TEACHING CHILDREN WITH AUTISM TO VOCALLY MAND FOR OTHERS TO PERFORM AN ACTION

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Mand training is a very logical and natural procedure to begin teaching communication skills to individuals with autism. Existing research has documented strategies for teaching children with autism to mand for preferred items, although there are fewer high quality studies on teaching children to mand for other people to perform an action. In addition to improving the general mand repertoire, teaching children to mand for others to perform an action is important because it allows children with autism to communicate ways in which another person could improve their environment by performing a simple action. The purpose of this study was to document a functional relation between mand training and acquisition and generalization of unprompted mands for another person to perform an action. Using a multiple-baseline design across participants, four children with autism were taught to mand for an adult to perform a variety of actions (e.g., to open a container so the child could obtain a preferred item). Results showed that the intervention produced an increase in unprompted mands for actions for all participants. Additionally, all participants demonstrated unprompted mands at or above mastery criteria during all generalization sessions in a different setting and different interventionist. The magnitude of effect was also large for all participants. This study extends the research on mand training by demonstrating a procedure that can be used to teach children with autism specific mands for actions. Additionally, this study will contribute to a body of strong and adequate studies that will eventually lead to mand training being considered an evidence-based practice.
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TEACHING CHILDREN WITH AUTISM TO VOCALLY MAND FOR OTHERS TO PERFORM AN ACTION

Introduction

The Centers for Disease Control (CDC) describes Autism Spectrum Disorder (ASD) as “a developmental disability that can cause significant social, communication, and behavioral challenges” (CDC, 2014a). The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) also lists deficits in social communication and interaction as diagnostic criteria for autism, adding that these deficits may include difficulty with engaging in social-emotional reciprocity, and using and understanding both verbal and nonverbal forms of communication (American Psychiatric Association, 2013). The CDC recently released information indicating an increasing prevalence of autism in the United States, which is currently estimated to affect one in sixty-eight children nationwide (CDC, 2014b).

Along with increasing prevalence rate, treatment options for children with ASD are becoming progressively more important for researchers. Because individuals with ASD typically experience some degree of communication deficits which can hinder the development of a variety of other abilities (e.g., social and academic skills), interventions specifically focusing on improving communication skills should be a priority (Prelock, Paul, & Allen, 2011). Additionally, individuals who have not learned an appropriate means of communication may exhibit problem behavior as a form of nonverbal communication. Such aberrant behaviors may be reduced simply by teaching a more appropriate and effective replacement response with a functionally equivalent outcome (Carr & Durand, 1985).

Given the importance of addressing communication deficits, it is equally important to select evidence-based practices or interventions that have been shown to be effective through
empirical research. Currently, there is growing evidence supporting the use of the principles of applied behavior analysis (ABA) when designing interventions for addressing language deficits for individuals with ASD. A range of practices specifically directed toward teaching communication skills through the manipulation of environmental contingencies has been developed (Petursdottir & Carr, 2011; Lovaas, 1977; Lovaas, 2003; Sigafoos, Schlosser, O’Reilly, & Lancioni, 2009). Other ABA interventions have focused on increasing vocalizations for learners with limited vocal repertoires (Esch, Carr, & Grow, 2009; Petursdottir, Carp, Matthies, & Esch, 2011; Smith, Michael, & Sundberg, 1996), teaching children to communicate through augmentative and alternative forms of communication (Bondy & Frost, 2001; Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010; Carr, Binkoff, Kologinsky, & Eddy, 1978), and even improving written language skills (Delano, 2007).

Currently, of the variety of ABA approaches for language training, verbal behavior (VB) approaches are gaining momentum within the empirical literature (Sautter & LeBlanc, 2006). Practitioners of the VB approach utilize Skinner’s analysis of language when designing treatment programs. The way in which the VB approach targets language skills differs from the naturalistic teaching approach in that it targets very specific types of language responses, called verbal operants, whereas naturalistic teaching approaches often target more general categories of communicative responses. The procedures in the current study are consistent with the VB model of ABA.

**Verbal Behavior**

Skinner broadly describes verbal behavior as “behavior reinforced through the mediation of other persons” (1957, p. 14). Verbal behavior is affected by the same general
types of environmental variables that can affect nonverbal behavior, such as antecedents and consequences. However, nonverbal behavior is reinforced directly by contact with the physical environment rather than through the mediation of another person (Sundberg & Michael, 2001).

Skinner presented a taxonomy of six verbal operants which are defined in terms of their functional relationship with the environment (1957). Each verbal operant consists of a separate functional response class that is distinct from a particular instance of a behavior (Sundberg & Michael, 2001). Using Skinner’s classification system, a learner’s fluency using various verbal operants can be evaluated, and any deficit can be addressed using interventions focused on increasing specific operants. One of these operants, the mand, is particularly important in the current study as it is the primary dependent variable under investigation. Skinner originally defined the mand as “. . . a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (1957, pp. 35-36). Sundberg and Michael further describe the mand as “a type of verbal behavior where the response form is controlled by a motivative variable” (2001, p. 702). Both descriptions emphasize that motivative variables, which deal with the value of a particular outcome at any given moment, functionally maintain the mand response.

The theoretical concept of the mand is closely tied to that of the establishing operation (EO), a general term describing operations that temporarily increase the reinforcing effectiveness of a particular stimulus and evoke behavior that, in the past, has resulted in access to that stimulus (Michael, 1982). Although the responses evoked by EOs may not
necessarily be mands, the concepts are closely tied together because mands are necessarily controlled by a motivative variable (Sundberg & Michael, 2001).

Given the interchangeable way in which practitioners have tended to use the terms EO and motivating operation (MO), Laraway, Syncerski, Michael, and Poling (2003) suggested the adoption of the term MO in lieu of EO as a generic term to describe motivative variables. MOs encompass variables previously defined as EOs but also include those variables that *decrease* the effectiveness of a consequence (i.e., abolishing operations), such as the ability of food satiation to decrease the value of food as a reinforcer, and thereby *decrease* the frequency of responses that result in those consequences. The concept of the MO is important for the development of procedures aimed to increase a learner’s mand repertoire because it draws attention to variables that may both increase and decrease the reinforcing effectiveness of the items used as reinforcers.

*Mand Training*

Mand training appears to be the most logical and natural way to begin communication training for children with autism. Often the first verbal operant that a child learns (Bijou & Baer, 1965; Skinner, 1957), the mand can be differentiated in that it is the only verbal operant that directly benefits the speaker by producing specific reinforcement (e.g., the mand *cookie* is reinforced by receiving a cookie; Sundberg & Michael, 2001). As such, Sundberg and Michael suggest that early language training for children with autism should focus heavily on increasing the mand repertoire because of its inherent functional value.

Mand training typically occurs in a more naturalistic context and involves creating a language-based environment, in which training is incorporated into typical daily activities, and
trainers capture and arrange a variety of communication opportunities (Sundberg & Partington, 1998). Literature on mand training for individuals with ASD has focused on teaching a variety of types of mands, with a large percentage focusing on teaching mands for items that are in sight or visible to the learner (Bowen, Shillingsburg, & Carr, 2012; Carr & Kologinsky, 1983; Ganz, Flores, & Lashley, 2011). Other studies have focused on teaching the type of mands Sundberg and Partington (1998) termed advanced mands, which include three additional types of mands: (1) manding for items that are out of sight or invisible for the learner (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012; Sweeney-Kerwin, Carbone, O’Brien, Zecchin, & Janecky, 2007); (2) manding for information (Betz, Higbee, & Pollard, 2010; Endicott & Higbee, 2007, Ostryn & Wolfe, 2011); and (3) manding for the removal of aversive conditions (Shillingsburg, Powell, & Bowen, 2013). The various types of mands that have been investigated in the empirical literature are further described in the proceeding sections.

Manding for Items in Sight

A considerable amount of research describing methods for teaching individuals with ASD to mand focuses on manding for items that are in sight or visible to children (e.g., Bowen, Shillingsburg, & Carr, 2012; Chaabane, Alber-Morgan, & DeBar, 2009; Ganz, Flores, & Lashley, 2011; Jennet, Harris, & Rutgers, 2008; Marckel, Neef, & Ferreri, 2006; Olive et al., 2007; Schlosser et al., 2007; Thomas, Lafasakis, & Sturmey, 2010). In general, the interventions utilized in these studies have been highly effective in training a mand repertoire. Many studies have demonstrated procedures for training specific mands where the mand indicates the exact outcome that should be delivered (e.g., asking for “cookie” and receiving a cookie; e.g., Bowen, Shillingsburg, & Carr, 2012; Ganz, Flores, & Lashley, 2011). Other studies have focused on
teaching *improvised* mands that allow the learner to request an item based on a feature/descriptor of the item, rather than the item itself (e.g., using a brown picture card to mand for a graham cracker because of the matching color; Chaabane et al., 2009; Marckel et al., 2006). One study by Drasgow, Halle, and Ostrosky (1998) involved teaching a single generalized mand *please* for a variety of reinforcers (i.e., food, toys, and events).

Manding for Items that are Out of Sight

Fewer studies have investigated interventions for teaching individuals with ASD to mand for items that are out of sight. Albert et al. (2012) taught three participants with ASD (5 to 8 years) to mand for items that were out of sight by instructing them to engage in a response chain that naturally lead to a reinforcing outcome (e.g., instructed to make a sandwich, and the participant could eat the sandwich after the chain was completed), when one of the items needed to complete the chain was missing. An important component in this study is the use of a time-delay prior to a prompt. Specifically, the child was given 10 seconds to engage in an independent mand for the missing item prior to the delivery of a prompt. The current study also used a similar time delay procedure in an attempt to transfer stimulus control from the external prompt to the participant’s MO.

Sweeney-Kerwin et al. (2007) taught mands for missing items (MO-controlled mands) in a more naturalistic context. The reinforcer remained out of sight for the first 30 minutes of all but the first treatment session. If the participant did not mand for a target reinforcer during the first 30 minutes, a rolling two-minute time delay began in which every 2 minutes, the reinforcer was briefly displayed. Participants were given access to the requested edible reinforcer both following prompted and unprompted responses, with no differentiation in the
amount received. However, the use of the time delay procedure helped to ensure that participants could access reinforcers more quickly and frequently by responding during the time delay interval and prior to a prompt. The time delay used in the current study was only 5 seconds in duration (as opposed to the two-minute time delay implemented by Sweeney-Kerwin et al.), but similarly, mands during the time delay (i.e., unprompted mands) and after the time delay (i.e., prompted mands) both resulted in the same magnitude of reinforcement.

Manding for Information

Recently, several studies have been published with a focus on teaching individuals with ASD to mand for information. For these types of mands, the information itself must be valuable to the learner in some way (Sundberg & Partington, 1998). For example, if the learner is being taught to request information about where something is located, the information related to the location of the item must be valuable. Usually, the information is valuable because it allows the child to access some other reinforcer more easily (for example, by knowing where to find the reinforcer, when it is available, how to access it, etc.). Interventions targeting mands for information have been developed for teaching mands using “where” (e.g., Betz et al., 2010), “what” (e.g., Ostryn & Wolfe, 2011), “who” (e.g., Endicott & Higbee, 2007) “when” and “which” (e.g., Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011). The pool of literature on manding for information has yielded promising strategies for teaching mands to individuals with ASD.

Procedures for manding for information may be comparable to interventions teaching mands for other people to perform actions in that both teach mands for outcomes that are not present at the time the mand occurs. Many studies teaching mands for information (e.g., Betz
et al., 2010; Endicott & Higbee, 2007; Koegel, Koegel, Green-Hopkins, & Barnes, 2010; Ostryn & Wolfe, 2011; Shillingsburg et al., 2011) were able to effectively teach participants to vocally mand using echoic prompts, and some studies used a time delay procedure prior to issuing prompts (Betz et al., 2010; Endicott & Higbee, 2007; Shillingsburg et al., 2011). The current study also utilized echoic prompts to teach vocal mands for actions and utilized a 5-second prompt delay, similar to the one demonstrated by Betz et al. (2010).

Manding for Removal of Stimuli

In addition to learning to mand for items and activities that a child desires, it is important for them to also learn to request the removal of undesired stimuli or conditions. Although the research in this area is sparse, two studies in particular have specifically focused on teaching individuals with ASD to mand for the removal of undesired stimuli. Choi, O’Reilly, Sigafoos, and Lancioni (2010) taught 3 participants with ASD and an additional participant without ASD to use mands to reject undesired items using either VOCA or PECS. In another study by Shillingsburg, Powell, and Bowen (2013), six participants with ASD were taught to vocally mand for the removal of stimuli that blocked access to preferred items. All participants in both studies successfully learned the target mand response.

Manding for Others to Perform an Action

Another type of advanced mand, manding for others to perform a specific action, has received very little attention in the empirical literature. These types of mands include scenarios such as a child sitting on a swing and manding “push” to get another person to push her, holding an empty cup and manding “pour” for a someone to add juice to the cup, and playing with an electronic toy and manding “on” for another person to turn on the toy. In some ways,
this type of mand is similar to mands for items that are out of sight, because typically when a child mands for an adult to perform an action, the adult is not currently performing the action, so it can be perceived as more abstract or the action being out of sight. For example, if a child is sitting on a swing and mands for an adult to “push” her on the swing, unless the adult is pushing another child on a swing at the time the mand occurred or just prior to it, the child was manding for an outcome that was out of sight.

