

*MANDS FOR INFORMATION USING “WHO?” AND “WHICH?” IN THE PRESENCE OF ESTABLISHING AND ABOLISHING OPERATIONS*

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Treatments designed to teach mands for information have included prompting and differential reinforcement, as well as procedures to manipulate the relevant establishing operation (EO). However, previous studies have not included relevant abolishing operation (AO) conditions to ensure that the mand is under relevant antecedent control. Data on listener responses (i.e., use of the information) are also absent in the literature. The current study shows differential responding under EO and AO conditions and reports listener responses that demonstrate use of the provided information. Three participants, diagnosed with an autism spectrum disorder, learned to mand for information using “who?” and “which?” questions exclusively under EO conditions. In addition, each participant responded to the information provided to access a preferred item. Generalization of the “which?” mand for information was also demonstrated across novel stimuli.

*Key words:* mands for information, establishing operation, abolishing operation, generalization

A mand is a type of verbal operant that is evoked by an establishing operation (EO) and reinforced by consequences specific to that EO (Skinner, 1957; Sundberg, 2007). Mands, or requests, can take a variety of forms, and the reinforcer specified by the mand also varies. For example, a mand can specify tangible items or activities but may also specify information as the reinforcer. Mands for information may take the form of “wh-” questions (i.e., who?, what?, when?, where?, why?, and which?). Unlike mands for a specific item or activity, mands for information do not result in immediate access to something tangible, but instead provide an individual with the information necessary to access preferred items or activities. For example, the mand for information “Who has my movie?”

might evoke a verbal statement specifying the location of the movie (i.e., information), which in turn sets the occasion for listener behavior leading to access to the item. In this way, it is possible for the information provided to become a conditioned reinforcer. Manding for information is readily apparent in typically developing children (Brown, 1968); however, this skill often has to be explicitly taught to children with autism and other language delays (Endicott & Higbee, 2007).

Although several early studies have sought to teach children with disabilities to mand for information (Bondy & Erickson, 1976; Hung, 1977; Knapczyk, 1989; Twardosz & Baer, 1973), these studies failed to manipulate the relevant EO systematically. For example, Twardosz and Baer (1973) taught the response “what letter?” in the presence of an unknown letter. However, it is not clear that there was an EO in place to establish the name of the letter as a reinforcer. Further, the experimenters delivered a tangible reinforcer for responding. Thus, it appears that in these studies requests for information were maintained by

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tangible reinforcers (e.g., tokens) rather than access to the information.

More recently, researchers have begun to focus on teaching mands for information by manipulating antecedent variables to contrive an EO, thereby increasing the value of the information as a reinforcer (Betz, Higbee, & Pollard, 2010; Endicott & Higbee, 2007; Lechago, Carr, Grow, Love, & Almason, 2010; Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011; Sundberg, Loeb, Hale, & Eigenheer, 2002; Williams, Donley, & Keller, 2000). For example, in a study with two 4-year-old children with autism, Williams et al. (2000) began teaching trials by opening a box and making a comment about the contents such as "Oh, I like this one!" while shielding the contents from the child. Because the child did not see what was in the box, this verbal stimulus served as an antecedent stimulus to evoke the mand "What's that?" Subsequently, "Can I see it?" and "Can I have it?" were also taught. Similarly, Sundberg et al. (2002) conducted two experiments with three children who had been diagnosed with autism in which the experimenters manipulated the EOs to chain together two mands for information. In Experiment 1, the authors instructed the child to "get —" (an item previously removed from a toy box), which evoked the response "where —?" from the child. In Experiment 2, after the child emitted the mand "where —?," the authors presented additional verbal stimuli, such as "I gave it to somebody," which in turn evoked the mand "who?" These procedures were replicated by Endicott and Higbee (2007) with four preschoolers with autism with similar results.

In the above-mentioned studies, researchers contrived EOs in order to increase the reinforcing value of the information by presenting specific antecedent stimuli (e.g., instructing a child to get a missing item that was hidden). Although creative and effective methods to contrive the relevant EO were described, appropriate control conditions were lacking. Specifically, these studies did not arrange conditions in which the absence of the EO was programmed. Given that

the manipulated antecedents are partially responsible for the emission of the mand, it is possible that after learning to mand in the presence of the EO, the child may then emit the mand in situations with very similar antecedents but when the information is not needed (i.e., when the EO is not present). For example, a child who learns the mand "where?" when an item is missing and given the instruction "Get your —" may begin asking "where?" in response to the same instruction even if the item is clearly visible. Similarly, acquisition of the mand "Who has it?" in the presence of the verbal stimulus, "I gave it to somebody," might result in the same "Who has it?" response in the presence of the verbal stimulus, "I gave it to Jerry." In the latter example the information is already given, therefore, an abolishing operation (AO) rather than an EO for the information is present. In these examples, because the putative mand is emitted regardless of whether the EO is in effect or not, the response may not actually function as a mand. Alternatively, the response might be under stimulus control of common aspects of the learning environment.

One approach to address this issue is to bring the learner's behavior under differential control of situations in which information is needed (i.e., an EO is present) and situations in which it is not needed (i.e., an AO is present). Therefore, acquisition of mands for information could be facilitated by presenting trials that vary only as to whether the information is needed or not, but other antecedents and consequences are held constant. At least two previous studies have approximated such conditions. In the Sundberg et al. (2002) study, a free-access condition was presented periodically, in which information was not needed (i.e., the target item was available), similar to an AO condition. However, no data were presented that would allow comparison of responding between occasions when the item was present or not present. Ingvarsson and Hollobaugh (2010) also incorporated a similar procedure by presenting known and unknown

questions to participants when teaching the response “I don’t know, please tell me” (IDKPTM). In their study, children were taught to emit IDKPTM when presented with unknown questions, essentially teaching participants to mand for information (i.e., the correct answer). The participants’ IDKPTM response generalized only to unknown questions (EO condition), and did not generalize to known questions (AO condition), suggesting that the EO to obtain the needed information was present.

