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Evaluation of the Efficiency of and Preference for Analog versus Mand Training on the Acquisition of Mands for Children with Autism Spectrum Disorder

By

Melissa L. King

A DISSERTATION

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in Partial Fulfillment of the Requirements

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Medical Sciences Interdepartmental Area Graduate Program

Psychology Department

(Applied Behavior Analysis)

Under the Supervision of Doctor Therese L. Mathews

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Evaluation of the Efficiency of and Preference for Analog versus Mand Training on the Acquisition of Mands for Children with Autism Spectrum Disorder

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University of Nebraska, 2015

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The present study provides a systematic replication of the Jennett, Harris, and Delmolino (2008) study comparing discrete trial instruction (DTI) and mand training on the acquisition of mands for children with autism spectrum disorder (ASD). An adapted alternating treatment design was implemented across three participants. Independent mands, variation in requested items, and duration of sessions were assessed across conditions. Generalization probes were conducted to assess generalization across communication partners (e.g., novel research assistants), along with a maintenance probe one-week post-training. Furthermore, a concurrent-chains arrangement was implemented to assess participants' preference for teaching strategies. All participants reached mastery criterion quickest with mand training. Implications, limitations, and areas of future research are discussed.

Keywords: autism, mand training, DTI

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Introduction

Typical language development occurs at various periods in the second and third year of a child's life. Pre-speech develops in infants in the form of crying, cooing, and babbling. Initial vocalizations occur in the form of crying, an unconditioned response, which is present since birth (Schlinger, 1995). Once differing forms of crying come in contact with specific consequences (e.g., receive food for a hunger cry and picked up for a pain cry), crying begins to come under the control of the environment (operant conditioning) (Schlinger, 1995). Within the first two months of life, infants begin cooing, and at 5 to 6 months of age, babbling is typically present. It is not until 6 to 10 months when infants produce consonant-vowel (CV) sounds and/or echolalic babbling (Schlinger, 1995). It is presumed that typically developing infant pre-speech (e.g., cooing and babbling) is developed and maintained by access to conditioned reinforcers (e.g., vocalization matches products of the verbal community); and later shaped to match vocalizations produced by the verbal community independent of access to conditioned reinforcers (Schlinger, 1995). However, for individuals diagnosed with autism spectrum disorder (ASD), language may not develop typically.

A defining feature of ASD is impairment in social interaction and communication, including verbal and nonverbal communication (American Psychiatric Association, 2013). A specific impairment of verbal communication includes delayed speech and language development. According to most recent literature, approximately 53% of children diagnosed with ASD will not acquire fluent speech by age 4 or older, and approximately 70% of children with ASD will only acquire phrase speech (Wodka, Mathy, & Kalb, 2013). For children that do not develop functional language, inappropriate or problem behaviors may come to function as the main source of communication (Sundberg & Partington, 1998). Early intervention is essential for

children with ASD to acquire functional language (e.g., Lovaas, 1987; National Autism Center [NAC], 2015; Sundberg & Partington, 1998). The most well-established interventions for individuals diagnosed with ASD are those specifically employing behavior analytic methodology to teach language (NAC; National Autism Center, 2009).

Behavior Analytic Methodology

Due to its generality, the principles of behavior analysis are common features of empirically-supported strategies to teach speech and language. Positive reinforcement is provided immediately following a response and used to increase the future frequency of a behavior. For example, when an infant begins to babble, a caregiver immediately repeats the babbling sounds and provides attention to the infant. Therefore, the attention delivered by the caregiver contingent on infant babbling increases the likelihood of the infant babbling in the future to access the caregivers' attention.

Shaping is another common strategy used to increase speech production of individuals with limited vocal verbal repertoires. Shaping involves differential reinforcement of successive approximations (e.g., "b" and "ba") to a terminal behavior (e.g., whole word production of "ball"). Differential reinforcement involves reinforcing appropriate responses along a dimension of behavior (e.g., frequency, duration, or magnitude) while placing all other responses on extinction (reinforcement withheld) (Cooper, Heron, & Heward, 2007). As a result of using shaping procedures, children with few vocalizations may increase their vocal speech in the form of sounds, approximations, or whole words (e.g., Lovaas, Koegel, Simmons, & Long, 1973).

Prompting is a strategy used to occasion a response following the delivery of a discriminative stimulus in order for the child to contact reinforcement for vocalizations. For example, a clinician may deliver the instruction, "say ball". In order for the child to respond appropriately when the instruction (discriminative stimulus) is presented, the clinician will simultaneously deliver an echoic prompt ("ball") to evoke the response "ball" then deliver a reinforcer. Transfer of stimulus control from the prompt to the discriminative stimulus is achieved

by fading prompts and implementing a prompt delay procedure (e.g., Touchette & Howard, 1984). For the above example, in order for the child to independently say, "ball" immediately after the delivery of the instruction to "say ball", the clinician will fade the intrusiveness of their prompt (e.g., partial verbal; "ba") and subsequently delay the presentation of a prompt.

Empirically-Supported Strategies to Teach Speech and Language

There is substantial empirical support for behavioral approaches to teaching emerging speech and more sophisticated language (NAC, 2009, 2015). Numerous behavioral teaching strategies specifically teach speech and language to remediate the debilitating communication deficits most often inherent with an ASD diagnosis. Earliest research supports using naturalistic teaching strategies (e.g., Hart & Risley, 1968) and discrete trial instruction (DTI; Lovaas, 1987) to teach early language while more contemporary research supports an applied verbal behavior approach (Sundberg & Partington, 1998).

Naturalistic Teaching Approaches (NTA). For at least two decades, speech and language acquisition procedures have focused on naturalized language acquisition for children with language delays (e.g., Charlop-Christy & Carpenter, 2000; Hart & Risley, 1968; Koegel, O'Dell, & Koegel, 1987). Naturalistic teaching strategies (NTA) emerged with early language teaching strategies described by Hart and Risley (1968) referred to as incidental teaching (IT). Incidental teaching was originally developed to expand the language of typically developing disadvantaged children through prompting and modeling more elaborate language (Hart & Risley, 1968). Episodes of incidental teaching occur during loosely structured sessions in which a child initiates an episode by prolonged attending to stimuli or indication of desired tangible stimuli. Numerous tangible stimuli are presented in a variety of contexts in the natural environment (e.g., play setting at home). When conducting IT sessions, there are no predetermined target responses to gain access to the tangible items (preferred item). For example, a child might indicate a desire to play with the doll by reaching for the doll. The clinician requires any vocalization (sound or word) in order for the child to gain access to the doll. Loose shaping procedures (e.g., no

systematic protocol) are used to shape more elaborate sounds or words. Several variations of naturalistic teaching strategies have been developed from the incidental teaching literature (Pivotal Response Training [PRT], Koegel, Koegel, Harrower, & Carter, 1999; Modified Incidental Teaching Session [MITS], Charlop-Christy & Carpenter, 2000; Natural Language Paradigm [NLP], Koegel, O'Dell, & Koegel, 1987; milieu teaching, Alpert & Kaiser, 1992; mand-model, Rogers-Warren, & Warren, 1980).

McGee and colleagues (1999) developed and examined an incidental teaching approach/program for children with autism known as the Walden Toddler Program (McGee, Morrier, & Daly, 1999). Services provided were both in-home and center-based. Hallmarks of the Walden Toddler Model include: (a) early access to intervention, (b) intensive number of hours of intervention (30 hours per week), (c) family involvement, (d) inclusive classrooms with typically developing peers, and (e) planned incidental teaching episodes. Toddlers with ASD enrolled in the study increased their vocalizations from 36% echolalic and perseverative speech at program entry to 82% vocalizing meaningful words upon exiting the program approximately one year later. The researchers of the Walden Toddler Program emphasized that incidental teaching in conjunction with discrete trial teaching was necessary as the natural environment may not offer a sufficient number of learning opportunities.

Discrete Trial Instruction (DTI). In 1987, Ivar Lovaas published a groundbreaking study that evaluated a behavioral treatment program for children diagnosed with ASD that yielded encouraging results. The experimental group received 40 hours of intensive, one-to-one treatment per week over two years. The control group received 10 hours or less of the same one-to-one treatment, referred to as minimal treatment. Results improved outcomes in IQ scores, language skills, and communication domains of broad screeners (e.g., Vineland Adaptive Behavior Scales) for participants in the experimental group making the participants indistinguishable from their first grade peers.

A lasting contribution of the Lovaas (1987) study was the development of a specialized form of instruction known as DTI (discrete trial instruction). DTI is a structured teaching format in which instructions are broken down into small units (trials) comprised of (a) a cue or discriminative stimulus (S^D), (b) prompt, (c) student response, (d) a consequence, and (e) an inter-trial interval (ITI). The inter-trial interval is a brief pause following the consequence and before the presentation of the subsequent S^D (Lovaas, 1987; Smith, 2001). DTI is considered an established intervention for language acquisition with early programming emphasizing acquisition of receptive skills (e.g., following directions, object identification, motor imitation) and/or expressive labeling of objects or pictures (Kates-McElrath & Axelrod, 2006; LeBlanc, Esch, Sidenar, & Firth, 2006; NAC, 2009).

Procedural components of DTI. Several procedural components founded in behavior analytic principles are imperative to reliable implementation of DTI. During implementation of DTI, reinforcement is delivered on a continuous schedule initially and faded to a thinner schedule of reinforcement. Token economies and choice boards can be incorporated to increase motivation for individual learners, as needed (Kates-McElrath & Axelrod, 2006). Instructions are delivered in a one-to-one teacher-student ratio with the student facing the teacher during instruction. The environment is void of distractions by using physical barriers (e.g., dividers). Numerous trials are delivered in order to provide multiple opportunities for the child to contact the contingencies. Initial programming in a DTI program focuses on errorless learning (e.g., most-to-least prompting, progressive prompt delay, stimulus fading, and blocked errors). For example, when teaching a new skill, the instruction is delivered simultaneously with a prompt to occasion the response and then reinforcement is delivered contingent on the response. Discrete trial instruction has been referred to as "analog" because of the contrived environment and the structure is different from the natural environment (Cowan & Allen, 2007; Delprato, 2001). Common stimuli in the natural environment that may interfere with acquisition are removed (e.g., removal of

siblings from the learning environment or turning off a television in the room) or minimized to promote and improve stimulus control.

Criticisms of DTI. Despite the overwhelming evidence to support the approach to teach skills, there have been tremendous criticisms about DTI. Criticisms include: (a) lack of generalization outside of the training environment, (b) lack of spontaneity (rote responding), and (c) lack of skills maintained by the contingencies in the natural environment when tangible reinforcers are removed (Smith, 2001). When teaching using discrete trial instruction, it is presumed that skills are taught within a narrow range of settings and with a narrow range of stimuli, limiting generalization (e.g., Steege, Mace, Perry, & Longenecker, 2007). Rote responding may occur due to the repetitive presentation of trials, and skills may not maintain because the individuals current motivating operations are not used during teaching opportunities; reducing the likelihood that natural contingencies maintain the acquired skills (Sundberg & Partington, 1998).

Generalized Motor Imitation. Generalized motor imitation is an additional behavioral teaching strategy used by some behavior analysts and speech and language pathologists to increase vocal speech, however there is limited empirical support. Ross and Greer (2003) described a procedure in which children were taught to fluently imitate ten motor movements prior to the delivery of the vocal response intended for the child to imitate. Once the children consistently imitated the model's vocalization, the rapid motor imitation sequence was faded. Additionally, the child was provided opportunities to mand (request preferred items) following opportunities to vocally imitate. Despite promising results, researchers were required to teach participants to fluently imitate motor movements prior to implementing the procedure, which averaged between 8 to 22 months to complete. Delaying implementation of a communication intervention to teach a pre-requisite skill, such as generalized motor imitation, could be detrimental for children with ASD due to the necessity of early intervention to remediate communication deficits.

Applied Verbal Behavior (AVB). Recently, applied verbal behavior has gained popularity in teaching language to children with ASD, however, there is limited research to support this approach. The applied verbal behavior approach incorporates discrete trial instruction into the natural environment. It relies heavily on B. F. Skinner's conceptual analysis of verbal behavior and language acquisition, with an emphasis on teaching mands as the first verbal operant through mand training (Sundberg & Michael, 2001; Sundberg & Partington, 1998). When programming for language acquisition, the applied verbal behavior approach focuses on early mand (requesting) training and transfer of stimulus control procedures to teach other verbal operants (Kates-McElrath & Axelrod, 2006). For example, mand training may be the initial focus of language programming but other operants (e.g., tacting, echoics) may be targeted in order to provide a comprehensive language acquisition intervention.

Procedural components of AVB approach. There are several components of the AVB approach that are conceptually rooted in behavior analysis. Initially, there is an emphasis on establishing the instructor as a conditioned reinforcer using pairing and stimulus fading procedures (see Sundberg & Partington, 1998). Similar to DTI programming, instructions are delivered in a one-to-one student-teacher ratio while using errorless teaching procedures, but unlike DTI, AVB programming can occur both in an analog setting and the natural environment. An additional characteristic of AVB is that previously acquired verbal behavior is used to prompt novel repertoires (Drash, High, & Tudor, 1999). For example, if a child has an established echoic repertoire (independently repeating the words of another speaker), the instructor will use echoics to begin teaching a mand for a specific item.

Manding. Mands (requesting something the individual wants) are the first type of verbal behavior typically acquired by humans (Skinner, 1957), in which the form of the verbal response is controlled by what the individual wants (establishing operation) (Sundberg & Michael, 2001). Each specific mand is consequated with a specific reinforcer (Sundberg & Michael, 2001). For example, an individual mands for (requests) water after running a marathon by saying, "I want a

bottle of water". The individual's response is consequated by receiving a bottle of water. Manding allows individuals to control access to conditioned (e.g., toys) and unconditioned (e.g., edibles) reinforcers, which directly benefits the speaker (Sundberg & Michael, 2001). When early language learners establish a manding repertoire, they "begin to establish the speaker and listener roles that are essential for further verbal development" (Sundberg & Michael, 2001). Due to manding occurring under the motivating conditions, mands are more likely to be emitted spontaneously and generalize more quickly. Research suggests "that mand training is more enjoyable for both parties, inappropriate behavior occurs less, and that children are more willing to participate in language training activities" (Sundberg & Michael, 2001).

