COMPARING VARIATIONS OF THE BEHAVIOR CHAIN INTERUPTION STRATEGY ON MAND ACQUISITION

by

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(Under the Direction of Kevin Ayres)

ABSTRACT

The present study compared two variations of the behavior chain interruption strategy (BCIS) on mand acquisition with four children with autism spectrum disorders (ASD). Variations included only withholding a required item within an activity (BCIS only condition) and withholding a required item while also having an adult complete the activity alongside the participant (BCIS with therapist modeling condition). An adapted alternating treatment design (AATD) was used to compare the two variations. Results indicate minimal differences between the two conditions regarding efficiency of mand acquisition, generalization across novel conditions, and transfer of control from mands to tacts. Limitations and areas for future research are also discussed.

INDEX WORDS: behavior chain interruption strategy, BCIS, interrupted chain procedure, children with autism, mand, manding, tact, tacting, generalization

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DEDICATION

To my mom, who always emphasized the importance of education.

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CHAPTER 1

INTRODUCTION

Children with autism spectrum disorders (ASD) have deficits in the area of social communication skills, which can manifest in low engagement of social reciprocity and lack of understanding of nonverbal communication (Centers for Disease Control and Prevention; CDC, 2015). These deficits can have a lasting impact on later communication and social skills (Kelley, Shillingsburg, Castro, Addison, LaRue, 2007; Venter, Lord, & Schopler, 1993). As a result, these skills must be explicitly taught and are often targeted during early intervention for children with ASD (Kelley et al., 2007). Because of the implications that manding (i.e., requesting) has on developing social communication skills and being included in the community (Shafer, 1994), many studies focus on teaching this skill. However, with the many skills that children with ASD need to be explicitly taught (Grunsell & Carter, 2002), instructional time must be maximized. Therefore, the purpose of this paper is to evaluate whether a more efficient, yet effective, variation of the Behavior Chain Interruption Strategy (BCIS) exists. The BCIS is one instructional procedure to teach individuals to mand.

Before comparing variations of the BCIS, this paper will first provide an overview of manding. This overview will encompass a brief description of verbal operants (i.e., units of language), benefits of learning to mand, core components of mand training procedures, and naturalistic approaches with teaching mands. The procedures for the BCIS will then be described followed by a review of the literature.

Verbal Operants in Verbal Behavior

When starting language interventions, practitioners should consider the functions of language that require instruction. Skinner (1957) identified several verbal operants in verbal behavior, which include echoics, tacts, mands, and intraverbals. Verbal operants are units of language that include the antecedent stimuli controlling and consequences maintaining the individual's response. An echoic has point to point correspondence with a verbal stimulus (e.g., when a child hears a person say "train" he says "train"), and the response is maintained with a generalized conditioned reinforcer (e.g., social praise, sticker). A tact is controlled by the presence of a stimulus (e.g., a child says "train" when he sees a train) and is also maintained by a generalized conditioned reinforcer. A mand is controlled by a motivating operation for a stimulus (e.g., when a child is thirsty, he says "drink"), and it is maintained by obtaining the stimulus directly related to the response (e.g., child receives a drink after saying "drink"). A mand is the only verbal operant that is not maintained by a generalized conditioned reinforcer. An intraverbal is controlled by a preceding verbal stimulus that does not have point to point correspondence with the response (e.g., when asked, "What do you want?" and the child answers "drink") and is maintained by a generalized conditioned reinforcer. Of these four verbal operants, mands are suggested to be the first verbal operant to teach since the mand directly benefits the speaker (Hall & Sundberg, 1987; Hartman & Klatt, 2005). When a speaker mands, a request is made to the communication partner, or the listener, which helps the speaker access reinforcement when the reinforcer is controlled by the listener (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012).

Benefits of Manding

Alleviate communication breakdowns. Communications barriers are alleviated between the child and the caregiver or teacher when a child learns to mand. When a message is not properly communicated, the consequence does not meet the purpose of the message; as a result, this can lead to increased stress levels for parents (Minjarez, Mercier, Williams, & Hardan, 2012). If the stimulus that the child wants or does not want is present in the environment, children can rely on using gestures to communicate the stimulus wanted (e.g., pointing, leading the adult to the stimulus); however, the situation is more complicated when the stimulus is not present in the immediate environment since the child cannot use these other strategies to communicate the desired result (i.e., obtain a wanted stimulus, remove an unwanted stimulus). As a result, caregivers are required to guess what the child is trying to mand for. In addition to frustration, communication barriers can also lead to engagement in maladaptive behaviors from the child with ASD.

Reduce challenging behaviors. Challenging behaviors (e.g., aggression, destruction, self-injury) are often related to a delay in communication skills (Durand & Carr, 1991; Kelley et al., 2007) As a result, teaching children with ASD can replace or reduce the number of maladaptive behaviors that the child engages in if the behavior previously functioned as the child's primary mode of communication (Grunsell & Carter, 2002). If children with ASD do not have a socially appropriate form of communication, they may engage in challenging behaviors either as a result of not obtaining the desired item or because it has become a learned method of communicating wants and needs. Through repeated experiences of engaging in challenging behaviors prior to accessing reinforcement, this pattern shapes challenging behaviors into becoming a functional

mode of communication for the child. By teaching children with ASD a more socially appropriate mode of communication, engagement in challenging behaviors will decrease, if the child was originally engaging in the challenging behavior to communicate. Therefore, teaching manding skills are often part of a treatment plan to reduce challenging behavior (Durand & Carr, 1991)

Inclusion in the community. With a reduction in maladaptive behaviors, children with ASD may be more included in their community. Caregivers often express that they cannot bring their child on community outings because of their child's engagement in challenging behaviors. If problem behaviors (e.g., aggression, self injury, elopement) are of high intensity, the caregiver may not be able to safely manage the behavior if alone with the child. In addition, community members often do not have the training to manage maladaptive behaviors if they occur, and problem behaviors are often not socially accepted by community members (Schleien, Miller, Walton, & Pruett, 2014). By reducing the occurrence and probability of maladaptive behaviors, it increases the likelihood for parents to bring their child into the community and for community members to engage with the child once there.

When children with autism have a repertoire of mands, they can also become more active members of their community as they are able to manipulate their environment through their mands (Hunt & Goetz, 1988). For example, on a community outing, children with ASD can mand for information or mand for food when ordering at a restaurant. They will no longer need to wait for someone to anticipate their need and provide them with the stimulus sought after. Although the response effort is less for the child when they simply wait for the adult to attend to their need, the latency to

reinforcement is less when manding. If the motivating operation is high, the individual will produce the mand (if the skill is in his repertoire) despite the greater response effort in order to access reinforcement (Cooper, Heron, & Heward, 2007; Hernstein, 1970).

Collateral benefits. Children with ASD who developed a manding repertoire have also been shown to gain collateral skills in communication. Through manding, the child with ASD can begin to identify that his or her words can have a direct effect on other's actions. With this exchange, the roles of the speaker and the listener become more evident as well as turn taking in social interactions (Sundberg & Michael, 2001). Other collateral skills include an increase in spontaneously communicating (Dyer, 1989) and social initiations (Albert et al., 2012).

Components of Mand Training

Although there are several methods of teaching mands, several components remain consistent among these methods. These components consist of establishing an establishing operation (EO), identifying preferred stimuli, identifying a response topography, providing prompts for the mand, and reinforcing correct responses. These components are further described below.

Establish an establishing operation. Mands are controlled by a motivating operation, specifically an EO and maintained by consequences directly related to the response (i.e., obtaining access to the manded stimulus; Michael, 1988; Skinner, 1957). An EO momentarily increases the value of a stimulus as a reinforcer, thereby increasing the occurrence of behaviors previously associated with obtaining the stimulus (Michael, 1988). As a result, when teaching manding, instructional trials can be conducted when events naturally occur in the learner's environment (Alwell et al., 2012). For example,

after a child plays outside in the the summer, he or she is likely thirsty, establishing an EO for water. Therefore, a trial can be conducted when the child walks inside the house. Environmental conditions also can be manipulated to establish an EO **(**Brady, Saunders, & Spradlin, 1994**)**. For instance, a child's environment can be arranged so that the child is not given a snack during the time immediately before dinner. If the child was allowed to eat a snack before dinner, the value of the reinforcer (i.e., food) would decrease; therefore, the mand for food is less likely to occur. When manipulating environmental conditions however, the practitioner must be mindful of ethical considerations and refrain from engaging in unethical behavior, such as withholding food for extended periods of the day. Although the EO is likely to be established in this instance, caregivers still have the responsibility to feed their child; otherwise, the situation could be seen as neglect.

The presence of an EO often evokes previous behaviors that resulted in obtaining the reinforcer in the past (Michael, 1988). Therefore, when teaching children with ASD to mand, different topographies of behaviors may emerge based on their learning history. As a result, the desired response form (i.e., manding) must be strengthened with repeated exposure to the desired consequence while other topographies (e.g., SIB, aggression) are put on extinction. In addition, when measuring for generalization of mands, the caregiver or teacher must ensure that the EO is present within the context; otherwise, a false conclusion that the child cannot generalize the skill may be inferred (Wolery & Hemmeter, 2011).

Identify preferred stimuli. Because a mand is controlled by an EO, the activity or item must have a reinforcing value to the child. Often, a preference assessment is conducted to identify potential stimuli to use for mand training. These preference

assessments typically include a caregiver or teacher interview followed by a multiple stimulus without replacement preference assessment (DeLeon & Iwata, 1996**)** or a free operant assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998). For activities containing multiple items, a transitive conditioned EO (CEO-T) is established for each item (Michael, 1988; Langthorne & McGill, 2009). With a CEO-T, a previously neutral item is now reinforcing due to repeated associations with the preferred stimulus (Cooper, Heward, & Heron, 2007). For example, when thirsty, an EO is established for obtaining a drink. As a result, seeing a cup, which once had neutral value, is now a CEO-T for pouring a drink into the cup. However, when the EO for a drink is no longer present, the cup no longer acts as a CEO-T since the sight of the cup no longer evokes pouring a drink. Therefore, the cup, once again, has neutral value. One strategy that utilizes CEO-Ts for manding instruction is the Behavior Chain Interruption Strategy (BCIS), which will be described later in this paper.

Identify a response topography. Individuals with ASD, collectively, use various modes of communication. It is estimated that 40% of the population do not communicate through vocal speech and approximately 25-30% of children with ASD experience regression, where they lose previously acquired social and communication skills around the age of two (Center for Disease Control and Prevention, 2015). Individuals with ASD may engage in gestural behaviors (e.g., leading a caregiver, pointing, eye gaze) or challenging behaviors to communicate their request. However, the communication partner, or the listener, may have difficulty understanding the meaning behind these behaviors (Schafer, 1994), particularly if the listener is unfamiliar with the speaker. As a

result, children with ASD would benefit from learning to use an alternative mode of communication.

Research studies have shown that in addition to vocal speech (Albert et al., 2012; Sigafoos & Littlewood, 1999) children with ASD can be taught to mand using manual signs (Hall & Sundberg, 1987), picture exchange (Roberts-Pennell & Sigafoos, 1999), and speech generating devices (SGDs; Sigafoos et al., 2013), When considering which communication modality to teach, practitioners must consider the child's cognitive skills, motor skills (Son, Sigafoos, O'Reilly, & Lancioni, 2006), and visual acuity (Couper et al., 2014). For instance, if a child has a severe vision impairment, practitioners may consider teaching an adapted manual signing system since the child does not need to distinguish between the visual stimuli required of a picture exchange system or SGDs. If a child has low muscle tone, practitioners may consider using picture exchange so the child can exchange a lightweight picture symbol rather than carry a heavier device; in addition, it would be difficult for the child to manipulate their hands into manual signs. Based on the student's strengths and weaknesses, a communication modality can be chosen to best fit the needs of the student.

Provide prompts. During instructional trials of manding instruction, prompts are delivered to the participant when a response is not emitted or sometimes when an incorrect response is emitted. The prompt informs the participant of the correct response because the participant receives the reinforcer following his or her prompted, correct response. In the manding literature, response prompts are delivered following a specified wait time which can last between 3 s to 10 s (Gee, Graham, Goetz, Oshima, & Yoshioka, 1991; Grunsell & Carter, 2002; Lechago, Carr, Grow, Love, & Almason, 2012; Roberts-

Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999**)**. In addition to using a variation of time delay procedure, the topography of the response prompt will depend on the communication modality that mands are taught with. When teaching vocal mands, vocal prompts are delivered, whereas, with mands using manual signs, picture exchange, or SGDs, physical prompts are delivered**.** However, the controlling prompt for each modality could also vary per child. As the child with ASD responds consistently with a controlling prompt, the prompt should be faded to promote independent use of the skill. Fading procedures can be implemented by increasing the time delay before a prompt is given.

Reinforce correct responses. Because the mand is maintained by a consequence directly related to the response (Skinner, 1957), correct responses should be reinforced by delivering the reinforcer (i.e., stimulus manded for) immediately following the correct response to maximize the connection between the response and the consequence. If the latency of when the reinforcer is delivered following a correct response is long, the reinforcer may fall under an incorrect stimulus control (Cooper, Heron, & Heward, 2007).

Naturalistic Manding Interventions

Jennett, Harris, and Delmolino (2008) compared teaching mands with discrete trial training and mand training and found that although participants acquired the mands in both models, the mand training model produced acquisition of the mands in fewer instructional trials. In the mand training model, the instructor alters the MO in order to evoke verbal responding from the participant. Instructional trials can easily be inserted within the learner's natural environment. The practitioner can contrive situations to

establish an EO or wait to conduct a trial when an opportunity for a mand arises naturally. Embedding manding training programs within the learner's natural environment can help facilitate generalization of the skill as the learned skill does not always transfer to new situations (Schafer, 1994). Several naturalistic approaches exist including incidental teaching, mand-model, and time delay.

Incidental teaching. With incidental teaching (Hart & Risley, 1968), trials are often conducted throughout the day when the opportunity naturally arises. Often, the learner initiates a trial by engaging in behavior that indicates the learner wants an item (e.g., reaches for it). When this gesture occurs, the adults can deliver a prompt for the mand before giving the manded item to the speaker. With this technique, the natural environment can also be manipulated to increase the likelihood of a mand by baiting the room with known preferred items but keeping the items out of the speaker's reach (LeBlanc, Esch, Sidener, & Firth, 2006; Shafer, 1994).

Mand-model. With the mand-model procedure (Rogers-Warren & Warren, 1980; Halle, Alpert, & Anderson, 1984), the learner's natural environment is baited with preferred toys, but in order for the child to access the toys, the child must emit a mand that meets a criterion set by the therapist. If the child does not emit the mand, the therapist prompts the learner for a response (e.g., "What do you want?"). If the learner's response meets criterion level, the therapist praises the learner and delivers the item manded. If the learner's response does not meet criterion level again, the therapist will either provide a model for the correct response or request the information at criterion (e.g., "Use a full sentence."). If the child responds at criterion, the therapist provides praise and the item manded for. If the child does not respond at criterion, the therapist

provides corrective feed back and the preferred item. With this technique, instructional trials can be initiated by either learner or therapist and the learner can still access the item without emitting a correct response (Halle et al., 1984).

Time delay. With time delay (Halle, Marshall, & Spradlin, 1979), the therapist delays providing the response prompt to the learner for a predetermined interval of time. If the learner does not respond, the therapists then delivers a prompt. This procedure can also be used for individuals who have previously learned to mand but remain prompt dependent as the time delay establishes an EO for the mand. The longer the delay, the stronger the EO will be, if the item was in fact preferred.

Behavior Chain Interruption Strategy

The BCIS can incorporate elements of each of the naturalistic techniques listed above within its procedures. The BCIS, originally developed to teach individuals with severe intellectual disability to mand for items within their natural environment (Grunsell & Carter, 2001), can provide a powerful context for teaching mands. The BCIS consists of inserting an instructional trial within a preferred chained task by interrupting the chain through withholding a necessary item to complete the chain or blocking access to the reinforcer. When the chain is interrupted, a CEO-T is established to access the next immediate reinforcer (i.e., next step of the chained activity) in order to access the terminal reinforcer (i.e., final step of the activity). As a result, the individual must mand for the missing item to continue the chained task and access the terminal reinforcer.

In the BCIS, the implementer alters the environment to create an EO by interrupting an ongoing behavior chain, preventing the individual from accessing the immediate reinforcer (next step of the chain) and the ultimate reinforcer (end of the

chain; Brady et al., 1994) unless a mand is initiated. Therefore, the child is more likely to mand in order to continue the behavior chain (Grunsell & Carter, 2002). When using the BCIS, it is essential that the learner will want to complete the task despite the disruption. Goetz et al. (1985) suggests choosing a procedure that will evoke behaviors indicating slight distress or attempts to complete the activity when there is an interruption in the strategy to indicate that an EO is present for the item to complete the activity. Because children with ASD often engage in restricted and repetitive behaviors or have a restricted interest area (CDC, 2015), the BCIS can use activities related to the restricted behaviors or interests to establish a strong EO.

Another advantage to using the BCIS for teaching manding is easy implementation. The implementer can insert an interruption into a behavior chain that is currently in the individual's daily routine (Brady et al., 1994). As a result, these trials can be inserted across the individual's natural environment. This single trial is easier to conduct than massed practice trials in many settings, and the single trial may be more effective in teaching the mand since a MO is established (Gee et al., 1991). Research has indicated that mand acquisition is more likely to occur when the mand has the desired effect on the environment (Hunt & Goetz, 1988).

Because of the many advantages associated with the BCIS, the strategy has potential to be widely used by practitioners, caregivers, and others working on increasing manding for individuals with disabilities.

CHAPTER TWO

LITERATURE REVIEW

A literature review was conducted on the BCIS to synthesize information regarding participants, components of the intervention, and results to make recommendations for application and future research on this strategy.

