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Teaching students with Autism Spectrum Disorder to Mand Within the Inclusive Classroom

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TEACHING STUDENTS WITH AUTISM SPECTRUM DISORDER TO MAND WITHIN THE INCLUSIVE CLASSROOM

A Dissertation Presented

By

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DEDICATION

To my patient and loving husband and girls.
Thank you for the time
.

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ABSTRACT

TEACHING STUDENTS WITH AUTISM SPECTRUM DISORDER TO MAND WITHIN THE INCLUSIVE CLASSROOM

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Recent federal legislation mandate that students with autism (ASD) be educated within the general education environment and held to high standards of achievement. Many interventions exist to teach language skills to children with ASD. Most have been developed in clinics or segregated settings, and have not been demonstrated as effective within general education classrooms. This research assessed the effectiveness of an intervention to teach two students with ASD to mand (request) within the general education classroom. Generalization and maintenance of independent manding (requesting) skills will be assessed. Both students learned to mand within the natural environment and demonstrated maintenance and generalization of the skill.

Keywords: autism spectrum disorder, mand, inclusion, elementary education

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CHAPTER 1

INTRODUCTION

With the passage of the Individuals with Disabilities Education Act of 1997 (IDEA, 1997) schools have been charged with including students with autism spectrum disorder (ASD) into regular education classrooms. Federal mandates have been directing the field towards practices that support students with autism in inclusive settings and provide them with the same experiences as those of typically developing students (Toelken & Miltenberger, 2012). However, the intent of the law has not been realized in practice. The data indicate that schools have increased the percentages of students being placed in general education classrooms (Hehir, Grindal, & Eidelman, 2012). Yet these students do not typically receive supports necessary to transition into or to succeed in general education settings. As a consequence, these students who are placed into inclusive classrooms during instructional activities are not ensured of instructional benefit needed to make progress on individual educational plan goals (Johnson, McDonnell, Holzwarth, & Hunter, 2004, Simpson, 2005). In order to support an environment that is truly inclusive and supportive of students with ASD, the field must develop empirically validated practices that are implemented and examined within inclusive settings.

Students with autism are behind other special education peers with respect to the percentages of students educated in general education settings. Additionally, there is a paucity of research on interventions for students with autism in natural education environments. Consequently, interventions for students with autism are still primarily taking place outside of the general education setting (Ryan et al., 2011). While in general education settings, students with autism are often just observing the educational practice,

usually with a one-on-one aid who works with the student on an alternate activity, or focuses on behavior management. As a result, students with autism are not actually participating in inclusion. They are being placed into a general education classroom in a practice reminiscent of “mainstreaming” practices common in the 1990’s.

Interventions have been developed that have been demonstrated as effective for increasing academic, language, and social skills for students with ASD. However, those practices have primarily been examined in clinics and specialized schools for children with ASD. If the field is to support true inclusion of students with autism, researchers need to develop and study the implementation of known effective practices in natural general education and inclusive settings.

Definition of Inclusion

Inclusion is a common label used to describe students with ASD attending some or all parts of a general education classroom. Currently, there is no legal definition of inclusion and the term cannot be found within the text of IDEA (1997; 2004). IDEA does reference students with disabilities spending time in the “least restrictive environment”. There is a common set of beliefs that hold the “least restrictive environment” to be the chronologically age-appropriate general education classroom in a student with ASDs home school, with individualized supports as needed per Individualized Education Plans (IEPs) (FSU, 2002). Partial inclusion refers to students receiving some of their schooling in the general education classroom, full inclusion refers to spending the whole school days with peers without disabilities (Ochs, Kremer-Sadlik, Solomon, & Sirota, 2001).

For the purposes of this study, I have adopted the definition of inclusion from the National Center on Educational Restructuring and Inclusion. This definition captures the intent of the law, while also providing discrete and observable ways to evaluate inclusion.

> "Inclusion is the provision of services to students with disabilities, including those with severe impairments, in the neighborhood school, in age-appropriate general education classes, with the necessary support services and supplementary aids (for the child and the teacher) both to assure the child's success — academic, behavioral, and social and to prepare the child to participate as a full and contributing member of the society ("National Study," 1995, p. 3).