However, training procedures for mands for actions may differ from procedures used to teach mands for items that are out of sight simply because it is difficult and sometimes even impractical, to visually display the action for the child as a method for transferring stimulus control from the visual stimulus to the child’s internal motivation for the outcome. For example, teaching a child to mand for the swing when it is out of sight may involve showing the swing to the child periodically to transfer stimulus control from the visual stimulus to the child’s motivation. But when then teaching the child to mand for the adult to push her on the swing, pushing the child on the swing to provide a visual stimulus for fading purposes would inadvertently result in the child receiving the desired outcome and reduce the probability that a mand would be evoked in that moment. Therefore, it is important to investigate procedures designed specifically to teach children to mand for actions.

Several studies have included mands for actions as dependent variables. Reichle, Dropik, Alden-Anderson, and Haley (2008) taught one child with autism and global developmental delay to use a mand “help” to request assistance in a variety of situations. However, this mand produced consequences from a general category, rather than specific consequences, in that the child always manded “help” to evoke a variety of actions on the part
of the trainer, such as opening a tightly closed jar or unfastening a clasp on the child’s clothing. While the ability to mand for assistance such as “help” in a variety of circumstances is a valuable skill, it is also important that learners’ mand repertoires be expanded to include various specific mands for actions. Some researchers have taught specific mands for actions such as “hug” (Yoon & Feliciano, 2007) and “tickle” (Plavnick & Ferreri, 2011), although acquisition of mands for actions was not analyzed separately from other types of mands, such as mands for items, limiting the ability to determine the effectiveness of the mand training procedure specifically on mands for actions.

Significance and Purpose of the Study

For individuals with autism who have limited communication skills, improving their mand repertoire will most likely facilitate independence by allowing them to communicate what they want or need others to do at any given time. Extending the empirical literature further, this study is the first to assess a procedure explicitly designed to teach children with ASD to mand for specific actions (e.g., push), rather than actions from a general category (e.g., help). Each participant was taught to use four different specific mands for actions, demonstrating the utility of the procedure for teaching not just one but a variety of mands for action. The intervention was designed to show that individuals with ASD can not only be taught to mand for other people to perform an action. In addition, they can be taught to emit a specific mand that is situationally appropriate, improving their ability to communicate to a listener exactly what action should be performed.

The study also addresses the need for technically sound research design and procedures to evaluate the impact of mand training. When existing research on mand training procedures
for individuals with ASD was evaluated using the criteria established by Horner, Swaminathan, Sugai, and Smolkowski (2012) and Reichow and colleagues (2008; 2011), it was found that many of the studies did not describe the intervention procedures with replicable precision. Frequently, studies did not include treatment fidelity data, effect size ratings, or social validity data. Some articles featured weak research designs with flaws such as fewer than three baseline measurement points, lack of stability of data, and excessive data overlap between adjacent conditions. The current study has been designed with consideration to criteria for high-quality single case experimental designs.

The purpose of the study was twofold: (a) to assess the effects of mand training on the acquisition of mands by children with autism for another person to perform an action that resulted in access to preferred items or activities, and (b) to assess the generalizability of this procedure to different interventionists and locations. Also, it is important to ensure that mands learned by a single individual in one environment will generalize across individuals and environments. The specific research questions were as follows.

**Research Questions**

1. Is there a functional relation between mand training and the rate of mands for actions for children with autism?

2. Is there a functional relation between mand training and generalization of mands across untrained settings and people?
Method

Participants

Four children with a formal and documented diagnosis of an ASD were selected to participate in the study. They were recruited from the UNT Kristin Farmer Autism Center (KFAC), which offers intensive one-on-one ABA therapy as well as therapy for speech and other needs. Only participants who met all of the following inclusion criteria were selected: (1) they must have a formal diagnosis of an ASD, as operationalized by a standardized diagnostic instrument or standardized manual of medical diagnoses, such as the DSM-5; (2) they must be between the ages of 2 and 18 years of age; (3) they must not already be manding for others to perform an action based on parent/primary caregiver reports and direct observation of child behavior at KFAC; and (4) they must demonstrate a minimal score of 10 on the Early Echoic Skills Assessment (EESA; Esch, 2008). The EESA is a subtest to the Verbal Behavior Milestones Assessment and Placement Program and is a fairly good indicator of a child’s ability to vocally imitate.

No participant was excluded from the study based on race, ethnicity, gender and level of functioning as long as they meet the inclusion criteria. Parents and caregivers who expressed interest in their child participating in the study were asked to sign an informed consent letter. The informed consent letter was created in accordance with the University of North Texas’ Institutional Review Board (IRB) requirements. It included information on the purpose of the study, description of procedures, potential risks and benefits, confidentiality of research records, and the participants’ rights and was approved by the IRB.
Logan was a 4-year-old male of Caucasian and Hispanic ethnicity. He had a diagnosis of autism spectrum disorder as diagnosed through the Childhood Autism Rating Scale. His score on the EESA was 16. Initial reports from his mother indicated he was not using mands for actions. Direct observation of the child by the student investigator also confirmed a lack of ability to mand for actions. Logan did demonstrate the ability to mand for a variety of items and activities that were in sight. He also sometimes used gestures and leading behaviors as mands.

Chandler was a Caucasian male who was 2 years old at the time the study began. He had a diagnosis of autism spectrum disorder diagnosed using the Diagnostic and Statistical Manual (DSM) Fifth Edition criteria. He scored a 58 on the EESA. Reports from Chandler’s parents indicated that he did not already have the ability to mand for actions. Direct observation confirmed that Chandler was unable to mand for actions. Chandler was able to vocally mand for a variety of items and activities that were in sight and was observed to occasionally mand for information (e.g., “Where is [therapist name]?”).

Isaac was an African American male who was 9 years old. He had a diagnosis of pervasive developmental disorder-not otherwise specified diagnosed through the DSM-IV. He scored a 70 on the EESA. Isaac’s father reported that Isaac was unable to mand for actions prior to the study. Direct observations confirmed that he was unable to mand for actions. Isaac was able to vocally mand for some items and activities, both in and out of sight, although with limited variety. He also sometimes used gestures and leading behaviors as mands.

William was a 4-year-old Caucasian male with a diagnosis of autism spectrum disorder that was operationalized by the DSM-5. He scored a 13.5 on the EESA. Reports from both
parents indicated he was not currently manding for actions, which was confirmed through direct observation. William could vocally mand for a few items when they were in sight. During the direct observation, the majority of William’s mands for items were vocally prompted by his staff.

Setting

The study took place in a treatment room at the KFAC, UNT. The treatment room was approximately 10 feet x 10 feet with shelves, a cabinet, and a table and two chairs used during therapy sessions. The treatment room had a window covered with a translucent privacy film. All participants used this room or a nearly identical room during part of a typical therapy session. Only the participant, interventionist, and the participant’s scheduled staff were present in the room during baseline, intervention, and generalization sessions. The staff used a video camera to record all experimental sessions.

Measurement Variables

The study measured two dependent variables including unprompted and prompted mands for actions.

Unprompted Mands

The definition of an unprompted mand for another person to perform an action (i.e., unprompted mand) was the child emitting the operationally defined vocalization (see Table 1) corresponding to the item for which he most recently engaged in a behavioral indication (see section titled behavioral indication) prior to a vocal prompt. An example of an unprompted mand would be a participant engaging in a behavioral indication toward the toy inside a closed container and manding “Open” prior to a prompt being issued for that trial. Non-examples of
an unprompted mand for an action would be the participant stating “Open” after a vocal prompt had occurred, or stating any vocalization other than the operationally defined vocalization for the mand relevant to the current trial (see Table 1).

An unprompted mand was the primary dependent variable in this study, and was used for making decisions regarding phase changes. Unprompted mands were measured in terms of percent correct per session.

Prompted Mands

The definition of a prompted mand for another person to perform an action (i.e., prompted mand) was the child emitting the operationally defined vocalization (see Table 1) corresponding to the item for which the child most recently engaged in a behavioral indication (see section titled behavioral indication) and after a vocal prompt was provided. An example of a prompted mand for an action would be the participant stating “Open” following a vocal prompt from the interventionist. Non-examples of a prompted mand for an action would be the participant stating “Open” prior to a vocal prompt during the current trial, or stating any vocalization other than the operationally defined vocalization for the mand relevant to the current session. Prompted mands were measured in terms of percent correct per session.

Behavioral Indication

Although not a dependent variable, a functional response class that is highly relevant to this study has been previously defined by Drasgow, Halle, Ostrosky, and Harbers (1996) as a behavioral indication. Drasgow and colleagues suggest that mands should only be trained when an individual indicates a desire or motivation to access the relevant consequence. A behavioral indication (e.g., reaching, leading) signals the presence of a specific MO, and
therefore allows for constant and ongoing reinforcer assessment. For the current study, a behavioral indication was defined as the child looking at, pointing to, reaching for, touching, or vocally manding for a putative reinforcer using the item’s full name, or emitting a vocal approximation of the item that was recognizable to the interventionist.

Table 1

*Operationally Defined Vocalizations and Outcomes*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Target Mand for Action</th>
<th>Vocalization</th>
<th>Outcome of Mand</th>
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<tbody>
<tr>
<td>Logan</td>
<td>Code (enter code into iPad)</td>
<td>kʊʊ</td>
<td>The mand code results in the interventionist immediately inputting the code into the iPad to make the applications accessible. The participant may engage with the iPad for 60 seconds. After 60 seconds, the interventionist will immediately turn off the iPad so that the code must be input again.</td>
</tr>
<tr>
<td></td>
<td>In (Load discs into disc launcher toy)</td>
<td>in</td>
<td>The mand in results in the interventionist loading 4 discs into the disc launcher toy. The toy will automatically launch all 4 discs.</td>
</tr>
<tr>
<td></td>
<td>On (Turn on mechanical bubble toy)</td>
<td>ɔn</td>
<td>The mand on results in the interventionist turning on a mechanical bubble toy and allowing it to produce bubbles for 60 seconds. After 60 seconds, the interventionist will immediately turn off the bubble toy.</td>
</tr>
<tr>
<td></td>
<td>Open (Open a container with toy inside)</td>
<td>ʌpɪ</td>
<td>The mand open results in the interventionist immediately opening the container. The participant may engage with the toy for 60 seconds. After 60 seconds, the interventionist will immediately remove the toy from the child, place it back in the container, and seal the container.</td>
</tr>
<tr>
<td>Chandler</td>
<td>Code (enter code into iPad)</td>
<td>kʊʊt</td>
<td>The mand code results in the interventionist immediately inputting the code into the iPad to make the applications accessible. The participant may engage with the iPad for 20 seconds. After 20 seconds, the interventionist will immediately turn off the iPad so that the code must be input again.</td>
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<tr>
<td></td>
<td>Play (Movie)</td>
<td>pweɪ</td>
<td>The mand play results in the interventionist playing the movie. After 20 seconds, the interventionist will immediately pause the movie.</td>
</tr>
<tr>
<td></td>
<td>On (Turn on mechanical toy)</td>
<td>on</td>
<td>The mand on results in the interventionist turning on a mechanical toy and allowing it to remain on for 20 seconds. After 20 seconds, the interventionist will immediately turn off the toy.</td>
</tr>
<tr>
<td></td>
<td>Open (Open a container with toy inside)</td>
<td>opɪn</td>
<td>The mand open results in the interventionist immediately opening the container. The participant may engage with the toy for 20 seconds. After 20 seconds, the interventionist will immediately remove the toy from the child, place it back in the container, and seal the container.</td>
</tr>
</tbody>
</table>

*(table continues)*
Table 1 (continued).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Target Mand for Action</th>
<th>Vocalization</th>
<th>Outcome of Mand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isaac</td>
<td>Code (enter code into iPad)</td>
<td>kʊod</td>
<td>The mand <em>code</em> results in the interventionist immediately inputting the code into the iPad to make the applications accessible. The participant may engage with the iPad for 20 seconds. After 20 seconds, the interventionist will immediately turn off the iPad so that the code must be input again.</td>
</tr>
<tr>
<td></td>
<td>Hold hand (the interventionist will hold the child’s hand)</td>
<td>hʊʊ hæn</td>
<td>The mand <em>hold hand</em> results in the interventionist holding the child’s hand until the child lets go or for 20 seconds (whichever occurs first).</td>
</tr>
<tr>
<td></td>
<td>Open (Open a container with toy inside)</td>
<td>opɪn</td>
<td>The mand <em>open</em> results in the interventionist immediately opening the container. The participant may engage with the toy for 20 seconds. After 20 seconds, the interventionist will immediately remove the toy from the child, place it back in the container, and seal the container.</td>
</tr>
<tr>
<td></td>
<td>Play (Movie)</td>
<td>plæɪ</td>
<td>The mand <em>play</em> results in the interventionist playing the movie. After 20 seconds, the interventionist will immediately pause the movie.</td>
</tr>
<tr>
<td>William</td>
<td>Blow (Blow bubbles)</td>
<td>bo</td>
<td>The mand <em>blow</em> results in the interventionist immediately blowing bubbles and continuing the activity for 20 seconds. After 20 seconds has elapsed, the interventionist will immediately stop blowing bubbles.</td>
</tr>
<tr>
<td></td>
<td>Code (enter code into iPad)</td>
<td>kʊ</td>
<td>The mand <em>code</em> results in the interventionist immediately inputting the code into the iPad to make the applications accessible. The participant may engage with the iPad for 20 seconds. After 20 seconds, the interventionist will immediately turn off the iPad so that the code must be input again.</td>
</tr>
<tr>
<td></td>
<td>On (Turn on mechanical toy)</td>
<td>Λ</td>
<td>The mand <em>on</em> results in the interventionist turning on a mechanical toy and allowing it to remain on for 20 seconds. After 20 seconds, the interventionist will immediately turn off the toy.</td>
</tr>
<tr>
<td></td>
<td>Open (Open a container with toy inside)</td>
<td>οpou</td>
<td>The mand <em>open</em> results in the interventionist immediately opening the container. The participant may engage with the toy for 20 seconds. After 20 seconds, the interventionist will immediately remove the toy from the child, place it back in the container, and seal the container.</td>
</tr>
</tbody>
</table>

Behavioral indications were used to determine the initiation of a trial and when prompts were to be delivered.

