training to establish an echoic repertoire in young children with autism. *Analysis of Verbal Behavior, 16*, 29–44.

Drash, P.W., & Tudor, R.M. (1993). A functional analysis of verbal delay in preschool children: Implications for prevention and total recovery. *Analysis of Verbal Behavior, 11,* 19–29.

Dunn, L.M., & Dunn, L.M. (1997). *Peabody Picture Vocabulary Test—Third Edition.*

Circle Pines, MN: American Guidance Service, Inc.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*, 491–498.

Horner, R.D., & Baer, D.M. (1978). Multiple-probe technique: A variation of the multiple baseline. *Journal of Applied Behavior Analysis, 11*, 189–196.

Koegel, R.L., Camarata, S., Koegel, L.K., Ben-Tall, A., & Smith, A.E. (1998). Increasing speech intelligibility in children with autism. *Journal of Autism and Developmental Disorders, 28*, 241–251.

Koegel, R.L., O'Dell, M.C., & Koegel, L.K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism and Developmental Disorders, 17,* 187–200.

Koegel, R.L., Koegel, L.K., & Surratt, A. (1992). Language intervention and disruptive behavior in preschool children with autism. *Journal of Autism and Developmental Disorders, 22*, 141–153.

Koegel, R.L., Russo, D.C., & Rincover, A. (1977). Assessing and training teachers in the generalized use of behavior modification with autistic children. *Journal of Applied Behavior Analysis, 10,* 197–205.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36,* 407–414.

McGee, G.G., Krantz, P.J., & McClannahan, L.E. (1985). The facilitative effects of incidental teaching on preposition use by autistic children. *Journal of Applied Behavior Analysis, 18,* 17–31.

Miranda-Linne, F., & Melin, L. (1992). Acquisition, generalization, and spontaneous use of color adjectives: A comparison of incidental teaching and traditional discrete-trial procedures for children with autism. *Research in Developmental Disabilities, 13*, 191–210.

Neef, N.A., Walters, J., & Egel, A.L. (1984). Establishing generative yes/no responses in developmentally disabled children. *Journal of Applied Behavior Analysis, 17*, 453–460.

Shafer, E. (1994). A review of interventions to teach a mand repertoire. *Analysis of Verbal Behavior, 12*, 53–66.

Skinner, B.F. (1957). *Verbal Behavior*. Englewood Cliffs, NJ: Prentice Hall, Inc.

Sundberg, M.L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behavior Modification, 25*(5), 698–724.

Sundberg, M.L., & Partington, J.W. (1998). *Teaching Language to Children with Autism or Other Developmental Disabilities*. Pleasant Hill, CA: Behavior Analysts, Inc.