Vocal Mand Training. Vocal mand training is a method to teach vocal requesting to individuals with communication deficits, such as individuals with autism spectrum disorder. Bourret, Vollmer, and Rapp (2004) suggest that vocal mands should be the first method taught because the response is more likely to be reinforced outside of the training environment in the natural environment (Bourret, Vollmer, & Rapp, 2004). However, vocal manding can be difficult to teach due to idiosyncratic variability among children such as (a) an item lacking reinforcing value, (b) no mand has been established for a particular item, (c) lack of generalization, (d) insufficient reinforcement for manding, or (e) faulty stimulus control. Common behavioral procedures used during vocal mand training include reinforcement, shaping, prompting, and prompt fading (Bourret, Vollmer, & Rapp, 2004). When teaching language, shaping can be enhanced when combined with an echoic prompt (say the specific name of the item). However, an echoic prompt must always be faded to ensure pure mands are emitted (Bourret, Vollmer, & Rapp, 2004).

Echoic training. Behavioral language training research originated with verbal imitation training (Sundberg & Partington, 1998) and for many years was the conventional approach to teaching vocal verbal behavior to nonverbal children with autism (Drash, High, & Tudor, 1999). Basic operant techniques such as shaping, reinforcement, and prompting were used to shape

sounds into words and establish a vocal imitative repertoire (Drash, High, & Tudor, 1999; Sundberg, 1990). However, limited attention was paid to Skinner's analysis of verbal behavior (Skinner, 1957) and echoic behavior (a speaker repeats the vocal behavior of others; Schafer, 1994). Echoic training involves reinforcement of successive approximations to the target response following the delivery of a vocal stimulus (Cooper, Heron, & Heward, 2007). The goal of establishing an echoic repertoire is to prompt other verbal operants. Unfortunately, establishing echoic control can prove difficult for some children and echoics have to be taught within a mand context due to the differing consequences; specific reinforcement is delivered for mands and praise is delivered for echoics (Drash, High, & Tudor, 1999). Schafer (1994) suggested that mand repertoires can be acquired more hastily than an echoic repertoire. Furthermore, Hall and Sundberg (1987) advocated that language treatment programs focusing on echoic training are less effective compared to mand training because the environmental variables that evoke and maintain mands are more powerful.

Analog versus Mand Training

While DTI is an efficacious and effective teaching strategy for learners diagnosed with ASD, it is not the only strategy to teach language. Numerous learning opportunities may be provided during DTI sessions but fewer learning opportunities may be provided with naturalistic teaching strategies due to waiting for ideal motivation. When teaching language to children with ASD that exhibit deficits in verbal communication, clinicians using naturalistic strategies may wait for incidental occasions to capture natural motivating conditions (Hart & Risley, 1975). While naturalistic procedures reduce the concerns with generalization compared to discrete trial instruction, waiting for ideal motivation may provide fewer learning opportunities and ultimately lead to decreased and inefficient language acquisition. The applied verbal behavior approach, specifically mand training, may address the limitations of both DTI and naturalistic teaching strategies but limited research is available.

Evidence-Based Language Development Teaching Strategies

Few studies have compared the efficiency and generalizability of established language acquisition strategies (e.g., DTI and AVB) for children with autism (Cowan & Allen, 2007; Kates-McElrath & Axelrod, 2006; Jennett, Harris, & Delmolino, 2008). To date, Jennett, Harris, and Delmolino (2008) were the first to investigate discrete trial instruction (DTI) and mand training on the acquisition of mands. These authors evaluated the effects of DTI and mand training on the acquisition of mands (requests) by using a multiple probe design across participants. Six children with ASD participated in the study. Three participants were exposed to mand training followed by DTI while three participants were exposed to DTI followed by mand training. Results indicated that mand training yielded more mands, faster acquisition of mands, and less instances of challenging behavior. Eye contact was slightly better in the DTI condition. Overall this study suggests that participants acquired mands more efficiently during mand training compared to DTI.

Despite the improved outcomes for the participants, there were several limitations to the study: (a) the authors failed to equate the number of opportunities to mand in each condition, (b) criteria differed for the number of items requested across conditions, (c) generalization of the manding skills were not assessed, (d) a lack of description of accuracy of vocalizations of the target mand, and (e) an empirically supported single subject design to compare two interventions was not used (alternating treatment design).

In the current study, we systematically replicated Jennett and colleagues (2008) research, although procedural modifications were implemented in order to determine the most efficient behavioral teaching strategy (DTI or AVB) in the acquisition of mands. Although the proposed study sought to provide empirical support for an efficient behavioral teaching strategy, it is not likely to be adopted and supported by relevant consumers (e.g., parents, teachers, researchers, or consumer) if the strategy is not considered socially acceptable (Wolf, 1978). Moreover, assessing acceptability of the behavioral teaching strategies is important for the consumer who directly experiences the intervention due to being valued stakeholders in the study.

Determining acceptability of interventions has proven difficult with young children with a limited vocal verbal repertoire (i.e., minimal expressive language). Nevertheless, a procedure known as a concurrent-chains arrangement was developed to directly assess preference for behavioral interventions for children with disabilities (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997). The concurrent-chains arrangement has been used to determine a preference for: forward or backwards chaining procedures (Slocum & Tiger, 2011), teaching strategies that differ on the amount of teacher directedness (Heal, Hanley, & Layer, 2009), availability of teacher attention (Tiger, Hanley, & Heal, 2006), and contingent versus noncontingent reinforcement under different schedules of reinforcement (Luczynski & Hanley, 2010). A concurrent chains procedure is arranged such that different colored stimuli are correlated with different interventions (or teaching strategies). A board with colored cards associated with each strategy is presented to the participant outside of the teaching environment. The participant is asked to pick/touch/give the one he or she likes best. Once the colored card is exchanged, the child experiences the contingency associated with the selected color in the respective room. The process is continued until the child consistently choses one color/strategy (e.g., Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Heal, Hanley, & Layer, 2009; Luczynski & Hanley, 2010). Thus, preferences were assessed by recording each child's selection of cues (colored cards) correlated with the teaching strategy. The preference evaluation assessed each participant's preference for the behavioral teaching strategies evaluated in the efficiency evaluation.

The purpose of the present investigation was to evaluate the efficiency of and preference for discrete trial instruction (analog) or mand training in the acquisition of mands. Efficiency of the behavioral teaching strategies was assessed by examining skill acquisition (i.e., percentage of correct manding per session and latency to mastery). In addition, direct measurement of each child's preference for a specific behavioral teaching strategy was determined by their selections over time in a concurrent chains arrangement. Furthermore, generalization and maintenance of

the acquired manding (i.e., requesting) repertoire was evaluated. The following research questions were investigated:

(1) What behavioral teaching strategy (DTI or mand training) is the most efficient (yields the quickest and most accurate acquisition of mands)?

(2) What behavioral teaching strategy produces maintained requesting for one week and generalized requesting with a novel research assistant?

(3) Which behavioral teaching strategy is more highly preferred?

Method

Participants

Participants were three toddlers with ASD aged 24 to 45 months (M = 33 months). The toddlers attended a university-based autism clinic serving uninsured and underserved toddlers with ASD. Inclusion criteria for participation included: (a) a medical diagnosis of an autism spectrum disorder, (b) aged 24 to 60 months, (c) limited or no vocal verbal behavior (i.e., requesting at a rate of less than one whole word or word approximation per minute during a 20-minute screening session), (d) minimal problem behavior (e.g., less than 5 occurrences of low intensity crying, kicking, or noncompliance) during the initial screening session, (e) no current enrollment in intensive early intervention services greater than 25 hours per week (f) no known oral-motor barriers impeding vocalization production (i.e., apraxia), (g) limited echoic repertoire: defined as between 2 to 20 echoics on group 1 of the Early Echoic Skills Assessment (EESA; Sundberg, 2008), (h) exhibit no more than Level 1 mand and tact skills on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008), and (i) emits at least 10 different sounds during the initial screening session.

Exclusion criteria included: (a) participants less than 24 months or older than 60 months of age, (b) having an extremely limited vocal verbal repertoire (i.e., emits less than 2 echoics on the EESA and/or less than 10 different sounds during the initial screening session), (c) having an extensive vocal verbal repertoire (i.e., Level 2 mand and tact skills on the VB-MAPP, emits more

than 20 echoics on the EESA, requests more than one word or word approximation per minute during the initial screening session), (d) engaging in moderate to severe problem behavior (e.g., greater than 5 occurrences of self-injurious behavior, aggression, or property destruction) during the initial screening session, (e) oral-motor barrier impeding vocalization production (i.e., apraxia), (f) uses an alternative mode of communication fluently (i.e., sign language, picture exchange communication system, or speech-generating device), or (g) hearing impairment. To maintain confidentiality, all participants were given pseudonyms. Informed consent was obtained by each participant's caregiver prior to initiating the study. The universities' Institutional Review Board (IRB) approved all study procedures.

Table 1 provides a summary of participant characteristics including chronological age, Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord, Luyster, Gotham, & Guthrie, 2012) module and range of concern or level of autism symptoms, Mullen Scales of Early Learning early learning composite score (MSEL; Mullen, 1995), Adaptive Behavior Assessment System, 2nd Edition (ABAS-II; Harrison & Oakland, 2000) global adaptive composite score, and Verbal Behavior Milestone Assessment and Placement (VB-MAPP) overall score. The ADOS-2 is a standardized assessment tool presented in a semi-structured format that assesses communication skills, social interaction skills, play/imaginative use of materials, and restricted and repetitive behaviors of individuals suspected of an autism spectrum disorder (Lord et al., 2012). The Mullen Scales of Early Learning was used to evaluate the participant's cognitive and motor functioning (Mullen, 1995). The ABAS-II was used to determine the participant's adaptive behavior and skills based on parent report (Harrison & Oakland, 2000). The VB-MAPP was used to determine each participant's skill repertoire (Sundberg, 2008).

Gary. Gary was 27 months when the study began. A licensed clinical psychologist diagnosed Gary with autism according to the *Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition* (DSM-V; American Psychiatric Association, 2013). During the initial screening session, Gary emitted two mands following echoic prompts, one mand independently,

and one generalized mand across people, settings, and stimuli. He emitted one tact and echoed four sounds independently. Gary received nine and a half hours of intensive, early behavioral intervention services per week throughout the duration of the study. In addition, he reportedly received one hour of speech services from the public school system one time per week.

Steve. Steve was 23 months at the time of his intake assessment and 24 months when the study began. A licensed clinical psychologist diagnosed Steve with autism according to the *Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition* (DSM-V; American Psychiatric Association, 2013). During the initial screening session, Steve emitted three mands following an echoic prompt, one tact, and echoed four sounds independently. Steve received nine and a half hours of intensive, early behavioral intervention services per week throughout the duration of the study. In addition, he reportedly received one hour of occupational therapy per week and one hour of speech services from the public school system per week.

Andrew. Andrew was 45 months when the study began. A licensed clinical psychologist diagnosed Andrew with autism according to the *Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition* (DSM-V; American Psychiatric Association, 2013). During the initial screening session, Andrew emitted two mands following an echoic prompt, one mand independently, one tact, and echoed 18 sounds independently. Andrew received 12 hours of intensive, early behavioral intervention services per week throughout the duration of the study. In addition, he reportedly received two hours of speech services from the public school system per week.

Setting and Materials

The study was conducted in therapy rooms at a Midwestern university-based community clinic for toddlers with ASD. Sessions were conducted for no more than 2 hours per day. Short breaks (e.g., 3 to 5 minutes) were provided between sessions. A video camera was used to record all sessions. A cube chair and a small table were used during the study. Preferred items were placed in boxes in the therapy room in sight but out of reach (refer to Table 2 for a list of all

preferred items used throughout the study). Participants only had access to the preferred items during session. A timer was used to record duration of sessions. All data were collected by paper and pencil on a 12 trial data sheet during sessions by the research assistant (see Appendix A). Each session was comprised of 12 trials across all conditions.

Measures

The primary dependent measure was percentage of correct mands (requests). Correct mands were defined as independently vocalizing the target word or approximation without a vocal prompt from the research assistant.

In order to assess procedural efficiency, the secondary dependent measures included the number of different items manded for (independently) during each session and the cumulative duration of sessions throughout the efficiency evaluation.

Social Validity

Caregivers. Following the completion of the study, caregivers were asked to review four videos of their child during baseline and treatment to determine if the treatment was socially acceptable. The caregivers rated the videos on a questionnaire using a 5-point Likert type scale (i.e., 1 = strongly disagree; 5 = strongly agree). Refer to appendix B for a sample questionnaire.

Research assistants. Following the completion of the study, each research assistant was asked to complete a questionnaire as the implementer of the intervention. The questionnaire used a 5-point Likert type scale (i.e., 1 = strongly disagree; 5 = strongly agree). Refer to Appendix C for a sample questionnaire.

Interobserver Agreement (IOA)

Interobserver agreement was recorded for 33% of the sessions for each participant during the entire study by a secondary observer. Interobserver agreement was calculated using the trial by trial method of adding the number of agreements and dividing by the number of agreements plus disagreements and multiplying by 100%. Agreement was achieved when both observers recorded the same response on a specific trial (e.g., both observers scored the participants

response as correct). Disagreement occurred when observers recorded different participant responses in a trial (e.g., the primary observer recorded an error and the secondary observer recorded a no response). The mean agreement scores for the efficiency evaluation were 80% (range, 17% to 100%) for Gary, 88% (range, 58% to 100%) for Steve, and 94% (range, 67% to 100%) for Andrew. During the preference evaluation, both observers scored 100% of the initial link selections for all participants and were in 100% agreement.