Each session across all experimental phases was recorded using a video camera for the purpose of data collection and coding. The primary data collector, who was also a Board Certified Behavior Analyst and pursuing a doctoral degree in special education, independently
coded the dependent variables using event recording while watching the videos. The participants’ responses were recorded on a trial-by-trial basis.

Interobserver Agreement

Interobserver agreement (IOA) was calculated in order to ensure integrity of the measurement process. There were a total of three data collectors in the study. They all were doctoral students in the Special Education (Autism) and Board Certified Behavior Analysts skilled in direct observation data collection and coding. The first primary observer collected data on the dependent variables whereas the second primary observer collected data on the independent variable (i.e., procedural fidelity). The student investigator served as a secondary observer on both the dependent and the independent variables of the study. Both primary observers were naïve to the purpose of the study.

The student investigator separately trained the two primary observers in the process of data collection. Both data collectors independently scored the occurrence and non-occurrence of dependent and independent variables from sample videos and discussed any differences in ratings after each video. This process continued with novel videos until interobserver agreement on the dependent variables and procedural fidelity was 90% or higher for three consecutive practice data sessions. Baseline data collection was initiated after the training was completed.

Interobserver agreement on the dependent variables was assessed for 33% of the sessions distributed equally across baseline and intervention for each participant. It was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The overall IOA for the dependent variables was 97.8%,
whereas the IOA for each participant was as follows: Logan, 100%; Chandler, 98.7% (range, 95.8%-100%); Isaac, 96.8% (range, 94.7%-100%); William, 96.5% (range, 94.1%-100%). IOA for the independent variable is reported under procedural fidelity.

At the end of data collection, Cohen’s Kappa was also calculated to obtain more technically sound reliability estimates because it takes into account the probability that observers could sometimes agree or disagree by chance. Kappa was calculated using the following formula: Kappa = (P_o - P_c)/(1 - P_c) where P_o is percent of agreement and P_c is percent of chance agreement (Cohen, 1960). The Kappa coefficient for this study was .9, which indicates a high level of clinical or practical significance (Cicchetti, 2001).

*Experimental Design and Procedures*

A multiple-baseline design across participants (Gast & Ledford, 2014) was utilized to evaluate the effect of mand training on the acquisition of unprompted mands in a staggered and sequential manner. There were three phases in the study including baseline, mand training (i.e., intervention) and generalization. All experimental sessions were scheduled at the same time of day for each participant.

*Preference Assessment*

Prior to the initiation of the study, the participants’ parents and ABA therapists were interviewed regarding the child’s most preferred foods, drinks, toys, and movies. A multiple-stimulus (without replacement) preference assessment (DeLeon & Iwata, 1996) was conducted using items that were identified through the interviews for each child. The top 10 items dictated which four mands were targeted for each participant (examples provided in Table 1). Including all items during each session increased the probability that valued items were present.
during training to create opportunities for unprompted manding. Whenever an iPad was used as a reinforcer, multiple games were available on the iPad in order to maximize the probability that it would serve as a reinforcer during sessions.

Vocal Approximation Assessment.

Prior to initiating the experimental procedures, each participant’s best vocal approximation of the target mand for each condition (four total words per participant) were assessed. Table 1 delineates the actions targeted as mands for each participant. For the vocal assessment, the interventionist asked the participant to repeat each target mand (e.g., “Say on”) in a random order.

After all four words were probed, the participant was allowed to engage with a preferred item or activity for approximately 60 seconds, and then the process was repeated until all words had been probed a total of five times each. Sessions were be audio-recorded and given to a licensed speech-language pathologist, who operationally defined the best vocal approximation demonstrated by each child, for each word. The speech-language pathologist also indicated to the student investigator which word on the recording was the best approximation for each target mand. The recordings of the best approximations were made available for all data collectors to listen to throughout the course of the study. The operationalized vocalizations were used as the target vocal response for each participant as listed in Table 1.

Baseline

To initiate baseline sessions, the interventionist and participant entered the designated room. The room was arranged with a variety of putative reinforcers (i.e., the top 10 most
preferred items from preference assessment) present, so that items from four different action categories (as noted in Table 1) were present. In other words, each putative reinforcer that was present was associated with one of four mands for actions targeted for that participant (e.g., an iPad to promote mands for “Code;” a mechanical toy to promote mands for “On;” a DVD player with a preferred movie paused onscreen to promote mands for “Play;” preferred toys inside individual closed transparent containers to promote mands for “Open”). As soon as the participant entered the treatment room, the interventionist started a timer for 15 minutes to indicate when the session ended. The participant had free access to the items in the room (i.e., the interventionist did not physically block access), although some items were inside a container that the participant could not open.

Once the participant engaged in a behavioral indication toward any one putative reinforcer, a mand trial was initiated and data collection began. The interventionist then immediately paused for 5 seconds to allow the participant an opportunity to emit an unprompted mand for an action. If at any time before the 5 seconds elapsed, the child emitted the target mand for an action corresponding to that particular reinforcer (e.g., the child mandated “Play” after engaging in a behavioral indication toward the DVD player), the reinforcer would have been delivered and an unprompted mand for an action recorded. If the participant engaged in a behavioral indication toward another putative reinforcer before the consequences listed in Table 1 had been completed, the current trial was discontinued (i.e., the consequence for the previous trial were terminated), and a new trial began. If the participant continued engaging in a behavioral indication toward a reinforcer from the time a trial was discontinued
(e.g., if the child continued looking at the DVD player screen after the interventionist paused the movie), then a new trial immediately began.

If the child engaged in a behavioral indication toward another putative reinforcer during the 5-second time delay, the trial for the initial reinforcer was discontinued (i.e., neither a prompted or unprompted mand for that trial were recorded), and a 5-second time delay was initiated for the new item. If the child did not emit the target mand during the 5-second time delay and did not engage in a behavioral indication toward another putative reinforcer, the interventionist immediately performed the relevant action after the 5 seconds had elapsed.

If the participant went longer than 10 seconds without engaging in a behavioral indication toward an item after first entering the treatment room or after a trial had ended, the interventionist randomly selected a putative reinforcer, touched it or pointed toward it, and talked about it for one to two sentences (e.g., “Did you see the movie? It’s the Lion King!”). This process repeated every 10 seconds until the participant engaged in a behavioral indication toward an item or until the session ended.

Each baseline session continued for 15 minutes. If the participant engaged in problem behavior at any point during a session due to no access to a preferred activity or adult action, he was redirected out of the room and to another activity for 5 minutes, or until the problem behavior ended, whichever was longest. The session timer was paused at the point where the child began engaging in problem behaviors. If problem behaviors began once a trial had been initiated, that trial was discontinued, and no data for that trial was recorded. Once at least 5 minutes have passed and the participant was no longer engaging in problem behaviors, he was taken back to the treatment room. The session immediately resumed as previously described,
and the interventionist began the session timer again from the point where it was paused as soon as the participant entered the treatment room.

Generalization probes, in which a different interventionist and different setting were utilized, were conducted during baseline sessions. These were conducted in order to determine the generalizability of the procedure to different interventionists and locations. Probes for generalization during baseline were collected concurrently across tiers.

**Intervention**

Intervention sessions were identical to baseline, except for the following changes. As in baseline, once the participant engaged in a behavioral indication toward a putative reinforcer, the interventionist waited 5 seconds to allow time for the participant to emit an unprompted mand for an action. If, during this 5-second interval, the child emitted any vocalization *other than an unprompted mand*, the interventionist immediately gave a full vocal prompt for the mand corresponding to that particular putative reinforcer (e.g., “Open”). If 5 seconds elapsed and the child did not engage in an unprompted mand for an action or did not engage in any other vocalization, the interventionist immediately gave a full vocal prompt to evoke a mand corresponding to that particular putative reinforcer (e.g., “Open.”). The interventionist stated the full word, not the child’s operationally defined vocalization or another approximation. The vocal prompt was repeated every 3 seconds until the participant stated the target mand or engaged in a behavioral indication toward a different putative reinforcer. If the participant repeated the target vocalization for the putative reinforcer, then the interventionist immediately stated the word again (e.g., “Open”) and performed the relevant consequence for that mand (see Table 1). The mand was recorded as prompted. If the participant did not
repeat the target vocalization and instead engaged in a behavioral indication toward another putative reinforcer, the previous trial was discontinued. A new trial was initiated with the latter putative reinforcer. Mastery criterion was set at three consecutive sessions in which 80% or more of mands for actions were unprompted.

Generalization

The generalization phase was implemented following completion of intervention for each participant. Three to five probes were conducted for each participant during both baseline and generalization, with an adult other than the interventionist with whom the child would usually work during a typical day at the center. Conducting probes during baseline allowed for the demonstration that the participants were not engaging in the target behaviors with the second adult or in the alternate location prior to mand training. These probes were conducted in a room different from the baseline and intervention conditions (i.e., the KFAC cafeteria) because the goal was to assess the degree of response generalization.

Interventionist

The interventionist in this study was the student investigator. She holds a Master’s degree in behavior analysis and is a Board Certified Behavior Analyst. She is currently pursuing a doctoral degree in Special Education (Autism). She has provided ABA therapy to individuals with ASD and related disorders for approximately 10 years in a variety of settings. At the time of the study, she worked as a part-time Intervention Coordinator at the KFAC.

Procedural Fidelity

A concern in single-subject research is whether or not the intervention is implemented accurately over time, which can be addressed by measuring procedural fidelity (Horner et al.,
Procedural fidelity is a measurement of the extent to which procedures of an experimental condition are implemented the way they are described in the methods section (Gast & Ledford, 2014). For the current study, even though the interventionist followed the checklist of procedures to ensure fidelity of implementation, formal data were collected by the second primary observer during all baseline and intervention sessions using the Fidelity of Implementation Checklist (see Table 2). The outcome for procedural fidelity showed an average of 95% or higher for each participant: Logan (95.0%; range, 83.3%-100.0%); Chandler (99.3%; range, 91.7%-100.0%); Isaac (99.3%; range, 91.6%-100.0%); William (99.4%; range, 91.7%-100.0%); total across all participants (99.0%; range, 83.3%-100.0%).

Procedural reliability was calculated by dividing the number of observed behaviors by the number of planned behaviors, multiplied by 100 (Gast & Ledford, 2014). A secondary data collector (i.e., the student investigator) conducted reliability checks in the same manner for at least 30% of all sessions for which the primary data collector collected procedural fidelity.

Procedural reliability indicated high levels of interobserver agreement: Logan (95.0%; range, 83.3%-100%); Chandler (100.0%); Isaac (98.6%; range, 91.6%-100.0%); William (100.0%); total across all participants (99.0%; range, 83.3%-100.0%).

Social Validity

An experimenter-designed questionnaire was given to the KFAC staff and parents of the participants in order to determine the social validity of and satisfaction with the intervention procedures. Parents and staff were asked to rate on a scale of 1-5 whether the procedure was effective in increasing the target behavior and whether the target behavior was important for the child to learn and maintain.
Table 2

_Fidelity of Implementation Checklist_

<table>
<thead>
<tr>
<th>Category</th>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Set-Up</td>
<td>● All relevant reinforcers are present.</td>
</tr>
<tr>
<td></td>
<td>● Intervener starts timer for 15 minutes.</td>
</tr>
<tr>
<td>Procedures</td>
<td>When participant engages in a behavioral indication:</td>
</tr>
<tr>
<td></td>
<td>● Intervener waits 5 seconds before giving echoic prompt.</td>
</tr>
<tr>
<td></td>
<td>○ If child emits a vocalization that does not correspond to the item the child most recently engaged in a behavioral indication toward, intervener immediately gives a full vocal model of the correct mand.</td>
</tr>
<tr>
<td></td>
<td>▪ Vocal prompt repeated every 3 seconds until participant either states the target mand or engages in a behavioral indication toward another reinforcer.</td>
</tr>
<tr>
<td></td>
<td>○ If 5 seconds elapses and child has not engaged in an unprompted mand for an action or any other vocalization, intervener gives a full vocal prompt to evoke a mand corresponding to that particular reinforcer (e.g., “Open.”).</td>
</tr>
<tr>
<td></td>
<td>▪ Vocal prompt repeated every 3 seconds until participant either states the target mand or engages in a behavioral indication toward another reinforcer.</td>
</tr>
<tr>
<td></td>
<td>● Following any prompted or unprompted mand for the putative reinforcer, then the intervener will immediately state the word again (e.g., “Open”) and perform the relevant consequence for that mand (see table 1 for reinforcer-specific outcomes).</td>
</tr>
<tr>
<td></td>
<td>● Following any vocal prompt, if the participant does not repeat the target vocalization and instead engages in a behavioral indication toward another reinforcer, the previous trial will be discontinued. A new trial will be initiated with the latter reinforcer.</td>
</tr>
<tr>
<td>General</td>
<td>● Participant has free access to all stimuli (i.e., intervener does not block access to items).</td>
</tr>
<tr>
<td></td>
<td>● If participant goes longer than 10-s without a behavioral indication toward an item after first entering the treatment room or after a trial has ended, intervener randomly selects a putative reinforcer, touches it or points toward it, states one to two sentences about it (e.g., “Did you see the movie? It’s the Lion King!”). This step repeats every 10-s until participant engages in a behavioral indication toward an item or session ends.</td>
</tr>
</tbody>
</table>

Responses were favorable, with all parents agreeing that the intervention produced socially important outcomes, that the child learned to mand for actions, and that they were satisfied with the outcome of the intervention. It is important to note that the intervener held a hierarchically higher rank than the staff within the organization where the research was conducted, which could have influenced staff rating the intervention and outcomes highly. The results of both parent and staff questionnaires are summarized in Table 3.
### Table 3

**Results of Social Validity Questionnaire**

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>The communication skills my child learned as a result of this intervention are important.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>The time and cost of implementing the intervention was worth the outcome.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>My child learned to mand (request) for actions by others as a result of this intervention.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>I am satisfied with the results of this intervention.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>The intervention was conducted by people who typically come in contact with my child.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>The intervention occurred in a context that simulated the natural play-based setting.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>Staff</td>
<td>The communication skills my client learned as a result of this intervention are important.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>The time and cost of implementing the intervention was worth the outcome.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>My client learned to mand (request) for actions by others as a result of this intervention.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>I am satisfied with the results of this intervention.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>If I was provided with the script and was permitted to work with the client, I would be able to implement the intervention as well.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>The intervention occurred in a context that simulated the natural play-based setting.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Results**

The video data were coded, graphed and analyzed concurrently with data collection for each participant using the scientific principles of visual analysis typical of single case experimental research (Gast & Ledford, 2014; Horner, Swaminathan, Sugai, & Smolkowski,
2012). Additionally, effect size was computed to obtain a measure of the magnitude of effect of the intervention on the primary dependent variable. Results are discussed in relation to the specific research questions.