Method

An electronic literature search was conducted to locate articles in the following databases: ERIC and Psych Info. The search terms used were *behavior chain interruption strategy* or *chain interruption* or *interruption chain*. Results were limited to articles that were peer reviewed and available in English. Inclusion criteria included: (a) at least one study condition (e.g., baseline, intervention) was described using the behavior chain intervention strategy, (b) used a research design that included a baseline condition allowing a comparison with intervention effects (c) contained a dependent variable quantifying mand responses, and (d) the interruption in the chained task occurred after the initial step of the chain. Studies were excluded if (a) the interruption occurred during the first step of a behavior chain and (b) it was a case study. A total of 13 articles (after duplicates were removed) were found using the search terms; six of these articles met inclusion criteria. An ancestral search was then conducted with the articles meeting criteria, informational articles that resulted from the original electronic search, and an earlier literature review completed on the topic. Nine more articles were found meeting criteria, resulting in a total of 15 articles in this review.

Results

The earliest study included in this review was published in 1985 (Goetz et al.) and the most recent study was published in 2013 (Sigafoos et al.). Overall, the studies were relatively evenly spaced among this time period.

Several single case research designs were used to evaluate intervention effects. Although group designs were not excluded, no studies containing group designs were found in this search. Of the single case research designs, the multiple baseline design across participants was most commonly used to evaluate intervention effects (7 studies; Gee et al., 1991; Grunsell & Carter, 2002; Hall & Sundberg, 1987; Hunt, Goetz, Alwell, & Sailor, 1986; Roberts-Pennell & Sigafoos, 1999; Rosales & Rehfeldt, 2007; Sigafoos et al., 2013). Other single case research designs employed were: multiple baseline design across behaviors (2 studies; Albert et al., 2012; Goetz et al., 1985), multiple probe design across participants (1 study; Sigafoos et al., 2013) multiple probe design across behaviors (2 studies; Alwell, Hunt, Goetz, & Sailor, 1989; Finn Miguel, & Ahearn, 2012;), nonconcurrent multiple baseline design across participants (1 study; Lechago et al., 2010), non concurrent multiple probe design across participants (1 study; Romer, Cullinan, & Schoenberg, 1994), an A-B design (1 study; Sigafoos & Littlewood, 1999), and an adapted alternating treatment design (AATD; Sidener, Carr, Karsten, Severtson, Cornelius, & Heinicke, 2010). See Table 2 for a list of research designs by study.

Participants. The literature review included a total of 43 individuals with disabilities. Ages ranged from three to 58 years of age with a mean of 10.6 years; 33 participants from ten studies were children under the age of 10 years, 4 participants from two studies were adolescents (between 11 to 17 years old), and 6 were adults from 2

studies (18 years and older). The participants had a range of reported diagnoses. Twenty-six participants were identified with an intellectual disability (ID); all participants were within the moderate (MID) to profound (PID) range. Fifteen participants were diagnosed with autism spectrum disorders (ASD) and two with developmental disabilities (DD). Four participants were specifically reported to have a communication disorder. Four individuals had a health-related disability, specifically seizure disorder, attention deficit hyperactivity disorder, or an anxiety disorder. Two participants had a vision impairment and two were Deaf. One participant was diagnosed with a psychotic disorder, not otherwise specified. Seventeen participants had a comorbid diagnosis. Interestingly, all the earlier studies, (before 2000) had at least one participant with ID, with the exception of one study (Sigafoos & Littlewood, 1999) and the later studies (2010 and after) included all participants with autism. See Table 1 for a description of ages and diagnoses by participant. Two participants had no reported disability diagnosis (Sidener et al., 2010).

Setting and communication partner. A majority of the studies were conducted within the participant's school (n=12; Albert et al., 2012; Alwell et al., 1989; Finn et al., 2012; Gee et al., 1991; Goetz et al., 1985; Grunsell & Carter, 2002; Hall & Sundberg, 1987; Hunt et al., 1986; Lechago et al., 2010; Roberts-Pennell & Sigafoos, 1999; Sidener et al., 2010; Sigafoos & Littlewood, 1999). Often, sessions were conducted in an empty room or the natural setting within the school where the activity typically occurred, but at a distance from other students. Two studies occurred within the participants' homes (Romer et al., 1994; Sidener et al., 2010). The remaining two studies occurred in a clinic

(Sigafoos et al., 2013) or a developmental training center for adults (Rosales & Rehfeldt, 2007).

Eleven of the 15 studies had a researcher as the communication partner, who was also the therapist and delivered prompts and reinforcement (Albert et al., 2012; Alwell et al., 1989, Finn et al., 2012; Goetz et al., 1985; Hall & Sundberg, 1987; Hunt et al., 1986; Lechago et al., 2010; Roberts-Pennell & Sigafoos, 1999; Rosales & Rehfeldt, 2007; Sidener et al., 2010; Sigafoos et al., 2013). One study had a speech language pathologist as the communication partner, and three studies included the participants' teacher as the communication partner (Gee et al., 1991; Grunsell & Carter, 2002; Sigafoos & Littlewood, 1999).

Independent variables. Different prompting procedures and reinforcement were components used in intervention. All 12 studies used at least one form of prompting as the sole intervention component or as part of a treatment package. A delayed model prompt following the interrupted step of the chain was the most common prompting technique used (7 studies; Albert et al., 2012; Alwell et al., 1989; Hall & Sundberg, 1987; Hunt et al., 1986; Romer et al., 1994; Sidener et al., 2010; Sigafoos et al., 2013). In these studies, the authors gave the participants an opportunity to emit the correct response prior to delivering the prompt. If the participant did not respond, the authors delivered the prompt between 3 to 10 s following the interrupted step. Hunt et al. (1986) did not report the time delay used. Five studies used a progressive time delay procedure (Gee et al., 1991; Grunsell & Carter, 2002; Lechago et al., 2012; Roberts-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999). The delay increased to 10 s following reaching the interrupted step. The progression of the delay typically increased from 3 s to 5 s to 10 s.

Two studies included an error correction procedure that provided participants with another opportunity to respond correctly following either no response or an incorrect response in the first opportunity (Hall & Sundberg, 1987; Rosales & Rehfeldt, 2007).

Reinforcement provided were behavior specific praise for correct responses (Goetz, Gee, Sailor, 1985; Rosales & Rehfeldt, 2007), a token that could be exchanged at the end of sessions (Hall & Sundberg, 1987; Finn et al., 2012), and immediate access to the requested item (Finn et al., 2012). While all studies provided immediate access to the requested item, Finn et al. (2012) was the only study that did not provide participants with access to the item contingent on a correct response during baseline conditions.

Dependent variable (DV). Several dependent measures were used to quantify mands. The most common dependent measure was cumulative number of correct responding (n=6; Alwell et al., 1989; Gee et al., 1991; Goetz, et al., 1985; Hunt et al., 1986; Lechago et al., 2010; Sigafoos et al., 2013).

Four studies had a dependent measure of number of mands by type (Albert et al., 2012; Finn et al., 2012; Hall & Sundberg, 1987; Grunsell & Carter, 2002). Two of these studies (Albert et al., 2012; Hall & Sundberg, 1987) graphed the data by trial whereas the other two studies graphed the data by sessions (Finn et al., 2012; Grunsell & Carter, 2002). One study measured sessions to criterion by activity (Sidener et al., 2010). The remaining four studies measured the percentage of correct responses (Roberts-Pennell & Sigafoos, 1999; Romer et al., 1994; Rosales & Rehfeldt, 2007; Sigafoos & Littlefield, 1999).

Topographies of mands. Topography of manding responses included vocal, manual sign, gesture, visual graphic symbol, and technology-aided device. Five studies measured vocal mands, which consisted of saying the specific label of the missing item (e.g., "glue"; Albert et al., 2012; Finn et al., 2012; Lechago et al., 2010) or a generic word that could be applied to many situations (e.g., "play", "more"; Robert-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999). Four studies taught participants to manually sign for the missing item (Hall & Sundberg, 1987; Romer et al., 1994) or with a generic sign (Alwell et al., 1989; Roberts-Pennell & Sigafoos, 1999). Alwell et al. (1989) taught one student to gesture to continue the activity. Five studies measured mands using a visual graphic symbol; two studies used words printed on a card (Alwell et al., 1989; Rosales & Rehfeldt, 2007) and two studies used line drawings or a photograph (Grunsell & Carter, 2002; Robert-Pennell & Sigafoos, 1999). Two studies measured mands using a form of a technology-aided device, specifically, a switch (Gee et al., 1991) and an iPad (Sigafoos et al., 2013).

Types of interruptions. Although all studies included an interruption in their behavior chain, the types of interruptions employed differed. A missing item format was the most common interruption. Prior to instructing the student to start the behavior chain, researchers in nine studies withheld one of the items needed to complete the behavior chain; this item was not in the participants' view (Albert et al., 2012; Alwell et al., 1989; Finn et al., 2012; Gee et al., 1991; Grunsell & Carter; 2002; Hall & Sundberg, 1987, Lechago et al., 2010; Romer et al., 1994; Rosales & Rehfeldt, 2007; Sidener et al., 2010). Five studies prevented access to the item/activity in view by blocking the physical response (reach or attempt to continue the activity) or removing the item from the

participant (Alwell et al. 1989; Gee et al.,1991; Goetz et al., 1985; Hunt et al., 1986; Roberts-Pennell & Sigafoos, 1999; Sigafoos et al. 2013). On the other hand, three studies placed the missing stimuli out of the participants' reach prior to the start of the behavior chain, but the item remained in the participants' view (Alwell et al., 1989; Gee et al, 1991; Grunsell & Carter, 2002). Two studies withheld physical assistance needed from the participants to complete the next step of the chain until a mand was initiated (Gee et al, 1991; Roberts-Pennell & Sigafoos, 1999).

Functional relations. Only seven of the 15 studies (Albert et al., 2012; Alwell et al., 1989; Gee et al., 1991; Goetz et al., 1985; Hunt et al., 1986; Grunsell & Carter, 2002; Roberts-Pennell & Sigafoos, 1999) demonstrated a functional relation even though both authors' report and data from visual analysis show an effect for all but one participant. A functional relation is determined if there are at least three demonstrations of an effect within a study design. Of the studies that did not show a functional relation, four studies did not include enough participants within the multiple baseline/probe design (Finn et al., 2012; Hall & Sundberg, 1987; Rosales & Rehfeldt, 2007; Sigafoos et al., 2013). These studies only included 2 participants, allowing for a maximum of two demonstrations of effects. Two studies used a nonconcurrent multiple baseline/probe design (Romer et al., 1994; Lechago et al., 2010), which is essentially a stacked A-B design. A-B designs permit only one demonstration of effect (Gast & Baekey, 2014). Sigafoos & Littlewood (1999) also used an A-B design (Sigafoos & Littlewood, 1999). Sidener et al. (2010) used an AATD which is designed to compare two more more treatments since the purpose of their study was to compare acquisition of mands using a mand only model to a mand-tact model. In addition, they did not visually display their data during the intervention

condition. Results per participant can be found in Table 1. Table 2 condenses the demonstration of a functional relation by study.

Generalization. Twelve studies reported generalization data; however, only four of these studies reported including generalization probes during the baseline condition or toward the introduction of the intervention condition (Alwell et al., 1989; Lechago et al., 2010; Romer et al., 1994; Rosales & Rehfeldt, 2007). Including generalization probes throughout of the intervention allows a more comprehensive analysis of whether generalization did occur; otherwise, the notion that the participant may have had the skill during baseline cannot be completely disregarded. Gee et al. (1991) reported collecting generalization data, but from the authors' description, generalization probes appeared to be baseline probes for the items that had not been trained yet in the multiple baseline design. Three studies (Finn et al. 2012; Goetz et al., 1985, Sidener, 2010) did not report collecting generalization data.

Generalization data were collected in a variety of novel contexts: untaught response within a taught activity (Albert et al., 2012; Grunsell & Carter, 2002; Hall & Sundberg, 1987; Rosales & Rhefeldt, 2007), taught response within a novel activity (Lechago, 2010, Roberts-Pennell & Sigafoos, 1999), untaught response within a novel activity (Grunsell & Carter, 2002 Hunt & Goetz, 1986; Lechago et al. 2010; Romer et al., 1994; Sigafoos et al. 2013; Sigafoos & Littlewood, 1999), setting (Albert et al., 2012, Alwell et al., 2012), communication partner (Albert et al., 2012; Alwell et al., 2012; Sigafoos & Littlewood, 1999), and verbal operants (Albert et al., 2012., Finn et al., 2012).

Of the 34 participants, all participants generalized mands to a novel context in at least some of the probes, if not all the probes. For two studies, participants generalized the skill across new items (Hall & Sundberg, 1987) or verbal operants (i.e., tacts; Albert et al., 2012) on most of the trials but not all. One participant in a study by Albert et al., 2012 did not generalize across all verbal operants from mand to text but did for a majority of the tact probes. In two other studies (Grunsell & Carter, 2002; Romer et al., 1994), participants did not generalize the skill to novel contexts immediately. For one participant in the study by Romer et al. (1991), he required additional training exemplars before the skill transferred. In addition to conducting generalization probes, Alwell et al. (1989) also asked the participants' teachers to observe whether spontaneous mands occurred within the natural environment. For two of the participants, spontaneous manding did occur in the natural environment with different items and people. The third participant required assistance removing her communication book from her purse; therefore, spontaneous manding could not be observed when her communication book was in her purse.

Maintenance. Nine studies reported collecting maintenance data (Alwell et al., 1989; Finn et al., 2012; Grunsell & Carter, 2002; Hall et al., 1986; Hunt & Goetz, 1986; Roberts-Pennell & Sigafoos, 1999; Romer et al., 1994; Rosales & Rehfeldt, 2007; Sigafoos et al., 2013). Of these 24 participants included in these studies, only three participants did not maintain their responses from intervention levels (see Table 1).

Inter-observer agreement (IOA) and procedural fidelity. All 15 studies reported collecting IOA data (see Table 2). Nine of these studies met the general recommendation of collecting IOA data for at least 20% of sessions with at least 80%

agreement (Ayres & Ledford, 2014). One study did have over 80% agreement but only collected IOA data in intervention conditions (Gee et al., 1991). Hunt & Goetz (1986) also had over 80% agreement but did not report how often IOA was collected. One study collected IOA data in fewer than 20% of sessions but reported 100% reliability (Roberts-Pennell & Sigafoos, 1999). Goetz et al. (1985) reported collecting IOA data for the criteria used to select activities for the BCIS, and also collected IOA data on the DV on approximately every fifth trial; as a result, it cannot be determined the exact percentage of sessions that IOA data were collected for. Sidener et al. (2010) only reported IOA data for 2 out of their 3 participants because of equipment failure.

Ten studies reported collecting procedural fidelity data. Of these ten studies, four collected fidelity data during intervention conditions only (Alwell et al., 1989; Finn et al., 2012; Gee et al., 1991; Goetz et al., 1985). Alwell et al. (1989) did not report how often they collected fidelity data. One study collected fidelity data in treatment and generalization conditions (Romer et al., 1994). For this study, data were collected in fewer than 20% of sessions but had over 80% fidelity. Hunt and Goetz (1986) had at least 80% fidelity but did not report how many sessions fidelity data were collected in. Sidener et al. (2010) again only reported fidelity data for 2 out of their 3 participants because of equipment failure. Three studies collected fidelity data in all conditions and met recommendations (Grunsell & Carter, 2002; Lechago et al., 2010; Sigafoos et a., 2013). Lechago et al. (2010) collected IOA data on their fidelity data with over 80% agreement.

Evaluating Study Rigor and Outcomes

Using the What Works Clearinghouse single case design standards, the above results indicate mixed results regarding methodological rigor of the studies included in

this review. Studies were evaluated based on the following criteria: minimized threats to internal validity, measured IOA over time, attempted to show a minimum of three demonstration of effects, and contained a minimum of three data points in each phase (Kratochwill et al., 2013).

The single-case analysis and review framework (SCARF; Ledford, Lane, Zimmerman, Chazin, & Ayres, 2016) was also used to evaluate the quality and rigor of the study designs and the overall effects of the studies in terms of general, generalization, and maintenance outcomes. The researcher inputted study information into the tool, and the tool calculated scores based on the information then generated these scores into three scatterplot graphs (i.e., general outcomes, generalization outcomes, and maintenance outcomes), where the data points were represented within four quadrants. Scores in quadrant 1 (i.e., upper right quadrant) indicate high quality evidence with positive effects. Scores in quadrant 2 (i.e., upper left quadrant) show low quality evidence but with positive effects. Scores in quadrant 3 (i.e., lower left quadrant) indicate low quality evidence, with minimal or negative effects. Lastly, scores in quadrant 4 (i.e., lower right quadrant) indicate high quality evidence but with minimal or negative effects. Calculated scores range between zero (i.e., lowest) and four (i.e., highest).

Only information from studies that attempted three demonstrations of effects were inputted into the tool. Each replication of effects within a study was entered as a separate study. For example, with a study utilizing a MBL design across behaviors with three participants, each participant's information would be entered separately. Therefore, this one study would be reported as three studies (i.e., entries) within SCARF. For this review, although information from only seven articles were entered into the tool, there

were a total of twelve entries altogether because three studies (Albert et al., 2012, Alwell et al., 1989, Goetz et al., 1985) contained replication of effects resulting in additional entries.

General outcomes. Seven entries from four studies (Albert et al., 2012; Alwell et al., 1989; Gee et al., 1991; Grunsell & Carter, 2002) had high quality evidence of positive effects. The remaining five entries from three studies (Albert et al., 2012; Goetz et al., 1985; Hunt et al., 1986) had low quality evidence of positive effects. No studies included in this review had high quality evidence of negative or minimal effects or low quality evidence of negative or minimal effects. See Figure 1.

Generalization outcomes. Five entries from three studies (Alwell et al., 1989; Gee et al., 1991; Grunsell & Carter, 2002) had high quality evidence of positive effects. Four entries from two studies (Albert et al., 2012; Roberts-Pennell & Sigafoos, 1999) had low quality evidence of positive effects. One entry from one study (Hunt et al., 1986) had high quality evidence of minimal effects, and the remaining two entries from two studies from one study (Goetz et al. 1985) had low quality evidence of negative or minimal effects. See Figure 2.