Treatment Integrity

Prior to beginning the study, research assistants were trained to implement all procedures using behavioral skills training (BST). Research assistants demonstrated all procedural steps with 100% accuracy during role-play before beginning the study. A secondary observer scored treatment integrity via videotaped sessions to ensure consistent implementation of the intervention. A checklist depicting the critical components of each phase of the intervention was used to score treatment integrity (see Appendices D-E for sample treatment integrity checklists for the efficiency and preference evaluations). Integrity was scored for 33% of sessions and calculated by dividing steps implemented correctly by the total steps of the checklist possible to be implemented and multiplied by 100%. Treatment integrity for the efficiency evaluation was 95% (range, 75% to 100%) for Gary, 98% (range, 90% to 100%) for Steve, and 99% (range, 92% to 100%) for Andrew. Treatment integrity for the preference evaluation was 98% (range, 95% to 100%) for Gary, 96% for Steve, and 99% (range, 88% to 100%) for Andrew.

Design

An adapted alternating treatment design (Sindelar, Rosenberg, & Wilson, 1985) was used to evaluate the efficiency of acquisition of mands across two behavioral teaching strategies. Two control conditions were implemented to evaluate the acquisition of requests in noninstructional conditions. In order to control for carryover effects and maturation, potential limitations of the adapted alternating treatment design, control conditions were implemented. All conditions were

counterbalanced and randomized to minimize sequence effects. The study was conducted with three participants in order to demonstrate replicability of the findings.

A concurrent-chains arrangement (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Heal, Hanley, & Layer, 2009; Slocum & Tiger, 2011) was used to assess participants' preference for behavioral teaching strategies in the acquisition of requesting skills.

Procedure

Four pre-treatment assessments were conducted prior to evaluating the efficiency and preference for the two teaching strategies. First, a paired choice preference assessment was conducted to identify preferred tangible items. Second, a tact assessment was conducted to determine each participant's tacting repertoire of the preferred items. Third, an echoic assessment was conducted to determine each child's ability to echo a model. Finally, a paired-choice color preference assessment was conducted to determine moderately preferred colors to be associated with each condition (i.e., mand, DTI, control).

Following the pre-treatment assessments, efficiency of acquisition of mands in different treatment conditions (i.e., DTI, mand training, and control) was evaluated based on the number of trials to mastery and duration of sessions to mastery. After the efficiency evaluation was complete, maintenance and generalization probes were conducted, followed by an evaluation for preference. Refer to Figures 1 and 2 for flowcharts outlining the procedural steps for mand training and DTI.

Pre-treatment Assessments

Preference assessment. The preference assessment was conducted prior to beginning the study. Prior to implementing the preference assessment, the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) was administered in an interview format, to a parent/guardian to identify preferred items. Based on the results of the interview, a free operant preference assessment was conducted in which approximately 20-30 items were placed on the floor and participants were allowed to engage with the items (Roane, Vollmer, Ringdahl, &

Marcus, 1998). Twelve of the items engaged with most frequently were chosen for inclusion in a paired choice preference assessment (adapted from Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992). The items were distributed between the various conditions and used throughout the duration of the study. Four items were used during the mand training condition (Set A), four items were used during the DTI condition (Set B), and four items were used during the control conditions (Set C) (refer to Table 2).

Tact assessment. Following the preference assessment, the research assistant conducted an assessment to determine whether the child could tact (label) each item. The research assistant held up one item at a time and said, "What is this?" If the child was able to tact the item and no other appropriate label was warranted, the item was removed and replaced with another preferred item from the set. If the child was able to tact the item but a more appropriate label was warranted, the research assistant said, "thank you". The primary investigator determined a different label to teach for the item. For example, if the child could already say, "fire" for "fire truck", the item was labeled "truck". If the child was unable to tact the item, the research assistant delivered the S^D up to three additional times. The primary investigator determined the terminal label for the item. The preferred items in each group had labels with similar levels of difficulty (i.e., same number of syllables and consonant/vowel or vowel/consonant) to ensure comparable response effort (language requirements) for each condition. Labels (terminal target response) were determined for each preferred item prior to beginning the study (see Table 2). The primary investigator consulted with a speech pathologist regarding speech requirements for each participant prior to beginning the next assessment.

Echoic assessment. An echoic assessment was conducted with each participant to identify the terminal target response (whole word or approximation) for each preferred item. The research assistant delivered an echoic prompt (e.g., terminal label identified from the tact assessment and ideal target vocalization for each preferred item). The participant had 3-5 seconds to emit a vocalization. The research assistant repeated the echoic prompt two additional times.

Then the research assistant identified the ideal and most consistent vocalization emitted by the participant as the terminal target response (whole word or approximation). For example, the research assistant said, "ball". If the participant said, "ba" consistently across three attempts, "ba" was chosen as the terminal target approximation. If the participant said, "ball" consistently across the three attempts, "ball" was chosen as the terminal target word.

Color preference assessment. A paired choice preference assessment (see Fisher et al., 1992) with ten colored cards was conducted with each participant. Each colored card was paired once with every other colored card. The order of card presentation was randomized. For each pair, (a) the research assistant held up two cards, (b) the instruction to "pick one" was delivered, (c) the research assistant allowed the participant 5-10 seconds to select (touch) a card, (c) the color card selected was recorded, and (d) a brief praise statement (e.g., "thanks") was delivered. A preference hierarchy was obtained upon completing the color preference assessment. Three moderately preferred colors were randomly assigned to each of the conditions throughout the entirety of the study (see Table 2).

Efficiency Evaluation

Baseline.

Mand training. During mand training baseline sessions, the research assistant placed the target preferred items on the floor, in sight but out of reach of the participant. When the participant reached for an item, the research assistant held up the item, thus initiating the trial. No prompts were provided. If the participant emitted the targeted mand within 3-5 seconds, the research assistant delivered access to the preferred item for 20-30 seconds. If the participant did not respond correctly (e.g., does not emit the target mand but vocalizes) within 3-5 seconds of the initiation of the trial, the research assistant placed the item back on the floor. If the participant did not respond within 3-5 seconds of the initiation of the trial, the research assistant placed the item back on the floor. Baseline data were collected until stability in data (e.g., decreasing or stable trend) were observed across 3 to 5 sessions (36 – 60 trials).

Discrete trial instruction. Discrete trial instruction (DTI) baseline sessions were conducted at the table. The research assistant held the preferred item in sight but out of reach while delivering the discriminative stimulus (S^D), "What do you want?" One preferred item was presented per 3-trial block with all four preferred items presented within each session. The sequence of the 3-trial blocks was randomly ordered within each session (i.e., three opportunities per each of the 4 items for a total of 12 opportunities per session). No prompts were provided. If the participant emitted the targeted mand within 3-5 seconds, the research assistant delivered access to the preferred item for 20-30 seconds. If the participant did not respond correctly (e.g., did not emit target mand but vocalizes) within 3-5 seconds of the initiation of the trial, the research assistant removed the item and presented the next trial. If the participant did not respond within 5 seconds of the initiation of the trial, the research assistant removed the item and presented the next item. Mastered tasks (e.g., previously acquired motor imitation, listener responding, or visual performance skills) were interspersed with mand trials at a 2:1 ratio (two mastered task trials to one mand trial) (see Table 3 for a list of mastered tasks for each participant). Correct responding for mastered tasks was reinforced with praise for every correct response (FR-1) and no programmed consequence were delivered for incorrect or non-responding. Baseline data were collected until stability in data (e.g., decreasing or stable trend) were observed across 3 to 5 sessions (36 – 60 trials).

Control baseline (Mand & DTI). Control baseline sessions were conducted identical to baseline mand training and DTI conditions except using Set C of preferred items. Control conditions were conducted to assess the participant's manding repertoire with a set of preferred items in the absence of formal teaching.

Intervention.

Mand Training. Prior to the participant entering the treatment area, the mand training condition was signaled by a specific colored card held by the research assistant until the

participant entered the treatment area and the research assistant wearing a specific colored shirt. Four preferred items from Set A were placed around the room and within reach of the participant. The participant was free to move about the room. A trial was initiated by the participant indicating an interest in an object by approaching the item, reaching for the item, or pointing to the item.

Shaping. When initially teaching (shaping vocalizations to the terminal response), the research assistant blocked access to the item, held up the item, and delivered a concurrent vocal prompt. If the participant emitted the terminal target response after a vocal prompt, the research assistant provided 20-30 seconds access to the requested item and verbal praise. If the participant emitted any approximation after a vocal prompt other than the target approximation or word, the research assistant provided 20-30 seconds access to the requested item and verbal praise. If the participant did not respond within 3-5 seconds of the initial vocal prompt, the research assistant repeated the vocal prompt an additional three times. If after the additional vocal prompts the participant emitted the target response, the research assistant provided 20-30 seconds access to the preferred item. If the participant continued to not respond or emitted the incorrect approximation, the research assistant removed the item and a new trial could begin. If at any time the participant emitted the terminal target response (approximation or word) during the initial teaching, any vocalization other than the terminal target response was scored and consequated as an independent approximation (i.e., delivery of 3 additional vocal prompts) in order to differentially reinforce the optimal response. After the participant accessed reinforcement, the item was replaced in the array about the room in order for the participant to initiate the next trial. If at any time the participant did not indicate an interest with any of the items, the research assistant would play with the items (i.e., throw items in front of child, flip item over, or press buttons to produce sounds) in an attempt to contrive interest in the item until the participant indicated an interest in the item.

Independent responding. Once the participant emitted the terminal target response (approximation or word) independently (in the absence of a concurrent vocal prompt), the research assistant blocked access to the item and held up the item on subsequent trials. If the participant independently emitted the terminal target response within 3-5 seconds, the research assistant provided 20-30 seconds access to the requested item and verbal praise. If the participant independently emitted an approximation within 3-5 seconds, the research assistant delivered a vocal prompt up to three additional times to prompt the terminal response. If the participant then emitted the terminal target response, the research assistant provided 20-30 seconds access to the preferred item. If the participant did not respond or emitted the incorrect response following the three additional prompts, the research assistant removed the item and a new trial could begin.

Mastery criteria was 83% (10 out of 12) or above correct mands across 2 consecutive sessions. Mand training ended (a) once the participant reached mastery criteria, (b) when a clear, stable differentiation between conditions was detectable, and (c) the participant had the opportunity to independently mand during DTI for a minimum of 3-5 sessions.

Fading of vocal prompt procedure. Once the participant correctly responded to the concurrent vocal prompt across 2 trials within a session, the vocal prompt was faded (partial vocal prompt) during the remaining trials with the specific item. If the participant did not independently respond after fading the prompt, the research assistant provided the least intrusive vocal prompt needed to evoke a response.

Discrete Trial Instruction. Prior to the participant entering the treatment area, the DTI condition was signaled by a specific colored card held by the research assistant until the participant entered the treatment area and the research assistant wearing a specific colored shirt. During DTI, the participant was seated at a table across from the research assistant. A randomly ordered list of preferred items from Set B guided the research assistant as to which preferred item to present. One preferred item was presented per 3-trial block with all four preferred items presented within each session. The sequence of the 3-trial blocks was randomly ordered within

each session. The trial began when the research assistant held up the target preferred item and said, “What do you want?” A progressive prompt delay procedure was employed throughout DTI including delivering a concurrent vocal prompt on a 0-second prompt delay (e.g., say, “label of item”).

Shaping. When implementing errorless teaching (0-s prompt delay), the research assistant differentially reinforced vocal topographies that resembled the terminal target response. If at any time the participant emitted the terminal target response (approximation or word) during the initial teaching (shaping vocalizations to the terminal response), any vocalization other than the terminal target response was scored and consequated as an independent approximation (i.e., correction trial). Once the participant obtained at least two out of three correct (terminal target word or approximation) with a partial verbal prompt over a 3-trial block, the prompt was faded and a 2-second prompt delay was employed, followed by a 5-second prompt delay after obtaining at least two out of three correct over a 3-trial block. After achieving three out of three correct over a 3-trial block with a 5-second prompt delay, prompts were discontinued (unless the progressive prompt delay procedure was re-implemented due to two errors occurring within a 3-trial block).

Independent responding. Once the participant emitted the terminal target response in the absence of the concurrent vocal prompt, differential consequences followed the participant’s responses. If the participant independently emitted the terminal target response (without the vocal prompt) within 3-5 seconds, the research assistant delivered access to the preferred item for 20-30 seconds and verbal praise. If the participant independently emitted an approximation within 3-5 seconds, the research assistant immediately implemented a correction trial. If the participant emitted the terminal target response within 3-5 seconds after the correction trial, the research assistant delivered access to the preferred item for 20-30 seconds and verbal praise. If the participant emitted an approximation within 3-5 seconds after the correction trial or did not respond, the research assistant removed the item and initiated the next trial. If at any time the participant did not respond within 3-5 seconds or the participant erred (e.g., incorrect target

word), the research assistant implemented a correction trial. During a correction trial, the research assistant re-presented the trial with a simultaneous partial or full verbal prompt. If the participant erred on two trials within a 3-trial block, the research assistant moved to the previous step on the progressive prompt delay. A new trial was initiated after the delivery of programmed consequences and a 5-second intertrial interval (ITI).

Mastered tasks were interspersed with mand trials at a 2:1 ratio (two mastered task trials to one mand trial). Correct responding for mastered tasks was consequated with praise for every correct response (FR-1). Incorrect and non-responding for mastered tasks resulted in physical guidance to engage in the correct response.

Mastery criteria was 83% (10 out of 12) or above correct mands across 2 consecutive sessions. Discrete trial instruction ended (a) once the participant reached mastery criteria and (b) when a clear, stable differentiation between conditions was detectable.

Control Conditions. The control conditions (mand training and DTI control conditions) were implemented in the same manner as the mand training and DTI baseline conditions. These conditions were implemented throughout the duration of the efficiency evaluation.

Generalization Probes. Generalization probes were conducted with a novel research assistant to assess generalization across people. Generalization probes were conducted following both baseline condition sessions and post intervention. One session was conducted consistent with each baseline condition. Generalization probes consisted of 12 trials (or opportunities) to mand for preferred items in each condition.