**Effectiveness of Mand Training on Unprompted Mands**

The first research question assessed the existence of a functional relation between mand training and the percent of unprompted mands. Baseline data for Logan showed no instances of unprompted mands for actions. After five consecutive stable data points, intervention was introduced. For the first three sessions of intervention, Logan showed only minimal improvement. However, beginning with the fourth intervention session (session 9), his performance improved dramatically when it exceeded the criterion and maintained for the remaining sessions of the intervention (see Figure 1).

Compared to baseline, \( M = 0\%, \text{ Mdn = 0\%}, \text{ Range = 0\%} \), Logan engaged in a higher percentage of unprompted mands during intervention \( M = 63\%, \text{ Mdn = 96\%}, \text{ Range = 0\%-100\%} \). During intervention, 63% of data points fell within 25% of the median, as compared to 100% of data points falling within 25% of the median during baseline. These levels indicate variable data during intervention and stable data during baseline. Both the relative and absolute level change (+95% and +100% respectively) showed an improving in the data pattern. Although there was no change in the direction of the data during baseline, intervention produced an accelerating direction in the data pattern. Trend stability was stable during baseline (100%) and variable during intervention (50%). Only a single data trajectory was observed in each phase. The percent of non-overlapping data (PND) was 75%. However, a
Figure 1. Percent prompted (open circles, dashed line) and unprompted (closed circles, solid line) mands for actions per session.

Generalization probe data are presented as open (prompted mands) and closed (unprompted mands) squares.
steadily increasing trend and stable performance for the last 5 sessions of intervention, appears to demonstrate the effectiveness of mand training.

Following an increasing trend in Logan’s data, intervention was introduced for Chandler. There was a minimal increase in the level of unprompted mands during the initial introduction of mand training. Further analysis indicted that during these first five intervention sessions, Chandler typically manded by stating a sentence requesting to engage with a particular item. For example, most of these mands followed the format, “I want do [item/activity], please.” Chandler had engaged in these and similar mands during baseline. Because baseline procedures called for the interventionist to deliver the reinforcer five seconds after a behavioral indication for an item, which included mands for the item, baseline protocols may have resulted in adventitious reinforcement of this response. More specifically, every time Chandler manded for the item in baseline (e.g., “I want do sand, please.”), he received the requested reinforcer within 5 seconds, possibly leading to reinforcement of this response. Additionally, an observation of Chandler with his typical staff showed that staff were frequently reinforcing and even prompting mands of this form (“I want do [item/activity], please.”).

It was hypothesized that the prompting procedure may have inadvertently created a superstitious response chain in which the participant manded for the item (e.g., “I want do sand, please.”), followed by a prompt for the target mand from the interventionist (e.g., “Open.”), which finally resulted in the child stating the target mand. Because the reinforcer was delivered at the end of this response chain, it was assumed that unless measures were taken to break the chain, the child may not make steady progress in learning the target mands. Therefore, a modification was added to the intervention. Beginning with session 19, if the child
engaged in a behavioral indication and vocalized prior to the 5-second time delay expiring, an additional time delay of 15 seconds was added before the vocal prompt for the relevant action was delivered. This additional time delay was put in place in an effort to allow an opportunity for the interventionist to prompt target mands without further reinforcing the response chain. The modified mand training procedure was called “Mand Training + Time Delay” (shown as “MT+TD” on Figure 1).

Chandler met the mastery criteria of three consecutive sessions at 80% or above within four sessions of entering the Mand Training + Time Delay phase. Then, to determine the effectiveness of the original mand training, the additional time delay was retracted. He mastered unprompted mands in the first three sessions during this second introduction of the mand training phase and maintained levels above 80% for the remainder of the phase.

Analysis of the effect of intervention on unprompted mands for Chandler was analyzed across all three phases. Chandler engaged in a higher percentage of unprompted mands during intervention ($M = 72\%$, $Mdn = 96\%$, Range $= 0\%-100\%$) as compared to baseline ($M = 0\%$, $Mdn = 0\%$, Range $= 0\%-0\%$). Level stability during intervention was variable, with 68\% of data points falling within 25\% of the median, as compared to 100\% of data points falling within 25\% of the median during baseline. The data pattern during intervention showed improvement in both relative ($+79\%$) and absolute ($+91\%$) level change. There was no change in the direction of the data during baseline, but data followed an accelerating trend during intervention. The trend was stable during baseline (100\%) and variable during intervention (37\%). PND totaled 95\%, lending evidence to the effectiveness of the intervention.
Isaac engaged in no unprompted mands for actions during baseline. Once Chandler demonstrated steady high rates of responding during the second mand training phase, intervention was introduced for Isaac (see Figure 1). Isaac engaged in only prompted mands during the first intervention session, but his performance steadily improved for all subsequent sessions. Isaac achieved mastery criteria after only six sessions of intervention and continued to perform at or above mastery criteria for the remainder of the mand training phase.

Unprompted mands occurred much more frequently during intervention (M = 80%, Mdn = 95%, Range = 0%-100%) than during baseline (M = 0%, Mdn = 0%, Range = 0%). Level stability during intervention was variable, with 73% of data points falling within 25% of the median. By comparison, 100% of data points during baseline fell within 25% of the median. An improving data pattern was observed in both the relative and absolute level change (+23% and +100% respectively). There was no change in the direction of the data during baseline as all unprompted mands were 0%. An accelerating direction in the data pattern was observed during intervention. The trend was stable during baseline (100%) and variable during intervention (55%). Only a single data trajectory was observed in each phase. The PND during intervention was high (91%).

The final participant, William, was introduced to intervention following 29 sessions of baseline in which no unprompted mands for actions occurred. Intervention was introduced for William only after the intervention data for Isaac showed a steady increasing trend. William engaged in zero-to-low rates of unprompted mands for the first five sessions of intervention. However, his performance began improving rapidly by the sixth intervention session and continued trending upward. William achieved mastery criteria after nine intervention sessions.
William engaged in much higher percentages of unprompted mands during intervention (M = 53%, Mdn = 75%, Range = 0%-100%) than during baseline (M = 0%, Mdn = 0%, Range = 0%). During intervention, level stability was variable, with 50% of the data points falling within 25% of the median. All data points during baseline fell within 25% of the median. The relative and absolute level change (+80% and +90% respectively) indicated an improving performance during intervention. The data pattern accelerated during intervention and did not change during baseline. The trend was stable during baseline (100%) and variable during intervention (42%), however, it was consistently increasing. Only one trajectory was observed in each phase. Intervention resulted in a high PND (83%).

**Effectiveness of Mand Training on Response Generalization**

As noted previously, the purpose of generalization assessment was to determine the extent to which unprompted mands would transfer to different therapists and settings (i.e., Research Question 2). The generalization phase was initiated in a staggered manner for all participants after each one indicated a steady performance at or above 80% criterion for three consecutive intervention sessions. Each participant was exposed to at least one different setting or therapist per probe session. Generalization sessions occurred between 10 and 46 days post-intervention.

Generalization data showed that all participants maintained the level of unprompted mands at or above the mastery criteria for all the probe sessions with Logan at the highest level of 100% throughout intervention. Averages during generalization for all other participants is as follows: Chandler 99% (range, 97%-100%); Isaac 90% (range, 83%-97%); and William 84% (range, 83%-85%).
**Effect Size**

In addition to visual analysis, a measure of effect size was calculated because of the need for a more objective measure of the magnitude of the intervention and improved credibility (Parker & Hagan-Burke, 2007). A commonly used measure of effect size in single case research is Cohen’s $d$ index (Dunst, Hamby, & Trivette, 2004). This measure of effect size was calculated for all unprompted mands, for all participants, across baseline and intervention phases. Cohen’s $d$ was calculated using the following formula:

$$
d = \frac{M_I - M_B}{(Sd_P / \sqrt{2(1 - r)})}
$$

“where $M_I$ is the mean score for the intervention, $M_B$ is the mean score for the baseline, $Sd_P$ is the pooled standard deviation for both phases, and $r$ is the correlation between the baseline and intervention” (Dunst, Hamby, & Trivette, 2004, p. 6).

All participants had a large effect size: Logan ($d = 1.0$); Chandler ($d = 1.3$); Isaac ($d = 3.6$); William ($d = 1.8$). The effect size for the entire intervention was also high ($d = 1.1$). High effect sizes provide additional evidence for the statistical strength of the intervention. It is important to note that effect sizes are discussed using parameters established for the interpretation of research using large sample sizes. Standards for interpretation of Cohen’s $d$ values have not yet been established for single case research.

**Discussion**

Two research questions were addressed in this study. The first evaluated whether there was a functional relation between mand training and the rate of unprompted mands for actions for children with autism. The intervention produced improved level and trend for all participants. PND for all participants except for Logan was above 80%, although Logan’s PND
was just below that threshold (75%). Intervention did not produce an immediate effect for any participant, although Logan, Isaac, and William all showed improvement after one to two sessions of intervention. Chandler required an additional phase (mand training + time delay) before significant improvement was noted, although improvement was immediate and maintained when the original mand training phase was re-introduced. Also, the effect size was large for all participants and for the study as a whole. Overall, there is evidence to support that the existence of a functional relation between this mand training procedure and the rate of unprompted mands for actions for children with autism.

Additionally, the second research question addressed whether or not this functional relation would be observed across people and settings that were not involved in training. All participants performed above mastery criteria during the generalization phase. It would appear this intervention is capable of increasing mands for actions even in untrained settings and with untrained people.

*Teaching Mands for Specific Actions*

This study extends the research on mand training by demonstrating a procedure that can be used to teach children with autism specific mands for actions. The procedures used in this intervention are similar to those used by other researchers to successfully teach mands for items that are in sight (e.g., Chaabane et al., 2009; Ganz et al., 2011; Marckel et al., 2006). Prior research had not addressed whether or not such procedures would work to teach mands for specific actions (e.g., Bowen, Shillingsburg, & Carr, 2012, Ostryn & Wolfe, 2011, Sweeney-Kerwin et al., 2007). When a child mands for an item that is in sight, the item’s presence paired with the child’s MO can increase the probability of a mand occurring. In contrast, it can be
more difficult to teach mands for items that are out of sight because the child’s MO is the only variable controlling the mand. Modified teaching procedures may need to be developed in order to teach the child to mand in the absence of stimuli associated with the presence of a preferred item (e.g., Sweeney-Kerwin et al., 2007).

**Indicators of High Quality Research**

This study was designed to fill a current gap in the literature by addressing the need for technically sound research design and procedures to evaluate the impact of mand training. The study was developed using the evaluative method established by Horner et al. (2012), Horner and Kratochwill (2012) and Reichow and colleagues (2008; 2011) with the intention of creating a technically sound study (e.g., at least three demonstrations of effect, minimum of five data points per baseline, assessment of generalization and demonstration of experimental control).

When the student investigator used the criteria established by Reichow et al. (2008; 2011) to evaluate the methodological rigor of existing research on mand training for individuals with ASD, all studies were given a strength rating of weak. According to Reichow and colleagues, only strong and adequate studies can be used in the determination of whether an intervention has gathered enough support to be considered an evidence-based practice. The current study will serve as an initial contribution to a body of strong and adequate studies that will eventually lead to mand training being considered an evidence-based practice.

**Implications for Practice**

It has been suggested that teaching mands for actions is an important and developmentally appropriate component to language training programs for children with autism (Sundberg, 2014; Sundberg & Partington, 1998). One of the primary findings of this
study was that unprompted mands for others to perform an action did not increase until mand training was introduced. The practical implication of this finding is that children must be specifically taught to mand for actions. Language training programs for children with autism should incorporate a mand training procedure specifically targetting mands for actions in order to improve this important component of the child’s manding repertoire.

Additionally, mand training sessions where only mands are targeted for a period of time appear to lead to improvement in the mand repertoire and should be a component of mand training in practice. Other studies have documented the effectiveness of teaching mands during timed sessions where exclusively mands are targeted (e.g., Jennett, Harris, & Rutgers, 2008; Sigafoos, Ganz, O’Reilly, Lancioni, & Schlosser, 2007). In addition to building manding opportunities into other activities (e.g., Sweeney-Kerwin et al., 2007; Ward, 2013), it might be beneficial to create blocks of time within a child’s schedule where only mands are targeted. There may even be natural times within a child’s schedule where practitioners can build in mand training sessions. For example, a child’s snack time may be an excellent time to contrive multiple mands for items (e.g., “cookie”) and even actions (e.g., “pour juice”).