Inclusion in Practice

In order to implement inclusion of students with ASD as defined by the National Center on Educational Restructuring and Inclusion, two things need to happen. First, the field of special education needs to study effective interventions for students with autism in natural general education settings, and develop clear guidelines for implementing these interventions in practice. In order to accomplish this, the field needs to ensure that these practices are implementable by typical intervention agents (teachers, special education teachers, paraprofessionals) in typical settings. Second, inclusion of students with autism must be done as a planned and well-conceived process based on the implementation of effective practices studied in inclusive settings. The passage of the No Child Left Behind Act (NCLB, 2001) requires schools to implement empirically validated practices and mandates that children with ASD make meaningful gains and adequate daily progress.

For a student with ASD, this process must result in a general education setting that includes the supports and services necessary to implement the student's

Individualized Education Program (IEP) within the context of the typical classroom activities. Educators should use known evidenced based practices to support students with ASD. However, there is limited research in the applied field on how to teach children with ASD to increase skills in the inclusive elementary setting (Ferraioli & Harris, 2011).

Still, even with the dearth of information on effective practices studied in natural general education settings, the US Department of Education continues to push for students with ASD to be educated within the general education classrooms. Because the literature on inclusion with children with ASD is limited, we can look to the general literature on inclusion practices as a whole to understand the benefits of inclusion. There appears to be several documented areas that provide reasons to implement inclusion practices with students with disabilities, including those with ASD: increased social development, increased communication development, the impact on general education teachers, and the impact on peers without disabilities.

Inclusion and social skill development

One of the most important and well-documented benefits of inclusion for students with ASD is increased social skill development (Boutot & Bryant, 2005; Katz & Mirenda. 2002; Ochs et al., 2001; Simpson, 2005; Stahmer & Ingersoll, 2004; Whitaker, 2004). While the research supports that students can make progress on social skills, it also calls for the need of at least some support and training for peers and teachers in this setting (Whitaker, 2004). A recent study done by Boutot and Bryant (2005) found that for the students they measured, social preference (acceptance or popularity), social impact

(visibility), and social network affiliation (membership in a peer group) did not differ for students with ASD and their peers within their elementary classrooms.

Inclusion and educational benefits

The educational benefits of inclusion for elementary aged children with ASD has not been studied. Emerging research has documented academic gains for preschool students. For example, Harris and colleagues (1991) found that preschool students made significant gains in both language skills and IQ after one year in an included classroom. A second report from Stahmer and Ingersoll (2004) found statistically significant increases in IQ as well as communication and socialization, functional communication, social interaction skills, and play skills for students in inclusive preschool classroom. There remains a scarcity of information that documents the benefits of inclusion on academic skills for elementary students with ASD.

Inclusion and the impact on general education teachers

Inclusion allows teachers to benefit from exposure to different types of learners and may develop increased expectations of what children with ASD are capable of (Mesibov & Shae, 1996). Teachers however, feel ill prepared to work with children with ASD (Able et al., 2015). Although collaboration is often offered and exposed as an important piece of inclusive programming, teachers feel that they do not have enough training and are still tasked with designing inclusive programs to help students with ASD make progress in the absence of clear guidelines and evidence based protocols (Simpson, de Boer-Ott & Smith-Myles, 2003).

Status of Inclusion Practices in Massachusetts

In order to understand how inclusion of students with ASD are functioning in Massachusetts, I examined the current inclusion practices within Massachusetts. Even though there is substantial documentation guiding inclusion practices, most of the information available is related to students with high incidence disabilities. Consequently, we also know very little about inclusion of students with ASD in Massachusetts, or about the types of practices that would result in the successful inclusion of students with ASD in the Commonwealth. In 2012, Hehir and colleagues (2012) published a review of special education services across Massachusetts. Holding constant other student and district level characteristics associated with MCAS performance, students with disabilities who spent more time being educated with their typically developing peers earned on average, higher scores on the MCAS than students who spent much of their time in substantially-separate, non-mainstream classes. However, this data was based solely on students with "high incidence" disabilities such as health, learning disabilities and communication disorders. They did report that students with disabilities, including students with ASD, were educated within inclusion classrooms in Massachusetts at the same rate or higher than the national average, and as a whole, these students outperformed students with disabilities across the country on the National Assessment of Educational Progress (NAEP). They did not provide data that individualized inclusion effects for each of the low-incidence disabilities, including ASD. This report highlights the need for more precise information about the effects of inclusion of students with ASD into the natural general education setting.