Maintenance Probes. One week following the completion of the intervention, maintenance probes were conducted. One session was conducted per condition and implemented identical to baseline conditions (e.g., mand baseline, DTI baseline, control baseline).

Preference Evaluation

The preference evaluation began with forced exposure sessions followed by an assessment of preference, as determined by initial link selections (selection of specific card associated with each condition).

Forced exposure. Training sessions exposed the participants to the different contingencies associated with each colored card. A white board with places for three colored cards was placed on the door directly outside of the treatment area. Each colored card was placed on the board in each position once. The primary investigator delivered the S^D, "Pick one" and physically guided the participant to remove the colored card from a board placed outside of the treatment area during the first training session. During subsequent training sessions, the primary investigator stood behind the participant and delivered the S^D, "Pick one" in a neutral tone every 20 seconds until the participant independently removed the colored card. Removing any card resulted in behavior specific praise (e.g., "Good touching the red card") and access to the terminal link (e.g., mand, DTI, and control sessions). DTI and mand training contingencies were conducted identical to the intervention of the efficiency evaluation. During the control condition, the research assistant sat in the corner of the room, void of any tangible items and all bids for attention were ignored. Attempts to remove numerous cards were blocked. The conditions were counterbalanced and the cards were randomly alternated when presented on the board.

The participant experienced 12 trials while in each room during the mand and DTI conditions. During the control condition, the participant experienced the contingencies for the average duration of both treatment conditions (DTI and mand) during the efficiency assessment. After 12 trials, the participant exited the room. The training continued until the participant contacted the contingencies paired with each color a minimum of three times and data were consistent with that of the efficiency evaluation.

Preference evaluation. Prior to the first session of the research block, the order of the presentation of colored cards was randomly determined. The cards were rotated counterclockwise following each subsequent session. The board with the colored cards was placed on the door

directly outside of the treatment area. Removing any card resulted in immediate praise and access to the terminal link. All terminal links (e.g., mand, DTI, and control sessions) were conducted identical to the forced exposure sessions. Each preference evaluation session was conducted for 12 trials each. After 12 trials, the participant exited the room. The preference evaluation continued until the participant selected one condition four consecutive selections over another condition and/or a cap of 30 sessions.

Results

Acquisition and Efficiency

The results of the participants' acquisition of mands are depicted in Figures 3, 4, and 5. Figure 3 represents the percentage of correct manding per session at baseline and during the treatment condition. During baseline, Gary engaged in low (8% during one baseline control mand session) to near zero levels of correct manding across all conditions. During treatment, Gary's responding was initially variable across each of the conditions (i.e., mand training, DTI, and control conditions). Gary reached mastery criteria (83% across 2 consecutive sessions) quickest with the mand teaching strategy (312 trials to mastery) while responding remained at 50% with the DTI teaching strategy and near zero for the control conditions, respectively. Gary never met mastery criteria in the DTI condition before differentiation was achieved.

Figure 4 represents the percentage correct manding per session from Steve's baseline and treatment. During baseline, Steve engaged in low to near zero levels of correct manding across all conditions. During treatment, Steve's responding was highly variable across all conditions. Steve reached mastery criteria quickest with the mand teaching strategy (528 trials to mastery) while responding remained at 42% with the DTI teaching strategy and near zero for the control conditions, respectively. Steve never met mastery criteria in the DTI condition before differentiation was achieved.

Figure 5 represents the percentage correct manding per session from Andrew's baseline and treatment. During baseline, Andrew engaged in zero level responding in DTI and control

conditions. Andrew engaged in high levels of responding in baseline during the mand condition but responding quickly decreased to near zero levels. During treatment, Andrew's responding initially remained at near zero levels across all conditions. As training continued, Andrew reached mastery criteria quickest with the mand teaching strategy (276 trials to mastery) while responding remained at 30% with the DTI teaching strategy and remained at near zero for the control conditions, respectively. Andrew never met mastery criteria in the DTI condition before differentiation was achieved.

By the end of the study, two out of three participants independently manded for all four preferred items in the mand training condition (refer to Table 4 for a graph depicting the number of different preferred items independently requested throughout the efficiency evaluation and the range of different preferred items requested within each session). Gary manded for four different preferred items within the mand training condition and two different preferred items within the DTI condition. Steve manded for four different preferred items within the mand training condition and two different preferred items within the DTI condition. Andrew independently manded for three of the four preferred items in the mand training condition while he independently manded for all four preferred items in the DTI condition.

Table 5 represents information to inform the rate of acquisition and efficiency of the teaching strategies. Gary reached mastery criteria with 2 hours 51 minutes of mand training. Alternatively, DTI was implemented with Gary for 2 hours 55 minutes without reaching mastery criteria. Steve reached mastery criteria with 4 hours 47 minutes of mand training. Alternatively, DTI was implemented with Steve for 5 hours 30 minutes without reaching mastery criteria. Andrew reached mastery criteria with 2 hours 41 minutes of mand training. Alternatively, DTI was implemented with Andrew for 2 hours 18 minutes without reaching mastery criteria. Rate of acquisition to mastery ranged from 1.7 to 1.8 trials per minute.

Maintenance and Generalization

The results of the participants maintenance and generalization probes at baseline and treatment are depicted in Figures 3, 4, and 5. Figure 3 represents Gary's responding during generalization and maintenance probes during baseline and treatment. During baseline generalization probes, Gary responded at 0% across all conditions. Following treatment, Gary independently and correctly manded at 92% during the mand condition generalization probe, 67% during DTI, and 0% during control conditions. Gary's responding maintained one week following the completion of treatment at 92% during the mand condition, increased to 58% during DTI, and maintained at 0% during control conditions.

Figure 4 represents Steve's responding during generalization and maintenance probes during baseline and treatment. During baseline generalization probes, Steve responded at 17% during DTI, 8% during control mand, and 0% during mand and control DTI, respectively. Following treatment, Steve independently and correctly manded at 33% during the mand generalization probes, 25% during DTI generalization probes, and 0% during control condition generalization probes, respectively. Steve's responding maintained but decreased one week following the completion of treatment to 58% during the mand condition, maintained at 42% during DTI, and 0% during control conditions, respectively.

Figure 5 represents Andrew's responding during generalization and maintenance probes during baseline and treatment. During baseline generalization probes, Andrew responded at 8% during the mand condition and 0% for the remaining conditions, respectively. Following treatment, Andrew independently and correctly manded at 100% during the mand condition generalization probe, and 0% for the remaining conditions, respectively. Andrew's responding maintained at 92% during the mand condition and 0% for the remaining conditions, respectively.

Preference Evaluation

Gary's preference evaluation results are depicted in Figure 6. During the first 15 sessions, Gary's initial link selections varied across conditions (i.e., mand training, DTI, and control). Gary

exclusively selected the control condition during the remaining sessions. These results suggest a relative preference for the control condition.

Steve's preference evaluation results are depicted in Figure 7. Steve selected the DTI condition first, then exclusively selected the mand condition. These results suggest a relative preference for the mand condition.

Andrew's preference evaluation results are depicted in Figure 8. Andrew selected the control condition first, the DTI condition second, then alternated between all conditions. These results suggest no relative preference for any condition. However, Andrew demonstrated a right side bias during the last 10 sessions of the evaluation.

These results suggest that only one participant showed a relative preference for the mand condition. None of the participants showed a preference for the DTI condition.

Social Validity

Caregivers. Caregivers completed a questionnaire after watching samples of baseline and treatment mand training and DTI sessions for their child. Data are reported in Table 6. Average ratings indicate that caregivers rated satisfaction with the ability to request after treatment (mand = 5, DTI = 4.8) and feasibility of the treatment (mand = 4.8, DTI = 3.8) higher in the mand training condition compared to the DTI condition. On average, caregivers reported that they somewhat agreed with the ability to understand their child's requests in the videos. All caregivers agreed with the importance of teaching requesting skills. Caregivers reported they were more likely to implement the mand training at home.

Research assistants. Research assistants completed a questionnaire following the completion of the study. The data are reported in Table 7. The average ratings from the questionnaire results indicate that research assistants rated the (a) effectiveness of the strategy to teach the child to request (mand = 4.67, DTI = 3.33, control = 1), (b) recommendation of the procedures (mand = 5, DTI = 3, control = 1), enjoyment in implementing the teaching strategies (mand = 3.67, DTI = 3, control = 1), and feasibility of the treatment (mand = 4.67, DTI = 3.33)

slightly higher in the mand training than in DTI. On average, research assistants reported to be neutral about the time requirements being reasonable to implement the study in its entirety. All research assistants believed it was important to use specific teaching strategies to increase vocalizations for children with ASD in this age group.

Discussion

This study compared two commonly used teaching strategies, mand training and DTI, in the acquisition of mands for children with ASD. Consistent with Jennett and colleagues (2008), mand training was found to be a more efficient and effective teaching strategy in the acquisition of mands. Additionally, mand training can be an approach that produces a broader mand repertoire, as demonstrated by more independent mands being acquired by the end of the study. Two of three participants (Gary and Steve) independently manded for all four preferred items in the mand training condition and only one participant (Andrew) independently manded for all four preferred items in the DTI condition. Results also favor the mand training in promoting generalization and maintenance. Two of three participants (Gary and Andrew) generalized their manding acquired in the mand training condition across research assistants and maintained their responding after one week. Manding generalized for one participant (Gary) and maintained for two participants (Gary and Steve) in the DTI condition. Mand training may have resulted in better generalization and maintenance of mands due to training occurring under the right evocative conditions.

For early language learners, identifying efficient procedures to teach language is important to help close the gap between a learners current communicative repertoire and that of their typically developing peers (Vladescu & Kodak, 2013). Previous research has demonstrated that language acquisition can be facilitated when establishing operations (EO's) are manipulated and specific reinforcement can be used (e.g., Hall and Sundberg, 1987; Michael, 1988). In this study, the mand training condition utilized motivating operations and the delivery of specific

reinforcement while DTI presented items that may or may not have had an establishing operation in place to mand. More specifically, during mand training, research assistants could capture momentary motivation when a participant reached or made prolonged eye contact with a tangible item. However, during the DTI condition, participants responded to the S^D, "What do you want?" with or without the presence of an EO. The current results support previous research that mands can be more readily acquired when taught under the right evocative conditions and specific consequences follow. Moreover, participants were able to acquire between three and four mands in three to five hours of direct teaching. With focused teaching time using mand training procedures, early learners may acquire more mands than if taught with DTI procedures.

Implications

Skinner's (1957) conceptual work has been widely disseminated both within and outside of the field of behavior analysis (Dixon, Small, & Rosales, 2007). However, over the years there has been increasing applied empirical support for Skinner's account of language. Our investigation provides further applied empirical support for Skinner's work. To date, this study is the first well-controlled experimental evaluation comparing mand training and DTI in the acquisition of mands.

Our study extends the applied verbal behavior literature in several aspects. Skinner (1957) suggested that mands should be taught under the ideal evocative conditions (i.e., natural environment), such as mand training, in order to capture the current motivating operations. Sundberg and Partington (1998) suggested that early language training (e.g., mands) should be conducted through naturalistic teaching strategies versus DTI. Unfortunately, little empirical support is available for the above statements. Carr and Firth (2005) recommended additional empirical support is needed for the quickly disseminated applied verbal behavior approach because of the discrepancies between published evidence and the increased use to teach early language learners. The current study provides empirical support for caregivers, practitioners, and researchers in the use of naturalistic teaching strategies (e.g., mand training) in the acquisition of

mands for early language learners due to (a) quicker acquisition of mands, (b) generalized and maintained responding, (c) increased acceptability for caregivers, and (d) increased acceptability for implementers.

Furthermore, Carr and Firth (2005) called for complete procedural descriptions when teaching early language learners using the applied verbal behavior approach. In order to provide a complete body of evidence for the applied verbal behavior approach, replications of current evaluations and results are needed. For successful replications, complete procedural descriptions are imperative. Procedural descriptions are found more readily in the DTI literature base than for naturalistic teaching strategies. Reasons for the limited amount of procedural descriptions for NET may include (a) staff must be highly trained to capture and contrive ongoing motivating operations, (b) staff must be highly trained to shape vocalizations, (c) data collection is complicated, (d) there is no specific script for implementation, (e) the staff may not be able to identify the child's motivation, (f) it can be cumbersome to always follow the child's momentary motivation and provide sufficient learning opportunities, and (g) each learner presents with a different language repertoire and learning history (Sundberg & Partington, 1998). The current evaluation provides a thorough procedural description to enable future replications.

Limitations

Some potential limitations of the current study should be noted. First, satiation with the preferred items occurred by the end of the evaluation. Participants began to throw the items after manding for the item. Furthermore, the duration of the mand training sessions increased by the end of the study which may also suggest satiation with the items (e.g., decrease in motivation to mand for the item). Anecdotally, an increase in engagement in challenging behaviors (e.g., throwing items after requesting the items, screaming, hitting research assistants) was observed in the DTI condition. Potential reasons for an increase in challenging behaviors in the DTI condition could be due to teaching responding under the wrong motivating conditions. In DTI, participants responded to the S^D, "What do you want?" without any manipulation or contriving of MO's.

The second limitation involved the control conditions. One way to potentially eliminate satiation with items, decrease the duration of the study, and decrease research assistant fatigue would be to probe control conditions instead of implementing an equal number of treatment conditions as control conditions. When implementing the control conditions, there was an observable decrease in compliance to mastered tasks and increase in challenging behaviors (e.g., crying, whining, and pushing toys away). The control conditions may have been aversive to the participants and research assistants, as indicated on the social validity questionnaire. Furthermore, the control conditions took away time that could have been used for treatment conditions.