Finally, special considerations may need to be made when teaching children to mand for actions who are already fluently and frequently manding for items. As observed in the results for this study, Chandler was already consistently manding for items by name during mand training, which lead to an immediate prompt from the interventionist. The immediacy of the prompt appeared to create a superstitious response chain wherein Chandler rarely gave unprompted mands for actions as his first response. For children such as Chandler who are
likely to consistently mand for items by name, a time delay procedure may be needed whereby vocal prompts are only delivered after the child has not vocalized for a period of time.

**Limitations and Directions for Future Research**

One limitation of the current study is that it is unknown whether the same teaching procedure would be effective in teaching mands for actions that do not involve a visible item present. It may be more difficult, for example, to teach children to mand for an adult to tickle them or to scratch their back, since there is no item present corresponding to those mands other than the presence of the adult. As seen in research on teaching mands for items that are out of sight (e.g., Sweeney-Kerwin et al., 2007; Ward, 2013), the presence of an adult may not be enough to evoke a mand, even when the child has mastered requesting the same item in sight. A direction for future research may be to document whether or not the procedure used in the current study can also be effective in teaching mands that do not involve a specific object or teaching mands for actions without a corresponding items present (e.g., “tickle”).

Another limitation is that while the original intention was to teach each child to mand for a variety of actions, three out of four participants almost always wanted a particular reinforcer during sessions. Their exclusivity resulted in almost all unprompted mands being a single target mand, rather than a variety of mands. However, limited preference for items or objects is not unusual for children with an autism spectrum disorder. Future research might target instruction on a variety of mands while protecting the integrity of the research design and procedures.

In addition to teaching children to mand for actions that result in a reinforcer, children should also be taught mands for others to stop an undesired action (Sundberg & Partington,
1998). For example, a child may be taught to mand for another person to “stop” an action that the child finds distasteful, such as singing.

It is possible that high generalizability in this study was achieved in large part due to the fact that the participants were taught a skill (i.e., a mand) that, in this particular setting, would almost always contact reinforcement from the natural contingencies operating within the environment (Stokes & Baer, 1977). In other words, all direct-support staff within the center have been taught to reinforce mands throughout the center. The current study tested for generalizability to a different location within the center and to a different staff. However, both the generalization staff and setting had a history of being paired with reinforcement of mands (albeit different mands than were targeted in the study). It is important to know whether or not the generalizability of this procedure would be as high in settings and with people who are not as strongly associated with the reinforcement of mands. Future research can address this issue by testing for generalizability to school and home-based settings and personnel/caregivers.

Also, this study did not assess the generalizability of mands to novel stimuli. For example, it is unknown whether the mand open taught in the current study would have generalized to a novel container, or whether the mand on would have generalized to a novel mechanical toy. Additional research is needed to assess how well mands trained using this procedure would generalize to novel stimuli.

Finally, the current study taught participants to vocally mand for actions. Participants were required to have a minimum score of 10 on the EESA to ensure they could respond effectively to the interventionist’s vocal prompts. For children with fewer vocal skills and who
may require augmentative or alternative forms of communication, the same prompting procedures used in this procedure would not be expected to work. An avenue for future research would be to investigate modifications to this procedure that would allow children to learn to mand for actions using various modalities of communication.

References


Choi, H., O’Reilly, M., Sigafoos, J., & Lancioni, G. (2010). Teaching requesting and rejecting sequences to four children with developmental disabilities using augmentative and

Cicchetti, D. V. (2001). The precision of reliability and validity estimates re-visited:


APPENDIX

MAND TRAINING FOR CHILDREN WITH AUTISM SPECTRUM DISORDER: A REVIEW OF LITERATURE
MAND TRAINING FOR CHILDREN WITH AUTISM SPECTRUM DISORDER: A REVIEW OF LITERATURE

Introduction

One of the primary deficits experienced by individuals with Autism Spectrum Disorder (ASD) is in the area of language and communication (American Psychiatric Association 2013). A range of practices specifically directed toward teaching communication skills have been developed, many involving the use of the principles of applied behavior analysis (ABA; Petursdottir and Carr 2011; Lovaas 1977). Interventions have focused on increasing vocalizations for learners with limited vocal repertoires (Esch, Carr, and Grow 2009) and teaching children to communicate through augmentative and alternative forms of communication (Bondy and Frost 2001; Carr and Kologinsky 1983).

Much of the ABA literature addressing communication training utilizes Skinner’s analysis of verbal behavior (Skinner 1957). Skinner presented a taxonomy of verbal operants, defined in terms of their functional relationship with the environment. He defined the mand as “. . . a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (1957, pp. 35-36).

The concept of the mand is closely tied to that of the motivating operation (MO), an omnibus term describing operations that temporarily increase or decrease the reinforcing effectiveness of a particular stimulus and evoke or abate behavior that, in the past, has resulted in the presentation of that stimulus (Laraway, Snycerski, Michael, and Poling 2003). For example, deprivation of food may temporarily increase the reinforcing effectiveness of food as
a reinforcer and, therefore, increase the frequency of responses that have produced access to food in the past. Similarly, food satiation is likely to decrease the value of food as a reinforcer, and thereby decrease the frequency of responses that result in access to food. Although the responses evoked by MOs may not necessarily be mands, the concepts are closely tied together because mands are necessarily controlled by a motivative variable (Sundberg and Michael 2001).

Mand training typically occurs in a naturalistic context. It involves creating a language-based environment in which training is incorporated into typical daily activities, and trainers capture and arrange a variety communication opportunities (Sundberg and Partington 1998). Often the first verbal operant that a child learns (Bijou and Baer 1965; Skinner 1957), the mand can be differentiated in that it is the only verbal operant that directly benefits the speaker by producing specific reinforcement (e.g., the mand cookie is reinforced by receiving a cookie; Sundberg and Michael 2001). As such, Sundberg and Michael suggest that early language training for children with autism should focus heavily on increasing the mand repertoire.

Mand training has also been shown to provide a variety of benefits for the learner in addition to improving the mand repertoire. For example, it has been linked to the reduction of challenging behaviors by teaching the child a mand to replace negatively reinforced problem behaviors evoked by the presentation of difficult tasks (e.g., Carr and Durand 1985) or the presentation of non-preferred stimuli (Yi, Christian, Vittimberga, and Lowenkron 2006). Mand training may also provide a means for teaching eye contact to children with ASD (Carbone, O’Brien, Sweeney-Kerwin, and Albert 2013) as well as improving compliance with instructions (Plavnick and Ferreri 2012).
A multitude of studies exist in which the effect of mand training on individuals with ASD has been examined, and the results are promising (e.g., Betz, Higbee, and Pollard 2010; Bowen, Shillingsburg, and Carr 2012; Ganz, Flores, and Lashley 2011; Marckel, Neef, and Ferreri 2006; Reichle, Dropik, Alden-Anderson and Haley 2008). For example, Reichle and colleagues (2008) investigated a procedure for teaching a child with autism to request assistance when presented with difficult tasks. He was taught to vocally mand “Help,” and both easy and difficult versions of tasks were presented to evaluate his appropriate usage of the mand. Later, he was taught how to complete the difficult task. Initially, the skill overgeneralized to both easy and difficult tasks, although the response frequency declined for both conditions once task competency increased.

However, as the number of studies on mand training increases, there is a need to evaluate the quality of methodology and evidence to facilitate future research and practice in this area. The purpose of the current literature review was to (1) delineate a taxonomy of the various types of mand training procedures that have been utilized for individuals with ASD, describe procedural components, and evaluate the clinical effectiveness of those procedures; (2) evaluate the quality of the research methodology on mand training; (3) present guidelines for implementing mand training in applied settings, and (4) make recommendations for further research.

Method

Locating Studies

In order to locate published articles related to the use of mand training with individuals with ASD, an electronic search of the following databases was conducted through our
university’s portal: Academic Search Complete, Education Research Complete, ERIC, PsycARTICLES, Psychology and Behavioral Sciences Collection, and PsycINFO. The search was conducted using the terms mand OR (request AND auti*). These broad search terms were used in an effort to produce the highest number of relevant results possible. The search produced 1,525 results. The abstracts of these studies were reviewed for relevance, and 68 were identified for possible inclusion based on the inclusion criteria. The reference lists for these 68 articles were analyzed to pinpoint additional studies qualifying for inclusion, and 74 more possible studies were identified from the reference lists. A manual search of the journal was conducted in cases where electronic articles were not available from these databases. Of this pool of 142 published articles, only 20 met the criteria for inclusion in the current review. Two of the 20 articles (i.e., Carr and Kologinsky 1983; Endicott and Higbee 2007) presented two separate experiments, thus, the analysis of quality indicators were conducted separately for each of the experiments.

**Inclusion and Exclusion Criteria**

Published articles included in the current review had to meet all of the following criteria:

1. Manding or requesting had to be operationally defined as the specific primary dependent variable in the experiment (e.g., Endicott and Higbee 2007). Non-examples included studies where (a) manding was not the sole dependent variable used to make phase change decisions (e.g., Kodak and Clements 2009); (b) a behavior other than mands was the primary dependent variable, but collateral changes in mands were evaluated (e.g., Kooistra, Buchmeier, and Klatt 2012); (c) participants already had mands in their repertoire but training focused on adding “carrier phrases” (e.g., instead of “cars,” “I want the cars”;
Hernandez, Hanley, Ingvarsson, and Tiger 2007); (d) the dependent variable involved the participant emitting a mand in conjunction with some other verbal operant (e.g., Charlop and Milstein 1989), or (e) a specific mand topography was trained, but the primary dependent variable measured a collateral change in a different manding topography or other behavior (e.g., Jurgens, Anderson, and Moore 2009).

2. The verbal responses presumed to be mands within the study were trained and maintained using the specific consequence specified by the mand response itself (e.g., the mand “what is it?” is reinforced by the information related to the label of the item, or the mand “car” is reinforced by the presentation of a toy car). Non-examples included studies where training of a verbal response involved the delivery of a tangible reinforcer immediately following the verbal response that was not specified by the verbal response (e.g., the mand “what is it?” is reinforced by giving the child a toy; or the mand “car” is reinforced by giving the child a piece of candy), even if it was presented in conjunction with a specific consequence (e.g., Warren, Baxter, Anderson, Marshall, and Baer 1981).

3. The research article had to involve the general evaluation of the effectiveness of an intervention that explicitly included mand training as a component for the sole purpose of establishing a repertoire of mands as a primary form of communication rather than to replace problem behavior (e.g., Betz et al. 2010; Endicott and Higbee 2007). Non-examples included studies where (a) manding was taught as a functional communication response to replace problem behavior (e.g., Carr and Durand 1985); (b) the intervention did not include a specific mand training procedure (e.g., Bernstein, Brown, and Sturmey 2009); (c) the purpose was the comparison of mand acquisition across different response topographies
(e.g., Tincani 2004) or symbol systems (e.g., Angermeier, Schlosser, Luiselli, Harrington, and Carter 2008); (d) intervention focused on generalizing the use of participants’ existing mand repertoires to another person or setting (e.g., Wert and Neisworth 2003); or (e) manding was taught as a repair strategy for failed attempts to communicate using an alternative method of communication (e.g., Sigafoos et al. 2004).

4. At least one participant in each study had to have a diagnosis of an ASD. Non-examples included studies where all participants were individuals with intellectual or any other disability but not ASD (Warren et al. 1981).

5. Published studies had to utilize a research design and methodology that allowed for evaluation of the experimental effect on the dependent variables. Examples of appropriate research designs included experimental with group comparisons, quasi-experimental designs, and single-subject research designs, including multiple baseline, alternating treatments, and reversal designs. Non-examples included single-subject research designs that did not allow for multiple demonstrations of experimental effect, such as an AB design (e.g., Kee, Casey, Cea, Bicard, and Bicard 2012), or a multiple baseline design (a) with fewer than 3 experimental conditions (i.e., an original effect and two replications of effect; e.g., Goh et al. 2000), (b) where data were presented on a graph where the ordinate did not represent frequency, percentage correct, or some other unit of measurement allowing for demonstration of experimental effect (e.g., Albert, Carbone, Murray, Hagerty, and Sweeney-Kerwin 2012), or (c) where data were displayed cumulatively (e.g., Bowen, Shillingsburg, and Carr 2012; Reichle, Dropik, Alden-Anderson, and Haley 2008; Shillingsburg Powell, and Bowen 2013). In a cumulative graph, the data do not allow for evaluation of
intervention effectiveness using the criteria by Reichow, Volkmar, and Cicchetti (2008) and Reichow, Doehring, Cicchetti, and Volkmar (2011). This is because the standard rules for visual analysis cannot be applied to cumulative graphs (e.g., cannot correctly calculate data overlap between adjacent conditions). However, the three studies still demonstrated clinically significant results and met all other inclusion criteria, so they are summarized in a separate section.

6. All articles included in the current literature review were required to have been published in a peer-reviewed journal in the English language. All database searches were conducted with the criterion of being published in a peer-reviewed journal as a requisite for search results. Non-examples included articles that were not published in a peer-reviewed journal (e.g., Warren et al. 1981) or in the English language (e.g., Katoh 1988).

Initially, the requirement was set that all studies should have received a strength rating of *strong* or *adequate* according to the evaluation criteria developed by Reichow and colleagues (2008; 2011). However, given that none of the 20 studies met this standard, all studies included in the current literature review received a strength rating of *weak* (detail provided in the following section). This standard was utilized for rating each research article based on methodological rigor, but it was removed as an inclusion criterion.