Maintenance outcomes. Compared to the overall study outcomes and generalization outcomes, the literature does not provide much high quality evidence of positive effects for maintenance outcomes (see Figure 3). Only two entries from two studies (Grunsell & Carter, 2002; Roberts-Pennell & Sigafoos, 1999) had high quality evidence of positive effects. Four entries from two studies (Alwell et al., 1989; Hunt et al., 1986) demonstrated low quality evidence of positive effects. The remaining six

entries from three studies (Albert et al., 2012; Gee et al., 1991; Goetz et al., 1985) had low quality evidence of negative or minimal effects.

Discussion

Even though the BCIS was developed to teach individuals with severe intellectual disabilities (ID) to mand (Goetz et al., 1985), this strategy can be used to teach individuals with a variety of disabilities. This review contained participants who had diagnoses of ID, ASD, developmental disabilities, vision impairments, Deaf and hearing impairments, communication disorders, and health related disabilities, specifically attention deficit hyperactivity disorder (ADHD) and a psychiatric disorder. However, of these disability categories, this review provides greater support for the use of this strategy with individuals with ID or ASD because participants with these diagnoses were more frequently included in the studies. Positive effects were shown for the other disability categories, but only one to four individuals were of these categories, and participants were mainly from the same study. As a result, despite the positive effects shown for these individuals, more research is needed to provide stronger support for use of the BCIS with these other disability categories.

This review also showed that earlier studies included primarily individuals with ID while later studies included mainly individuals with ASD. This shift in the population studied could be the result of the increasing prevalence rate in ASD and the growing interest in ASD research over the years. Even so, continued research using this strategy for children with ASD is needed, despite the fact that nearly half the articles (n=7) included in this review included at least one participant with ASD because deficits in social communication is a common characteristic of ASD (American Psychiatric

Association, 2013**)**. Individuals with ASD often require explicit instruction in this area, which includes manding. With early intervention, large gains can be made since research shows that learning to mand has collateral effects on other social skills (Sundberg & Michael, 2001; Dyer, 1989; Albert et al., 2012) and appropriate behaviors to convey a message are taught before learning histories develop with alternative, and potentially problematic, behaviors. In addition, many types of interruptions can be used within the BCIS. As a result, when this factor is accounted for, only a limited number of studies for each subcategory within disability categories exist. For instance, only three studies taught children with ASD to mand for missing items when the item was withheld and out of view (Albert et al., 2012; Alwell et al., 1989; Finn et al., 2012). Although this review demonstrates that almost half of the BCIS literature contain individuals with ASD, continued research with this population will provide greater support for this strategy that is easy for practitioners and caregivers to implement in the child's natural environment.

With the majority of studies (n=12), researchers had the role of the communication partner and therapist; however, only 3 studies evaluated generalization to a novel person who was familiar to the participant. Because of the simplicity of the strategy and the ability to insert single trials throughout the day when a natural instructional trial arises (Brady et al., 1994), it is beneficial to know that the skill can generalize to a caregiver or teacher since these individuals are the ones who interact with the participant the most. In addition, if a caregiver or teacher has the opportunity to be the communication partner during generalization probes, they will have a better understanding of how to implement the BCIS in the individual's natural environment. If caregivers and/or teachers are trained on how to implement the BCIS, the number of

opportunities created for the participant to mand in the natural environment increases (Sigafoos, Kerr, Roberts, Couzens, 1994). As a result, future studies should evaluate generalization to the participant's other communicative partners or have the communication partners provide instruction during the intervention.

Various approaches to interrupting the behavior chain were used, but the most common interruption was withholding an item necessary to complete the behavior chain while keeping the item out of view. However, when looking at results of the studies for each individual, all participants had success acquiring the mands taught. As a result, from this preliminary look, there does not appear to be a superior interruption over others in terms of facilitating mand acquisition. Theoretically, as long as an EO is established, regardless of the interruption type, the likelihood of a mand increases. However, it should be noted that the number of studies using each type of interruption varied, preventing an adequate comparison between the groups. In addition, the number of studies in each group would be too small to draw conclusions from.

When teaching children with ASD to mand, researchers should also consider potential variables controlling the mand. A mand is rarely evoked by only an EO (i.e., a pure mand) since other verbal operants may be present in the environment and influence the response (Brady et al., 1994). For instance, a mand can also be evoked by an intraverbal when asked, "what do you want?"; by a tact when the child sees the item in his environment; or by an echoic when given a verbal prompt (i.e., model). Several studies included in the review delivered a verbal prompt in the form of an intraverbal for when the interruption in the chained activity occurred (Goetz et al., 1985; Hall & Sundberg, 1987; Hunt & Goetz, 1986; Roberts-Pennell & Sigafoos, 1999). As a result,

the participant's response is an impure mand; therefore, it can be difficult to determine whether the mand was controlled by the intraverbal, the EO or a combination of both without conducting further tests.

Impure mands often occur in the natural environment. For example, when children are in a group (e.g., school, camp, extracurricular activity), often, these children are engaged in similar activities. When a child is unsure of what to do, the child can often observe his or her peers and imitate what the peers do. If a child mands for an item after observing their peers with the specified item, the mand is part tact from seeing the item. This situation can be used to potentially enhance the efficiency of the BCIS because research has shown that observing others engage with a neutral item (for the individual) as a reinforcer increases the reinforcing value of the item and conditions it as a reinforcer for the individual (Greer & Singer-Dudek, 2008; Singer-Dudek & Oblak, 2013). Therefore, when teaching children with ASD to mand for a missing item, does observing an individual engage in a similar activity increase the reinforcing value of the missing item for the activity even more since the item was already a CEO? Although the BCIS have been used to teach individuals with a variety of disabilities to mand for a variety of stimuli using various modes of communications, studies have not yet evaluated whether observing someone else access the reinforcer with the BCIS enhances the efficiency of the procedure since theoretically a stronger EO will be present for the missing item.

When adding variables to control a response, the response is usually stronger (Brady et al., 1994); however, researchers must evaluate and compare the effects of adding variables on skill acquisition and generalization. Although a mixed mand-tact instructional procedures is predicted to lead to more efficient acquisition of a mand

because of greater stimulus control, mands under less stimulus control generally result in greater stimulus generalization (Stokes & Baer, 1977). Therefore, researchers must understand the balance between effects on acquisition and generalization when selecting the most effective strategy for the child.

The BCIS contains few components, making it an easy strategy to implement. These components include: presence of an EO, a prompting strategy to teach correct responding, and natural reinforcement of giving access to the stimulus manded for. Sometimes, practitioners may deliver praise statements in addition to the item manded for (Goetz, Gee, Sailor, 1985; Rosales & Rehfeldt, 2007); however, praise (i.e., a generalized conditioned reinforcer) does not maintain mands (Skinner, 1957). If only praise was delivered following the mand, over time, the mand would extinguish because the mand is no longer contacting the stimulus requested. As a result, it is unnecessary to include praise as a reinforcer unless participants need additional reinforcers in order to respond. However, if praise statements were used, these statements should be faded as the participant emits independent correct mands. Because the strategy only contains a few components from the start, the process of fading elements of the intervention following skill acquisition is much easier than if there were many elements to fade out. In addition, the response prompts used (e.g., progressive time delay, time delay) typically lend themselves to systematic removal over time (e.g., progressive time delay extends the delay before the prompt is given). As a result, the use of these interventions can promote maintenance of manding.

Generalization does not always occur spontaneously (Baer, Wolf, & Risley, 1968); as a result, most studies include a measure of how well the skill generalizes to a

novel context including novel settings, persons, activities, items, or a combination of the above. From the twelve studies in this review that included generalization measures, all participants showed generalization of the skill in some aspect. While not all participants generalized mands across every probe, the overall finding is promising. However, consumers must consider the number of training trials received by the participant as well as the number of exemplars trained prior to collecting generalization probes post-intervention. For instance, there is a difference between generalizing the response after one trained exemplar as opposed to three trained exemplars, and this difference has implications on the amount of time required to teach a child with ASD to mand. Researchers should provide information about the participant's communication abilities; therefore, the amount of training required for children with ASD to generalize mands, can be linked with the participant's initial communication abilities and compared to determine whether a pattern exists.

Determining true generalization effects for all the studies that reported the data is difficult because many of the studies did not include a baseline for the generalization probes. Therefore, it would be presumptuous to conclude that generalization did occur, despite obtaining results similar to intervention conditions, if there were no data to show the level of responding prior to intervention. Similar to researchers requiring a baseline or control condition to compare outcomes from the intervention condition to (in order to evaluate change) the same logic should be applied with generalization data when determining results. Change does not occur if the data are at the same level as in the baseline condition; however, this knowledge cannot be determined unless data are measured before the intervention.

When skills do not generalize, or overgeneralize, training should occur within that new context. For example, in the study by Lechago et al., (2010), all but three participants generalized the skill correctly whereas the fourth participant overgeneralized the response. Participants were taught to mand for a missing item to complete activities. Generalization was assessed in scenarios where the same item from instructional trials was withheld but with different activities and where a different item from instructional trials was withheld within a different activity. All participants did generalize the mand with activities that involved the trained item; however, one participant generalized the response for the trained item during the activity where a different item was withheld. As a result, faulty stimulus control may have occurred with this one participant since he was overgeneralizing the response when the manded item was not involved in that generalization activity. After authors provided training with the untaught item, correct responding occurred.

As children with ASD learn to mand for stimuli, researchers, practitioners, and caregivers must not expect mands to automatically transfer to tacts even though the same word is uttered because mands and tacts are functionally independent responses (Skinner, 1957). Only two studies evaluated the generalization across verbal operants in this review (Albert et al., 2012; Finn et al., 2012). Although both studies did show a transfer of control between the mands and tacts, more studies are needed to evaluate this idea, considering the literature (i.e., studies not only looking at BCIS) on generalization of verbal operants does not have a clear answer. Some studies have found that the mands do transfer to tacts (Albert et al., 2012, Petusdottier et al., 2005) while other studies showed that the transfer of control does not occur (Lamarre and Holland, 1985, Twyman, 1996).

Despite the mixed results, this area necessitates continued research because of the implications to language interventions. If the learned response in one operant does transfer across verbal operants, knowing this piece of information can save instructional time since the responses will not need to be taught in the context of every operant. Skinner (1957) did claim that an individual's learning history can influence the transfer across verbal operants based on the conditions that the verbal operants were taught in and how developed the individual's language is, but to what extent are these variables contributing to the transfer of verbal operants?

Purpose

This study aimed to enhance the BCIS used to teach children with ASD to mand. The researcher hypothesized that adding an additional component of having a therapist engage in the same activity alongside the participant will strengthen the EO for the missing item, thereby increasing the likelihood of the mand. However, with the potential for increasing the efficiency of mand acquisition, comes the possibility of restricting generalization across novel contexts and the transfer of the acquired response to a different verbal operant (i.e., tact). Research questions addressed in this study were: (a) Does adding a therapist engaged in an identical activity to the BCIS enhance mand acquisition as measured by fewer sessions required to reach mastery criterion? (b) Does adding a therapist engaged in an identical activity to the BCIS hinder generalization of mands? (c) Does the transfer of control from mand to tacts occur more in the condition that teaches an impure mand (i.e. BCIS with therapist modeling) than the condition teaching a pure mand (BCIS only)?

Table 1

Participation Information and Results

Reference	Number of Participants	Ages	Diagnosis	Positive Results	Generalization Occurred	Maintenance Occurred
Albert et al. (2012)	3	5 – 8	ASD and MOID	Y	Y	N/A
			ASD, seizures, and MOID-SID	Y	Y	N/A
			ASD and MOID	Y	Y	N/A
Alwell et al. (1989)	3	6-7	ASD and SID	Y	Y	Y
			SID and seizure disorder	Y	Y	Y
			Severe DD	Y	Y	Y
Finn et al. (2012)	4	3-6	ASD	Y	Y	Y
			ASD	Y	Y	Y
			ASD	Y	Y	Y
			ASD	Y	Y	--
Gee et al. (1991)	3	5-10	Blind and PID	Y	N/A	N/A
			PID and functional HI	Y	N/A	N/A
			PID and VI	Y	N/A	N/A
Goetz et al. (1985)	2	12-14	SID	Y	N/A	N/A
			SID	Y	N/A	N/A
Grunsell & Carter (2002)	4	7-8	SID and CD	Y	Y	Y
			MID and Severe CD	Y	Y	Y
			MID and Severe CD	Y	Y	Y
			SID, ADHD, Severe CD	Y	Y	Y

Hall & Sundberg (1987)	2	16-17	Deaf and SID	Y	Y	Y
			Deaf and SID	Y	Y	Y
Hunt & Goetz (1986)	3	6-7	SID	Y	Y	Y
			SID, multiple disabilities	Y	Y	Y
			SID	Y	Y	Y
Lechago et al. (2010)	3	4-7	ASD	Y	Y*	N/A
			ASD	Y	Y	N/A
			ASD	Y	Y	N/A
Roberts-Pennell & Sigafoos (1999)	3	3	DD and VI	Y	Y	Y
			LG and ID	Y	Y	Y
			ASD and ID	--	N/A	N/A
Romer et al. (1994)	4	27- 37	MOID to SID	Y	Y	Y
			MOID to SID	Y	Y	Y
			MOID to SID	Y*	Y	Y
			MOID to SID	Y	Y	Y
Rosales & Rehfeldt (2007)	2	34-58	ID, DS	Y	Y	--
			PSY-NOS	Y	Y	--
Sidener et al. (2010)	3	3	None	Y	N/A	N/A
			None	Y	N/A	N/A
			None	Y	N/A	N/A
Sigafoos et al. (2013)	2	4-5	ASD	Y	Y	Y
			ASD	Y	Y	Y

Sigafoos & Littlewood (1999)	1	ASD	Y	Y	N/A

Notes: Y=Yes; Y* = Some; -- = No; N/A = not available; MOID = moderate intellectual disability; SID = severe intellectual disability; PID = profound intellectual disability: HI = hearing impairment; ASD = autism; VI = vision impairment; LG – Lennox-Gestaut (seizures); DS = Down syndrome; CD = communication disorder; PSY-NOS = psychiatric disorder, not otherwise specified

Table 2

Study Results

Reference	Research Design	Functional Relation	IOA[a]	PF[b]	Generalization	Maintenance
Albert et al. (2012)	MB - 3 bx	Y	Y/Y	NA	Y	NA
Alwell et al. (1989)	MP - 3 bx	Y	Y/Y	NA/Y*	Y	Y
Finn et al. (2012)	MP - 2 bx	--	Y/Y	Y/Y*	Y	NA
Gee et al. (1991)	MB - 3 participants	Y	--/Y*	Y/Y*	NA	NA
Goetz et al. (1985)	MB - bx	Y	--/Y	N/A	N/A	N/A
Grunsell & Carter (2002)	MB - 4 participants	Y	Y/Y	Y/Y*	Y	Y
Hall & Sundberg (1987)	MB - 2 participants	--	Y/Y	NA	Y	NA
Hunt & Goetz (1986)	MB participants	Y	NA/Y	NA/Y	Y	Y
Lechago et al. (2010)	NC MB - 3 participants	--	Y/Y	Y/Y	Y	NA
Roberts-Pennell & Sigafoos (1999)	MB across 3 participants	--	--/NA	NA	Y	Y
Romer et al. (1994)	NC MP - 4 participants	--	Y/Y	--/Y**	Y	Y
Rosales & Rehfeldt (2007)	MP - 2 participants	--	Y/Y	NA	Y	Y
Sidener et al. (2010)	AATD	--	--/--	--/--	NA	N/A

Sigafoos et al. (2013)	MB - 2 participants	--	Y/Y	Y/Y	Y	Y
Sigafoos & Littlewood (1999)	A-B	--	Y/Y	NA	Y	NA

Notes: IOA – inter-observer agreement; PF = procedural fidelity; MB = multiple baseline; MP = multiple probe; NC = nonconcurrent AATD = adapted alternating treatment design; A-B = withdrawal with one condition change; bx = behaviors; Y= met criteria; -- = did not meet criteria; N/A = not available; * = evaluated in treatment condition only; ** = evaluated in treatment condition and generalization probes

[a] IOA was collected for at least 20% of sessions with at least 80% agreement. [b] PF was collected for at least 20% of sessions with at least 80% fidelity.

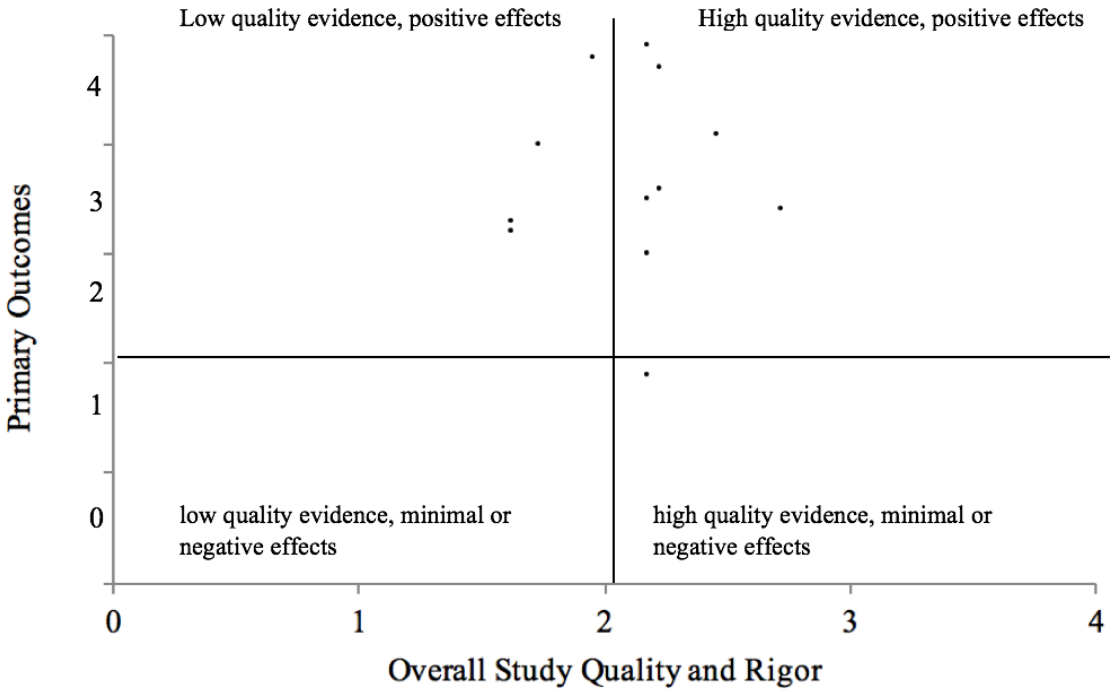

Figure 1. Results related to general study outcomes and the quality of study designs.