Summary of Inclusion for Students with Autism Spectrum Disorder

Federal law mandates that schools implement inclusion practices in an effort to include students with ASD in general education settings with their peers without disabilities. In order to successfully include students with ASD, the field needs to take the existing evidence based interventions known to work in segregated educational settings, and study their impact and usability in natural general education settings. To date, there have been few studies of this type, and there have been no studies examining language development interventions in natural elementary general education settings. Because language impairments are a fundamental characteristic of ASD and because language impairments are the greatest barrier to successful inclusion, the field needs to dedicate substantial time and resources to studying language interventions in inclusive elementary settings. The study I propose for this dissertation is a language development intervention in a natural inclusive elementary setting with students with ASD.

Autism Spectrum Disorders and their Prevalence

Autism Spectrum Disorder is a developmental disability that can cause significant social communication and behavioral challenges. Impairments in children with ASD range in severity from minimal to highly impaired (CDC, 2014; Matson & Sturmey, 2011). To receive an ASD diagnosis, the DSM-V holds that children must currently, or by history, meet the following criteria: "A) persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifest by all 3 of the following: 1) deficits in social-emotional reciprocity; 2) deficits in nonverbal communicative behaviors used for social interaction; 3) deficits in developing and maintaining relationships." They must also demonstrate "Restricted,

repetitive patterns of behavior, interests, or activities as manifested by at least two of the following: 1) stereotyped or repetitive speech, motor movements, or use of objects; 2) excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change; 3) highly restricted, fixated interests that are abnormal in intensity or focus; 4) hyper-or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment (DSM-5, 2013)." Two final qualification are that "Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities" and "Symptoms together limit and impair every functioning." The symptoms of people with ASD will fall on a continuum. Some children will demonstrate only mild symptoms. Others will show more severe symptoms.

It is estimated that 1 in 68 children have ASD (CDC, 2014). In 2013, the Massachusetts government commissioned a special report on people with ASD (Massachusetts Government, 2013). The report provided an estimation of approximately 12,000 students with ASD in Massachusetts between the ages of 6 and 18. A report done by the Department of Elementary and Secondary Education (DESE, 2014) suggests that the number of children with ASD educated in Massachusetts schools between the ages of 6 and 21 is 10,000. Many of these students are included in the natural general education settings. This highlights the need for the field to develop and study effective interventions for students with ASD in these settings. There is a need for both effective interventions and the development of clear guidelines for implementing these interventions in practice.

Educating Children with Autism

Educating children with ASD requires an understanding of the unique learning needs of these individuals. Children with ASD have cognitive, social, sensory and

communication differences that create the need for intensive, systematic programming (Mesibov & Shea, 1996; Simpson et al., 2003). ASD is a spectrum disorder. The cognition, daily living skills and self-help skills of children with ASD range in severity from minimally to highly impaired (CDC, 2014; Kaufmann, 2014). Limited and disorganized language skills are fundamental to the learning difficulties displayed by children with ASD (Sundberg, 2008). Independent of their ability and functioning levels, all youth with ASD require an intensive, individual program to achieve success (Simpson et al., 2003). This is especially true for the area of language development, which affects all areas of education, socialization, and the development of independence. The field has an established set of language interventions for students with ASD. Most of these effective interventions arte based upon the principle of Applied Behavior Analysis (ABA) and are currently recommended by the National Research Council (Lord & McGee, 2001) as the best interventions for students with ASD (Ryan et al., 2011; Simpson, 2004).

Verbal Behavior

A fundamental goal of language intervention is to teach children with ASD how to communicate using verbal behavior. In 1957, B.F. Skinner introduced the idea that all humans learn to communicate by connecting words with their purposes. Children learn that their spoken words or gestures can help them to obtain desired objects or gain other results. Verbal behavior is more than just understanding that words are labels. Verbal behavior is the process of using language to make requests and communicate ideas, understanding why we use words and how a person might function as both speaker and listener. Communication deficits are a main characteristic of students with ASD.