In the process of conducting the literature review, both authors independently reviewed and then discussed 20 published studies in order to determine the ones that met the inclusion criteria. The discussion focused on the extent to which each study documented the presence of primary and secondary quality indicators and the overall strength rating based on the criteria presented by Reichow and colleagues (2008; 2011). Following initial review and
discussions, after both raters received an agreement score of 90% or higher on three consecutive studies scored independently, they randomly selected 33% of the published studies (i.e., 7 of 20) for calculating interobserver agreements (IOA). An agreement was noted on an item-by-item basis for each primary and secondary quality indicator and the strength rating for each study. The published studies included both, those that met or did not meet the inclusion criteria because the goal was to determine IOA across raters. Thus, the percent of agreements and disagreements were evaluated for the presence of six primary quality indicators and seven secondary indicators on an item-by-item basis, as well as the overall strength rating (i.e., strong, adequate or weak).

Results of the IOA showed 100% agreement on four studies, 88%, 75% and 67% on three studies respectively, with an overall agreement score of 90%.

Results and Discussion

*Manding for Information*

Sundberg and Michael (2001) summarized a category of mands called mands for information: “Questions are mands that are reinforced by verbal behavior on the part of the listener, who typically supplies what can be considered information about the environment. Questions are thus under the control of EOs that make such information valuable to the asker” (p. 711). Of the 20 studies included in the current literature review, 5 studies focused specifically on teaching mands for information (e.g., Betz et al. 2010; Endicott and Higbee, 2007; Koegel, Koegel, Green-Hopkins, and Barnes 2010; Ostryn and Wolfe 2011; Shillingsburg, Valentino, Bowen, Bradley, and Zavatkay 2011). One study (Endicott and Higbee 2007) included two experiments, each teaching a different type of mand for information (“where” and “who”).
These two experiments were reviewed separately in Table A1 to highlight procedural differences. A total of 15 unique participants (3 females, 12 males) were represented in the 5 studies. All studies utilized speech as the modality for communication, with the exception of Ostryn and Wolfe (2011) who initially used a picture communication symbol but changed the dependent variable to a vocal response for two participants and a vocal response with an accompanying point for the third participant.

Three of the experiments focused specifically on teaching participants to mand using only a “where” question (e.g., Betz et al. 2010; Endicott and Higbee 2007, experiment 1; Koegel et al. 2010). Only one experiment focused solely on teaching mands for information using “who” (Endicott and Higbee 2007, experiment 2) and “what” questions (Ostryn and Wolfe 2011). Shillingsburg et al. (2011) taught three different mands for information to each participant (“who” and “when” for both participants; “which” for one participant and “where” for the second participant). Specific information for each study is provided in Table A1.

All participants in the studies in this category successfully acquired the target mand, indicating promising strategies for teaching mands for information to individuals with ASD. Typically, generalization to novel reinforcers (Betz et al. 2010), novel settings, (Betz et al. 2010; Endicott and Higbee 2007; Koegel et al. 2010; Ostryn and Wolfe 2011), novel adults (Ostryn and Wolfe 2011), and sometimes novel scenarios (Shillingsburg et al. 2011) was also achieved. In some cases, generalization appeared to be an issue when sessions were more dissimilar from those during training (Betz et al. 2010; Shillingsburg et al. 2011). Problems with generalization may be ameliorated by teaching the child to respond in multiple scenarios with a variety of
Table A1

Summary of Research on Manding for Information

<table>
<thead>
<tr>
<th>Reference</th>
<th>Participants</th>
<th>Dependent Variables</th>
<th>Research Design</th>
<th>IOA and FOI Outcomes</th>
<th>Intervention Components</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Betz et al. (2010)</td>
<td>3 children (3.5-5 years), all with ASD</td>
<td>Percent independent vocal mands for information “where + (item name)”</td>
<td>Multiple baseline across participants</td>
<td>100% IOA for all participants</td>
<td>• 30-s pre-trial NCR</td>
<td>All acquired the target response, maintained at 1-2 month follow-up; generalized to novel toys and settings. None used the target response in the natural behavior chain where the verbal instruction was absent until further training.</td>
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<td>Greater than 99% FOI for all participants</td>
<td>• Vocal instruction to retrieve missing reinforcer</td>
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<td>• Echoic prompts after 5-s time delay</td>
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<td>• Praise for prompted responses</td>
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<td>• Location of item given contingently</td>
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<td>Endicott and Higbee (2007) Expt. 1</td>
<td>3 males (ages 3-4 years), all with ASD</td>
<td>Percent correct vocal mands for information “where”</td>
<td>Multiple baseline across participants with a multi-element component</td>
<td>99.7% IOA across participants</td>
<td>• Up to 30-s pre-trial NCR</td>
<td>All generalized to a different setting; 1 manded at higher rates for high-preference reinforcers; the other 2 manded at high rates regardless of the reinforcer.</td>
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<td>• Vocal instruction to retrieve missing reinforcer</td>
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<td>• Echoic prompts after 30-s time delay</td>
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<td>• Location of item given contingently</td>
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<tr>
<td>Endicott and Higbee (2007) Expt. 2</td>
<td>3 males (ages 4-5 years), all with ASD</td>
<td>Percent correct vocal mands for information “who”</td>
<td>Multiple baseline across participants with a multi-element component</td>
<td>98% IOA across participants</td>
<td>• Up to 30-s pre-trial NCR</td>
<td>All acquired target response and emitted it at high rates regardless of whether high- or low-preference reinforcers were used.</td>
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<td>• 10 trials per session (5 with high- and 5 with low preference reinforcers)</td>
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<td>• Child told to retrieve missing item</td>
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<td>• Echoic prompts after 30-s time delay</td>
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<td>• Name of person given contingently</td>
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<tr>
<td>Koegel et al. (2010)</td>
<td>3 males (ages 3.2-4.8 years), all with autism</td>
<td>Percent vocal unprompted “Where?” questions; percent unprompted prepositions/ ordinal markers</td>
<td>Multiple baseline across participants</td>
<td>IOA not reported</td>
<td>• Preferred items hidden</td>
<td>All participants acquired target response “where is it?” and demonstrated it in an alternative setting and with a different person during generalization probes.</td>
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<td>FOI not reported</td>
<td>• Echoic prompts to ask “Where is it?”</td>
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<td>• Correct response resulted in information regarding the location of the item that also included a preposition (e.g., on the table)</td>
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<td>• Prompt fading and a time delay added</td>
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</table>

Note: NCR = Noncontingent reinforcement

*(table continues)*
Table A1 (continued).

<table>
<thead>
<tr>
<th>Reference</th>
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<th>Intervention Components</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| Ostryn and Wolfe (2011)       | 3 children (3-4 years) with PDD-NOS, ASD and moderate autism                 | Percent unprompted pictorial communication of “What’s that?”                         | Multiple baseline across participants | 100% IOA across all participants | • Toy placed in translucent bag  
• Echoic prompt “What’s that?” while pointing to picture symbol and bag  
• Physical prompt after 2-s time delay  
• Correct response resulted in information regarding the name and other details about the toy in the bag, followed by a manding opportunity, prompt, or being asked if they would like to have the item. | All participants acquired target response and generalized to a different setting, person, and container. Maintenance demonstrated for 2 participants at 3- and 6-month follow-up and for 1 participant at a 3-month follow-up session. |
| Shillingsburg et al. (2011)   | 2 males (7.9-11.11 years), both with autism and 1 with comorbid CP           | Percent correct vocal requests for information (“who,” “which,” and “when” for first participant; “who,” “where,” and “when” for second participant) | Multiple probe across “wh” questions | 99% IOA across both participants | • One scenario for a “wh” question presented at a time. Nonverbal and verbal stimuli presented (e.g., child told “someone has a surprise for you” with 3 adults present for “who” scenario).  
• Verbal stimulus represented with echoic prompt for child to ask appropriate “wh” question following a 3-s time delay  
• Contingent presentation of relevant information (e.g., name of person who has item for “who” scenario) | Both participants acquired all target responses. Participants failed to generalize to some novel scenarios. For 1 participant, maintenance was demonstrated between 1 day and 10 weeks for all but 2 scenarios. For the other participant, maintenance was demonstrated between 6 and 18 days with a range of 60-100% accuracy per question. |
antecedent stimuli rather than just a single scenario, although further investigation is warranted.

**Manding for Items in Sight**

Manding for items that are in sight occurs when a person mands for a specific item (e.g., juice) and the item is in sight at the time the mand occurred (e.g., a bottle of juice was present and visible). Eleven studies in the current review focused on teaching participants to mand for items that were in sight (Chaabane, Alber-Morgan, and DeBar 2009; Charlop, Shreibman, and Thibodeau 1985; Drasgow, Halle, and Ostrosky 1998; Ganz et al. 2011; Jennet, Harris, and Rutgers 2008; Leung and Chan 1993; Leung 1994; Marckel et al. 2006; Olive et al. 2007; Schlosser et al. 2007; Thomas, Lafasakis, and Sturmey 2010). An additional article involving two experiments (Carr and Kologinsky 1983) was reviewed among these studies, although the procedures described in the article did not provide clear information as to whether the item for which the participants were taught to mand was in sight or out of sight at the time of mand training. These two experiments were reviewed separately in Table A2 as the research design and procedures varied significantly from one another. A total of 45 unique participants (5 females, 40 males) participated in the 12 studies described in this category.

A variety of communication modalities were used and included sign (9 participants), vocal (24 participants), Picture Exchange Communication System (PECS; Bondy and Frost 2001; 4 participants), and voice output communication aids (VOCA; 8 participants). All participants who used PECS were taught to use descriptor cards representing either a color, shape, or function of the reinforcer, rather than a picture of the reinforcer. For example, they were taught to use a brown card to mand for a graham cracker because of the matching color. These
### Table A2

**Summary of Research on Manding for Items in Sight**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Participants</th>
<th>Dependent Variables</th>
<th>Research Design</th>
<th>IOA and FOI Outcomes</th>
<th>Intervention Components</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carr and Kologinsky (1983)</td>
<td>Expt. 1 a</td>
<td>3 males (9-14 years) with autism or “autistic-type”</td>
<td>Percent correct requests using signs 1 and 2</td>
<td>ABCBCD design with B and C conforming to a reversal design</td>
<td>84% IOA across all participants FOI not reported • First session: immediate model prompt of sign for 10 edibles, followed by small piece of edible • Following sessions: interventionist waited for child to sign by looking child in eye • Only first 2 instances of each sign in a session were reinforced (additional instances ignored) • After 5-m, if child had not manded for all reinforcers twice, interventionist provided model prompt for remaining signs</td>
<td>For all participants, target response increased from baseline, was maintained in a final session under baseline conditions, and generalized to novel interventionists. Self-stimulatory behavior decreased from baseline.</td>
</tr>
<tr>
<td>Carr and Kologinsky (1983)</td>
<td>Expt. 2 a</td>
<td>3 males (10-14 years) with autism or “autistic-type”</td>
<td>Percent correct requests using signs 1 and 2</td>
<td>ABCBCD design with B and C conforming to a reversal design</td>
<td>99% IOA across all participants FOI not reported 2 signs for edible reinforcers selected for each participant (signs 1 and 2). Conditions alternated in which 1 sign was reinforced while the other was extinguished. Final phase involved the reinforcement of both signs. • Participant brought into room; interventionist came out of hiding and approached him. • Model prompt after 10-s time delay; prompts faded over time. • Correct sign resulted in access to reinforcer</td>
<td>All participants acquired both signs. Signs decreased when exposed to extinction and increased when reinforced. Target skill demonstrated to occur in novel settings and with novel interventionists during generalization probes.</td>
</tr>
<tr>
<td>Chaabane et al. (2009)</td>
<td>2 males (5-6 years) with ASD</td>
<td>Percentage of independent mand improvisations and errors with PECS</td>
<td>Multiple baseline design across symbol categories</td>
<td>90% IOA across all participants FOI averaged 98% for all participants</td>
<td>• Reinf orcer and neutral item placed in front of child, with a descriptor card (either color, shape, or function) corresponding to each item • Physical prompts given to select correct card • Selecting incorrect card resulted in access to neutral item, then a prompt to select correct card • Selecting correct card resulted in brief access to reinforcer (or a small piece, if it was an edible) and descriptive praise</td>
<td>Improvised mands for items across all three categories (color, shape, and function) were acquired. Both participants demonstrated generalization to untrained stimuli.</td>
</tr>
</tbody>
</table>

a There was insufficient information present in the intervention procedures to determine whether reinforcers were in sight or out of sight when the participant manded. These studies were placed in the “in sight” category by default.

Note: PDD = pervasive developmental disorder; PECS = Picture Exchange Communication System.
Table A2 (continued).