The third limitation included potential threats to internal validity. When using an adapted alternating treatment design, carryover effects, maturation, history, and multiple treatment interference could threaten internal validity. To protect against threats to internal validity (a) control conditions were implemented to expose any potential carryover effects and (b) baseline data were collected to demonstrate current levels of responding in comparison to treatment in order to provide a convincing argument for effects instead of maturation or history as the reason for a change in behavior. Multiple treatment interference could be a possible threat to internal validity. Inherent in the adapted alternating treatment design is the use of unique sets of instructional items to not only increase discriminability but to potentially protect against and expose multiple treatment interference, if present. Furthermore, different colored cards were present throughout treatment to increase discriminability and signal the onset of each condition (e.g., Kazdin, 1982).

Fourth, treatment integrity errors could have posed as a potential limitation in the acquisition of mands for the participants. Each research assistant was given the freedom to make data-based and clinical decisions when shaping vocalizations to the terminal response during the mand training and DTI conditions. Due to mand training having a looser teaching procedure (e.g., requires more clinical judgement), the treatment integrity could have been compromised.

However, high treatment integrity scores would suggest that treatment integrity errors did not compromise the acquisition of mands for the participants in this study.

When implementing Gary's sessions, the teaching environment had numerous distractors (e.g., loud noises, multiple conversations, singing, therapy sessions). Due to the loud environment, assessing for IOA and treatment integrity proved difficult because the videos recorded all background sounds. The second observer had difficulty hearing the participant's responses, which may have contributed to the lower IOA and treatment integrity scores.

Fifth, the social validity questionnaire completed by the caregivers and research assistants may have needed clarification. While feasibility was defined as (a) the length of time to acquire requesting skills, (b) effort to implement treatment, and (c) ease of implementation, the questions surrounding feasibility may have better been described as acceptability for the caregivers. Unlike the caregivers, the research assistants were better prepared to answer questions regarding feasibility due to implementing the procedures.

Finally, the concurrent chain preference assessment may not have provided an accurate depiction of relative preference for teaching strategies. Only one of three participants demonstrated a relative preference for mand training. Andrew demonstrated idiosyncratic results (e.g., no particular pattern in responding) although his overt behavior in the session room indicated otherwise. When Andrew walked into the session room, he would go to the purple box with the preferred items for mand training. The research assistant would block access to the items and he would typically engage in challenging behaviors (e.g., crying and reaching for toys). Meanwhile, after numerous pairings of the mand training with the color purple, he did not pick the purple card during the preference evaluation. Future modifications of the concurrent-chains arrangement may benefit individuals with developmental disabilities to assess preference.

Future Research

The outcomes of the current study suggest several areas for future research. First, future research should replicate the current study in order to provide convincing empirical evidence to

support the common recommendation to teach early language learners mands using naturalistic teaching strategies. Second, future research should attempt to assess generalization across environments (e.g., home). It would be useful to develop standardized protocols to teach parents to effectively and efficiently implement behavioral strategies in the home environment. This could aid in (a) generalization of manding skills taught in the clinic or school setting, (b) provide more manding opportunities outside of the teaching environment, and (c) expand their child's current manding repertoire. Furthermore, the development of standard protocols could be used to inform service providers (i.e., behavior analysts, speech and language pathologists, and early childhood education teachers) how to effectively and efficiently implement behavioral strategies. This may be a departure from the norm for some providers following the Lovaas model. Third, future research should develop efficient methodology for identifying the best teaching strategy for various skills (e.g., tacts, echoics) and sensitive for individual learner idiosyncrasies (Lerman, 2015). Fourth, eye contact and challenging behaviors should be recorded in the future. Anecdotally, we observed an increase in eye-contact during the mand condition. We also observed an increase in challenging behaviors during DTI. Unfortunately, we do not have any empirical data to support our observations. Finally, future research should empirically evaluate if an extensive echoic repertoire effects acquisition of mands. Andrew demonstrated the fastest acquisition of mands but also demonstrated the most extensive echoic repertoire during the initial assessment of all of the participants in the study. Research suggests that an echoic repertoire is needed to increase vocalizations for children with autism (e.g., Leaf & McEachin, 1999).

While both strategies are established interventions to teach communication (NAC, 2015), the present evaluation suggests that mands are more efficiently acquired through mand training. Although our preference evaluation did not yield convincing evidence that mand training was a more highly preferred teaching strategy than DTI, formal assessment of participants' preference for various behavioral interventions should be included in future research.

References

Alpert, C. L. & Kaiser, A. P. (1992). Training parents as milieu language teachers. *Journal of Early Intervention, 16*(1), 31-52.

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders*. (5th ed.) Arlington, VA: Author.

Bourret, J., Vollmer, T. R., & Rapp J. T. (2004). Evaluation of a vocal mand assessment and vocal mand training procedures. *Journal of Applied Behavior Analysis, 37,* 129-144.

Carr, J. E., & Firth, A. M. (2005). The verbal behavior approach to early and intensive behavioral intervention for autism: a call for additional empirical support. *Journal of Early and Intensive Behavior Intervention, 2*(1), 18-27.

Charlop-Christy, M. H. & Carpenter, M. H. (2000). Modified incidental teaching sessions: a procedure for parents to increase spontaneous speech in their children with autism. *Journal of Positive Behavior Interventions, 2*(2), 98-112.

Cooper, J. O., Heron, T. E., and Heward, W.L. (2007). *Applied Behavior Analysis*. (2nd ed.). Upper Saddle River, New Jersey: Pearson Education, Inc.

Cowan, R. J. & Allen, K. D. (2007). Using naturalistic procedures to enhance learning in individuals with autism: a focus on generalized teaching within the school setting. *Psychology in the Schools, 44*(7), 701-715.

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*(3), 315-325.

Dixon, M. R., Small, S. L., & Rosales, R. (2007). Extended analysis of empirical citations with Skinner's *Verbal Behavior*: 1984-2004., *The Behavior Analyst, 30*(2), 197-209.

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

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.

Hall, G. & Sundberg, M. L. (1987). Teaching mands by manipulating conditioned establishing operations. *The Analysis of Verbal Behavior, 5*, 41-53.

Hanley, G. P., Piazza, C. C., Fisher, W. W., Contrucci, S. A., & Maglieri, K. A. (1997). Evaluation of client preference for function-based treatment packages. *Journal of Applied Behavior Analysis, 30*(3), 459-473.

Harrison, P. L. & Oakland, T. (2003). *Adaptive Behavior Assessment System* (2nd ed.). Minneapolis, MC: Pearson Assessment.

Hart, B. M. & Risley, T. R. (1968). Establishing use of descriptive adjectives in the spontaneous speech of disadvantaged preschool children. *Journal of Applied Behavior Analysis, 1*(2), 109-120.

Heal, N. A., Hanley, G. P., & Layer, S. A. (2009). An evaluation of the relative efficacy of and children's preferences for teaching strategies that differ in amount of teacher directedness. *Journal of Applied Behavior Analysis, 42*(1), 123-143.

Jennett, H. K., Harris, S. L., & Delmolino, L. (2008). Discrete trial instruction vs. mand training for teaching children with autism to make requests. *The Analysis of Verbal Behavior, 24*, 69-85.

Kates-McElrath, K. & Axelrod, S. (2006). Behavioral intervention for autism: a distinction between two behavior analytic approaches. *The Behavior Analyst Today, 7*(2), 242-252.

Kazdin, A. E. (1982). *Single-case research designs: methods for clinical and applied settings.* New York: Oxford University Press.

Koegel, L. K., Koegel, R. L., Harrower, J. K., & Carter, C. M. (1999). Pivotal response intervention I: overview of approach. *Journal of the Association for Persons with Severe Handicaps, 24*(3), 174-185.

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*(2), 187-200.

Leaf, R. & McEachin, J. (1999). *A work in progress: behavior management strategies and a curriculum for intensive behavioral treatment of autism.* New York, NY: DRL Books.

LeBlanc, L. A., Esch, J., Sidener, T. M., & Firth, A. (2006). Behavioral language interventions for children with autism: comparing applied verbal behavior and naturalistic teaching approaches. *The Analysis of Verbal Behavior, 22,* 49-60.

Lerman, D. C. (2015). *Linking Assessment and Treatment in Acquisition Programs for Children with Autism.* Invited presenter at Ninth Annual Autism Conference. Las Vegas, NV.

Lord, C., Luyster, R. J., Gotham, K., & Guthrie, W. (2012). *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) Manual (Part II): Toddler Module.* Torrance, CA: Western Psychological Services.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting & Clinical Psychology, 55,* 3-9.

Lovaas, O. I., Koegel, R., Simmons, J. Q., & Long, J. S. (1973). Some generalization and follow-up measures on autistic children in behavior therapy. *Journal of Applied Behavior Analysis, 8*(1), 131-166.

Luczynski, K. C. & Hanley, G. P. (2010). Examining the generality of children's preference for contingent reinforcement via extension to different responses, reinforcers, and schedules. *Journal of Applied Behavior Analysis, 43*(3), 397-409.

McGee, G. G., Morrier, M. J., & Daly, T. (1999). An incidental teaching approach to early intervention for toddlers with autism. *Research and Practice for Persons with Severe Disabilities, 24*(3), 133-146.

Michael, J. L. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior, (6),* 3-9.

Mullen, E. M. (1995). *Mullen Scales of Early Learning.* Circle Pines, MN: AGS.

National Autism Center. (2009). *National Standards Report-Addressing the need for evidence-based practice guidelines for Autism Spectrum Disorders.* Massachusetts: National Autism Center.

National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2.* Randolph, MA: Author.

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis, 31*(4), 605-620.

Rogers-Warren, A. & Warren, S. F. (1980). Mands for verbalization: Facilitating the display of newly trained language in children. *Behavior Modification, 4*(3), 361-382.

Ross, D. E. & Greer, R. D. (2003). Generalized imitation and the mand: inducing first instances of speech in young children with autism. *Research in Developmental Disabilities, 24*, 58-74.

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

Schlinger, H.D. (1995). *A behavior analytic view of child development.* New York: Plenum Press.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education & Treatment of Children, 8*(1), 67-76.

Skinner, B. F. (1957). *Verbal Behavior*. New York: Appleton-Century-Crofts.

Slocum, S. K. & Tiger, J. H. An assessment of the efficiency of and child preference for forward and backward chaining. *Journal of Applied Behavior Analysis, 44*(4), 793-805.

Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on Autism and Other Developmental Disabilities, 16*(2), 86-92.

Steege, M. W., Mace, F. C., Perry, L., & Longenecker, H. (2007). Applied behavior analysis: beyond discrete trial teaching. *Psychology in the Schools, 44*(1), 91-99.

Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: The VB-MAPP*. Concord, CA: AVB Press.

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.

Tiger, J. H., Hanley, G. P., & Heal, N. A. (2006). The effectiveness of and preschoolers' preference for variations of multiple-schedule arrangements. *Journal of Applied Behavior Analysis, 39*, 475-488.

Touchette, P. E. & Howard, J. S. (1984). Errorless learning: reinforcement contingencies and stimulus control transfer in delayed prompting. *Journal of Applied Behavior Analysis, 17*(2), 175-188.

Vladescu, J. C. & Kodak, T. M. (2013). Increasing instructional efficiency by presenting additional stimuli in learning trials for children with autism spectrum disorders. *Journal of Applied Behavior Analysis, 46*(4), 805-816.

Wodka, E. L., Mathy, P., & Kalb, L. (2013). Predictors of phrase and fluent speech in children with autism and severe language delay. *Pediatrics, 131*(4), e1128-e1134.

Wolf, M. M. (1978). Social validity: the case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis, 11*(2), 203-214.

Table 1
Initial developmental and autism assessment scores

Participant	Age	ADOS-2 Module	Range of Concern (ADOS-2)	Level of autism symptoms (ADOS-2)	Mullens Scale of Early Learning (ELC)	Adaptive Behavior Assessment System, 2nd Edition ABAS-II (GAC)	VB-MAPP Score
Gary	27 months	Toddler Module	Moderate-to-severe concern	-	49	65	22.5
Steve	23 months	Toddler Module	Moderate-to-severe concern	-	73	56	21.5
Andrew	45 months	Module 1	-	Moderate-to-severe range	49	48	44

Note: ADOS-2 = Autism Diagnostic Observation Schedule-2nd edition; ELC = early learning composite score; GAC = general adaptive composite score

Table 2
Individualized target approximations and target words for each respective preferred item per condition. Colors paired with each condition are included.