When an individual mands for information, a second person responds by providing information (e.g., verbal directions) that allows the individual to behave as a listener in order to access the terminal reinforcer. The reinforcer for the mand is the information provided by the second person, but the listener behavior evoked by the information is an important indicator of the practical value of teaching this repertoire. Therefore, it is important to measure not only the putative mand but also the listener behavior occasioned by the presentation of the information. Some recent research on mands for information has included an assessment of listener behavior to ensure that the information provided can be used to access the terminal reinforcer (Betz et al., 2010; Endicott & Higbee, 2007; Lechago et al., 2010). To that end, researchers have conducted a preassessment to determine if the participants can follow instructions to go to a particular location or a particular person. However, we are not aware of studies on manding for information that have reported data on relevant listener behavior evoked by the presentation of verbal information. Information provided after a mand likely takes a slightly different form than an instruction, which is typically what is provided during the preassessment. For example, an instruction may take the form of “Go to the bookshelf,” whereas information provided in response to “Where is my toy?” may take the form of “Your toy is on the bookshelf.” It may be useful to observe whether information provided after a mand results in a similar response of going to the location.

In addition to response acquisition, generalization across contexts is an important issue to consider when teaching mands for information. Generalization should be assessed and programmed, because teaching mands for information in each relevant setting would become cumbersome and limit the functionality of the mand repertoire. Several previous studies have examined generalization of mands for information with varying results. Betz et al. (2010) taught mands for information using “where?” to three preschool children with autism. Betz et al. used a verbal cue and subsequently probed for generalization of the mand for information with the verbal cue using novel toys and in novel settings. In these situations, generalization occurred. However, when these authors probed for generalization in naturally occurring behavior chains (e.g., giving the participant an empty box of crayons following the instruction “It’s time to color”) without the verbal cue, generalization was not observed. Training without the verbal cue was necessary to produce generalization. Treatment procedures to teach mands for information should include not only an assessment of generalization but also procedures to promote generalization if it does not occur.

The primary purpose of the current study was to expand the literature on procedures to teach mands for information using “who?” and “which?” under AO conditions (i.e., information not needed) and EO conditions (i.e., information needed) and subsequent listener behavior (i.e., use of the information). In addition, for the “which?” mand, we examined subsequent listener behavior (i.e., use of the information) and generalization from teaching trials to novel situations.

## METHOD

### *Participants, Setting, and Materials*

Three children who attended an intensive behavioral intervention clinic to address language impairments participated in the study. Ian was a 12-year 4-month old boy who had been diagnosed with autism. His repertoire consisted

of over 100 tacts for items, people, and actions and use of carrier phrases when tacting. He emitted intraverbal behavior, including intraverbal responses to fill-ins and “what?” and “where?” questions. He vocally emitted multiple-word mands and consistently responded as a listener to verbal instructions. Jeb was an 8-year-old boy who had been diagnosed with autism. His vocal verbal repertoire was similar to that of Ian, and consisted of frequent mands in the form of short phrases, consistent listener responding to verbal instructions, approximately 100 tacts, use of carrier phrases, intraverbal fill-ins, and responding to “what?” and “where?” questions. Jen was a 6-year 1-month-old girl who had been diagnosed with partial fetal alcohol syndrome and pervasive developmental disorder not otherwise specified. She responded consistently as a listener to verbal instructions and had a vocal verbal repertoire that consisted of approximately 50 to 100 tacts of items, people, and actions. She responded to several personal information and “what?” questions. Her mand repertoire consisted of high rates of multiple-word vocal phrases.

All trials were conducted in a classroom with at least one therapist present. The room contained tables, chairs, shelves, and other teaching materials typically found in a classroom setting. Additional children and instructors were present but did not interact with the participants during the study. Study materials included small plastic cups, small cardboard boxes, small paper bags, and classroom cabinets for each participant. Containers were differentiated with stickers that represented different characteristics, including colors, numbers, letters, or pictures, and were chosen individually for each participant based on previously mastered skill sets in his or her clinical treatment programming. Preferred edible and tangible items were also included, and varied according to each participant’s preferences. Preferred items were identified based on the participant’s verbal requests and informal assessments including observation and presenting choices of items to the participant.

### *Measurement*

Trained observers collected trial-by-trial data using paper and pen. Observers scored a correct independent response, correct prompted response, incorrect response, or a nonresponse for mands for information emitted by the participants and correct, incorrect, or nonresponse for the participants’ approach to the person or container. Mands for information using “who?” were scored as correct if the participants said either “who?” or “who has it?” Mands for information using “which?” were scored as correct if the participant emitted the response “which —?” and named the specific container in which the item was hidden. For example, if the therapist indicated that a preferred item was in one of the boxes, a correct response consisted of “which box?” Alternatively, if the therapist indicated that the item was in one of the cabinets, a correct response consisted of “which cabinet?” Correct independent mands were those emitted before the prompt. Correct prompted mands were those emitted within 5 s of the presentation of the prompt. An approach response consisted of approaching the correct person (“who?”) or the correct container (“which?”) within 5 s of the location being provided. All other responses were scored as incorrect.

The primary dependent variable was the cumulative number of correct independent mands for information during EO and AO conditions. The mastery criterion in the EO condition was 9 of 10 consecutive trials with independent target responses.

### *Interobserver Agreement and Treatment Integrity*

A second observer collected data on the target mands “who?” and “which?” simultaneously with, but independently of, the experimenter during preassessment, baseline, mand training, posttraining probes, and generalization probe trials. Trial-by-trial interobserver agreement was calculated by dividing the number of agreements by the number of agreements and disagreements and converting the ratio to a percentage. An

agreement was defined as both the primary and secondary observers recording a response as correct, incorrect, or a nonresponse within a trial. Interobserver agreement for “which?” for Ian, Jeb, and Jen was 97%, 97%, and 92%, respectively, and was calculated for 41%, 53%, and 54% of trials, respectively. Agreement for “who?” was 96%, 100%, and 87% for Ian, Jeb, and Jen, respectively, and was calculated for 52%, 43%, and 54% of trials. During the alternating condition, agreement was 93%, 89%, and 98% for Ian, Jeb, and Jen, respectively, and was calculated for 40%, 37%, and 33% of trials.