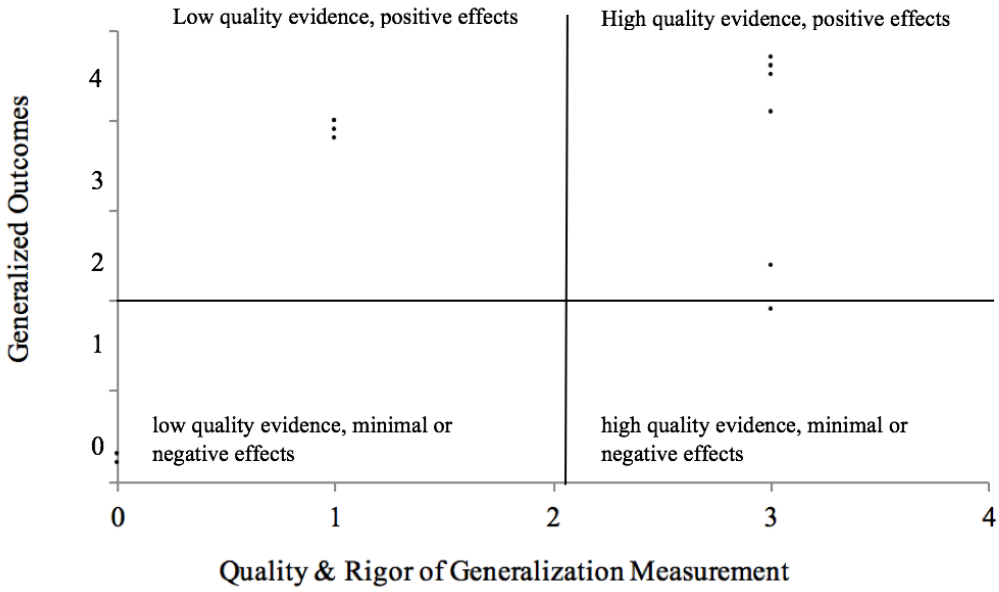

Figure 2. Results related to generalization outcomes and the quality of generalization measurement

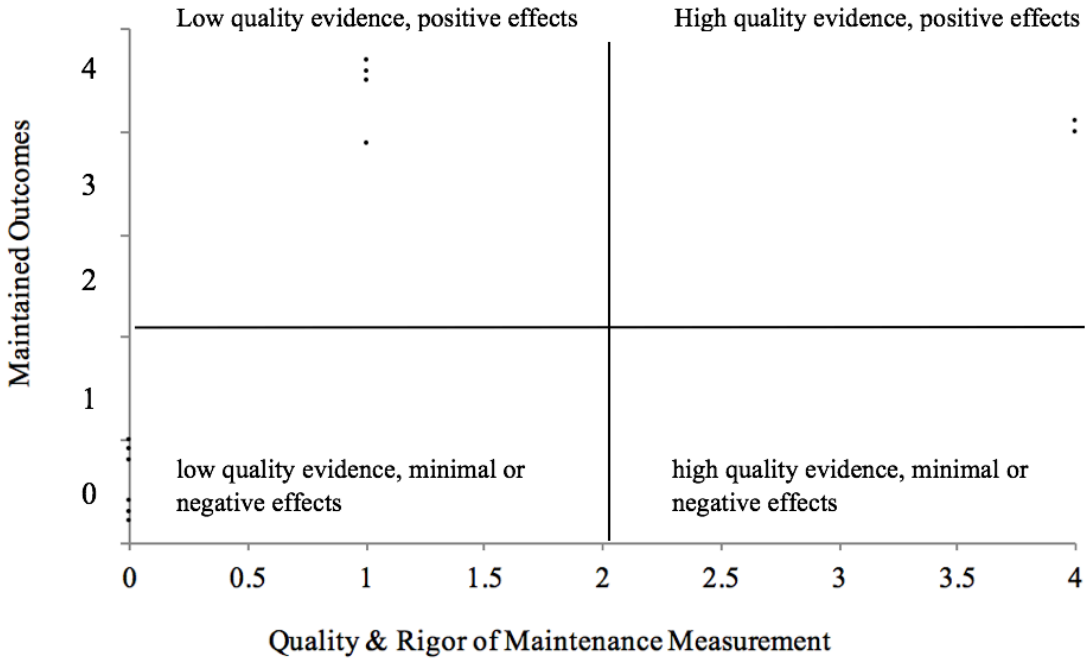

Figure 3. Results related to maintenance outcomes and the quality of maintenance measurement

CHAPTER THREE

METHODOLOGY

Participants

Prior to recruiting participants, the researcher obtained permission to conduct the study from a university Institutional Review Board in the southeast region of the United States. The researcher recruited participants from local summer educational programs for students with disabilities and through a university behavior clinic. The researcher spoke with teachers, the program director of the summer educational program, and therapists regarding the purpose of the study and inclusion criteria of participants. Potential participants were identified by the teachers and program director of the summer educational program and clinicians from the university clinic. Signed consents were received for five subjects prior to screening activities.

All participants were between the ages of 3-11 years old and diagnosed with ASD or a developmental delay. Participants were not excluded based on gender, ethnicity, or socio-economic status. All nominated participants were reported to have deficits with spontaneous vocal mands and were vocally imitative. Participants spontaneously manded using gestures (e.g., pointed, lead the communication partner to an item) but required adult prompting (i.e., asked “what do you want?” or vocal model) to emit a vocal mand containing the label of the item. In addition, participants did not engage in problem behavior for an extended period of time (i.e., over 5 min) when their routine was interrupted.

Kaden. Kaden was a 3-year-old, African American male, diagnosed with ASD. The parent had contacted the university clinic to work on increasing his communication skills. At the time of study enrollment, his mother reported few spoken words, and this observation was also noted during his intake with the clinicians. He scored a 4 on the VB-MAPP Barriers Assessment (Sundberg, 2008), which indicated an impaired mand and echoic repertoire. However, the therapist who worked with Kaden reported that he did emit vocal imitations during clinical sessions. He rarely emitted spontaneous vocal mands.

Brandon. Brandon was an 11-year-old boy diagnosed with ASD. He met eligibility for special education services in the areas of developmental delay and speech-language impairment. During the school year, he attended a private school primarily attended by children with disabilities. He was a student in the grades 3-5 class. As reported in his performance plan and by his mother, he occasionally used writing to communicate with others, specifically when a communication breakdown occurred (e.g., he emitted a spontaneous, but unintelligible, vocal mand; communication partner asked him a question but could not understand his response). His teacher reported that Brandon inconsistently emitted spontaneous vocal mands. Therefore, when an opportunity for a mand occurred, and Brandon did not respond, his teacher provided prompting by either asking him, “what do you want,” or by providing him with a model prompt. During instances where Brandon did not emit a vocal mand and a prompt had not been delivered yet, he waited for an adult to provide the item, looked for the item himself, or engaged in SIB (i.e., hitting his face or chin repeatedly with his fist from a distance of 1 inch).

Throughout the day, Brandon also engaged in scripting and singing. He rarely initiated social interactions with others (e.g., peers, teachers) unless he needed something.

Charles. Charles was a 7-year-old, Caucasian male diagnosed with ASD. He met eligibility for special education serves in the categories of ASD and speech-language impairment. He was a first grade student at his neighborhood elementary school. He was primarily served in a self contained classroom, but he also received 90 minutes of instruction in a co-taught classroom and attended specials with his peers who were typically developing. As specified in his IEP, he frequently engaged in echolalia and only occasionally initiated intelligible vocalizations (i.e., mands, responses to questions, responses to social interactions) spontaneously. His language skills affected his ability to vocally mand (i.e., with an intelligible vocalization) for items, activities, and information across all settings. His teacher reported that he obtained items by retrieving the item himself or by emitting non-vocal mands (i.e., pointing or leading his teacher to the item). Spontaneous vocal mands, which were often unintelligible vocalizations with negative affect or "no", were often emitted in response to other's behaviors that directly affected him (e.g., preparing his lunch differently). In addition, he had difficulty answering WH questions (i.e., who, what, where, when, why). In large group settings, he engaged in inappropriate behaviors of screaming, eloping, and refusing to follow directions and was frequently off- task; however, the frequency of these behaviors decreased in small group and 1:1 settings.

Sharon. Sharon was a 9-year-old, Asian, female diagnosed with ASD. She was eligible for special education services through the categories of ASD, moderate intellectual disability, and speech or language impairment. She attended her

neighborhood elementary school, but was in a self contained classroom. As reported in Sharon's IEP, Sharon could vocally tact 30 items found in her home and school and also tact 20 adjectives. The number of words in her vocabulary grew throughout the year, and she made improvements understanding directions and information after the first presentation of the information. However, Sharon continued to have difficulty spontaneously manding for items and activities during her free and instructional time. When Sharon did spontaneously mand for items, she guided her communication partner to the item, showed an upturned palm, vocally manded "help", or vocally manding for the item using a tact (if she knew it), but did so inconsistently. When Sharon did not spontaneously mand during opportunities, she waited for the adult to give her the missing item for an activity or retrieved the item herself. In addition, teachers reported that she had difficulty identifying objects using characteristics. At school, Sharon engaged in humming, saying "it's okay," or scratching or biting her teachers when her routine was disrupted.

Walter. Walter was a five-year old, African American boy, who was diagnosed with ASD. He was eligible for special education services through the categories of developmental delay and speech-language impairment. During the school year, he attended a private school primarily attended by students with disabilities, where he was in the preschool class. His teacher reported that his receptive language skills were higher than his expressive language skills. He could follow one step directions but his expressive language was only developing. At the time of study enrollment, Walter had approximately ten spoken words in his repertoire including his name and "no." In class, Walter often eloped from his work space to run around the classroom and climb on

furniture. Walter spontaneously manded for items by looking for the items and leading his communication partner to the item. He rarely emitted vocal mands spontaneously, and often required a model prompt in order to emit vocal mands.

Setting

The study was conducted in two settings: an inclusive summer program run by a local private school and a university clinic. Three participants (i.e., Brandon, Charles, and Walter) were enrolled in the the summer program, which consisted of extended school year (ESY) sessions and themed camps (e.g., pottery, superhero). The ESY sessions were structured similar to a school day at the private school; therefore, it consisted of morning meeting, ELA, math, lunch, recess, social skills, and an elective depending on the day of the week (i.e., music, library). The themed camps consisted of arts and crafts activities related to the themed week, academics, social skills, and recess. ESY sessions were held at the local private school; whereas, the themed summer camps were based out of a local church with school rooms. The private school partnered with the church every summer. Sessions consisting of pre-baseline activities (e.g., selecting activities for each participant) started out in the participants' classrooms. However, other students in the classrooms attempted to engage with the researcher and/or the participant became distracted with other activities occurring in the classroom. Therefore, the remainder of sessions were conducted in an empty classroom to prevent extraneous variables from interfering with the study procedures.

Brandon and Walter were enrolled in the ESY sessions. The ESY program contained approximately 30 students, with 10 students in each age group: preschool, elementary (grades K-5), and secondary (grades 6-12). These classrooms were staffed

with one lead teacher and two teaching assistants. The empty classroom was still packed up from the end of the school year. As a result, chairs were stacked and student desks were pushed toward the right side of the classroom. Sessions were conducted at a 3 feet by 6 feet table on one side of the room. The researcher and the participant were seated side by side at the table. Session materials were kept on the floor to the right of the researcher and out of sight by the participants unless the materials were required for the specific trial. An iPhone 6 was propped up on the table against the wall in order to video record the sessions for inter-observer agreement (IOA) and procedural fidelity purposes.

Brandon and Charles were enrolled in the summer camps. Approximately 50 students attended the themed summer camp. Students were assigned to grade level groups (i.e., preschool, Grades K-2, grades 3-5, grades 6-12). Each group consisted of one lead teacher, one teaching assistant, and one to two junior assistants (high school and college aged volunteers). Although the junior assistants were assigned to one group, they also provided assistance to other groups as needed (e.g., shortage of staff; different group required more support). Tables were set up in the middle of the classroom with chairs placed along the perimeter of the table configuration. Tables containing student work were placed against the wall near the door and against opposite wall. A large cabinet holding classroom supplies was placed against the wall to the right of the door. During the sessions, the researcher sat perpendicular to the participant but within arm's reach along one of the corners of the table. Materials were kept on the floor next to the researcher and on the opposite side of where the student was sitting so that the materials were out of sight, unless the specific material was required for the trial.

Sessions for Kaden and Sharon were conducted in a university clinic room. The clinic room was approximately an 8'x8' room. The room contained a two-way mirror, a white board located opposite the two-way mirror, a table with two chairs placed side by side, a trash can and a plastic drawer set. The table was placed against the two-way mirror. An iPhone 6 was propped on the table and against the wall with the two-way mirror to video record sessions. Materials were kept on the floor to the left of the researcher. Sharon sat in a chair on the right side of the researcher. The table was clear except for the iPhone and materials used during the trials.

Materials

Session materials consisted of a data sheet (see Appendix A), pencil, an iPhone 6, and specific items required to complete activities for each participant (see Table 4). When selecting activities for each participant, the researcher collected items such as watercolors, Legos, puzzles, pipe cleaners, beads, popsicle sticks, coloring books, crayons, cars, ramps, blocks, glue, tape, cupcake wrappers, ribbons, flashcards, paper, pencils, Play-Doh, cookie cutters, etc. With these items, participants were instructed to complete specific activities with the items, and the researcher observed whether the participants engaged in the activity, completed the activity, engaged in problem behavior, and could tact the materials required of the activities. Activities were selected if the participant did engage with and complete the activity independently and could not tact at least one item in the activity set. Activities selected for each participant are as follows. Brandon completed puzzles, match clips to a card, beaded a pipe cleaner, and made popsicle stick picture frames. Charles completed puzzles, copied words from flashcards in writing, colored a coloring sheet, and completed a matching activity. Sharon made an

arts and crafts flower, completed puzzles, played with Play-Doh, and matched clips to paper. Walter completed puzzles, made an arts and crafts flower, counted blocks, and did a matching activity. The list of materials for each activity for each participant, and the item withheld from each activity is listed in Table 4. Sessions typically lasted between 3-10 minutes depending on the activity.

Dependent Variable and Data Collection

In this study, the percentage of correct vocal mands (i.e., responding) was the dependent variable. Examples of correct vocal mands included: saying the label of the missing item and saying an approximation of the label for the missing item. Non-examples included: pointing to the missing item if it was in view, gesturing how to use the item, saying the name of a different item than the one needed to complete the chain, saying an incorrect tact of the item. Event recording was used to document whether the vocal mand was produced independently (i.e., spontaneously), was prompted, or no response occurred. During the baseline phase, responses were scored as independent if the participant correctly manded for the "missing" item within 5 s of the discriminative stimulus (SD; i.e., moment participant's hand releases the object completing the previous step in the behavior chain) and without a verbal prompt by an adult. Responses were scored as no response if the participant did not initiate a vocal mand within 5s of the SD. In the comparison phase, correct responses were scored similarly to the baseline phase. No responses were also scored similarly to the baseline phase with the addition of if the participant did not respond within 5s following two model prompts by the adult, this absent response was also coded as no response. In the comparison phase, unlike the baseline phase, responses also could be scored as prompted if the participant manded

correctly within 5s of the model prompt given by an adult and completed the mand within 3s. A prompt was given if the participant provided no response or an incorrect response within 5s of the SD during the comparison phase. A second prompt was given if the participant did not respond to the first prompt. The percentage of mand occurrence (prompted and independent) were graphed in a line graph for visual analysis per activity for each participant. Number of sessions to criterion were also counted for each activity by participant.

Experimental Design

An adapted alternating treatment design (AATD) was used to compare BCIS only and BCIS with therapist modeling on acquisition of manding. AATD designs can be used to compare the efficiency of components within an intervention. Threats to internal validity due to history and maturation were minimized since the design does not require data collection over an extended period of time. In addition, threats to procedural fidelity were minimized with fidelity checks for at least 20% of sessions in each phase within each activity (Wolery, Gast, & Ledford, 2014).

In this study, two activities for each condition were used in order to demonstrate whether results within participants and determine whether the difficulty of the activity and complexity of the vocal mand affected results. These four activities were evaluated simultaneously rather than evaluating one set (one activity each of BCIS only and BCIS with therapist modeling) at a time. This decision was made to maximize the number of sessions conducted within a day and prevent the absence of an EO. If the researcher continually instructed students to complete the same two activities, the participant could become satiated on the task hence an EO for the mand would be abolished. By evaluating

four activities simultaneous, greater variation with activities occur; satiation is less likely to occur where there are more options.

Throughout the study, the researcher vocally told the participant if the participant was to complete the activity by themselves or if the researcher was going to complete the activity along side the participant. The researcher gave these instructions at the start of each session to help the participant further discriminate the conditions between the BCIS only and BCIS with therapist modeling. For example, in the BCIS only condition, the researcher might say, “Make a lollipop by yourself.” In comparison, during the BCIS with therapist modeling, condition, the therapist might say, “Let’s make bracelets. I’m going to do this with you.” In addition, at the start of each trial, the researcher again specified, though somewhat subtly, whether the researcher would complete the activity. For example, “make a ____” (BCIS only) versus, “let’s make a____” (BCIS with therapist modeling).

Procedures

Activity screening. After receiving consent, the researcher asked the participants’ parent or teacher to identify preferred activities of the participants’. After receiving these suggestions, the researcher directly observed how the participant engaged in the identified activity and whether each activity consisted of multiple steps that the participant completed independently. Preferred activities were excluded from the participants identified activities in a couple of instances. For Kaden, he used preferred items in a stereotypical routine and did not notice if an item was missing. For example, when playing with cars, he lined up cars in a row, however, he would not notice if there was a car missing since he simply started the routine over once he lined up the last car.