Gary

Condition (Color)	Preferred Item	Approximation	Target Mand
Mand (yellow)	Blue pins	in	pin
	Giraffe popper	pop	pop
	Thomas the Train book	ook	book
	Dump truck	uck	truck
DTI (blue)	Minnie Mouse mirror	ouse	mouse
	Playdoh	doh	doh
	Wind-up bug	gug	bug
	Mickey book	ickey	mickey
Control (purple)	Yellow race car	car	car
	Animal pop-up	ut	up
	Hot wheels car	-	wheel
	Ambulance	-	beep

Steve

Condition (Color)	Preferred Item	Approximation	Target Word
Mand (red)	Yellow race car	car	car
	Giraffe popper	puh	pop
	Animal pop-up	up	up
	Elmo music	sih-sih	music
DTI (blue)	Minnie Mouse mirror	didee	minnie
	Wind-up bug	guh	bug
	Blue pins	tin	pin
	Dump truck	tuck	truck
Control (green)	ABC snail	B-C	A-B-C
	Whac-a-mole	dole	mole
	Mickey book	buh-deh	book
	Light-up ball	ball	ball

Andrew

Condition (Color)	Preferred Item	Approximation	Target Word
Mand (purple)	Mickey doll	cookie	mickey
	Nemo	mee-baw	nemo
	Lizard	gren	green
	Frozen camera	cam-ra	cam-ra
DTI (blue)	Minnie mirror	me-my	minnie
	Dora book	doya	Dora
	Wind-up bug	bug	bugah
	Mickey book	ook	book
Control (green)	Animal pop-up	up-pa	pop
	Light-up ball	ball	ball
	Blue pins	pis	pins
	Puppet	pu	puppet

Table 3
List of mastered tasks interspersed during the discrete trial instruction condition

Gary

Target Area	S^D	Target Area	S^D
Listener Responding	"Point to (picture of ball)" in array of 2	Motor Imitation	"Do this" (clapping)
Listener Responding	"Point to (picture of bread)" in array of 2	Motor Imitation	"Do this" (arms up)
Listener Responding	"Point to (picture of car)" in array of 2	Motor Imitation	"Do this" (pat table)
Listener Responding	"Point to (picture of cup)" in array of 2	Motor Imitation	"Do this" (knock)
Listener Responding	"Point to (picture of ball)" in array of 2"Point to (picture of chips)" in array of 2	Motor Imitation	"Do this" (wave)
		Motor Imitation	"Do this" (pat head)
Visual Performance	"Put block in cup"	Motor Imitation	"Do this" (roll car)
Visual Performance	"Stack blocks"	Motor Imitation	"Do this" (stack blocks)

Steve

Target Area	S^D
Listener Responding	"Stack blocks"
Listener Responding	"Put blocks in cup"
Listener Responding	"Put ring on ring stacker"
Listener Responding	"Put in" (shape sorter)
Listener Responding	"Put on" (duck on duck pond"

Andrew

Target Area	S^D	Target Area	S^D
Listener Responding	"Stomp your feet"	Motor Imitation	"Do this" (clap hands)
Listener Responding	"Clap your hands"	Motor Imitation	"Do this" (arms up)
Listener Responding	"Arms up"	Motor Imitation	"Do this" (wave)
Listener Responding	"Touch (picture of apple)" in array of 2	Motor Imitation	"Do this" (pat head)
Listener Responding	"Touch (picture of cookies) in array of 2	Motor Imitation	"Do this" (blow kiss)
		Motor Imitation	"Do this" (block in cup)

Table 4
Sessions to mastery and range of preferred items requested

	Sessions to Mastery		# of Different Items Requested		Range of Items Requested Within Each Session	
Participant	Mand Training	DTI	Mand Training	DTI	Mand Training	DTI
Gary	26	28+	4	2	0 - 4	0 - 2
Steve	44	47+	4	2	0 - 4	0 - 2
Andrew	23	22+	3	4	0 - 3	0 - 3

Note: Sessions to mastery for Gary, Steve, and Andrew are represented in the first column. The number of different items independently requested throughout the efficiency evaluation is represented in the second column. The highest number of different items requested within each condition is four. The range of different items requested within each session is represented in the third column.

Table 5
Rate of acquisition of manding repertoire to mastery.

	Trials to Mastery		Total Session Duration (minutes)		Rate of Acquisition to Mastery	
Participant	Mand Training	DTI	Mand Training	DTI	Mand Training	DTI
Gary	312	336+	171	175	1.8 trials per minute	1.9 trials per minute
Steve	528	564+	287	330	1.8 trials per minute	1.7 trials per minute
Andrew	276	264+	161	138	1.7 trials per minute	1.9 trials per minute

Note: The grayed boxes are indicative of continuation of condition because the participant did not meet mastery criteria.

Table 6
Caregiver social validity questionnaire results

	Gary	Steve		Andrew		Average rating
Reporter	Biological Mother	Grandmother	Grandfather	Biological Mother	Biological Father	
Satisfied with the way my child requested by the end of the mand treatment	5	5	5	5	5	5
Satisfied with the way my child requested by the end of the DTI treatment	5	4	5	5	5	4.8
Understand my child's requests	3	4	4	5	5	4.2
Teaching requesting skills is important	5	5	5	5	5	5
Mand training was a *feasible* (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment	5	4	5	5	5	4.8
DTI was a *feasible* treatment	5	3	2	5	4	3.8
Teaching strategy most likely to implement at home	Mand	Mand	Mand	Mand	N/A	Mand

Note: 5 = strongly agree; 1 = strongly disagree

Table 7
Research assistant social validity questionnaire results

	Gary's Research Assistant	Steve's Research Assistant	Andrew's Research Assistant	Average rating
Mand training was *effective* in teaching the child to request	5	5	4	4.67
DTI was *effective* in teaching the child to request	4	4	2	3.33
Control conditions were *effective* in teaching the child to request	1	1	1	1
Recommend mand condition procedures	5	5	5	5
Recommend DTI condition procedures	4	3	2	3
Recommend control condition procedures	1	1	1	1
Enjoyed implementing mand condition	5	4	2	3.67
Enjoyed implementing DTI	4	4	1	3
Enjoyed implementing control conditions	1	1	1	1
Time requirements were reasonable	4	4	1	3
Mand training was a *feasible* (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment	5	5	4	4.67
DTI was a *feasible* treatment	4	4	2	3.33
Believe it is important to use specific teaching strategies to increase vocalizations for children with autism in this age group.	5	5	5	5

Note: 5 = strongly agree; 1 = strongly disagree

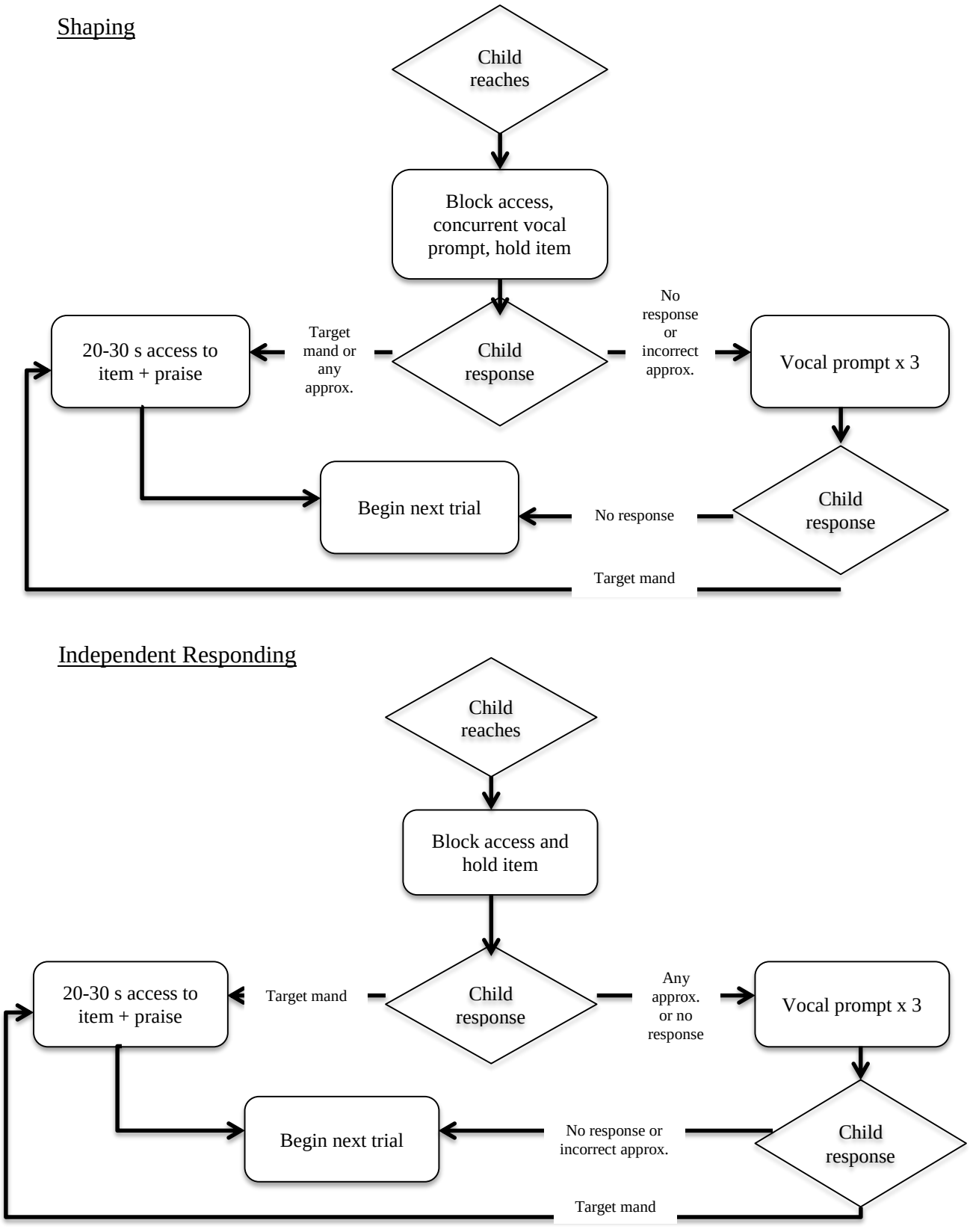

Figure 1. Flow chart outlining the procedural steps for shaping correct responding and once the participant independently responds in the mand training condition.

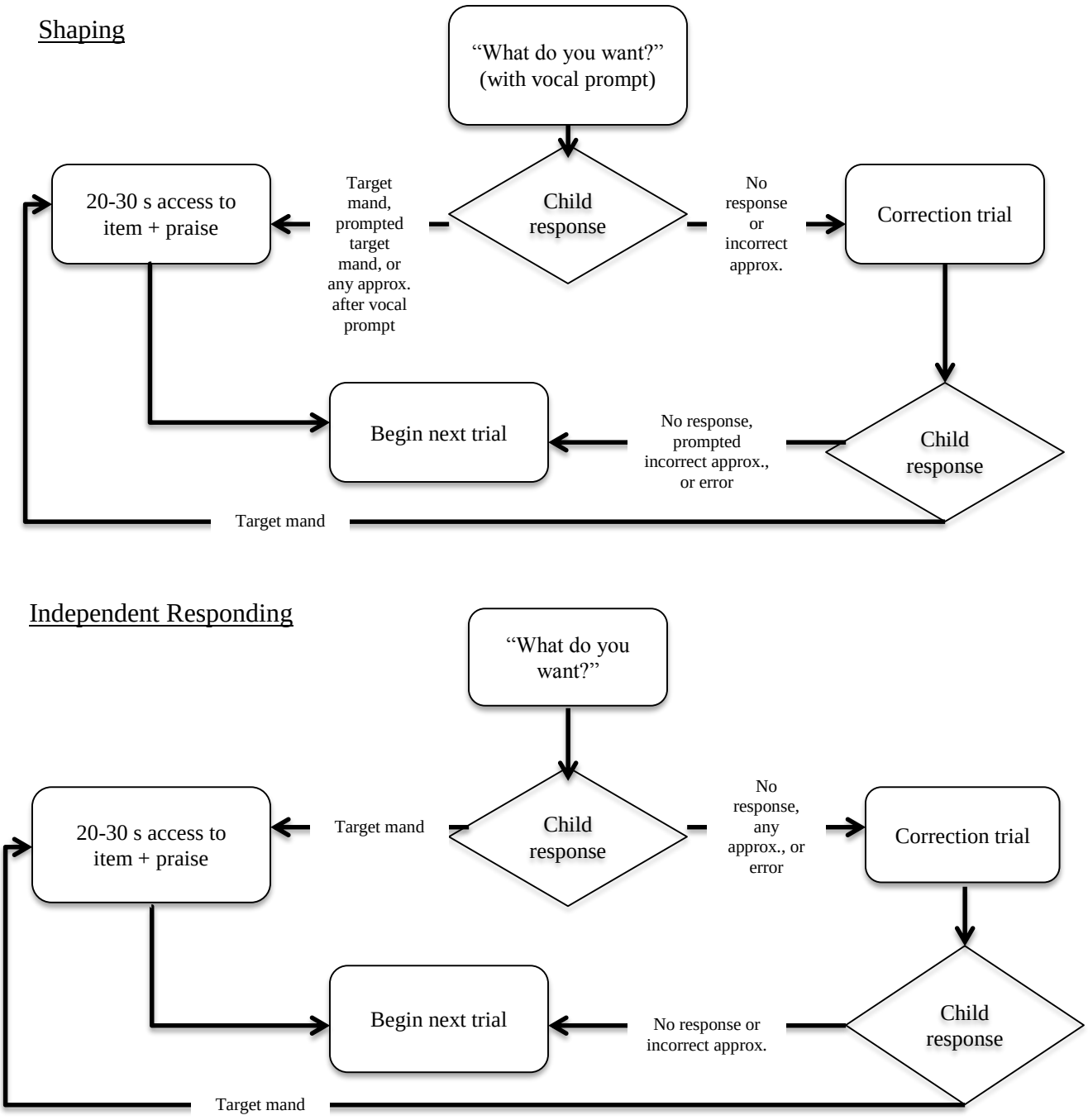

Figure 2. Flow chart outlining the procedural steps for shaping correct responding and once the participant independently responds in the DTI condition.