Treatment integrity was measured via a six-item checklist of therapist behaviors required to complete a trial. Behaviors included providing the participant’s preferred item to a therapist (“who?”) or placing the item under a designated cup (“which?”), presenting the appropriate discriminative stimulus, and implementing the appropriate delays and consequences. Treatment integrity was assessed for Ian during “which?,” “who?,” and alternating trials during 43%, 37%, and 22% of trials, respectively, and averaged 99%, 100%, and 100%. Integrity was assessed for Jeb during 34%, 21%, and 33% of trials for “which?,” “who?,” and alternating trials, respectively, and averaged 98%, 98%, and 100% for these measures. For Jen, treatment integrity was assessed for “which?,” “who?,” and alternating trials during 19%, 18%, and 22% of trials, respectively, and averaged 100% for all measures.

### *Design*

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the effects of mand training in the presence of an EO or an AO within participants. A nonconcurrent multiple baseline design across participants was also used to demonstrate replication of the treatment effects of mand training.

Mands for information “which?” and “who?” were targeted concurrently, but in separate trial blocks. A block of “who?” trials was conducted a

minimum of 30 min after completing a block of “which?” trials. The number of trials conducted in each block for each mand varied each day (range, 2 to 13 for Ian, 2 to 19 for Jeb, and 5 to 15 for Jen).

### *Procedure*

*Preassessment.* The purpose of the preassessment was to evaluate each participant’s ability to follow vocal instructions, to ensure that the participant could use the information provided in response to the mand. During the preassessment for the “which?” scenario, the participant was presented with an array of nine opaque containers, each with a unique symbol or characteristic. The containers included cups, bags, boxes, and cabinets. All participants were able to tact each type of container. While the participant was not looking, the therapist placed a preferred item under a designated container such that the item was no longer visible to the participant. The therapist then presented the demand “Give [hand me or pick up] the — cup” while specifying a particular color, number, letter, or picture. The participant was given 5 s to emit a response. If the participant selected the correct container, the preferred item could be consumed. If he or she selected the incorrect container or did not select a container, reinforcement was not available and the therapist proceeded to the next trial. Each container with a specific characteristic was probed three times. If the participant correctly followed a particular instruction three times, it was considered to be part of the participant’s listener repertoire. The preassessment continued until nine characteristics for each container were identified. The selected containers with the different characteristics were subsequently used when teaching the mand “which?” One container was selected for teaching trials, and the others were used in subsequent generalization probes (Table 1).

During the preassessment for “who?” at least three additional therapists were present in addition to the primary therapist and participant.

Table 1  
 “Which?” Scenario Teaching and Generalization Targets

	Teaching	Generalization
Ian	Colored cups	Colored boxes, numbered bags, numbered cups, numbered cabinets
Jeb	Colored cups	Colored boxes, numbered bags, numbered cups, numbered cabinets
Jen	Animal picture cups	Animal picture bags, animal picture cabinets, animal picture boxes

The primary therapist provided a preferred item to one of the additional therapists when the participant’s attention was diverted and instructed the participant to “go to [show me or point to] [individual’s name].” Following the instruction, the participant was given 5 s to respond. If the participant approached the correct individual, reinforcement was provided. If he or she approached the incorrect individual or did not respond, no reinforcement was provided and the therapist moved to the next trial. Participants were required to approach at least three additional therapists correctly in order to proceed with the intervention. Only therapists whom the participant had correctly identified and approached in the preassessment were included when teaching “who?”

*“Which?” scenario conditions.* During the “which?” scenario trials, nine opaque cups were placed upside down and side by side in front of the participant. Colored cups were used during teaching for Ian and Jeb, and animal cups were used for Jen. A highly preferred item was placed under one of the cups without the participant seeing its location. The location of the preferred item was different on each trial and was randomized among the nine cups. An empty candy wrapper (e.g., an empty Skittles bag) or some reference to the item (e.g., related items) was placed in sight of the participant to serve as a stimulus that signaled the availability of the preferred item. A trial began when the participant emitted a mand for the preferred item that was under the cup (e.g., “May I have a Skittle?”). In the EO condition, the therapist presented the verbal stimulus associated with the EO (i.e., “You can have a Skittle; it’s under one of these cups.”).

Any further information regarding the location (e.g., which cup the Skittle was under) was not provided, potentially contriving a scenario in which emitting a mand for information using “which?” would be appropriate. In the AO condition, the therapist presented the verbal stimulus associated with the AO, which included information regarding the location of the item being provided (e.g., “Your Skittle is under the orange cup.”). This created a scenario in which emitting the mand for information using “which?” would not be appropriate (the information of the location of the item had already been provided).

*“Who?” scenario conditions.* During “who?” trials, at least three additional therapists were standing or sitting near the participant’s table. A highly preferred item was given to one of the extra therapists when the participant was not looking, and the therapist hid the item out of his or her view. The target therapist varied randomly from trial to trial. The primary therapist then placed an empty candy wrapper (e.g., an empty Skittles bag) or something to signal the availability of the item (e.g., a related item) in view of the participant. A trial began when the participant emitted a mand for the preferred item. A procedure similar to the “which?” scenario was used to assess EO control. During the EO trials, the therapist provided the verbal stimulus associated with the EO (e.g., “One of your therapists has your chip.”) to contrive a scenario in which the mand for information using “who?” was appropriate. During the AO trials, the therapist provided the verbal stimulus associated with the AO (e.g., “Brittany has your chip.”) to contrive a scenario in which emitting the mand

for information using “who?” would not be appropriate (the needed information had already been provided).