For Sharon, preferred activities included items that she could already tact, therefore, the researcher could not include these activities as part of the study. If the researcher could not identify four preferred activities, the researcher also considered activities commonly present in elementary school classrooms (e.g., counting, writing) or age appropriate activities (e.g., playing with Play-Doh). Through this process, one participant (Kaden) was excluded from the study because he could not complete multistep activities independently. He had several preferred activities, consisting of stereotypical routines (e.g., lining up cars), but would only complete activities, not consisting of stereotypical routines, with adult prompting (e.g., physical prompts, model) during each step within the activity. Due to time constraints, the researcher did not have enough time to teach him to complete four activities independently and conduct all procedures within the study.

Once activities were identified, the researcher withheld a required item at a predetermined step and probed whether the participant attempted to complete the activity (e.g., looked for items, informed the researcher that an item was missing). If the participant accurately manded for the missing item, this activity was omitted. If the participant attempted to complete the activity without manding correctly, the researcher gave the missing item to the participant and allowed the participant to complete the activity. This activity was then included in the study. If the participant did not attempt to complete the activity following the interruption (e.g., sat and waited for researcher to initiate the next step, moved onto a different activity), this activity was not included for the participant. Four activities were selected for each participant. See Table 4 for activities for each participant.

Evaluating tacts. Prior to the baseline phase and following the comparison phase, the researcher evaluated whether the participant could vocally tact all items required for each behavior chain selected for the participant. The researcher asked, "What's this?" while holding up each item in front of the participant then waited 5 s for a response. The researcher did not provide feedback indicating whether the participant response was correct or incorrect but did provide behavior specific praise to attending behaviors (e.g., "Great job staying in your seat!") during these trials. The researcher recorded all participant's responses on a data sheet.

Choosing a predetermined step in the behavior chain. When selecting a predetermined step, the researcher selected a step involving an item that the participant could not tact in order to evaluate whether the mand response transferred to a tact following acquisition of the target mand. Therefore, if a participant could not tact only one item during the tact evaluation, the step that first required the use of the item was selected as the predetermined step. This scenario occurred during two of Brandon's activities (i.e., arts and craft frame frame, fine motor clip) and two of Sharon's activities (i.e., fine motor clip and making a lollipop). If there were multiple items that the participant could not tact, the researcher selected the item used closest to the terminal reinforcer (e.g., puzzle piece instead of the puzzle board). When the researcher withheld items used at the beginning of the activity, the participants manipulated the items with their hands (e.g., passed an item between the hands) and were less likely to mand for the missing item in order to start the activity. However, when an item required later in the activity was removed, the participant was already in the process of completing the activity, as a result an EO for the missing item was more likely established.

Baseline phase. Initial performance with the four identified behavior chains were assessed. During each session, the researcher sat at approximately an arm's length distance from the participant and the materials (one of the items required for the chain was "missing"). The session started when the researcher provided a vocal direction for the participant to complete one of the behavior chains (e.g., "Make a lollipop"), while withholding one of the items that the participant needs to complete the task (e.g., popsicle stick). The missing item was not in the participant's view. If the participant manded for the missing item (e.g., "popsicle stick") within 5 s of reaching the interrupted step in the chain, the instructor handed the missing item to the participant. If the participant did not mand for the item within 5 s or gave an incorrect response, the researcher handed the missing item to the participant. Each behavior chain was assessed a minimum of three times. If the participant vocally manded for the missing item in two out of three consecutive sessions, the particular behavior chain was not included, and a different behavior chain was included.

Throughout the study, the researcher intermittently provided opportunities for the participant to complete the behavior chain without any interruptions in order to ensure that the participant had opportunities to complete the behavior chain without having to mand for the same missing item every time the direction to complete the activity was given. This procedure was included in an effort to prevent faulty stimulus control of requesting the missing item once the direction to start the behavior chain was delivered.

Comparison phase. The researcher assigned the activities to the following conditions: BCIS only and BCIS with therapist modeling. For participants who had puzzles as one of their activities, this activity was always assigned to the BCIS only

condition because the researcher did not have two identical sets of the puzzles. For all other activities, the researcher assigned the activities based on the order with which the activities were identified, and the following sequence of activities: BCIS only 1, BCIS with therapist modeling 1, BCIS only 2, BCIS with therapist modeling 2.

BCIS only probe procedures. Sessions began with the researcher giving a vocal task direction (e.g., "Make a flower.") for the participant to start the behavior chain. When the participant reached the step with the missing item, the instructor waited 5 s for the participant to initiate the mand and 3 s to complete the mand for a correct response. If the participant correctly responded, the researcher gave the "missing" item to the student along with a vocal statement acknowledging the participant's response (e.g., "Sure; here's the [item]."). If the participant provided an incorrect response (e.g., manded for an item other than the missing item or the response duration was longer than 3 s), the instructor immediately interrupted and provided the model prompt (i.e., said label of the missing item). If the participant did not respond within 5 s, the researcher provided the model prompt. It was intended that the model prompt would serve as a controlling prompt since the participant was vocally imitative and the activity was identified as a preferred activity. However, not all activities selected were verified as preferred activities but simply activities that the participants could and would complete independently. Following each correct response, the researcher gave the "missing" item to the student along with a vocal statement acknowledging the participant's mand ("Here is the [item]."). If the participant did not respond correctly or did not respond following a model prompt, the researcher gave the model prompt a second time. If the participant still

responded incorrectly or did not respond, the trial ended and the researcher removed the materials from the participant.

BCIS with therapist modeling probe procedures. Procedures were similar to the BCIS only probe procedures with two exceptions. First, the researcher vocally specified that the researcher would also complete the activity (e.g., "Let's make bracelets. I'm going to make one with you."). Second, the researcher was also engaged in the same activity at approximately an arm's length distance from the participant. The researcher completed the chain at approximately the same pace of the participant and had all the items required to complete the chain; therefore, the missing item was in the participant's view but out of reach. The researcher also had an "extra" of the missing item for when the participant mands for the missing item, but the extra item was not placed in the participant's view.

Criterion level. The criterion level for each of these probe procedures was three consecutive sessions with a minimum of 80% independent correct response. If one of the probe procedures reached criterion before the others, periodic sessions were conducted for that probe. The other probe procedure not at criterion continued until it reached criterion or until 1.5 times the number of sessions for the first probe to reach criterion had occurred, whichever procedure occurred first. However, due to time constraints, the researcher was unable to continue conducting sessions until all activities reached mastery criterion.

Generalization. Throughout the study, the researcher probed for generalization to evaluate whether the mand generalized to a different "missing item" within the activities used in the study and to a novel person (i.e., person other than the researcher who

conducted the instructional trials). These probes used procedures similar to the condition in which the generalization probes occurred. For the within context generalization probes, the researcher withheld an item that the participant could tact prior to baseline conditions. As a result, if the participant did not mand for the item, researchers could exclude the possibility that the response was not in the participant's repertoire. Therefore, not all activities for each participant contained generalization probes for within context activities if the participant did not tact for other items during the tact evaluation. For Brandon, a different item within one activity (i.e., arts and craft frame) was evaluated. The researcher evaluated different items for two of Sharon's activities (arts and crafts flower and Play-Doh activity) and one of Walter's activities (arts and craft flower). See Table 5 for which missing items were evaluated during generalization probes.

When evaluating generalization to a novel person (i.e., not involved in instructional procedures), a familiar person was asked to conduct these sessions (e.g., parent, teacher). For Brandon and Walter, a teacher was asked to conduct the sessions. For Sharon, her mother conducted the generalization sessions. The researcher was unable to conduct generalization probes across a novel person for Charles because his mother and teachers were unavailable due to work and class schedules, respectively.

Reliability

IOA and procedural fidelity data were collected during the baseline and comparison phases of the study for all participants. For IOA data, the researcher served as the primary observer and trained two independent observers as secondary observers. The secondary observers were both recent graduates of the university attended by the researcher. The secondary observers also collected procedural fidelity data during the

baseline and comparison phase. One secondary observer collected IOA and procedural fidelity data for Brandon and Charles while the other secondary observer collected IOA and procedural fidelity data for Sharon and Walter.

IOA. Prior to collecting baseline data, the primary researcher trained the two secondary observers to differentiate unprompted mands from prompted mands and correct mands from incorrect mands. The researcher provided the definitions of each term with examples and non-examples. The secondary observers then practiced independently collecting data using a data collection sheet by watching video recordings of the sessions that were not included in the IOA data set. Total agreement for measuring mand responses between observers was determined by dividing the total number of agreements by the total number of agreements and disagreements. The researcher then multiplied the quotient by 100 for the percentage of agreement. Secondary observer training ended after receiving 80% IOA with the primary data collector on three consecutive practice videos.

Secondary coders collected IOA data for at least 20% of each phase for each participant. The primary researcher collected data in vivo while the secondary observers collected data from video recordings of the sessions. The secondary observers were also blind to session conditions during data collection. For Brandon, IOA was collected for 33% of baseline sessions (M = 100%) and 37.5% of intervention sessions (M = 95%, range = 80 - 100%). IOA was collected for Charles in 33% of baseline sessions (M = 100%) and 33% of intervention sessions (M = 95%, range = 80 – 100%). For Sharon, IOA was collected for 33% of baseline sessions (M = 100%) and 26.67% of intervention sessions (M = 90%, range = 80 – 100%). Lastly, IOA was collected for Walter in 33% of

baseline sessions (*M* = 100%) and 31.82% of intervention sessions (*M* = 98.5%, range= 97.5 – 100%). See Table 6

Procedural fidelity. The secondary coders also collected fidelity data for at least 20% of each phase. The primary researcher provided the secondary coders with a checklist of components (see Appendix B). While watching the video recordings of the sessions, the secondary coders identified whether each component occurred (+), did not occur (-), or was not applicable (NA). Procedural fidelity was calculated by dividing the number of completed components by the number of total components for the phase. The quotient was then multiplied by 100 to get the percentage of fidelity for one session. Once procedural fidelity for each session in the set was calculated, the mean procedural fidelity for the study was then calculated by adding the fidelity of all the sessions coded and dividing the sum by the number of sessions in which secondary coders collected fidelity for. The quotient was multiplied by 100 to get the average percentage of procedural fidelity across the study. The study was implemented with a mean of 99.5% fidelity during baseline conditions (range of 94 – 100%) and a mean of 98.87% fidelity during intervention conditions (range of 95 – 100%). For specific procedural fidelity data by participant, see Table 6.

Social Validity

Secondary coders evaluated the social validity of this intervention by watching a set of three videos (from the same activity) for each participant and placing the videos in chronological order. The secondary coders were blind to when the videos occurred during the study. The secondary coders sequenced the sets of videos for Brandon with 100%

accuracy, Charles with 100% accuracy, Sharon with 100% accuracy, and Walter with 100% accuracy.

Although caregiver feedback was not specifically solicited, during Sharon's sessions, Sharon's mother commented how simple the procedures were and recorded several sessions to show Sharon's father so the parents could implement the procedures at home.

Table 3

Participant Information

Participant	Age	Gender	Ethnicity	Disability
Kaden	3	M	African American	ASD
Brandon	11	M	Caucasian	developmental delay, speech-language impairment
Charles	7	M	Caucasian	ASD, speech-language impairment
Sharon	9	F	Asian	ASD, moderate ID, speech-language impairment
Walter	5	M	African American	developmental delay, speech-language impairment

Note. M = male; F = female; ASD = autism spectrum disorder; ID = intellectual disability

Table 4

Activities and Materials Used

Condition	Activity	Materials
Brandon		
BCIS 1	Puzzle	6 **puzzle pieces**, puzzle board
BCIS with Therapist 1	Arts and craft frame	4 **popsicle sticks**, Glue, Paper
BCIS 2	Fine motor bead	pipe cleaner, 4 **beads**
BCIS with Therapist 2	Fine motor clip	paper, 4 colored **clips**
Charles		
BCIS 1	Puzzle	6 **puzzle pieces**, puzzle board
BCIS with Therapist 1	Fine motor clip	paper, 4 colored **clips**
BCIS 2	Writing	flashcard, **paper**, pencil
BCIS with Therapist 2	Coloring	box of crayons, **crayons**, coloring sheet
Sharon		
BCIS 1	Arts and craft flower	glue, paper, **ribbon**, baking wrapper
BCIS with Therapist 1	Arts and crafts bracelet	5 beads, **pipe cleaner**, container lid
BCIS 2	Play-Doh	container of Play-Doh, Play-Doh, **popsicle stick**
BCIS with Therapist 2	Fine motor clip	paper, 4 **colored clips**
Walter		
BCIS 1	Puzzle	6 **puzzle pieces**, puzzle board
BCIS with Therapist 1	Fine motor clip	paper, 4 colored **clips**
BCIS 2	Arts and craft flower	glue, paper, **ribbon**, baking wrapper
BCIS with Therapist 2	Counting	flashcard, 3-6 **blocks**

Note. The missing item for each activity is denoted with boldface font.

Table 5

Generalization Across Novel Items Within the Same Instructional Activities

Participant	Activity	Novel item
Brandon	Arts and craft frame	Glue
Charles	Writing	Pencil
Sharon	Arts and craft flower	glue
	Play-Doh	Play-Doh
Walter	Arts and craft flower	glue

Note. The novel item used within the generalization probe were items that the participants tacted correctly during the initial tact evaluation.

Table 6

Percentage of Interobserver Agreement and Procedural Fidelity Per Activity by Participant

	IOA		Procedural Fidelity	
Condition	Baseline *M* (range)	Comparison *M* (range)	Baseline *M* (range)	Comparison *M* (range)
Brandon				
BCIS 1	100	92 (80-100)	100	99.5 (97.5-100)
BCIS with Therapist 1	100	90 (80-100)	100	97.5
BCIS 2	100	100	100	100
BCIS with Therapist 2	100	100	100	100
Charles				
BCIS 1	100	100	100	100
BCIS with Therapist 1	100	80	100	100
BCIS 2	100	100	100	97.5
BCIS with Therapist 2	100	100	100	97.5
Sharon				
BCIS 1	100	100	100	100
BCIS with Therapist 1	100	90 (80-100)	100	100
BCIS 2	100	100	100	100
BCIS with Therapist 2	100	100	100	100
Walter				
BCIS 1	100	90 (80-100)	94	98.75 (97.5-100)
BCIS with Therapist 1	100	100	100	97.5
BCIS 2	100	100	100	100
BCIS with Therapist 2	100	100	100	97.5

Note: IOA= interobserver agreement; *M* = mean; BCIS = behavior chain interruption strategy.

CHAPTER FOUR

RESULTS

Figure 4 shows the percentage of correct independent mands said by each participant during baseline and the comparison probe sessions. Correct mands are defined as vocal mands that contain the label of the missing item. The percentage of prompted and independent correct mands also were graphed separately by activity for each participant. See Figure 5 for Brandon's individual data, Figure 6 for Chase's individual data, Figure 7 for Sharon's individual data, and Figure 8 for Walter's individual data. During baseline sessions, all participants did not correctly mand in any of the opportunities. Once the intervention was introduced in the comparison phase, data showed an increase in correct manding for most of the activities that each participant completed. Table 7 shows the number of intervention sessions to criterion for each participant by activity.

Individual Participant Results

Brandon. Brandon did not correctly mand for any of the missing items during the baseline phase (see Figure 4). When Brandon reached the step requiring the missing item during baseline sessions, he scanned his work area for the missing item, engaged in SIB, and/or said "is missing" but did not specify what object was missing. After the intervention was introduced, there was an upward trend in the percentage of correct mands (see Figures 4 and 5) and downward trend in the percentage of correct prompted mands for all activities (see Figure 5). Intervention data were fairly stable with little

variability during the phase, and levels of independent correct mands were significantly higher than in the baseline phase for all activities.

During the first BCIS only activity (i.e., puzzle), Brandon did not correctly mand during baseline (i.e., sessions 1, 6, and 9). Following the introduction of the intervention in session 14, Brandon correctly manded in 100% of opportunities with prompting. In the subsequent three sessions (i.e., sessions 18, 21, and 25) there was a gradual increase with independent correct mands (i.e., 40%, 40%, and 60% respectively) with a corresponding decrease in prompted correct mands (i.e., 60%, 60%, and 40% respectively). There was a momentary decrease in independent correct mands (i.e., 40%) and increase in prompted correct mands (i.e., 60%) during the fifth intervention session (i.e., session 31) before independent correct mands increased again (i.e., 80%, 100% and 100% respectively) while prompted correct mands decreased (i.e., 20%, 0%, and 0%) during the sixth through eight intervention data points (i.e., sessions 33, 37, and 41). Brandon reached mastery criterion for this activity in eight intervention sessions.

During the first BCIS with therapist modeling activity (i.e., fine motor – bead), Brandon did not correctly mand during the baseline phase (i.e., sessions 2, 5, and 10). After the introduction of the intervention, Brandon immediately manded correctly with prompting (i.e., 100%) during the first intervention session (i.e., session 14). In the following three sessions (i.e., 17, 22, and 26), there was an immediate increase in trend with independent correct mands (i.e., 40%, 100%, 100%), hence a decreasing trend with prompted correct mands (i.e., 60%, 0%, and 0%). During the fifth intervention session (i.e., session 32), there was a sudden decrease in independent correct mands (i.e., 40%) with an increase in prompted correct mands (i.e., 60%), however independent correct

mands increased again (i.e., 80%, 100%, 100%) in the following three sessions (i.e., sessions 34, 38, and 42). Brandon also reached mastery criterion for this activity in eight intervention sessions.

In the second BCIS only activity (i.e., arts and crafts frames), Brandon did not correctly mand during the baseline phase (i.e., sessions 3, 7, and 12). After the intervention was introduced (i.e., session 16), Brandon correctly manded with prompting for 100% of the opportunities. Independent correct mands increased (i.e., 25% and 80%) while prompted correct mands decreased (i.e., 75% and 20%) during the next two intervention sessions (i.e., sessions 20 and 24). In the fourth intervention session (i.e., session 28), there was a decrease in independent correct mands to 60% of opportunities and prompted correct mands had increased to 40%. However, in the following three sessions (i.e., sessions 36, 39, and 44), independent correct mands suddenly increased and maintained at 100% of opportunities; therefore, prompted correct mands dropped to 0% in these three sessions. Brandon reached mastery criterion in seven sessions.