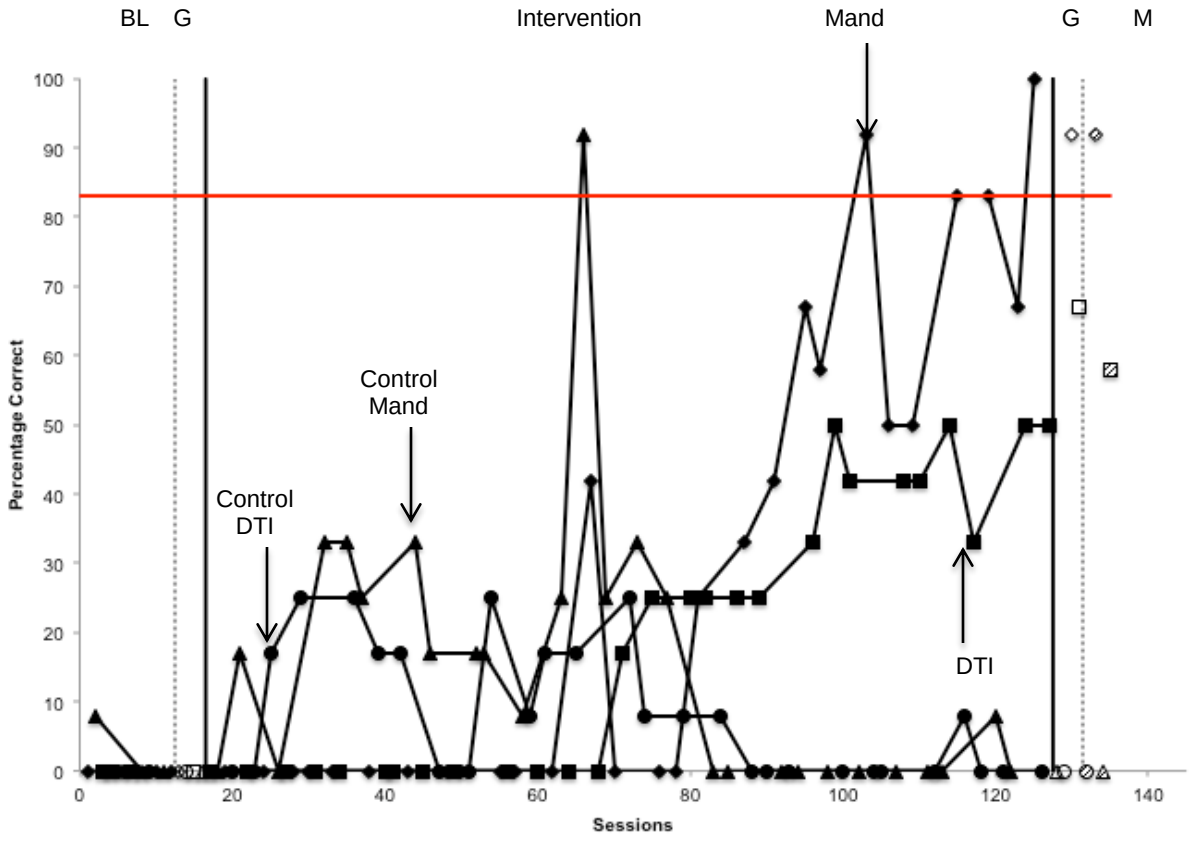

Figure 3. Percentage of correct manding for Gary during the efficiency evaluation. Diamonds represent mand conditions. Squares represent DTI conditions. Triangles represent the control mand condition. Circles represent control DTI conditions. Closed shapes represent baseline and treatment. Open shapes represent generalization probes. Patterned shapes represent maintenance probes.

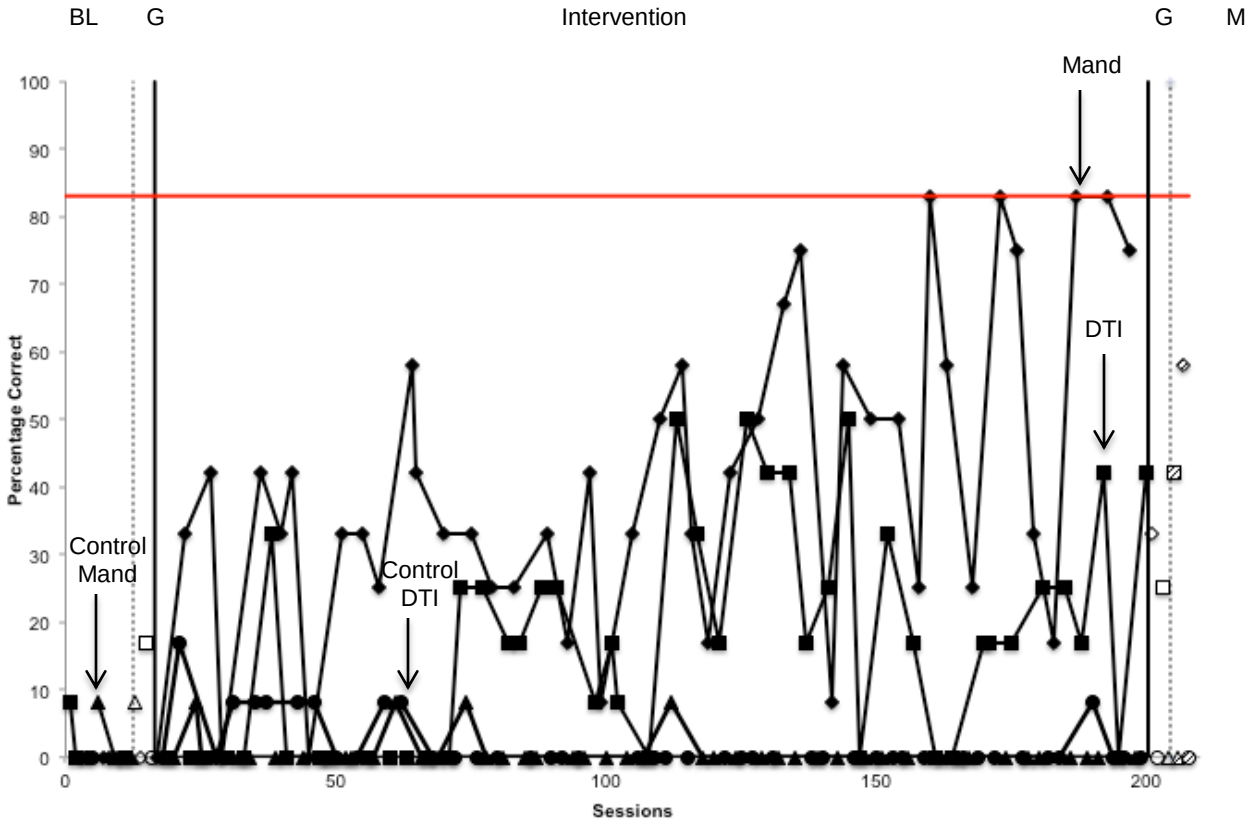

Figure 4. Percentage of correct manding for Steve during the efficiency evaluation. Diamonds represent mand conditions. Squares represent DTI conditions. Triangles represent the control mand condition. Circles represent control DTI conditions. Closed shapes represent baseline and treatment. Open shapes represent generalization probes. Patterned shapes represent maintenance probes.

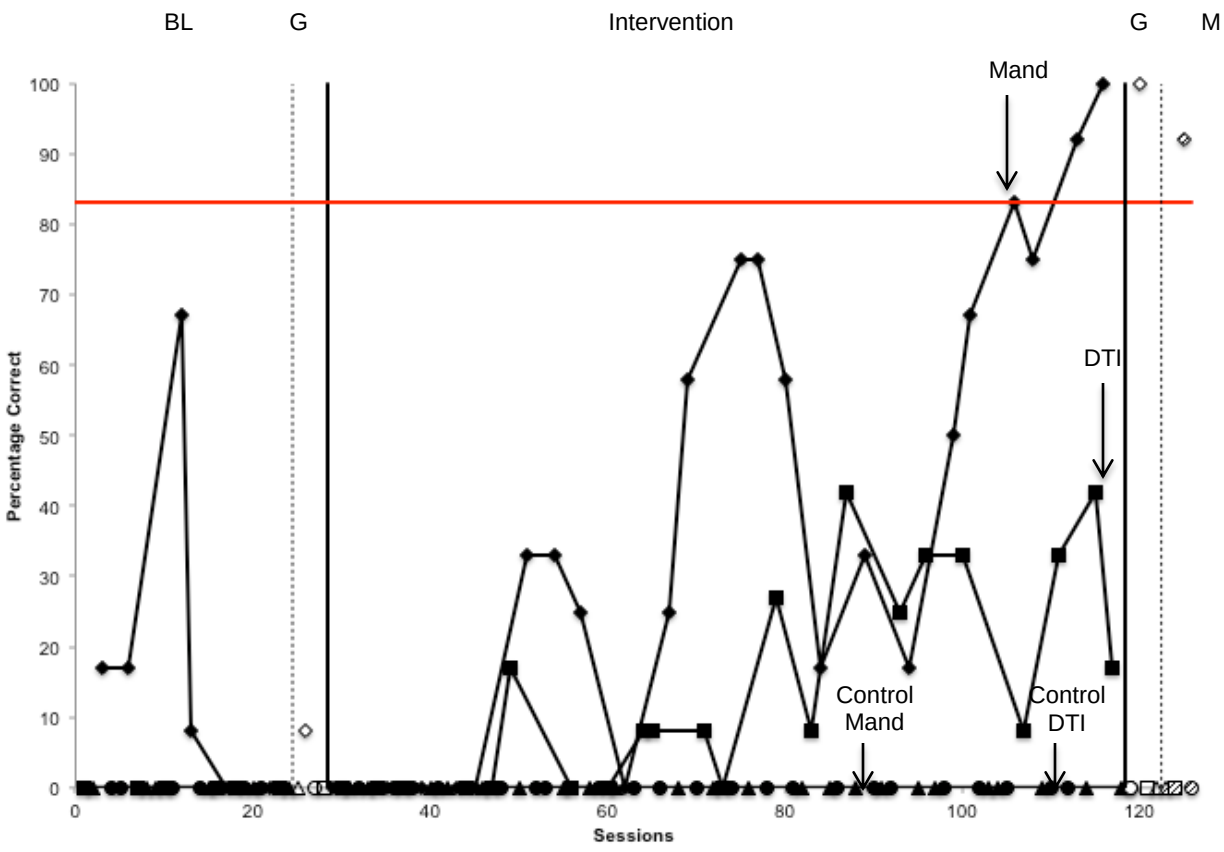

Figure 5. Percentage of correct manding for Andrew during the efficiency evaluation. Diamonds represent mand conditions. Squares represent DTI conditions. Triangles represent the control mand condition. Circles represent control DTI conditions. Closed shapes represent baseline and treatment. Open shapes represent generalization probes. Patterned shapes represent maintenance probes.