During both “who?” and “which?” trials, the participants were allowed to guess where the preferred item was located (i.e., guess the container or the person), regardless of whether they manded for information. In other words, access to the containers or therapists was not blocked. This was done so that blocking access to the cups during an EO trial and lack of blocking access during AO trials would not serve as a cue to indicate that a vocal response was required, thereby introducing undesirable stimulus control. In addition, attempts to guess incorrectly rather than manding for information may facilitate acquisition of the mand because incorrect guesses would not lead to access to the preferred item, whereas manding for information would likely result in accessing the correct container or person on each trial. Only one guessed response was permitted before the trial was terminated.

*Baseline and posttraining probes.* Baseline probes were conducted for the “which?” scenario followed by baseline probes for the “who?” scenario separated by a minimum of 30 min. EO and AO condition trials were interspersed. During EO trials, if the participant emitted the correct mand for information (e.g., “Which cup?” or “who?”) the therapist immediately provided the location or information (e.g., “The Skittle is under the purple cup.”). If the participant responded incorrectly or did not respond, no information or reinforcement was provided and the therapist moved to the next trial. If the participant did not emit a response but attempted to select a container or therapist and selected the correct one by chance, he or she was allowed access to the reinforcer.

During AO trials, if the participant selected the correct location or therapist, he or she was allowed access to the reinforcer. If the participant did not select a location or therapist or selected the incorrect location or therapist, no reinforce-

ment was provided and the therapist moved to the next trial. If the participant emitted the mand “which?” or “who?” the trial was terminated.

*Treatment.* During treatment, EO and AO trials were conducted as in the baseline probes with the exception that a constant prompt delay (Schuster, Gast, Wolery, & Gultinan, 1988) was implemented to teach the mands “who?” and “which?” during EO trials. The procedure consisted of an initial 0-s delay that was presented for a minimum of the first eight EO trials. During EO trials, when the therapist presented the verbal stimulus associated with the EO, the therapist immediately provided a vocal prompt relevant to the mand being taught (i.e., “Which cup?” or “Who has it?”) and allowed 5 s for the participant to imitate the response. Correct prompted responses resulted in the therapist providing the information needed to retrieve the preferred item. When at least eight trials with a 0-s delay had been conducted and the participant had responded correctly to the prompt for three consecutive trials, a 2-s prompt delay was incorporated to allow an opportunity for an independent response. Correct prompted and independent responses resulted in information regarding the location of the preferred item. A prompt for the correct response was given after 2 s without a response or contingent on an error. Mastery criteria consisted of emitting correct independent mands for information for 9 of 10 EO trials and the absence of manding in at least the last three AO trials. During AO trials, following the mand for the preferred item emitted by the participant, the therapist provided the verbal stimulus associated with the AO, which included the information to access the preferred item. No consequences were provided if the mand for information was emitted during an AO trial (this never happened for Jeb or Jen).

*Alternating scenarios.* Subsequent to mastery of both mands for information, EO and AO trials for “which?” and “who?” were alternated in a quasirandom fashion. These trials were identical to those conducted in the baseline probe phase.

*Generalization probes.* Generalization probes were conducted for the mand “which?” with preferred items located in containers other than those used during teaching trials. During this phase, the therapist conducted trials similar to the baseline probes, but placed the objects in a variety of containers such as colored or numbered bags, boxes, and classroom cabinets (see Table 1). If generalized use of the mand “which —?” did not occur, additional strategies (described below) were used to promote generalization. Generalization probes for the mand “who?” were not conducted.

*Tact training.* Booster tact training was implemented if the “which —?” response did not generalize to the new containers. Although all participants emitted tacts for all containers in the preassessment, one did not exhibit generalized responding to untaught containers during generalization probes (described in results) and instead continued to emit “which —?” specifying the container name used during teaching rather than the new container. Booster tact training was conducted to assess whether recent practice of each container’s name would facilitate accurate manding. Tact training consisted of presenting the container (i.e., bag, box) and asking “What is it?” If the participant did not respond, a vocal prompt to label the item was provided, followed by a partial vocal prompt, and another independent opportunity. After the participant had correctly tacted the container on five consecutive independent opportunities, a generalization probe for the mand “which —?” using that container was conducted.

*Multiple exemplar training.* If booster tact training did not produce generalization of the mand “which —?” additional teaching trials with the novel containers were conducted. Teaching trials and mastery criteria were identical to the teaching trials with the first taught container. One additional container was taught to mastery followed by a probe of the remaining untaught containers to assess generalization. If generalization did not occur, an additional container was

taught followed by a probe of untaught containers, and this continued until all containers were taught or generalization occurred.

## RESULTS

Figures 1 through 6 show the results of mand training and generalization probes for all three participants. Figure 1 (left) shows baseline and posttraining of mands for information using “which?” for Ian (top), Jeb (middle), and Jen (bottom). Figure 1 (right) shows baseline and posttraining approach responses (i.e., listener responses) to select the correct container. In baseline none of the participants emitted the mand “which?” in EO or AO conditions, and they reliably selected the correct container only in the AO condition when the information had already been provided. After mastery of the “which?” mand (see Figure 2), posttraining probes were conducted. During posttraining (Figure 1) each participant emitted the mand for information using “which?” only under EO conditions and did not emit the mand under AO conditions (i.e., information already provided). In addition, when the participants manded and information was provided, they began to respond as listeners by approaching and selecting the correct container. In other words, they used the information provided to access the reinforcers. Ian and Jen used the information 100% of the time during both EO and AO conditions, and Jeb used the information during 100% of EO trials and 80% of AO trials.