In the second BCIS with therapist modeling activity (i.e., fine motor clip), Brandon did not correctly mand during baseline (i.e., sessions 4, 8, and 11). Once intervention was introduced in session 15, Brandon correctly manded with prompting in 100% of sessions. In the subsequent seven sessions (i.e., sessions 19, 23, 27, 29, 35, 40, and 43), there was an immediate increase in independent correct mands (i.e., 80%, 60%, 100%, 80%, 80%, 100%, and 100% respectively) and decrease in prompted correct mands (20%, 40%, 0%, 20%, 20%, 0%, 0%). There was some variability during these sessions, however, the level of independent correct mands remained high at approximately 85% of opportunities. Brandon reached mastery criterion in six sessions

during this activity; the fewest number of intervention sessions compared to the the other three activities.

Charles. Charles did not correctly mand for the items with a tact for any of the activities during the baseline phase (see Figure 4). During the baseline phase, he often looked for the missing item around his work area and around his seat when he reached the step requiring the missing item. Occasionally, he said "where," while looking for the item; however, the researcher was unclear whether Charles was manding for information or engaging in self talk. In other instances, Charles looked for the item, paused, then began looking for the item again. He continued looking for the missing item until the researcher gave the item to him once the wait interval for the mand to occur ended. With the introduction of the intervention, correct mands increased for all activities (see Figures 4; see Figure 6 for percentage of prompted correct mands). Unfortunately, limited data during the comparison phase exist due to time constraints.

During the baseline phase of the first BCIS only activity (i.e., puzzles), Charles did not correctly mand during the three consecutive sessions (i.e., sessions 1, 5, 10). When the introduction was introduced (i.e., session 13), Charles correctly manded in 100% of opportunities with prompting. In the following two sessions (i.e., sessions 17 and 21), independent correct mands suddenly increased to 100% in both sessions.

In the first BCIS with therapist modeling activity (i.e., fine motor clip), Charles did not correctly mand during the three baseline sessions (i.e., sessions 2, 7, and 13). With the introduction of the the intervention, Charles correctly manded with prompting in 100% of opportunities. In the following two sessions (i.e., session 19 and 23), the percentage of independent and prompted correct mands varied (i.e., 60% and 20%

respectively for independent correct mands, and 40% and 80% for prompted correct mands), however, the level of independent correct mands remained higher in the comparison phase than in the baseline phase.

During the second BCIS only activity (writing), Charles did not correctly mand during any of the baseline sessions (i.e., sessions 3, 6, and 9). Immediately following the introduction of the intervention (i.e., session 15), correct mands immediately increased to 80%. A prompted correct mand (i.e., 20%) only occurred during the first trial that session. However, in the subsequent two session related to this activity, independent correct mands varied by first increasing to 100% (i.e., sessions 20) before decreasing to 40% (i.e., session 24). Prompted correct mands corresponded accordingly at 0% and 60% of opportunities respectively.

During the second BCIS with therapist modeling activity (coloring), Charles did not correctly mand during the baseline phase (i.e., sessions, 4, 8, and 11). Following the introduction of the intervention, Charles did not correctly mand independently (i.e., 0%) but did correct mand with prompting in 100% of opportunities during the first two intervention sessions (i.e., sessions 16 and 18). Independent correct mands emerged during the third intervention session (i.e., session 22) when Charles correctly manded independently in 20% of opportunities and correctly manded with prompting in 80% of opportunities. Data were beginning to show an upward trend, however, with the few data points, the researcher cannot predict the future trend and stability of the data.

Charles did not reach mastery criterion for any of the behavior chains due to time constraints. However, when examining the changes in the mean level of correct mands

per activity, the largest charge in correct mands occurred during the two BCIS only activities.

Sharon. Sharon did not correctly mand during baseline sessions for any of the behavior chains (see Figure 4). Initially, she looked for the missing item in her area, and then looked at the researcher. However, after the second baseline session, she started to emit vocal mands in the form of naming characteristics of the item. For example, if a red clip was missing, she would mand "red" when she reached the step requiring the missing step. These vocal mands were inadvertently reinforced since the researcher gave her the item. During baseline conditions, the researcher gave the missing item regardless of whether the participant's mand was correct or incorrect. Therefore, although Sharon did not emit the correct mand for the missing item, often, she emitted a mand related to the appearance or function of the missing item following receiving reinforcement. These incorrect mands were observed in the first few interventions sessions. When the intervention was introduced, overall, correct responding increased in an upward, therapeutic trend for all behavior chains (see Figure 4; see Figure 7 for percentage of prompted mand).

With the first BCIS only activity (i.e., arts and craft flower), Sharon did not correctly mand during the three baseline sessions (i.e., sessions, 3, 7, and 10). During the third baseline session, Sharon began manding for "stem" when she arrived at the step requiring the withheld item (i.e., ribbon) because the ribbon served as the flower stem in this activity. Although the ribbon functioned as a stem, the target mand for this activity was "ribbon;" as a result, these mands were scored incorrect. When the intervention was introduced in the comparison phase, Sharon correctly manded with prompting in 100% of

opportunities during the first two sessions in the comparison phase (i.e., sessions 14 and 18). Correct mands emerged at 80% of opportunities by the third data point in the comparison phase (i.e., session 25). Correct mands then decreased to 60% (i.e., session 30) before increasing again to 100% in the fifth intervention session (i.e., session 34) and maintaining for the next two sessions (i.e., sessions 35 and 39). Overall, data showed an upward trend with little variability following the introduction of the intervention. Sharon met mastery criterion with this activity in seven sessions.

In the first BCIS with therapist modeling activity (i.e., bracelet), Sharon did not correctly vocally mand during the three baseline sessions (i.e., sessions 6, 8, and 12). Upon the introduction of the intervention, data indicate an overall therapeutic upward trend throughout the eight sessions in the comparison phase. Sharon did not emit any correct mands during the first intervention session but did correctly mand with prompting in 100% of opportunities. Independent, correct mands immediately increased to 60% and prompted correct mands decreased to 40% during the second intervention session (i.e., session 19). There was a brief decrease in correct mands during the third and fourth intervention session (i.e., sessions 22 and 26) to 40% and 20% of opportunities respectively. However, correct mands suddenly increased again to 100% of opportunities in the fourth intervention session (i.e., session 29) and maintained at this level for the following three sessions (i.e., sessions 33, 36, and 40). Despite the decrease in correct mands during the middle of the intervention, intervention data in the comparison phase indicate an overall therapeutic, upward trend in data with a mean level of correct mands higher than that of the baseline phase. Sharon met mastery criterion with this activity in seven sessions.

For the second BCIS only activity (i.e., Play-Doh), Sharon did not correctly mand during the baseline phase (i.e., sessions 6, 8, and 12). With the introduction of the intervention (i.e., session 15), Sharon correctly manded independently in 20% of opportunities and with prompting in 80% of opportunities. Independent correct mands then decreased to 0%, with 100% prompted correct mands in the second intervention session (i.e., session 16); however, in the following six sessions (i.e., sessions 20, 23, 29, 31, 37, and 41) there was a shift in correct independent mands to a steady, increasing trend (i.e., 20%, 80%, 100%, 100%, 100%, and 100% respectively. Sharon reached criterion levels in six sessions.

In the second BCIS with therapist modeling activity (i.e., fine motor clip), Sharon did not correctly mand in any of the three baseline sessions (i.e., sessions 1, 5, and 11). However, upon introduction of the intervention (i.e., session 17), there was an immediate and steady increase in the percentage of correct mands (i.e., 20%, 20%, 40%, 80%, 100%, 100%, 100%) emitted by Sharon in the following six sessions (i.e., sessions 21, 24, 27, 32, 38, and 42). Prompted correct mands decreased accordingly with the increase in independent correct mands throughout the comparison phase. Data indicated a stable, upward trend in a therapeutic direction. Sharon met the mastery criterion with this activity in six sessions.

Overall, all data indicated an increasing, therapeutic trend, with minor, if any, variability for all activities and an increase in level between baseline and comparison phases for each activity.

Walter. Walter did not correctly mand during baseline sessions with any of his four identified activities (see Figure 4). When Walter arrived at the step with the missing

item, he often looked in his work area for the missing item and did not emit vocalizations while doing so. At times, he eloped from his seat and ran to the opposite side of the classroom between trials; however, this problem behavior was maintained more by teacher attention, then to escape from the task since Walter would laugh and emit a high pitched sound with positive intonation while eloping and look to the teacher to chase him. The researcher continued with the trial once Walter sat in his seat again. Once the intervention was introduced, data indicated an upward data trend with independent correct mands for three of the four activities (see Figure 4; see Figure 8 for percentage of prompted correct mands).

With the first BCIS only activity (i.e., puzzle), Walter did not correctly mand during the three consecutive baseline sessions (i.e., sessions 1, 3, and 8). Upon the introduction of the intervention, Walter manded correctly with prompting in 100% of opportunities during the first two intervention sessions (i.e., sessions 13 and 15). Independent correct mands then emerged and increased in the following four sessions (i.e., sessions 20, 24, 27, and 32) from 20-100% of opportunities (i.e., 20%, 80%, 100%, and 100% respectively). He reached mastery criterion in six intervention sessions with this activity.

In the first BCIS with therapist modeling activity (i.e., fine motor clip), Walter did not correctly mand in any of the baseline sessions (i.e., sessions 2, 4, and 7). Once the intervention was introduced in session 14, Walter manded correctly with prompts in 100% of opportunities for the first intervention session (i.e., session 14) and in 80% of opportunities during the second intervention session (i.e., session 16). He did not emit any independent correct mands during these these sessions. During the second

intervention session, Walter did not vocally mand in 20% of opportunities despite receiving two model prompts from the the researcher. Correct independent mands emerged at 20% of opportunities during the third intervention session (i.e., session 19), and momentarily increased to 60% during the fourth and fifth intervention session (i.e., sessions 23 and 28). Independent correct mands decreased to 40% during the sixth intervention session. Due to time constraints, Walter did not meet mastery criteria for this activity. Although data indicate an increasing, therapeutic trend until the last intervention data point, Walter did not reach criterion with this activity due to time constraints.

For the second BCIS only activity (i.e., counting), did not correctly mand during the three baseline sessions (i.e., sessions 5, 10, and 12). Upon introduction of the intervention (i.e., session 18), Walter correctly manded with prompting in 80% of opportunities and did not vocally mand in 20% of opportunities despite receiving two model prompts from the researcher. Correct independent mands emerged and steadily increased (i.e., 40%, 40%, 60%, and 80%) in the subsequent four sessions (i.e., sessions, 22, 25, 29, and 33) until it reached 80%. Correct prompted mands decreased accordingly during these four sessions (i.e., 60%, 40%, 40%, and 20%). Due to time constraints, Walter did not meet mastery criterion for this activity either; however, data indicated a steady upward trend in a therapeutic direction with no variability. The researcher predicted that Walter may have reached mastery criterion given a couple more sessions.

In the second BCIS with therapist modeling activity (i.e., arts and craft flower), Walter did not correctly mand during any of the sessions in the baseline phase (i.e., sessions 6, 9, and 11). After the intervention was introduced (session 18), Walter correctly manded with prompting in 40% of the opportunities. He did not vocally mand

despite receiving prompting in the other 60% of opportunities. Correct vocal mands continued to vary (i.e., 100%, 60%, 40%, and 100% respectively) in the remaining four sessions (i.e., sessions, 21, 26, 29, and 34). Walter did not emit correct mands independently in any of the intervention sessions; hence, did not meet mastery criterion in this activity. Several factors may have affected the percentage of correct vocal mands emitted. Often, Walter manded for another item used in the chain (i.e., glue). In addition, he occasionally manded for the missing item with a word that was based on the context of the item ("cake") instead of the target mand ("wrapper").

Generalization

Across novel persons. Generalization probes were conducted for three of the four participants (see Figures 5, 7, and 8). One of the participants' teachers or parents conducted the generalization across the probes. Generalization probes did not occur with Charles due to time constraints and the availability of novel persons from his daily environment (i.e., parent or teacher). Generalization across novel persons occurred for two of the three participants.

Brandon. A teaching assistant conducted the sessions during the generalization probes (see Figure 5). During the first generalization probe which occurred following the first baseline sessions in each of the four activities (i.e., after session 4), Brandon did not emit the correct mand for any of the behavior chains during baseline sessions. When he reached the step requiring the missing item, Brandon first looked in his work area for the item. After not finding the item, he waited while continuing to engage in his self talk. During the second generalization probe, which occurred following the fourth intervention sessions for three of the activities in the comparison phase (i.e., after session 16),

independent correct mands occurred in 100% of opportunities for the first BCIS only activity (i.e., puzzle), 0% of opportunities for the first BCIS activity with therapist modeling (i.e., fine motor bead), and 100% of opportunities in the second BCIS activity with the therapist modeling (i.e., arts and craft frame). During the third generalization probe, which occurred following the seventh intervention sessions for each activity in the comparison phase (i.e., after session 28), Brandon correctly manded independently in 100% of opportunities for all four activities.

Sharon. Sharon's mother conducted the session during the generalization probes (see Figure 7). During the first generalization probe that occurred following the second baseline sessions for each activity (i.e., after session 8), Sharon did not emit any correct mands. When Sharon reached the step with the missing item, Sharon looked at her mother and either manded with a characteristic of the missing item, similar to baseline conditions with the researcher, or emitted a vocalization with negative affect that was unintelligible. During the second generalization probe, which occurred following the second intervention sessions in the comparison phase for both BCIS with therapist modeling activities and the third intervention sessions in the comparison phase for both the BCIS only activities (i.e., after session 22), independent correct mands occurred in 60% of opportunities for the first BCIS only activity (i.e., arts and crafts flower), 60% of opportunities for the first BCIS activity with therapist modeling (i.e., bracelet), 60% of opportunities for second BCIS activity, and 80% of opportunities in the second BCIS activity with the therapist modeling (i.e., fine motor clip). A third generalization probe was conducted following the seventh intervention session for both the BCIS with therapist modeling activities and the eight sessions for both the BCIS only activities

during the comparison phase (i.e., after session 42). Sharon generalized correct independent mands in 100% of opportunities for each activity with her mother.

Walter. The teaching assistant in Walter's classroom conducted the generalization probes with Walter (see Figure 8). During the first generalization probe conducted following the second baseline sessions for the first set of activities and the first baseline sessions for the second set of activities (i.e., after sessions 6), Walter did not emit correct mands (0%) for any of the activities during the probes. A second generalization probe was conducted with Walter following the final intervention sessions in the comparison phase (i.e., after session 36). For the first BCIS only activity (i.e., puzzle), Walter correctly manded independently in 25% of opportunities and manded correctly following prompting in 25% of opportunities. He did not mand in 50% of the opportunities even after receiving model prompts. For the second BCIS only activity (i.e., arts and craft flower), Walter only manded in 25% of opportunities after receiving model prompts. He did not respond independently or to prompting in either of the BCIS with therapist modeling activities (i.e., fine motor clip and counting) during the generalization probes.

Novel item within same instructional activity. Using the information from the tact evaluation during the screening process, the researcher selected items that the participants could tact to evaluate whether the generalization of the manding would occur with a novel item that the participant could tact. As a result, not all activities were evaluated for these generalization probes. The activities, along with the novel item withheld, are displayed in Table 5. Generalization across novel items occurred for all but one participant. During the tact evaluation, Walter only tacted glue; therefore, only the second BCIS activity with therapist modeling (i.e., arts and craft flower) was probed for

generalization of novel item. However, Walter correctly manded for glue during probes in both baseline and the comparison phase; therefore, generalization did not occur since the mand for the novel item was already in Walter's repertoire. As the study progressed, Walter's frequent mands for glue indicated that glue was a preferred item for Walter.

For the remaining three participants, generalization across novel items did occur since none of the participants correctly manded for the item during the probe in the baseline phase but did mand correctly during the probe in the comparison phase. For Brandon, glue was withheld for the second BCIS only activity (i.e., arts and craft frame). During the baseline probe, Brandon engaged in SIB and/or said "something is missing." For Charles, a pencil was withheld from the second BCIS only activity (i.e., writing). Charles waited while shifting his gaze between the paper and the researcher when he reached the step requiring the pencil during the baseline probe. Lastly, for Sharon, glue and Play-Doh were withheld from the first BCIS only activity (i.e., arts and craft flower) and the second BCIS activity only (i.e., Play-Doh) respectively. Sharon manded for help and emitted vocalizations with negative affect during the probe in the baseline phase. During probes conducted within the comparison phase, Brandon, Charles, and Sharon correctly manded for the novel items which were withheld.

Tact Re-evaluation of Missing Items

After the researcher conducted the final intervention session with the participants, tacts for the missing items were re-evaluated to determine whether the participants were able to transfer the mand to a tact. The researcher held up each missing item from the instructional activity and asked, "What is it?" Eleven of the 16 mands, across participants, did transfer from a mand to a tact.

Brandon. Missing items for Brandon included a puzzle piece, a clip, a popsicle stick, and a bead. Brandon correctly tacted "popsicle stick" and "clip". However, for the puzzle piece and the bead, physical characteristics of the items had stronger control over the tact. With the puzzle piece, Brandon tacted the picture on the puzzle piece (e.g., "duck"). However, out of curiosity, when the researcher held a group of puzzle pieces in her hand and asked "what is it," Brandon did tact "puzzle piece." When asked to tact a bead, Brandon tacted the color of the bead only (e.g., "red").

Charles. The researcher withheld a crayon, a clip, a piece of paper, and a puzzle piece throughout the study. After Charles' last intervention session, he did tact there of his four items (i.e., "crayon", "clip", and "paper"). With the puzzle piece, he, similar to Brandon, tacted the picture on the puzzle piece (e.g., "duck").