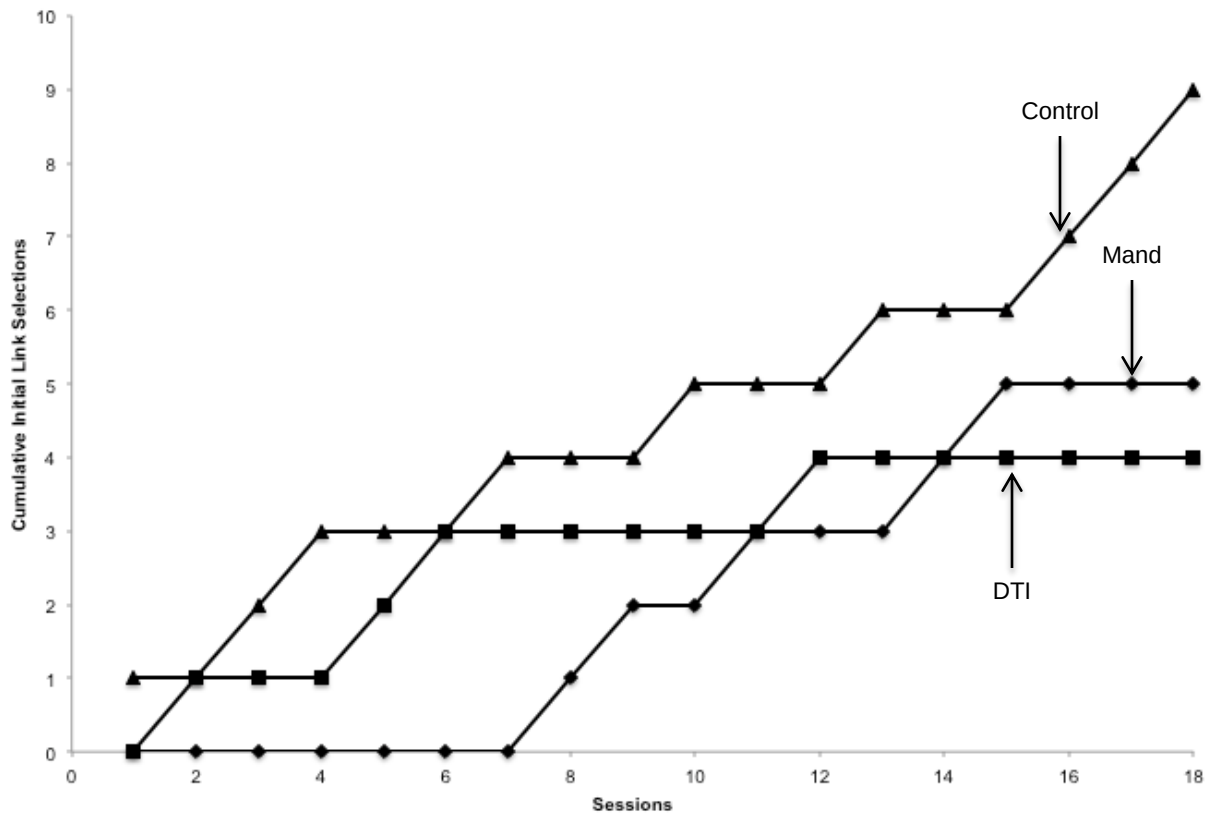

Figure 6. Gary's cumulative initial link selections

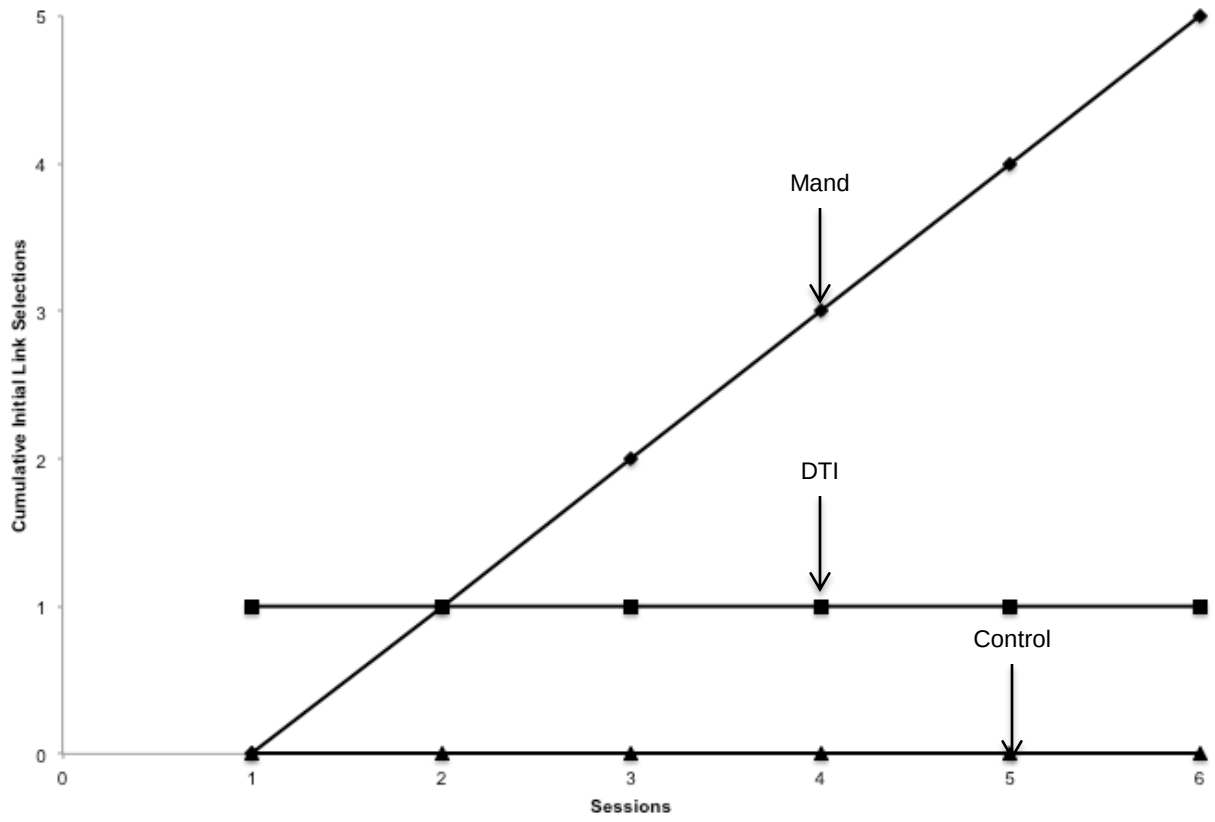

Figure 7. Steve's cumulative initial link selections

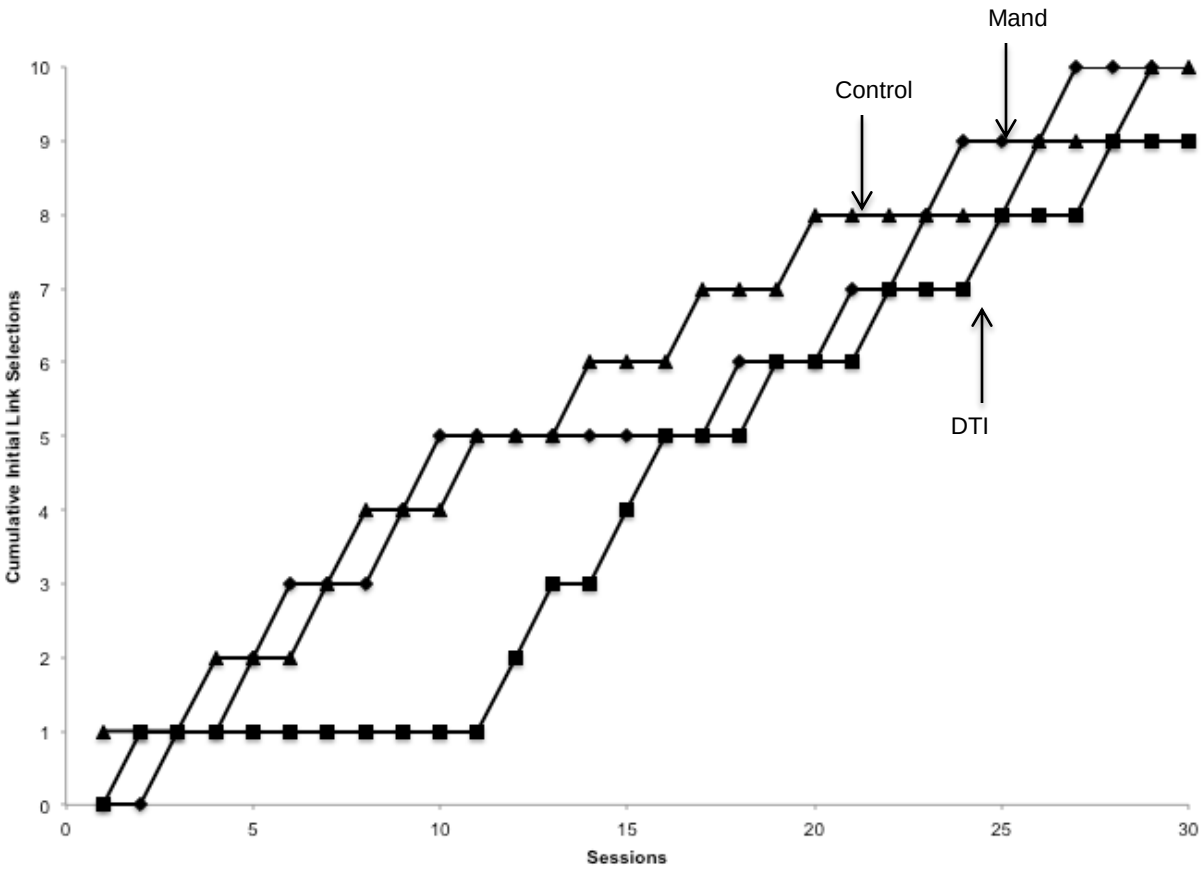

Figure 8. Andrew's cumulative initial link selections

Appendix A
Sample 12 trial data sheet.

Date	Session #	Condition	Primary / Reli	Data Collector	Participant
Duration of Session:	I = Independent response IA = Independent Approximation P = Prompted response NR = No Response E = Error				
	Prompt Delay Steps: 1 (0-sec) 2 (2-sec) 3 (5-sec)				

	1	2	3	4	5	6	7	8	9	10	11	12	Percentage
Item													
Response													
Prompt	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	
Delay													
Approx./ Sound													

Date	Session #	Condition	Primary / Reli	Data Collector	Participant
Duration of Session:	I = Independent response IA = Independent Approximation P = Prompted response NR = No Response E = Error				
	Prompting Steps: 1 (0-sec) 2 (2-sec) 3 (5-sec)				

	1	2	3	4	5	6	7	8	9	10	11	12	Percentage
Item													
Response													
Prompt	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	FV PV	
Delay													
Approx./ Sound													

Appendix B
Sample caregiver social validity questionnaire.

You are about to watch four short videos of your child at the beginning and end of treatment. After viewing each set of videos, please indicate the extent to which you agree or disagree with the following statements by circling a number that most closely reflects your opinion.

Strongly Disagree	Disagree Somewhat	No Opinion	Agree Somewhat	Strongly Agree
1	2	3	4	5

1. After viewing the *first and second video (baseline and treatment mand)*, I am satisfied with the way my child requested for preferred items by the end of treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

2. After viewing the *third and fourth video (baseline and treatment DTI)*, I am satisfied with the way my child requested for preferred items by the end of treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

3. I can understand what my child is requesting in the videos.

1 2 3 4 5

Please comment on why you chose this rating:

---

4. I believe it is important for my child to learn requesting skills.

1 2 3 4 5

Please comment on why you chose this rating:

---

5. I found the ***mand*** to be a feasible (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

6. I found the ***discrete trial instruction (DTI)*** to be a feasible (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

7. Which teaching strategy would you be more likely to implement at home?

Discrete Trial Instruction (DTI)	Neither	Mand

Please comment on why you chose this rating:

Appendix C
Sample research assistant social validity questionnaire.

Please indicate the extent to which you agree or disagree with the following statements by circling a number that most closely reflects your opinion.

Strongly Disagree	Disagree Somewhat	Neutral	Agree Somewhat	Strongly Agree
1	2	3	4	5

1. Overall, I believe the ***mand*** condition was effective in teaching the child to learn to request for preferred items.

1 2 3 4 5

Please comment on why you chose this rating:

---

2. Overall, I believe the ***discrete trial instruction (DTI)*** condition was effective in teaching the child to learn to request for preferred items.

1 2 3 4 5

Please comment on why you chose this rating:

---

3. Overall, I believe the ***control*** conditions were effective in teaching the child to learn to request for preferred items.

1 2 3 4 5

Please comment on why you chose this rating:

---

4. I would recommend the ***mand*** condition procedures to others.

1 2 3 4 5

Please comment on why you chose this rating:

---

5. I would recommend the ***DTI*** condition procedures to others.

1 2 3 4 5

Please comment on why you chose this rating:

---

6. I would recommend the ***control*** condition procedures to others.

1 2 3 4 5

Please comment on why you chose this rating:

---

7. I enjoyed implementing the ***mand*** condition.

1 2 3 4 5

Please comment on why you chose this rating:

---

8. I enjoyed implementing the ***DTI*** condition.

1 2 3 4 5

Please comment on why you chose this rating:

---

9. I enjoyed implementing the ***control*** conditions.

1 2 3 4 5

Please comment on why you chose this rating:

---

10. The time requirements of this study were reasonable.

1 2 3 4 5

Please comment on why you chose this rating:

---

11. I found the ***mand*** to be a feasible (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

12. I found the ***discrete trial instruction (DTI)*** to be a feasible (i.e., length of time to acquire requesting skills, effort to implement treatment, and ease of implementation) treatment.

1 2 3 4 5

Please comment on why you chose this rating:

---

13. I believe it is important to use specific teaching strategies to increase vocalizations (e.g., requesting skills) for children with autism in this age group.

1 2 3 4 5

Please comment on why you chose this rating:

Other comments:

Appendix D

Sample treatment integrity checklist for DTI condition of efficiency evaluation.

Instructions: Record a "+" if the step was demonstrated. Record a " – " if the step was not demonstrated. Record N/A if the step was not applicable to the trial.

Steps Implemented	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Research assistant has all materials for DTI (e.g., data sheet, pen/pencil, preferred items identified from Set B, colored card, colored shirt, cube chair, table)												
Prior to entering the room, the research assistant signals the DTI condition by holding a specific colored card in front of the participant and wearing the same colored shirt												
Research assistant seats the participant at the table												
Shaping												
Research assistant holds up the item and delivers the S^D, "What do you want?" with a vocal prompt (progressive prompt delay)												
If the participant emits the terminal target response after a vocal prompt within prompt delay, the research assistant delivers access to the preferred item for 20-30 seconds and verbal praise												
If the participant emits any approximation after vocal prompt within prompt delay, the research assistant provides 20-30 seconds access to the requested item and verbal praise												
If the participant does not respond within prompt delay, the research assistant implements a correction trial.												
If the participant errs on 2 trials within a 3-trial block, the research assistant moves to the previous step on progressive prompt delay												
Independent Responding												
Research assistant holds up a preferred item from the randomly ordered list of preferred items from Set B and delivers the S^D, "What do you want?"												

If the participant independently emits the terminal target response within prompt delay, the research assistant delivers access to the preferred item for 20-30 seconds and verbal praise												
If the participant independently emits any approximation other than terminal target response (word or approximation) within prompt delay, the research assistant immediately implements a correction trial.												
If the participant does not respond within 3-5 seconds, the research assistant immediately implements a correction trial												
If the participant errs (e.g., incorrect target word), the research assistant immediately implements a correction trial												
One preferred item is presented per 3-trial block and all 4 items are presented per session												
Sequence of 3-trial blocks is randomly ordered within each session												
Research assistant intersperses two mastered tasks per one mand trial												
Research assistant reinforces correct responding on mastered tasks on a FR-1 praise												
Research assistant provides physical guidance to correctly respond for incorrect or non-responding on mastered tasks												
Research assistant accurately records all 12 trials												

Appendix E

Sample treatment integrity checklist for the mand training condition of preference evaluation.

Instructions: Record a "+" if the step was demonstrated. Record a " – " if the step was not demonstrated. Record N/A if the step was not applicable to the trial.

Steps Implemented	1	2	3	4	5	6	7	8	9	10	11	12
Concurrent Chain Arrangement												
Experimenter places all 3 colored cards on the board in front of the child												
Experimenter delivers the S^D, "Pick one"												
Experimenter delivers behavior specific praise after the child choses one colored card												
Prior to entering the room, the research assistant signals the mand training condition by holding a specific colored card in front of the participant and putting on the same colored shirt												
Session Setup												
Research assistant has all materials for mand training (e.g., data sheet, pen/pencil, preferred items identified from Set A, colored card, colored shirt)												
Research assistant places 4 specific preferred items from Set A around the room and within reach of the participant												
When the participant reaches, approaches, or points towards the item, the research assistant blocks access to the item and holds up the item												
Shaping												
If the research assistant blocks access to the item, delivers a concurrent vocal prompt and holds the item up and the participant emits the terminal target response after the vocal prompt, the research assistant provides 20-30 seconds access to the requested item and verbal praise												
If the research assistant blocks access to the item, delivers a concurrent vocal prompt, and holds the item up and the participant emits any approximation after the vocal prompt, the research assistant provides 20-30 seconds access to the requested item and verbal praise												
If the research assistant blocks access to the item (with or without the delivery of a concurrent vocal prompt) and holds up the item and the participant does not respond within 3-5 seconds, the research assistant repeats the vocal prompt 3 additional times												

Independent Responding												
If the participant independently emits the terminal targeted mand within 3-5 seconds (no vocal prompt), the research assistant delivers access to the preferred item for 20-30 second and verbal praise.												
If the participant independently emits any approximation within 3-5 seconds (no vocal prompt), the research assistant delivers 3 additional vocal prompts												
If after the additional vocal prompts the participant continues to not respond or emit the incorrect approximation, remove the item and start a new trial												
If at any time the participant emits the target response after the additional vocal prompts, provide 20-30 seconds access to the preferred item.												
Research assistant fades vocal prompt												
Research assistant replaces item to its original position in the room at the end of each trial												
Research assistant accurately records all 12 trials												