Figure 2 shows the teaching trials for “which?” for all three participants. Ian met criteria to fade to a 2-s delay after 24 trials of alternating EO and AO trials and met mastery criteria after 53 trials. Jeb met criteria to fade to a 2-s delay after 18 trials of alternating EO and AO trials and met mastery criteria after 61 trials. Jen met criteria to fade to a 2-s delay after 16 trials of alternating EO and AO trials and met mastery criteria after 33 trials. Approach responses were seen throughout all teaching trials when information was given and



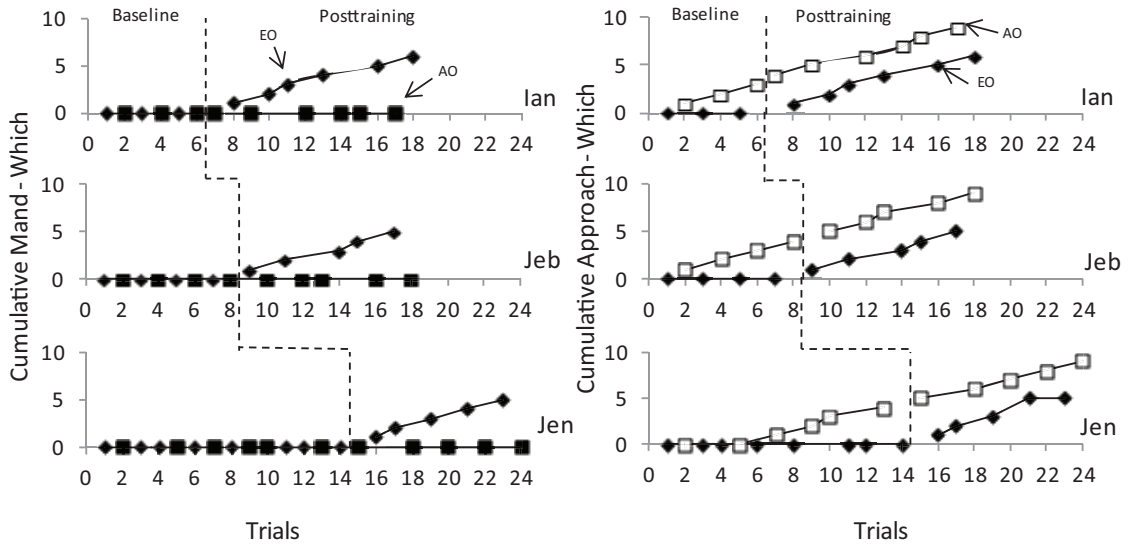


Figure 1. Cumulative record of independent responses for manding “which?” (left) and cumulative record for approach behavior (right) during baseline and posttraining probes for Ian, Jeb, and Jen.

occurred during 86% of EO trials and 100% of AO trials for Ian, 91% of EO trials and 96% of AO trials for Jeb, and 94% of EO trials and 75% of AO trials for Jen.

Figure 3 (left) shows baseline and posttraining mands for information using “who?” Figure 3 (right) shows approach responses (i.e., use of the information). In baseline, none of the participants

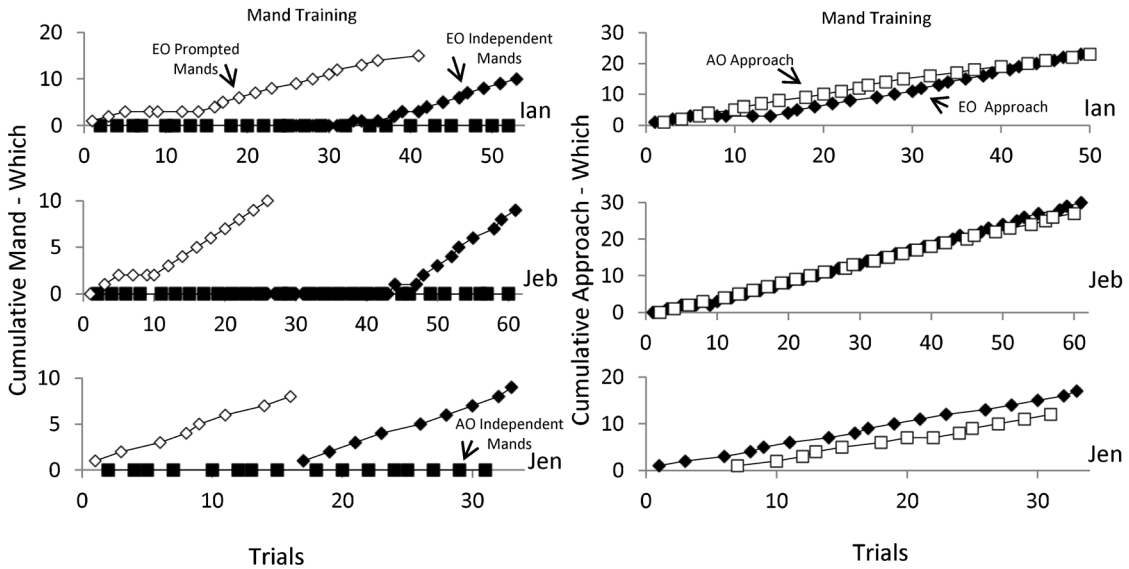


Figure 2. Cumulative record of independent and prompted responses for manding “which?” (left) and cumulative record for approach behavior (right) during mand training for Ian, Jeb, and Jen.