Sharon. Missing items from Sharon's activities included a bead, a pipe cleaner, a ribbon, and a popsicle stick. The researcher evaluated tacts for missing items after the last two intervention sessions. In the first tact evaluation of missing items (i.e., after session 36) Sharon correctly tacted the bead, pipe cleaner, and ribbon (i.e., "bead," "pipe cleaner," and "ribbon") however, Sharon did not correctly tact the popsicle stick. During the second tact evaluation, Sharon clearly articulated the tact for three of the four items (i.e., bead, pipe cleaner, and popsicle stick), however, her tact for ribbon was unclear. The researcher clearly heard Sharon emit an "r" sound, and the intonation of the vocalization resembled that of "ribbon", however, the vocalization was not well articulated. When the researcher asked Sharon to repeat her answer, Sharon gave other responses (i.e., "stem" followed by unintelligible vocalizations with negative affect).

Walter. Missing items for Walter during the instructional trials were a puzzle piece (i.e., a baking wrapper (i.e., "wrapper"), a block ("block"), and a clip ("clip"). After his last intervention session, Walter correctly tacted the puzzle piece, block, and clip. When asked to tact the cupcake wrapper, he tacted "cake" instead of "wrapper". This response for the baking wrapper was the same tact that Walter had emitted during initial tact evaluation.

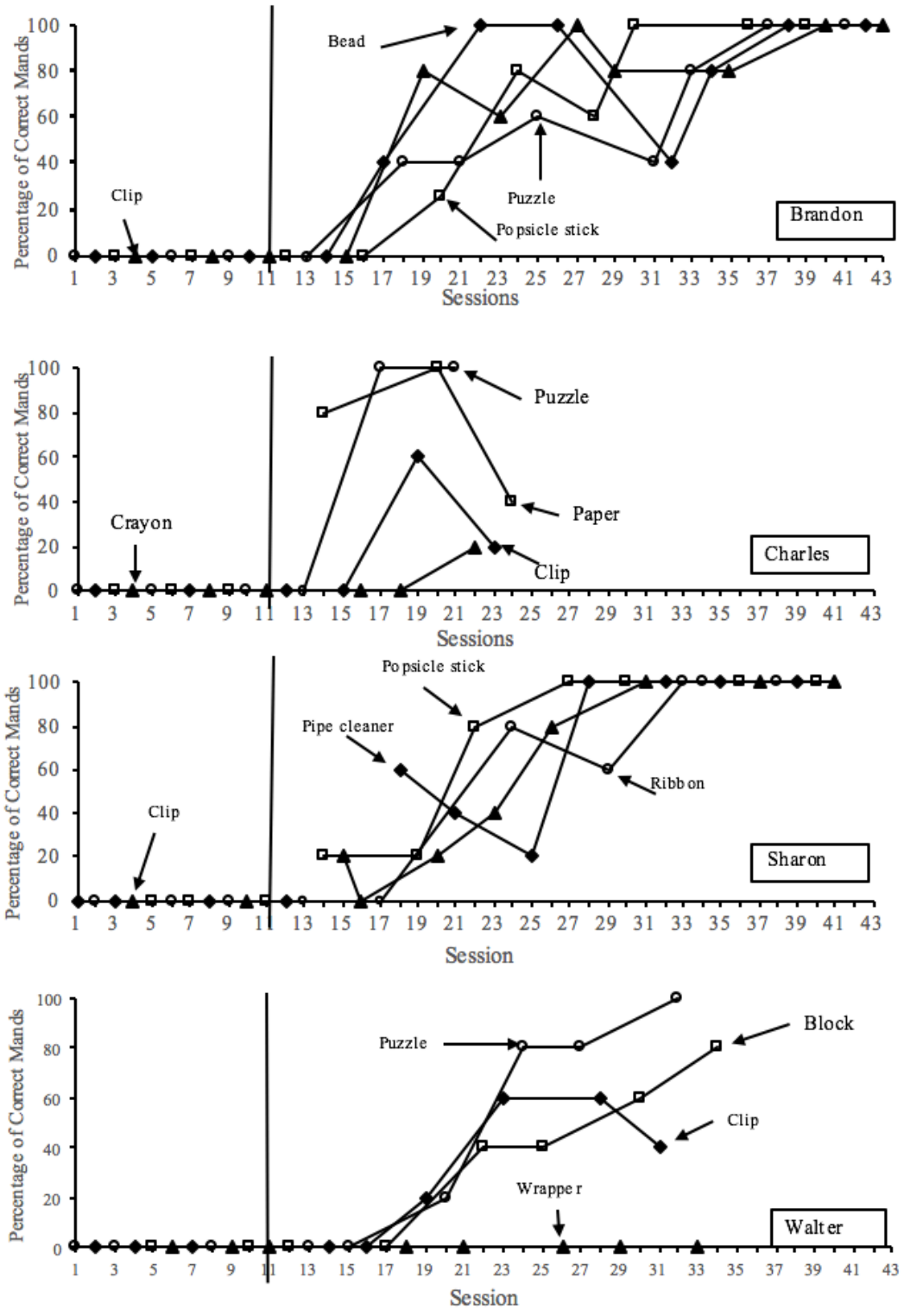

Figure 4. Percentage of correct mands per activity by participant. Behavior chain interruption strategy (BCIS) only activities are denoted by open markers. BCIS with therapist modeling activities are denoted by closed markers.

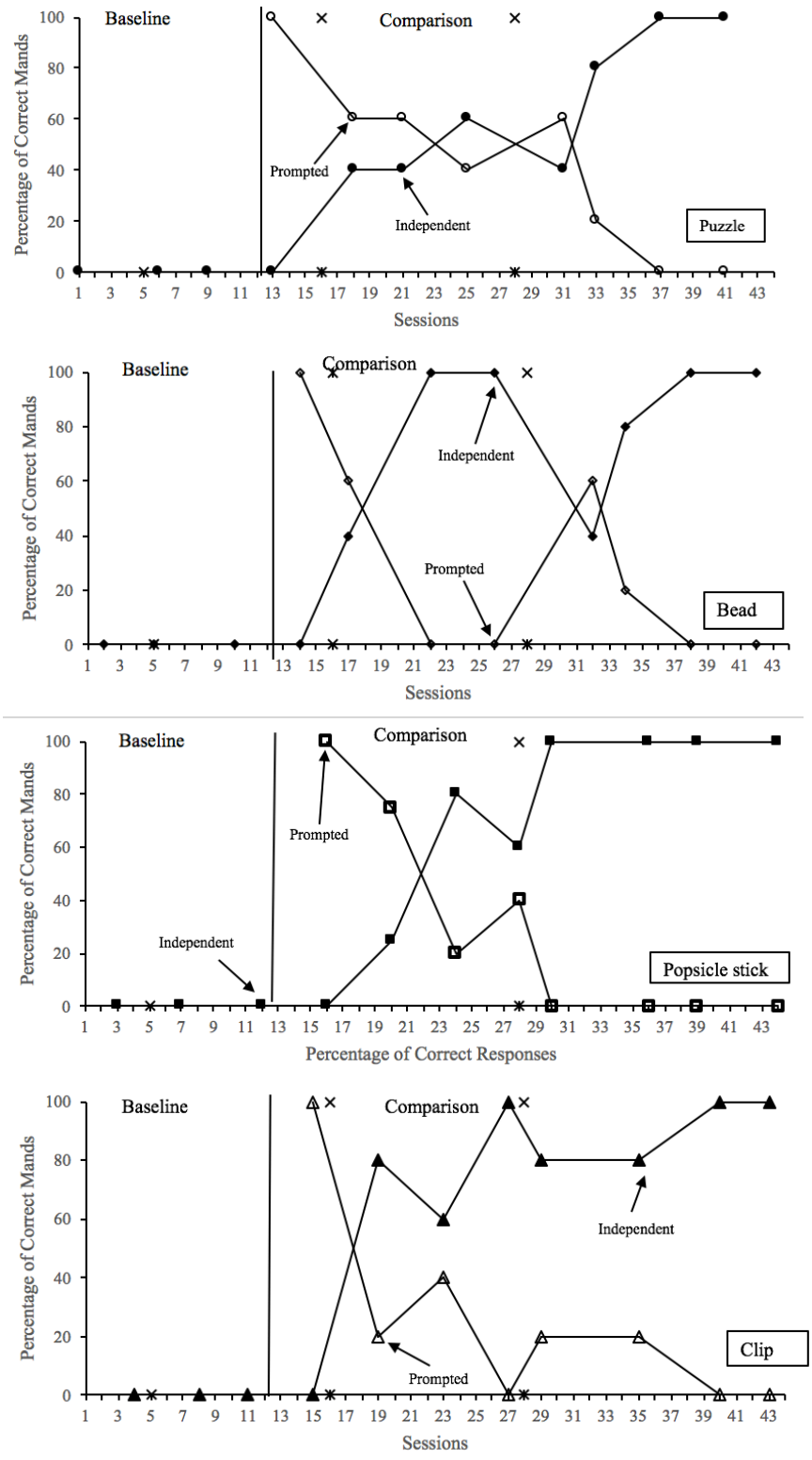

Figure 5. Percentage of correct mands by activity for Brandon. Mands for generalization probes with a teaching assistant are represented with x marks (independent mands) and stars (prompted mands).

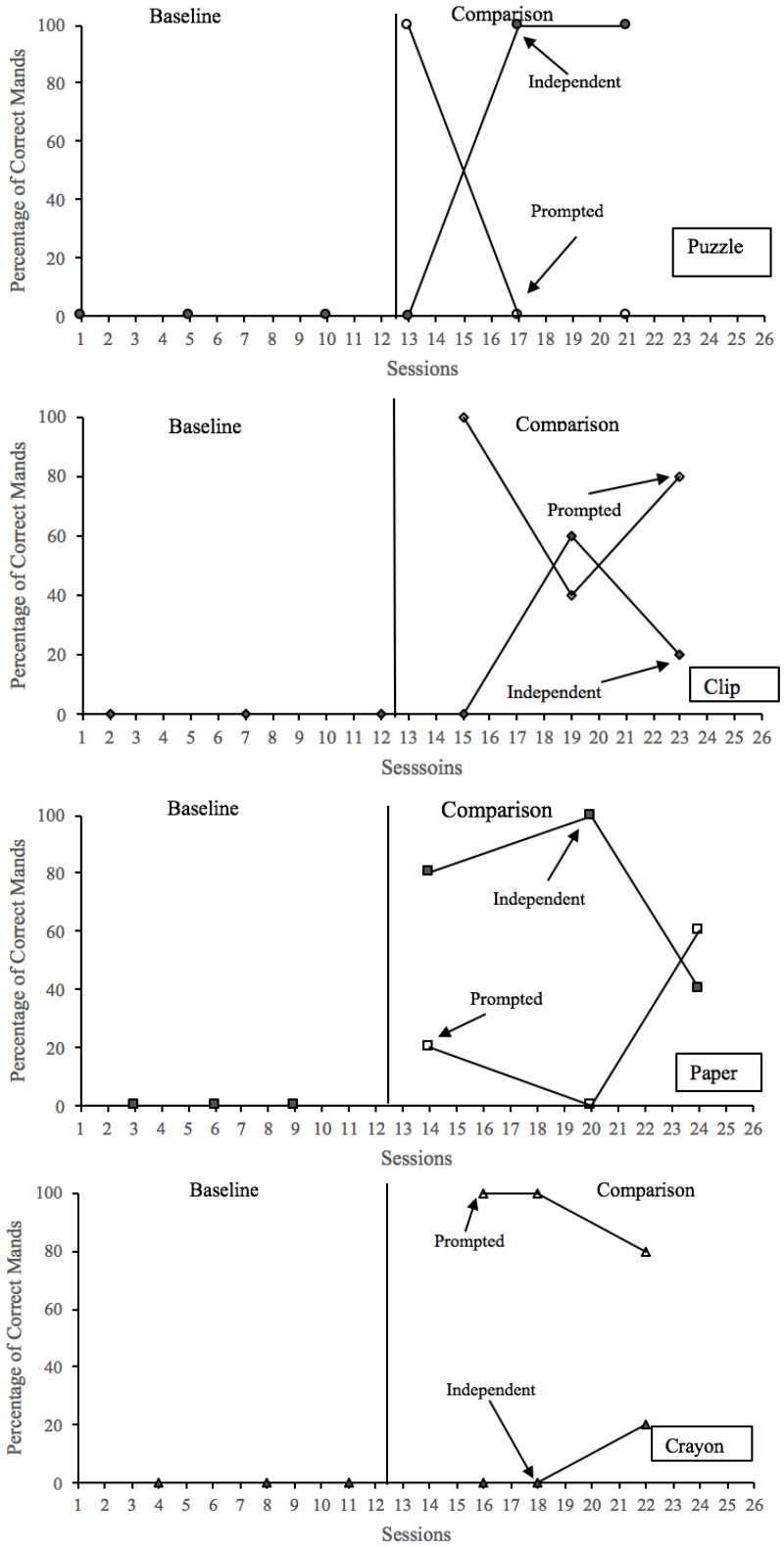

Figure 6. Percentage of correct mands by activity for Charles.

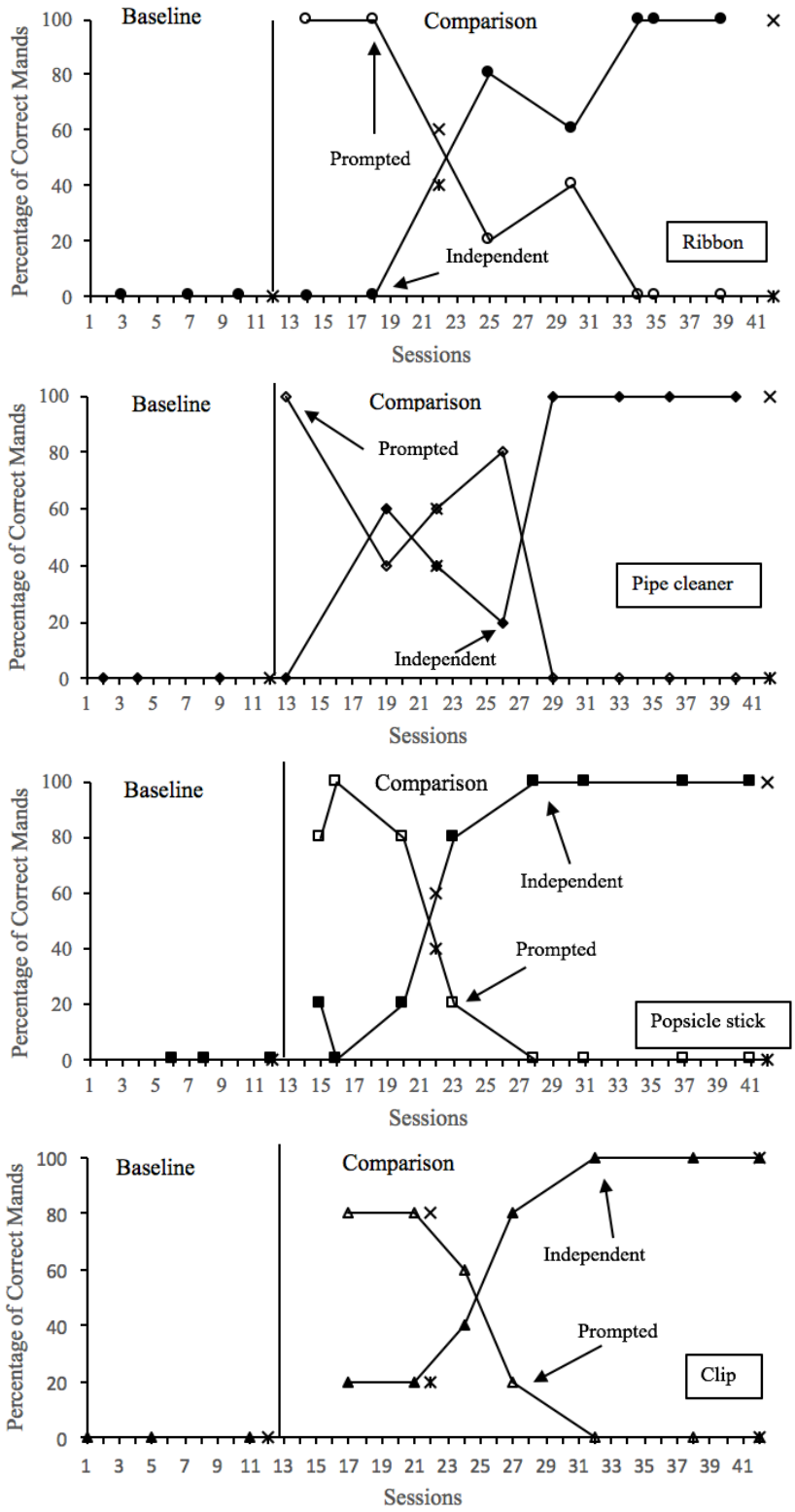

Figure 7. Percentage of correct mands by activity for Sharon. Mands for generalization probes with her mother are represented with x marks (independent mands) and stars (prompted mands).