<table>
<thead>
<tr>
<th>Reference</th>
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</tr>
</thead>
</table>
| Charlop et al. (1985) | 7 males [5-11 years] with autism                                              | Percent correct vocal mands “I want [item name]“         | Multiple baseline across participants                                           | 98% IOA for all participants (not listed for each participant)                          | • All reinforcers were foods or drinks  
• Interventionist presented presumed reinforcer  
• Echoic prompt “I want [item name]” given with 0-s time delay; time delay then increased systematically, beginning with 2-s, ending at 10-s  
• Correct response resulted in participant being given edible reinforcer              | For all participants, correct mands increased from baseline and generalization occurred across settings and people. Six out of 7 participants demonstrated the target response for untrained reinforcers. |
| Drasgow et al. (1998) | 3 children (3 years) all with autism or PDD and 1 with comorbid Fragile X    | Frequency of mands using signed “Please” and frequency of pre-existing mand topographies (e.g., leading, reaching) | Multiple baseline across stimulus class items (food, toys, events)              | 99% IOA in baseline and 96% in intervention for all participants                      | • Sign “please” first taught in massed trial training:  
  o Single reinforcer used for training  
  o Physical prompts used to evoke sign  
  o Correct signs resulted in access to the reinforcer  
• Next, probes were conducted in a natural context across reinforcer categories (food, toys, events):  
  o Pre-existing mand forms placed on extinction  
  o Correct signs “please” resulted in access to reinforcer | The frequency of mands “please” increased for all 3 participants. For 2 participants, the use of “please” became more frequent by the end of intervention than pre-existing mand forms. |
| Ganz et al. (2011)   | 2 males (3-4 years) with autism, 1 with comorbid speech impairment            | Percent correct vocal requests following a verbal model, independent vocal requests, and word approximations                   | Multiple baseline across objects                                                  | 99% IOA in baseline, 97% in intervention, and 89% in generalization across all participants | • Interventionist held reinforcer in view of child and waited to see if child would show interest  
• Echoic prompt after 5-s time delay, repeated up to 3 times with 2-s between prompts  
• Failure to respond to prompts resulted in child receiving the item for 10-s following prompts  
• Any of the 3 target responses resulted in immediate 10-s access to item | Target responses increased for both participants, generalized to a novel interventionist, and maintained during 3-week follow-up. One participant made gains in independent requests, while the other made gains in word approximations. |

Note: PDD = pervasive developmental disorder

(table continues)
### Table A2 (continued).

<table>
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<tr>
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</tr>
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</table>
| Jennett et al. (2008) | 6 children (3-5 years) with Autistic Disorder or PDD-NOS | Frequency of independent and echoic (prompted) vocal requests | Multiple probe design across participants | 94% IOA for all participants FOI averaged 97% during DTI sessions and 98% during mand training, for all participants | • Compared mand training and discrete trial training
  • 2 sets of reinforcers used (Sets A and B); each reinforcer from Set A had a corresponding item in Set B (e.g., a cassette tape and tape player)
  Mand Training:
  • Reinforcers from set A placed around room
  • When child showed interest in item, interventionist showed corresponding reinforcer from set B and vocally modeled target response every 5 to 10-s
  • Correct response resulted in social praise and 30-s access to reinforcer
  Discrete Trial Training:
  • Participant presented with one item at a time from Set B in a rotating sequence, then the corresponding reinforcer from Set A
  • Interventionist asked, “What do you want?”
  • Echoic prompt after 0-, 2- or 5-s time delay
  • Correct response followed by praise and up to 30-s access to both reinforcers | 5 out of 6 participants showed an increased frequency of independent requests and acquired mands faster in the mand training condition. One participant did not acquire mands in either condition. 2 participants engaged in more challenging behavior in discrete trial training than mand training, while the other 4 showed no difference. All participants engaged in more eye contact in discrete trial training than mand training. |
| Leung (1994) | 3 males (5-11 years) with autism | Percent correct vocal requests | Multiple baseline across participants | 98% IOA for all participants (not listed for each participant) FOI not reported | • Training utilized toys with multiple pieces
  • Single toy piece shown to child with echoic prompt (e.g., “Mr. Chan, I want jigsaw puzzle please”)
  • Echoic prompts first delivered with 0-s time delay; time delay increased systematically in 2-s intervals up to 10-s
  • Correct response resulted in access to toy piece | For all 3 participants, the target skill was acquired quickly, maintained during 1- and 3-month follow-up sessions, and generalized to another setting, trainer, as well as a different toy and a food reinforcer. |

*Note: PDD-NOS = pervasive developmental disorder-not otherwise specified*
Table A2 (continued).

<table>
<thead>
<tr>
<th>Reference</th>
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</table>
| Leung and Chan (1993) | 3 males (7-10 years) with autism | Percent correct vocal requests | Multiple baseline across participants | 98% IOA for all participants (not listed for each participant) | • Training utilized 2 different food reinforcers per participant  
• Reinforcer shown to child with echoic prompt (e.g., “Miss Chan, I want [food] please”)  
• Echoic prompts first delivered with 0-s time delay; time delay increased systematically in 2-s intervals up to 10-s  
• Correct response resulted in access to reinforcer | For all 3 participants, the target skill was acquired, maintained during 1-month follow-up sessions, and generalized to another setting, trainer, other food items, and to novel toys. |
| Marckel et al. (2006) | 2 males (4-5 years) with autism | Number of independent PECS requests with improvisation | Multiple baseline across descriptors | 99% IOA for all participants  
FOI averaged 100% for both participants | • Reinforcer placed in front of child  
• Interventionist physically prompted (with time delay) use of correct descriptor card on PECS book, from an array of descriptor cards from a category (functions, colors, or shapes)  
• Error correction procedure introduced after prompts were faded  
• Correct response followed by praise and brief access to reinforcer | Both participants improvised mands for items across all three categories (color, shape, and function). The target response generalized to novel stimuli and environments. |
| Olive et al. (2007) | 3 males (3-5 years) with autism or PDD-NOS | Frequency of correct, incorrect, and prompted requests using VOCA, gestural communicative acts, and verbal communicative acts | Multiple baseline across participants | 96% IOA across participants  
FOI averaged 96% for all participants | • 5-m play sessions using a toy the participant selected prior to the session  
• When child used an informal gesture, interventionist used most-to-least prompting to evoke a correct VOCA response  
• Correct response followed by expansion of VOCA recording (e.g., “You want more cars!”) and access to the toy | All 3 participants showed an increase in correct requesting using the VOCA device. |

*Note: PECS = Picture Exchange Communication System; VOCA = voice output communication aid; PDD-NOS = pervasive developmental disorder-not otherwise specified.*
Table A2 (continued).

<table>
<thead>
<tr>
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</thead>
</table>
| Schlosser et al. (2007) | 5 children (8-10) with autism, 1 with comorbid intellectual disability and 1 with comorbid global developmental delays | Percentage of correct requests with VOCA, number of sessions to criterion, percentage of correct elicited vocalizations | Adapted alternating treatments design               | For requests, IOA was 100% during acquisition probes, 97% when speech output was turned off, and 99% when speech output was turned on, across participants. IOA was 100% across participants during elicited vocalization probes. FOI averaged 100% for all conditions, across participants. | • Compared 2 intervention conditions where speech output was on or off  
• One reinforcer placed in front of participant; Interventionist stated, “Let me know if you want [name of object].”  
• Correct response modeled, at first with 0-s prompt delay; later, delay was systematically increased in 1-s increments up to 10-s  
• Prompt “Tell me you want [name of object]” and physical prompt delivered after 5-s time delay  
• Interventionist gave corrective feedback following incorrect responses  
• Correct response followed by 5-s access to reinforcer or opportunity to consume (if edible) | Two students requested more effectively when speech output was turned on. One student requested more effectively without speech output. The remaining two students showed no difference. No students reached mastery criterion prior to the end of the study. |
| Thomas et al. (2010) | 3 children (3 years) with PDD-NOS or autism                                    | Percent correct of independent VM, IM (e.g., grabbing), and AR (included independent vocal mands, pointing, looking, oral motor approximations, and echoic vocalizations) | Multiple baseline design across participant s       | IOA averaged 97%, 98%, and 93% across participants for independent vocalizations, immature mands, and appropriate responses, respectively  
FOI not reported | • Participants taught step by step to point to reinforcer, make eye contact with interventionist, and vocally mand for item  
• Interventionist presented one reinforcer and modeled the target sound  
• Physical prompts used after 4 to 5-s prompt delay to evoke correct pointing; prompts faded  
• Interventionist moved reinforcer toward face after 4 to 5-s prompt delay to evoke correct eye contact  
• Interventionist leaned toward child and gave echoic prompt for target vocalization to prompt oral movement or vocal response  
• Engaging in target responses (as determined by the current step of the intervention) resulted in child gaining access to the reinforcer | Two participants achieved an increased frequency of independent vocal mands during the intervention. One did not learn vocal mands during intervention, but did display vocal mands during a 2-month follow-up. Another participant demonstrated a moderate percentage of independent vocal mands during a 4-month follow-up. |

*Note: AR = appropriate responses; IM = immature mands; PDD-NOS = pervasive developmental disorder-not otherwise specified; VM = vocal mands; VOCA = voice output communication aid*
mands were called *improvised* mands because they allowed the learner to request an item based on a feature of the item, when the corresponding picture was unavailable (Chaabane et al. 2009; Marckel et al. 2006). One of the studies (Drasgow et al. 1998) involved teaching a single mand “please” to access a variety of reinforcers (i.e., food, toys, events). All other studies taught specific mands (e.g., asking for “cookie” and receiving a cookie).

In general, all studies were able to show effectiveness of the intervention, with a few exceptions. Schlosser et al. (2007) demonstrated significant changes in responding from baseline to intervention, although none of the three participants met the pre-established mastery criterion before intervention was terminated when the school session ended. Similarly, in the study by Jennett et al. (2008), one participant failed to acquire mands, despite a change in the response requirement that allowed him to respond vocally or with a sign. The authors hypothesized that the effect of an increased response requirement on MO may have resulted in his poor response to intervention. In addition, the intervention used by Thomas et al. (2010) failed to produce an increase in independent vocal mands during post-training trials for one of three participants, although he did acquire what the authors termed *appropriate responses*, which included a variety of other manding topographies taught during intervention, including pointing and making oral motor approximations, and he did emit high rates of independent vocal mands during follow-up sessions. Further investigation of the variables differentiating responders from non-responders for interventions targeting the acquisition of vocal mands is needed to determine which learners are likely to benefit from such interventions, and which are unlikely to benefit.
An additional study, which did not meet the inclusion criteria due to methodological issues needs to be noted here because of the significance of clinical effects. Bowen, Shillingsburg, and Carr (2012) used a mand training procedure to teach mands for items that were in sight. Two participants with autism (one male and one female) were taught to mand for items that were in sight. One participant was taught to mand using sign, while the other was taught to mand vocally. The study also compared the rate of acquisition of mands under two conditions: when the child was asked the question “What do you want?” and when this question was absent. Similar to other studies where mands for items in sight were taught, the intervention produced increased rates of mands, and acquisition rate did not differ significantly between the question-present and question-absent conditions.

Manding for Items out of Sight

The research included in this category involved teaching participants to mand for items that were out of sight at the time the mand occurred (e.g., teaching a child to mand for a toy when the toy is not visible). Only one study investigated interventions for teaching individuals with ASD to use vocal mands for items that were out of sight (Sweeney-Kerwin, Carbone, O’Brien, Zecchin, and Janecky 2007), with a total of 2 participants, both male. This study is summarized in Table A3.

Sweeney-Kerwin et al. (2007) taught mands for missing items in a naturalistic context in which preferred edible reinforcers were kept out of sight from participants’ during the initial parts of sessions, and then briefly displayed following a rolling two-minute time-delay for the remainder of the session if the participant failed to mand during the initial period. The intervention led to acquisition of mands for missing items for both participants.
Table A3

Summary of Research on Manding for Items that are Out of Sight

<table>
<thead>
<tr>
<th>Reference</th>
<th>Participants</th>
<th>Dependent Variables</th>
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</tr>
</thead>
</table>
| Sweeney-Kerwin et al. (2007) | 2 males (3-7 years) with autism | Frequency of MO-controlled vocal mands      | Multiple baseline across behaviors | 100% IOA for all participants | • During first session, target edible reinforcer was displayed at beginning of session. In subsequent sessions, target remained out of sight for first 30-m of each 3-h session  
• If participant manded for item during initial 30-m where item was out of sight, the edible was not displayed again the remainder of the session  
• If target edible was displayed (i.e., no MO mands during initial 30-m), rolling 2-m time delays began in which every 2-m, the edible was briefly displayed  
• MO-controlled mands, as well as in-sight mands (during periods where item was displayed) resulted in participant receiving small amount of target edible | Both participants learned to engage in MO-controlled mands for all target items. Generalization and maintenance was conducted for one participant after treatment ended, lasting for 3 months, and he engaged in MO-controlled mands with different interventionists at higher rates than baseline, although at lower rates than intervention. |

*Note: PDD = pervasive developmental disorder; ASD = autism spectrum disorder*
While this procedure holds promise for advancing the mand repertoires of individuals with ASD, more research is clearly needed to determine the overall generality of this intervention. Furthermore, all participants in these studies were able to mand for items in sight prior to the beginning of the study, which provokes further questions about pre-requisite manding repertoires that may be necessary before intervention to teach individuals to mand for out-of-sight items begins.

_Manding for Removal of Stimuli_

This category of mand training involves teaching children to mand for the removal (rather than the presentation) of an item. Only one included study (Choi, O’Reilly, Sigafoos, and Lancioni 2010) taught participants to mand for the removal of stimuli (see Table A4) using VOCA. A total of 4 participants were included, all male. The intervention focused on teaching participants to engage in a rejecting response (e.g., selecting a “No” icon on the VOCA device) when the child manded for an item and the incorrect item was offered.

All participants acquired the target responses, although one participant required procedural modifications. Because of a failure to acquire the rejecting response during initial training sessions, one participant required an extra phase involving errorless teaching. This study presented a promising intervention for teaching individuals with ASD to mand for removal of stimuli, although the scenarios in which the response was used are quite limited. Future research should focus on teaching a wider variety of scenarios to identify more ways in which individuals can be taught to mand for meaningful changes in their environments.