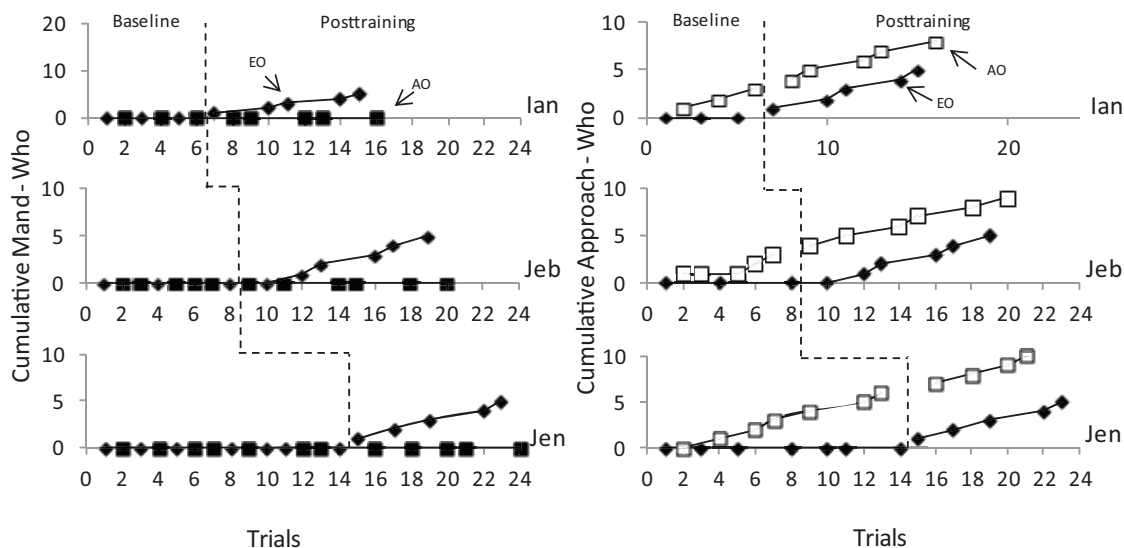


Figure 3. Cumulative record of independent responses for manding “who?” (left) and cumulative record for approach behavior (right) during baseline and posttraining probes for Ian, Jeb, and Jen.

emitted the mand “who?” in the EO or AO conditions, and they reliably approached the correct person only when the information had already been provided in the AO condition. After mastery during “who?” teaching trials (see Figure 4), posttraining probes were conducted. During posttraining each participant emitted the mand for information using “who?” under EO conditions and did not emit the mand under AO conditions. In addition, when the participant manded and information was provided, he or she used the information to approach the correct person. Ian used the information 100% of the time during both conditions. Jeb used the information during 100% of EO trials and 81% of AO trials, and Jen used the information during 100% of EO trials and 92% of AO trials.

Figure 4 shows teaching trials for “who?” for all three participants. During treatment, Ian met criteria to fade to a 2-s delay after 34 trials of alternating EO and AO trials and met mastery criteria after 94 trials. Jeb met criteria to fade to a 2-s delay after 18 trials of alternating EO and AO

trials and met mastery criteria after 36 trials. Jen met criteria to fade to a 2-s delay after 16 trials of alternating EO and AO trials and met mastery criteria after 57 trials. Ian, Jeb, and Jen used the information during EO trials for 84%, 94%, and 93% of trials and 98%, 83%, and 89% of AO trials, respectively.

Figure 5 shows the results of the assessment of alternating “which?” and “who?” trials with each participant. All three participants differentially emitted “which?” and “who?” correctly during EO trials. Jeb and Jen also did not emit mands for information in the AO condition for both scenarios. Ian, however, emitted the mand “who?” in the AO condition on four of the first five trials. During these trials, it appeared that Ian emitted “who?” before the therapist could tell him which person had the preferred item. Beginning with Trial 6, the therapist discontinued saying “Yes, you can have your Skittle” and instead simply stated the name of the person immediately. Following this modification, Ian never asked “who?” in the AO condition. The participants used the information during the

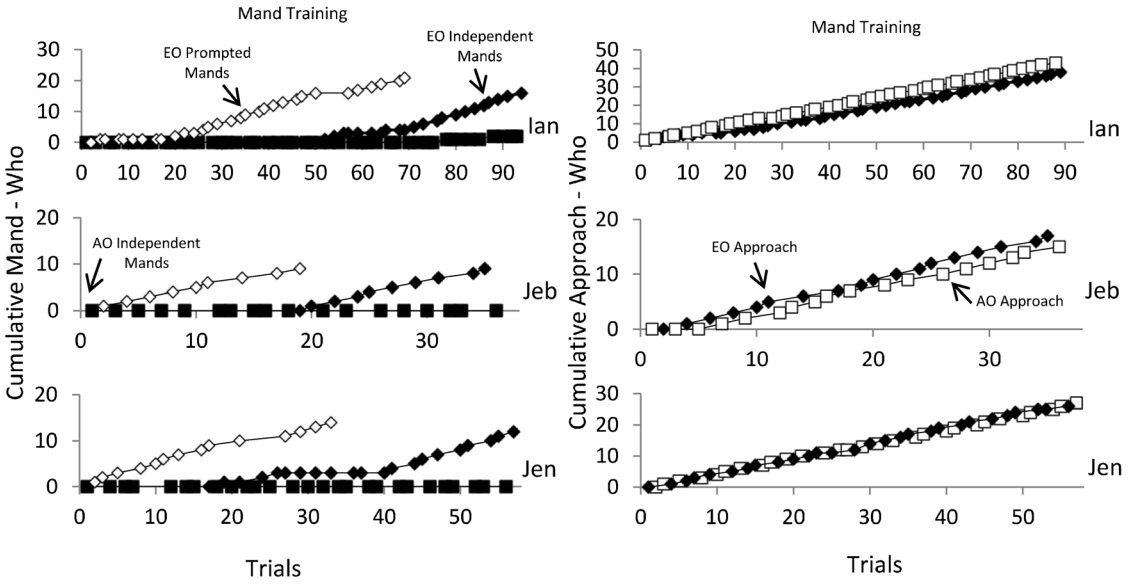


Figure 4. Cumulative record of independent responses for manding “who?” (left) and cumulative record for approach behavior (right) during mand training for Ian, Jeb, and Jen.

“which?” alternating assessment for 100% of all trials during both EO and AO trials. During the “who?” alternating assessment, Ian, Jeb, and Jen used the information during 100%, 83%, and

100% of EO trials and 60%, 100%, and 100% of AO trials, respectively.

Figure 6 shows the results of the generalization probes for the mand for information “which?”