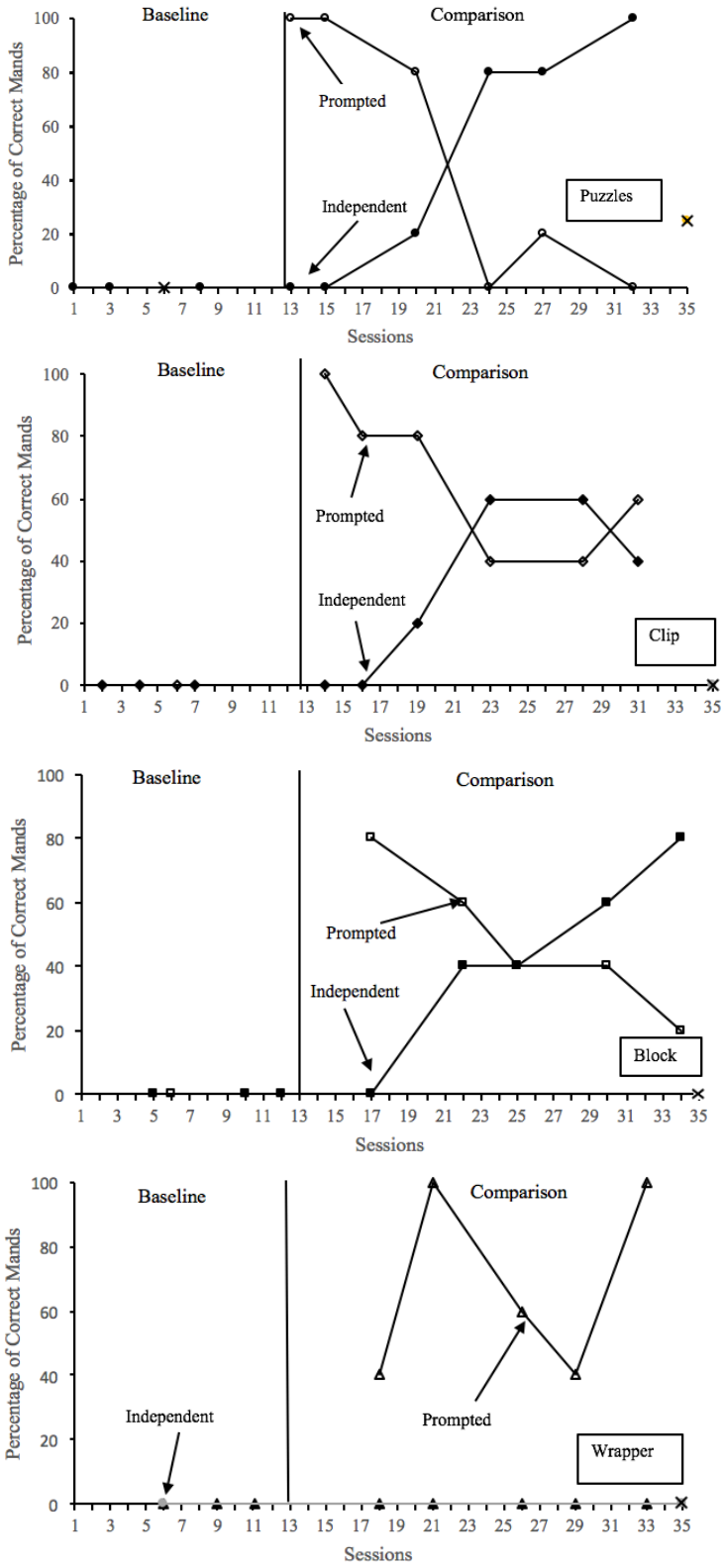

Figure 8. Percentage of correct mands by activity for Walter. Mands for generalization probes with a teaching assistant are represented with x marks (independent mands) and stars (prompted mands).

Table 7

Number of Intervention Sessions to Mastery Criteria

Participant	BCIS Only 1	BCIS with Therapist Modeling 1	BCIS Only 2	BCIS with Therapist Modeling 2
Brandon	8	8	7	6
Charles	NA	NA	NA	NA
Sharon	7	7	6	6
Walter	6	NA	NA	NA

Notes. BCIS = behavior chain interruption strategy; NA = not available

CHAPTER FIVE

DISCUSSION

Previous literature has demonstrated the effectiveness of using the BCIS to teach individuals with disabilities to mand (Albert et al., 2012; Alwell et al., 1989; Gee et al., 1991; Goetz et al., 1985). However, with the increasing number of skills that need to be taught to children with disabilities, and the increasing prevalence of ASD, identifying more efficient ways of teaching skills to children with ASD is beneficial for all parties involved. As a result, this study aimed to evaluate whether a more efficient form of the BCIS exists for teaching children with ASD to mand.

The first question addressed by this study was: Does adding a therapist engaged in an identical activity to the BCIS enhance mand acquisition as measured by fewer sessions required to reach mastery criterion? Results suggest that having a therapist engaged in an identical activity to the BCIS does not enhance mand acquisition. Of the eight comparisons between BCIS only and BCIS with therapist modeling, only one set of activities with Brandon indicated fewer sessions to criterion using BCIS with therapist modeling. In comparison, only one set with Walter's activities showed fewer sessions to criteria using BCIS only than BCIS with therapist modeling. Three sets (i.e., one set of Brandon's activities and both sets of Sharon's activities) required the same number of sessions to criterion for both conditions. Furthermore, in three sets of activities, participants (i.e., Charles and Walter) did not reach mastery criterion for either conditions. However, when looking at the data levels for both of Charles' activity sets, both BCIS only activities had higher levels of and a steeper increase in trend of correct,

independent responding than that of the BCIS with therapist modeling condition. For Walter, the BCIS activity (i.e., counting) had higher levels of independent correct mands than the BCIS with therapist activity (arts and craft flower) in addition to less variability regarding prompted correct mands across sessions. Although correct mands were not mastered in the aforementioned three activities, data collected indicate that greater progress for independent correct mands were made within the BCIS condition than the BCIS with therapist condition for the two participants across the three activities; however, readers should interpret these limited data with caution.

Although Charles did not meet mastery criterion for any of the activities given the limited timeframe in which to conduct the study, he almost met the mastery criteria for two of the four activities (i.e., BCIS puzzle piece and BCIS writing). For one of the activities (i.e., BCIS writing), the researcher is unclear whether Charles already had the tact for the missing item after comparing his mand acquisition results across the four activities. Immediately following the introduction of the intervention during the BCIS writing activity, Charles' independent correct mands immediately increased to 80% of opportunities from 0% during baseline sessions. However, following the introduction of the intervention for the other three activities, Charles only manded correctly with prompting during that first intervention session. As a result, the researcher is unclear if Charles already had a tact for the pencil but did not respond during the tact evaluation. His IEP identified answering wh- questions as an objective for the year. Therefore, one can hypothesize that Charles may have had the tact for a pencil in his repertoire, but may not have responded (i.e., tacted the item) based on his difficulty answering w- questions. Charles did respond to other "what is it" questions at the start and end of the study,

however, these responses may indicate inconsistent responding to wh- questions. If Charles had the tact for the missing item (i.e., paper) in his repertoire, this information may have skewed his overall correct manding for the activity.

The second question addressed in this study was: Does adding a therapist engaged in an identical activity to the BCIS hinder generalization of mands? Generalization was measured across two conditions. First, generalization was measured across novel (i.e., novel to the instructional sessions) persons from the participants' natural environment, which included either a teaching assistant or a parent. Brandon and Sharon were able to generalize all mands to a novel person regardless of the condition. Walter did not generalize the mands to probes when a teaching assistant conducted the sessions. However, Walter's lack of generalization during the comparison phase could have resulted from the unstructured environment during the generalization probes. Due to personnel shortages that day, his generalization sessions were conducted in the library where his class and another class was located. Although the generalization probes occurred in a quiet area away from the classes, he often looked in the direction of the class and stood up from a seated position, presumably to see what the class was doing, during the probes. In addition, teachers and teaching assistants often walked by the area since the area was located near the door. In addition, Walter's lack of generalization could have resulted from an absence of the EO during the sessions, particularly since Walter did not vocally mand following adult prompting either. As a result, Walter's level of independent responding, and prompted responding during the probes may not have accurately reflected his true performance and, therefore, were lower than those during instructional trials with the researcher.

Second, generalization probes were conducted with different items within the same instructional activities. For these probes, the items withheld were ones that the participants could tact during the initial tact evaluation. As a result, only five activities were included during these generalization probes; however, four of these activities were within the BCIS only condition and only one of the activities were within the BCIS with therapist modeling condition. As a result, an even comparison cannot be made between the two conditions. In addition, for the activity within the BCIS with therapist condition (i.e., arts and craft flower with Walter), generalization did not occur since the mand for the novel item was already in the participant's repertoire during the generalization probe in the baseline phase. With the remaining four novel items, within BCIS only activities, generalization of mands did occur.

The third and final question addressed in this study was: Does the transfer of control from mand to tacts occur more in the condition that teaches an impure mand (i.e. BCIS with therapist modeling) than the condition teaching a pure mand (BCIS only)? Results from this study indicate a minimal difference between the transfer of control between the two study conditions. Transfer of control occurred in five of the BCIS only activities and six of the BCIS with therapist modeling activities, and transfer of control did not occur in five activities across the two conditions. Controlling variables of the items, such as physical characteristics of the item or a contextual association of how the item is commonly used (e.g., tacting a baking wrapper as "cake") may have interfered with the transfer of control in four of the five occasions where the mand did not transfer. At the start of the study, Brandon incorrectly tacted the puzzle piece, clip, and bead by a physical characteristic. (In this study, a correct tact is defined as a tact of the item itself,

and not other variables related to the item). Even though Brandon later met mastery criteria for the three activities requiring those items, he continued to tact a bead and a puzzle piece by a characteristic of the item (e.g., color of the bead and picture on the puzzle piece) during the tact re-evaluation. Although Charles did not originally tact the item prior to the start of the study, he also tacted the puzzle piece by the picture on the puzzle piece during the tact re-evaluation. Walter incorrectly tacted "wrapper" as "cake" during the initial tact evaluation and again during the re-evaluation, which indicated that Walter's association between the baking wrappers with cupcakes served as a controlling variable for the tact. Sharon, on the other hand, tacted items by their physical characteristics (i.e., color of bead and clip) during the initial tact evaluation; however, during the re-evaluation of tacts, Sharon correctly tacted three of the four items, including the items which she had previously tacted by a physical characteristic. A possible explanation why Sharon, unlike Brandon and Walter, correctly tacted items during the re-evaluation is that Sharon's initial tacts may have resulted from her overgeneralizing an IEP goal that focused on identifying characteristics of items.

Throughout the study, Brandon and Sharon continued to mand for the missing items with controlling attributes, however, the participants were also required to include the tact of the item for the response to scored as a correct response. Therefore, the participants simply added the correct tact of the item following the controlling attribute for the mand (e.g., "red bead" instead of "bead"). These procedures did not punish emitting tacts of controlling attributes of the items; however, the researcher is unclear the extent to which allowing participants to continue emitting tacts of the controlling attributes may have hindered the transfer of control from mands to tacts of the item itself.

During the tact re-evaluation, one instance occurred where the participant's response was unclear to the researcher; as a result, the researcher scored this response as incorrect. Sharon's response contained the initial "r" sound and the intonation and syllabic makeup of the response matched that of "ribbon" (i.e., correct response) but the vocalization was not well articulated. When the researcher asked Sharon to repeat her tact, Sharon emitted a different response (i.e., "stem") than her initial response. This response was one she emitted during baseline sessions where she tacted the functional use of the ribbon in the arts and craft flower activity.

The researcher also observed that Walter began manding for information (i.e., "what's this?") before placing each puzzle piece into the corresponding hole on the puzzle board. The researcher hypothesized that his mand for information referred to tacts of the picture on the puzzle piece because he would mand after picking up each puzzle piece. In addition, he independently and correctly manded for the missing puzzle piece at this time. Although Walter manded for the tact related to the picture on the puzzle piece, results from the tact re-evaluation indicate that this mand did not interfere with the transfer of control from the mand to tact of the actual missing item (i.e., puzzle piece).

Limitations

Several limitations exist for this study. First, due to time constraints, participants only reached mastery criteria for 11 of the 16 activities. Therefore, although these results indicate that adding a therapist to the BCIS condition does not enhance the acquisition of mands, three of the activity sets were unaccounted for. Changes in data levels between the baseline and comparison phase for these activity sets were greater in the BCIS only

phase though; however, with the limited number of data points, these results should be interpreted with extreme caution.

Second, the EO for a mand may not have been present when an item was withheld from the activity, particularly since the researcher was unable to identify all preferred activities for each participant. The EO could certainly have been absent during Walter's second BCIS with therapist modeling activity (i.e., counting). With this activity, independent correct responding did not emerge as it did with the other three activities; in addition, prompted correct responding was variable. On the contrary, even with preferred activities that were included, sessions could have contained trials where the EO was absent. For instance, Charles' teacher identified writing (i.e., second BCIS only activity) as one of Charles' preferred activities; however, the researcher posits that the EO was absent during the third intervention session of this activity since data showed an immediate decrease in the percentage of correct, independent responding from the second to third session in the comparison phase.

Third, although the researcher intended to randomize activities in an effort to control the degree which the activity (e.g., preference, difficulty) may contribute to mand acquisition, activities were not randomly assigned. The researcher purposely assigned the puzzle activity to the BCIS only condition since the researcher did not a have duplicate set of materials; however, the researcher did not intentionally assign the fine motor clip activity to the BCIS with therapist condition for all four participants. Results from the puzzle and fine motor clip activity across participants indicate variability with the number of intervention sessions to reach mastery criterion though. With the puzzle activity, Brandon required the greatest number of sessions to meet mastery criteria for this

activity, and Walter required the least number of sessions. Charles did not meet mastery mastery criteria with this activity, however, his last two data points were within range of meeting mastery criteria but required one more data point within the specified range. With the fine motor clip activity, Brandon and Sharon both required fewer number of intervention sessions to meet mastery criteria, however, with both participants, the corresponding BCIS only activity also required the same number of sessions to criteria. For both Charles and Walter, they did not meet mastery criteria with this activity. Because of the variability with results, the lack of randomization when assigning the activities to study conditions may have had minimal effects, however, this issue should be further evaluated in future research.

A fourth limitation is that the activities in the BCIS only conditions did not contain all impure mands. For several of the activities (i.e., puzzles, arts and craft frame, and counting), there was an item similar to the missing item present during the sessions. For instance, with the puzzle activity, the withheld item was one of the puzzle pieces in the set. Therefore, the other puzzle pieces may have served as visual prompts for the withheld puzzle piece.

Finally, the researcher did not evaluate for echoics, with the labels of each withheld item, to ensure that the responses for the correct vocal mands were in the participants' repertoires prior to the start of the study. Fortunately, all participants did emit correct prompted mands which indicated that the responses were in the participants' repertoires. However, if correct prompted mands did not emerge, this issue would raise the question of whether the lack of vocal mands were due to the absence of an EO,

ineffectiveness of the intervention, or the absence of the response from the participants' repertoires.

Implications for Practice

Because study results showed minor, if any, differences between the two conditions (i.e., BCIS only and BCIS with therapist modeling), either intervention can be used to teach children with ASD to mand for missing items. However, depending on the availability of communication partners, the BCIS only could be easier to implement than the BCIS with therapist modeling in terms of not requiring a communication partner to complete the activity alongside the child with ASD. With the BCIS only, the communication partner also can complete other tasks while concurrently reinforcing the correct mands or prompting the child for a correct mand.

During baseline sessions, three of the participants vocally manded for the missing items by its controlling attributes (i.e., either the physical characteristics of the items or the functional use of the item). Although manding for missing item using these controlling attributes is superior to not manding at all, this strategy is only beneficial when the communication partner knows what item the child is referring to. If the communication partner knows which activity the child is engaged in and the materials required for the task or the child's preferred items, the communication partner has a higher chance of identifying what item the child is manding for. However, in other scenarios, the communication partner is less likely to identify the item, which could prevent these spontaneous mands from being reinforced. Through both the BCIS only and BCIS with therapist modeling interventions, mands using the tacts of the missing item itself emerged in 15 of the 16 activities across the four participants.

Using the BCIS only and BCIS with therapist modeling can also benefit children with ASD who have limited tacts. For participants who did not tact an item using a controlling attribute of the missing item during the initial tact evaluation and who met the criterion level within the activity, a transfer of mand to tact did occur during the tact re-evaluation. For participants who did tact a controlling attribute of the item, more sessions may be required to transfer the control of the mand to the tact.

Future Research

Continued research is required to evaluate the efficiency of using variations of the BCIS to teach manding to children with ASD. In an earlier study (Lam & Ayers, in preparation), results were different than that found in this study. In Lam and Ayres (in preparation), results indicated that the BCIS with therapist modeling led to the fastest acquisition of the mand (i.e., fewer sessions to mastery criterion) for three of the four participants. However, in this study, results indicated minimal difference for mand acquisition between the BCIS only and BCIS with therapist conditions. Second, future research could probe for tacts at the start of the session. With the addition of this procedure, the SD for the tact (i.e., "What is it?") may serve as cue for the student to pay attention to the tact and aid mand acquisition; in addition to potentially assisting the transfer of control from mands to tacts and tacts to mands. Third, researchers should consider alternative methods to evaluate for tacts in the event that participants have difficulty answering wh- questions and cannot respond to these questions accordingly. When comparing two interventions, the researcher must ensure that the variables within each condition are similar to each other in order to most accurately compare the results from the interventions. Fourth, the researcher should also evaluate for echoics to evaluate

whether the correct response topography is in the participant's repertoire and evaluate for intraverbals to determine whether an alternative method of evaluating tacts is required. Fifth, once activities are identified for each participant, a preference assessment could be completed to determine the order of activity preferences. The results of the preference assessment can later be compared against the results of the study to determine how much of impact preferences may have on the number of sessions to mastery criteria for each activity. Although results from this study did not indicate significant differences between using the BCIS only and BCIS with therapist modeling when teaching children with ASD to mand, this area of research is important because caregivers and practitioners should strive to maximize instructional time for children with ASD in order to best prepare them for the future.

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APPENDIX A

Data Collection Form

Participant Name: _____ Coder Initials: _____

Directions:

1) Under the "condition" column, indicate "with therapist" if the therapist completes the activity alongside the child. Indicate "alone" if only the child completes the activity.
2) For each trial, score if the child mand was prompted (P) or independent (I). Then write what the child manded for. If the child did not mand during the trial, write "NR".

File Name	**Condition (With therapist or Alone)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Example	*With therapist*	*P – NR*	*P – car*	*P – car*	*I – car*	*I - car*

APPENDIX B

Procedural Fidelity Checklist

Participant Name: _____ IOA collector initials: _____

Directions: Check the components that were observed in the video clips. If the component was not observed, write "NA".
Note: Correct mands:
Brandon – popsicle stick, puzzle piece, clip, bead
Charles – crayon, paper, puzzle piece, clip
Sharon – popsicle stick, ribbon, pipe cleaner, clip
Walter – block, puzzle piece, clip, wrapper

Components	**File Name**								
The therapist told the child that she would complete the task with him/her.									
The therapist completed the activity alongside the child.									
The therapist withheld one of the missing items.									
If the child did not respond within 5 s, the therapist provided a verbal prompt for the item.									
If the child gave an incorrect mand, the therapist provided a verbal prompt for the correct mand.									
The therapist gave the child the missing item following a correct mand.									
The therapist gave the child the missing item following an incorrect mand or no response.									
The therapist provided a verbal response following a correct mand (e.g., "Here's the (item)."									