Another study, which did not meet the inclusion criteria due to methodological issues needs to be noted here because of the significance of clinical effects. Shillingsburg et al. (2013)
<table>
<thead>
<tr>
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</table>
| Choi et al.  | 4 males (6-9 years) with autism and/or developmental disabilities | Percentage of correct requesting, rejecting, and re-requesting using speech-generating device (3 participants) or picture exchange (1 participant) | Multiple-probe design across participants | 98% IOA across participants; FOI averaged 99% for all participants | - Participant told to engage in an activity that required multiple items, with one item missing  
- Following a request for the missing item, the interventionist sometimes offered the wrong item  
- Time delay and gestural prompts used to prompt correct rejecting response  
- Correct rejecting response resulted in withdrawal of the wrong item  
- Participant then given opportunity to request the missing item again (a re-request)  
- Time delay and gestural prompts used to prompt correct re-request  
- Correct re-request resulted in access to requested item | All 4 participants acquired rejecting and re-requesting responses, although 1 participant required an extra phase involving errorless teaching of rejecting. These responses generalized to 2 untrained activities. Participants demonstrated target response during 4- and 5-month follow-up sessions, although 1 participant showed skill deterioration. |

Note: PDD-NOS = pervasive developmental disorder-not otherwise specified; EO = establishing operation
taught five participants (three males and two females) to vocally mand for the removal of an obstruction that prevented them from seeing a computer or TV screen. The intervention was successful in teaching mands for removal of the obstruction, although one participant required procedural modifications. This participant failed to respond consistently during intervention, so a different interventionist was substituted, as well as adding a 3-minute delay period before the obstruction was removed in the absence of a mand. However, presentation of the data in the form of a cumulative graph made a systematic visual analysis difficult.

**Video Modeling Mand Training Strategies**

Only one study used video modeling as a strategy for teaching mands to individuals with ASD (Plavnick and Ferreri 2011). In this study, mands corresponded to a variety of outcomes (including items, actions, and activities). The study included a total of four participants (1 female, 3 males). Table A5 summarizes the study further.

Participants were shown brief video clips (15-27 seconds) in which a peer manded for a particular outcome. Outcomes varied and included the interventionist performing an action, providing assistance, or providing a toy. All participants acquired mands for outcomes that corresponded to a function of the idiosyncratic mand forms they used prior to intervention.

**Evaluation of Methodological Rigor**

The research discussed in the current review included studies on teaching mands for information, mands for items that are both in and out of sight, and mands for the removal of stimuli. Also, one study used video modeling to teach a variety of different types of mands. An issue with the current pool of literature related to mand training for individuals with ASD is that it may be insufficient for classifying a particular mand training procedure as an evidence-based
Table A5

*Summary of Research on Video Modeling Mand Training Strategies*

<table>
<thead>
<tr>
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| Plavnick and Ferreri (2011) | 4 children (4-6 years) with autism    | Percentage of correct vocal (3 participants) and picture (1 participant) mands for a variety of items/activities/actions, for both function and non-function based mands | Alternating treatments within a multiple probe across behaviors design for 3 participants, and an alternating treatments design for 1 participant | IOA averaged 100% during baseline and 98% during both function- and nonfunction-based video modeling, across participants FOI 96% for all participants | • 2 conditions were alternated (function-based video modeling and nonfunction-based video modeling)  
• Function-based video modeling: responses taught that corresponded to functions of gestures the participants used to mand  
• Nonfunction-based video modeling: responses taught that did not correspond to functions of gestures the participants used to mand  
• Participant shown 15-27-s video clip of a peer manding and receiving appropriate outcome  
• 20-s time delay followed during which participant could emit target response  
• Correct response resulted in 20-s presentation of requested outcome (e.g., break from a work task; brief access to a preferred item) | All participants acquired the function-based target mands following implementation of the intervention, but did not acquire nonfunction-based mands. Function-based mands were emitted in non-training environments during generalization probes and at high rates during follow-up sessions for the two participants for whom follow-up was conducted. |
practice. When the authors used the evaluative method established by Reichow and colleagues (2008; 2011), all studies in this review received a score of weak. A wide variety of issues prevented studies from earning a higher score of adequate or strong, although there were a few recurring issues that could be easily resolved to improve the quality rating scores of future research. A common problem was that articles failed to provide detailed information about the qualification and training of the interventionist, such as years of experience, credentials, etc.

Another issue was associated with the use of a cumulative graph to display and analyze the data pattern. Three studies (Bowen et al. 2012; Reichle et al. 2008, Shillingsburg et al. 2013) met other requirements of the inclusion criteria except the use of a cumulative graph to display data. This method of displaying did not allow for systematic visual analysis or a determination of experimental control as defined by Reichow and colleagues (2008) even though all the studies demonstrated clinical effect. The methodological parameters for all three studies are summarized in Table A6.

Discussing the issues with methodological rigor further, the more serious areas of concern included a lack of replicable precision in the description of intervention procedures, omitting details such as the exact moment in time when prompts were provided, or what researchers did if a child did not respond to prompts. Frequently, studies did not include treatment fidelity data or IOA on procedural fidelity, effect size ratings, or even social validity data. A summary of the ratings each study received in the evaluation process is available in Table A7.

The inclusion of these and other components necessary to receive higher scores on criteria such as those established by Reichow and colleagues (2008; 2011) is likely to lead to
Table A6

**Summary of Research on Manding Utilizing a Cumulative Graph**

<table>
<thead>
<tr>
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| Bowen et al. (2012)   | 2 children (3-11 years) with autism   | Cumulative number of vocal or signed independent and prompted mands | Adapted alternating treatments design with a non-concurrent multiple baseline across 2 participants | 100% IOA across all participants. FOI at 100% for all participants | • 2 variations of the intervention compared (with question “What do you want?” and without)  
  • One type of edible reinforcer used per variation.  
  • Trials occurred during natural contexts  
  • Echoic prompt after 0-s time delay during first 8 trials  
  • Time delay increased in 2-s increments, up to 6-s  
  • Correct prompted and independent responses resulted in 20-s access to item or until consumed | Both intervention conditions resulted in acquisition of the target mand, for both participants. Rate of acquisition did not vary substantially between the 2 conditions, for either participant. |
| Reichle et al. (2008) | 1 male (5 years) with autism and global developmental delay | Cumulative vocal requests for assistance “Help” and task completion | Multiple-probe design across 3 tasks | 95% IOA 98% FOI | • Participant taught to request “help” for difficult versions of 3 different tasks  
  • Vocal instruction to engage in a task and to ask for help, if needed  
  • Echoic prompt “Tell me ‘help’” provided following a 0-s (and later, 5-s) time delay  
  • Correct response resulted in assistance with task. After task was completed, participant gained access to a pre-established reinforcer  
  • Later phase introduced in which participant was taught to complete each difficult task | The participant learned to request “help” for all 3 tasks, but overgeneralized to easy tasks. Requests for help decreased as task competency increased. The “help” response did not generalize to novel tasks. |

*(table continues)*
Table A6 (continued).

<table>
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<th>Reference</th>
<th>Participants</th>
<th>Dependent Variables</th>
<th>Research Design</th>
<th>IOA and FOI Outcomes</th>
<th>Intervention Components</th>
<th>Outcome</th>
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</table>
| Shillingsburg et al. (2013) | 4 children (3-8 years) with autism; 1 child (5 years) with PDD-NOS and partial fetal alcohol syndrome | Cumulative correct independent vocal mands for removal (“Excuse me” for 3 participants, and “Move please” for 2 participants) | Adapted alternating treatments design with a non-concurrent multiple-baseline across participants | 99% IOA for all participants  
FOI not reported | • 2 conditions (EO-present and EO-absent) were alternated  
• EO-present: TV/computer screen obstructed  
• EO-absent: TV/computer screen not obstructed  
• During EO-present condition, when child indicated interest in the TV or computer, the interventionist obstructed the screen  
• Echoic prompts after 0-s time delay (later changed to 5-s)  
• Correct response resulted in immediate removal of obstruction and 30-s access to screen  
• No correct response resulted in removal of obstruction after 5-s time delay elapsed  
• In the EO-absent condition, mands for removal were ignored  
All participants acquired mands for removal during training. One participant required procedural modifications (different interventionist and delay period before the obstruction was removed without a mand occurring was increased to 3-m). The response was maintained during a post-training condition, for all participants. |
Table A7

Presence of Primary and Secondary Quality Indicators by Study

<table>
<thead>
<tr>
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<th>Primary Quality Indicators</th>
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*Note: H = High; A = Acceptable; U = Unacceptable; An asterisk* represents a study that did not lend itself to visual analyses for determining the effectiveness of an intervention.
Table A7 (continued).

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*Note: H = High; A = Acceptable; U = Unacceptable*
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<td>Thomas et al. (2010)</td>
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*Note: H = High; A = Acceptable; U = Unacceptable
An asterisk* represents a study that did not lend itself to visual analyses for determining the effectiveness of an intervention
faster adoption of mand training procedures as an evidence-based practice. In addition, greater adherence to quality standards may help bridge the research-to-practice gap. For example, describing intervention procedures with replicable precision will enable practitioners to more effectively implement mand training procedures.

Guidelines for Effective Mand Training

It is important to note that all research included in this review failed to meet the standards for high-quality research established by Reichow and colleagues (2008; 2011). Future research that employs greater methodological rigor will help solidify a set of recommendations to guide practitioners in conducting mand training. Still, the current body of research on mand training for individuals with ASD indicates some promising strategies for teaching mands in applied settings. The recommended guidelines for effective implementation of mand training procedures are listed below:

1. Time delay procedures may be an effective method for teaching mands (e.g., Carr and Kologinsky 1983; Ostryn and Wolfe 2011; Shillingsburg et al. 2011). Several studies used an increasing time delay, whereby the duration of the time delay before a prompt was presented was increased systematically to allow more time for the learner to demonstrate independent mands (e.g., Charlop et al. 1985; Jennett et al. 2008). Possibly the primary benefit of this teaching strategy is that it allows time for the learner to mand independently, while still providing prompts after a period of time has passed. The built-in consequence of this strategy is that children may access reinforcing outcomes faster by manding independently, before the prompt, rather than waiting to be prompted.
2. All studies where participants were taught to mand using a vocal response used echoic prompts to evoke mands (e.g., Koegel et al. 2010; Ganz et al. 2011). Some studies used echoic prompts that involved the interventionist stating a carrier phrase like “Say...” or “Can you say...” prior to telling the participant the appropriate word or phrase to repeat (e.g., “Say ‘Where [item]’”; Endicott and Higbee 2007). Other studies included echoic prompts that solely used the word or phrase the child was supposed to repeat (e.g., “I want crayon”; Jennett et al. 2008). Both types of prompts appeared to be generally effective in training vocal mands.

3. Some children with a limited vocal repertoire may not respond to mand training procedures that teach vocal mands (e.g., Thomas et al. 2010). Learners who may have difficulty learning to mand vocally may be successfully taught to mand using a variety of other response modalities, including sign language (e.g., Carr and Kologinsky 1983), PECS (e.g., Chaabane et al. 2009), and VOCA (e.g., Olive et al. 2007).

4. When teaching learners to mand for information, responses may not generalize to a more natural context unless the child is taught to use the mand in a variety of different situations. Betz et al. (2010) found that participants did not generalize the mand “where” to a naturally occurring behavior chain without additional training. Similarly, Shillingsburg et al. (2011) found that participants failed to generalize mands for information to some novel scenarios. Teaching learners to use a particular mand for information in a variety of relevant scenarios may increase the probability of the mand generalizing to novel situations.

5. It is important to teach children to mand for a variety of outcomes. The current literature review included research where children were taught to mand for items that were in sight
(e.g., Bowen et al. 2012; Chaabane et al. 2009), out of sight (e.g., Sweeney-Kerwin et al. 2007), mand for information (e.g., Betz et al. 2010; Endicott and Higbee 2007), and mand for the removal of undesired stimuli (e.g., Choi et al. 2010). Each of these types of mands allows the child to access a different outcome, and each may be an important component for intervention programs for learners with ASD.

Recommendations for Future Research

There is a growing body of literature supporting the effectiveness of mand training with individuals with ASD. The studies contained in this review utilized a wide variety of intervention procedures, although there were some commonalities. Echoic prompting has been widely used as a strategy for teaching vocal mands, although the delay during which the prompt is presented varies between procedures. Additionally, some studies used an increasing time delay procedure in which the length of the delay was increased as intervention progressed. Some studies successfully taught a mand when the outcome was presented, regardless of whether a mand occurred, at the end of a delay period, with the idea that a mand simply decreases the delay period before reinforcement is contacted. At this time, it is unclear which of these procedures may be the most effective, which may provide fruitful topics for future research.

Additionally, the taxonomy of mands presented in this review includes areas where more research is clearly needed, such as in the categories of manding for removal of stimuli and manding for items that are out of sight. Only one study used video modeling to teach a manding repertoire, a procedure which may be promising in a variety of contexts and for many learners, although only further investigation will tell.
The age range of participants in all of these studies was 3 to 14 years. It is possible that effective interventions for these children may not work for older individuals, especially when problem behaviors are considered. More research is needed using older children and adults in order to determine effective procedures for these populations.

Finally, before any of the procedures demonstrated for teaching mands may be considered an evidence-based practice, more research is needed with high methodological rigor. Evaluative measures such as those established by Reichow et al. (2008; 2011) can be useful tools in designing and evaluating future research. Often, the inclusion of some additional information regarding the intervention, the interventionist, the participants, etc., improves both the score a study receives and its utility in applied settings. Additionally, ensuring that the study demonstrates high-quality measurements for components such as dependent variables, treatment integrity, interobserver agreement, and social validity only improve evidence for the intervention’s effectiveness. It is recommended that future research include these and other features discussed in the criteria outlined by Reichow and colleagues in order to more easily identify which mand training practices show evidence of effectiveness and should inform practice.

References

* Denotes study included in analysis.