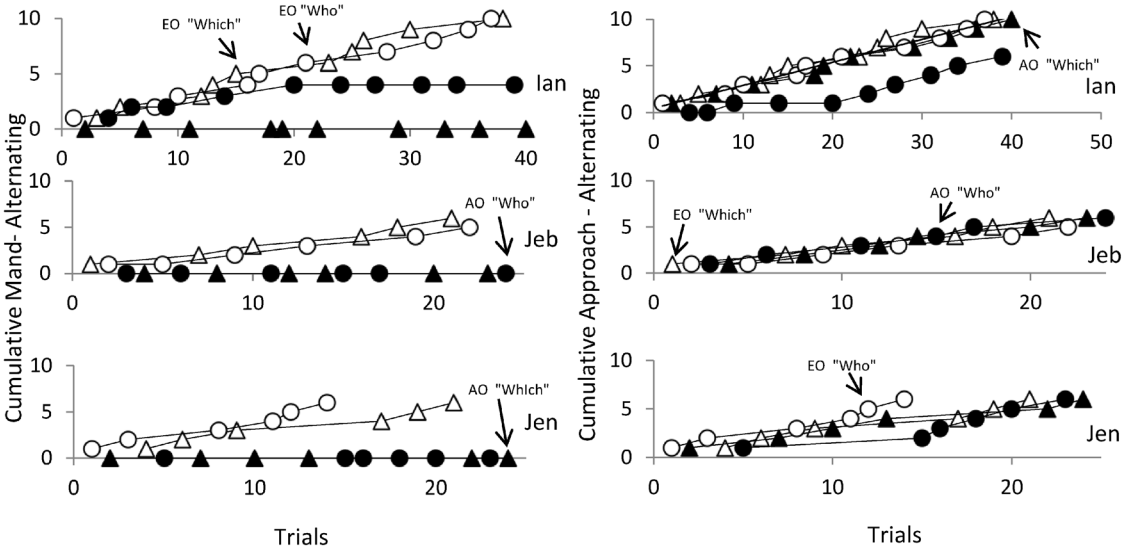


Figure 5. Cumulative record of independent responses for manding “which?” and “who?” (left) and cumulative record for approach behavior (right) during alternating conditions for Ian, Jeb, and Jen.

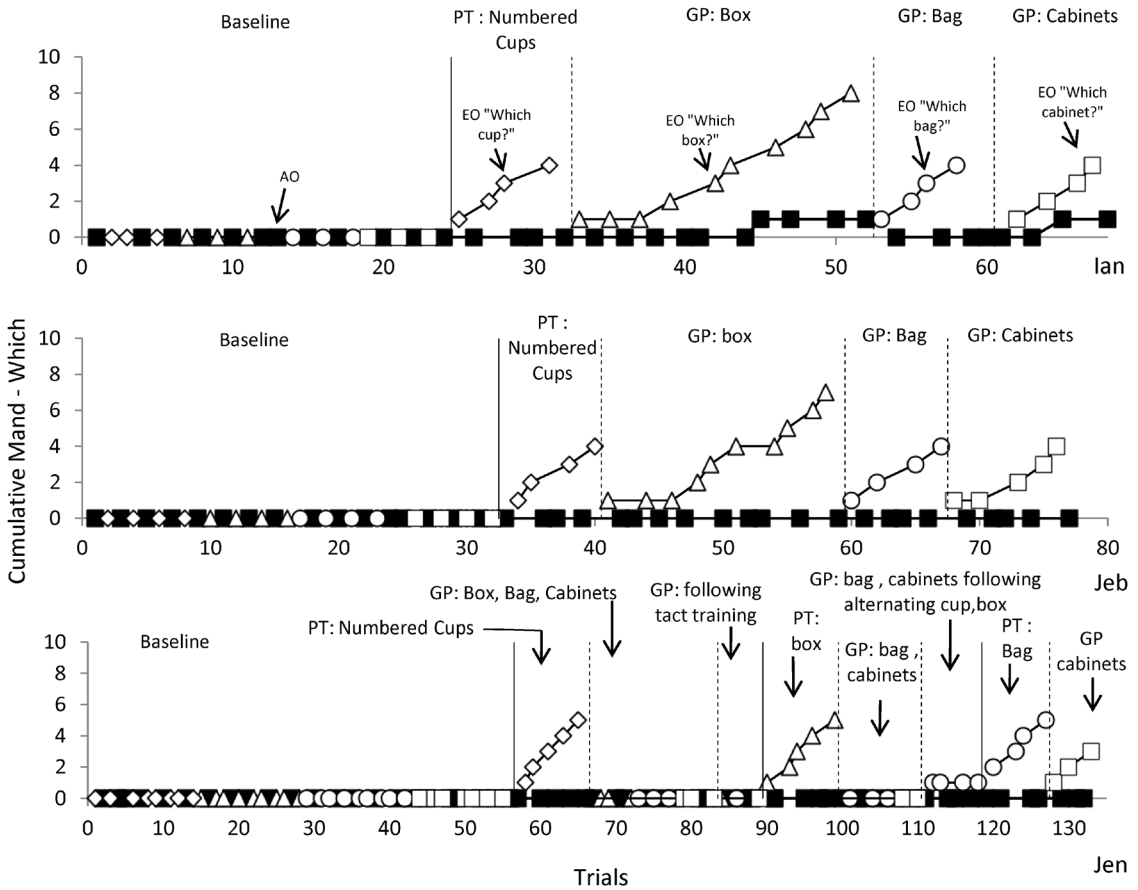


Figure 6. Cumulative record of independent responses for manding “which?” during generalization probes for Ian, Jeb, and Jen. Solid lines indicate when mand training occurred. Dotted lines indicate that a separate generalization probe occurred or tact training of the containers used in the generalization probes. PT = posttraining; GP = generalization probe.

Before teaching the mand “which?” with numbered cups, all containers (see Table 1) were probed in baseline. No manding for information was observed with any containers. Following mastery of the mand “which?” using the numbered cups, probes to assess manding using novel containers were conducted. After learning to mand “which cup?” both Ian and Jeb emitted mands for “which box?,” “which bag?,” and “which cabinet?,” demonstrating generalized use of the mand “which?” Use of information during the EO trials occurred during 91%, 78%, and 100% of EO trials and 94%, 100%, and 92% of AO trials for Ian, Jeb, and Jen, respectively.

Generalized responding was not observed with Jen following mastery of the mand “which cup?” Instead she emitted “which cup?” rather than the name of the specified container. Therefore, tact training to label each container was conducted. Tacts of the containers were considered mastered following five trials of independent labeling (data available from the first author). Tact training was not sufficient to produce the mand “which?” using the correct container name. Therefore, we directly taught a second exemplar (“which box?”). Mastery of this mand did not result in generalization; therefore, trials of “which cup?” and “which box?” were

alternated rapidly. Generalization still failed to occur; therefore, another exemplar was taught (“which bag?”). Following mastery of “which bag?” generalization of the mand “which cabinet?” was observed in the classroom.

## DISCUSSION

The current study demonstrates successful acquisition of the mands for information “who?” and “which?” under EO conditions and subsequent listener responses (i.e., use of the information) with three participants. All participants showed differential responding between conditions in which information was needed (EO condition) versus when it had already been provided (AO condition), demonstrating control of the response by the relevant EO. All participants also emitted the correct mand for information when alternating between situations in which the mand “who?” or “which?” was appropriate. Generalization of the “which?” mand to novel scenarios was observed for two of the three participants without additional teaching. One participant, Jen, required additional strategies to promote generalization of the “which?” mand. Ultimately, multiple exemplar instruction resulted in generalized use of the mand when the preferred item was hidden in one of several cabinets in the classroom.

The current study highlights some potentially important components to consider when teaching mands for information. First, programming both EO and AO conditions ensures functional use of the mand for information by reducing the probability of alternative sources of control (e.g., teaching materials or stimuli associated with therapist presence). In addition, in the current study the experimenter waited for the child to emit a mand for the hidden preferred item spontaneously. When the child manded for the hidden item, information regarding the location was provided (i.e., it’s under one of the cups, or it’s under the yellow cup). By contrast, in previous studies, the adult typically initiated the trial

by giving an instruction (e.g., “Let’s play, get your toy”; Ostryn & Wolfe, 2011; Sundberg *et al.*, 2002). We suggest that the current approach served to ensure control by relevant EOs rather than potential discriminative stimuli.

Another novel component of the present study was measuring use of the information (i.e., listener responses) during baseline, treatment, and posttraining, rather than relying solely on a preassessment of listener responses. Failure to use the information by failing to approach the appropriate container or person could indicate either absence of an EO for the hidden preferred item or an inadequate listener repertoire. Several previous studies included preassessments to ensure appropriate listener responses before intervention (Betz *et al.*, 2010; Lechago *et al.*, 2010; Ostryn & Wolfe, 2011); however, no previous studies have reported data on listener responses that constituted use of information during the study. Although a preassessment of the listener repertoire is a good indicator of future use of provided information, it is also necessary to measure listener responses during and after treatment to evaluate the functionality of the mands being taught.

Another component to consider is teaching more than one mand. Previous researchers have discussed the potential benefit of teaching more than one “wh-?” question when targeting mands for information to promote differentiated use of the mand under the appropriate conditions (Ostryn & Wolfe, 2011). These researchers indicated a temporary decline in correct use of the first mastered mand for information when an additional mand was targeted for instruction. Thus, for a period of time the participants tended to emit the new mand during situations when the previously mastered mand would have been appropriate. In the current study, two different mands for information were taught simultaneously to promote differentiated responding. Targeting “which?” and “who?” simultaneously may have increased the likelihood that the appropriate response would be used under the

appropriate conditions. Future researchers could compare whether teaching two mands simultaneously rather than sequentially results in faster or slower overall acquisition.

Measurement of generalized responding is another important component when teaching mands for information. Generalization was assessed with all three participants, and specific teaching procedures were tested to promote generalization of responding when it did not occur for the "which?" mand. Although generalization was observed for two of the three participants without additional programming, one participant (Jen) required multiple exemplar training with additional scenarios to achieve generalized use of the mand "which?" It is possible that Jen's overall verbal repertoire and learning history explain the lack of generalization. Both Ian and Jeb had a history of emitting carrier phrases when manding and tacting. Jen had only recently learned to emit mand frames and did not emit carrier phrases when tacting. In addition, she often required more extensive teaching to acquire new skills. Future research should evaluate the probability of generalized responding across participants with diverse repertoires.

One limitation of the current study was the lack of a generalization assessment for the mand "who?" Due to staffing limitations, generalization probes with alternative people were not feasible in the clinic setting. Also, we did not assess generalization outside the clinic setting, although novel materials were used. Future research may assess generalization with a variety of people and across settings.

Future research should also address a limitation that was present during the AO conditions for both of the mands taught. When a participant emitted "who?" or "which?" mands (during their respective trials) under AO conditions, no consequences were provided and the trial was terminated, potentially resulting in extinction. This occurred through all phases of the study. Information provided during AO conditions

should not have value as a reinforcer, because the child already has the information necessary to access the preferred item. However, the ability to evaluate the differential reinforcing value of the information was compromised by not delivering it in the AO condition. Further, this approach can potentially lead to differential reinforcement of the putative mand for information, which limits the ability to isolate the relevant EO (i.e., lack of information) as the controlling variable.

Although this was a limitation of the current procedure, only one participant emitted mands during AO trials, and this occurred infrequently (only six times throughout the study). Therefore, this methodological shortcoming cannot be considered a major flaw of the current study. Nevertheless, future research should program identical consequences for all responses during both AO and EO conditions to isolate the effects of the relevant motivating operation (MO; Smith, Iwata, Goh, & Shore, 1995).

This study extends the literature by highlighting and expanding the role of the relevant MO when teaching mands for information to children with autism. Two methodological features helped ascertain that mands were being taught under the appropriate antecedent (MO) conditions: (a) the inclusion of the AO condition and (b) defining trials based on child initiation. Inclusion of an evaluation of listener behavior also extends previous research by evaluating the extent to which participants were able to use the information presented to them. Future research should further evaluate the effectiveness and efficiency of these procedures, as well as the potential for the current procedures to produce lasting and generalized behavior change.

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