Combined with their social impairments, verbal behavior can be difficult for students with ASD to learn. They need to be taught the steps of verbal behavior in an orderly and systematic manner.

Typical Development of Verbal Behavior

Most children learn to use verbal behavior in the first three years of life. Initially, they learn to cry to get their needs met. Verbal behavior is shaped by the baby's environment. By three months, most infants have developed different cries to signal their need for food, comfort or companionship. This differentiation of crying behavior happens when babies cry and as a consequence a caregiver comes to meet their needs. This crying is one of the first times a baby makes a demand upon his natural environment. It develops from a state of need. By six months, babies begin to babble and produce a multitude of sounds. Parents and caregivers echo some of these sounds back to the babies, and shape the sounds into a set of new sounds or babbling that are common to the parent's natural language. Within a year, most infants are learning to use babbling to get and keep attention. This is the beginning of verbal behavior.

Infants also develop non-verbal strategies such as gestures and simple sounds that begin to replace crying and other babbling behavior as a way to get their needs met. During the second year of life, infants begin to use simple words (NIDCD, 2014). Infants string words together to make more complex demands, such as "go bye bye" or "where kitty?" By their third year, most children have developed complex verbal behavior that is used to get their needs met as well as to begin to communicate things about the world around them (NIDCD, 2014). These complex verbal behaviors are understood by most

people. They are used to get needs met, to seek new information, and to engage in social interactions.

Mands (Requests)

A mand is one type of verbal behavior. A mand can be thought of as a request, or a verbalization that specifies what a speaker wants and generally results in the delivery of that particular item or object. Students with ASD who are able to mand can increase their ability to control their environments by accessing what they want, both conditioned and unconditioned reinforcers. This can also increase the value of interacting with other members of the verbal community (Sweeney-Kerwin et al., 2007).

Manding as a verbal operant

Skinner (1957) introduced the concept of mand, and defined it as "a verbal operant [a functional unit of language] in which a response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation." If a child cried because they were hungry, one could say that the crying was a functional element of language that was reinforced by the consequence of a caregiver (the delivery of milk for example), and that the crying was under the functional control of a state of deprivation (the child's hunger). Therefore, the cry would be considered a mand. As a baby begins to differentiate his mands (the different types of cries he makes), the caregiver learns different responses to each of these cries. Thus, the baby's first mand repertoire develops.

The development of manding increasingly allows children to get their needs met independently (Sundberg & Partington, 1998). Manding behavior (commonly termed

requesting and/or commanding) develops early and quite quickly for most children (Murphy, Barnes-Holmes, & Barnes-Holmes, 2009). In the typical learning environment, when a child needs something, they mand and then receive what they need. In this way, children learn to obtain reinforcers or remove aversive stimuli by verbally influencing the behavior of a caregiver (Sundberg, 2008). This power over the environment results in an active control or influence over one's world and the behaviors of others in that world. In early development, manding with words soon takes the place of crying because it is a more efficient and effective means of getting one's increasingly complex needs met.

Children with Autism Spectrum Disorder and manding

Children with ASD do not develop manding consistent with their peers without disabilities (Sundberg & Partington, 1998), and often fail to develop even a basic mand repertoire. Without interventions, these students are unable to participate in typical educational activities and are unable to be successfully included with their peers without disabilities. The combination of limited spoken language, lack of social awareness, and failure of educators to teach manding interferes with a child's ability to develop mands. Without an adequate mand repertoire, students with ASD will not get their needs met appropriately. Further, because of deficits with generalization ability, if students with ASD are not taught to mand in natural general education settings, they may not even be able to use their limited mand repertoire in an inclusive setting. Thus, it is critical to both teach students with ASD how to mand, and to teach students with ASD how to mand in natural general education settings.

Research on Manding

Sundberg and his colleagues (1998) have developed a set of naturalistic teaching procedures known as mand training, which rely on manipulating motivation operations to increase students with ASD's desire and ability to request. A motivating operation is an event or item that influences the effectiveness of reinforcement. For instance, a child may find that markers are reinforcing during art class, but may be less reinforcing after art class because they have been satiated with the use of the markers, or because they no longer need a marker. If we want to teach a child to mand for markers, we would want to implement an intervention at the beginning of art class when the motivation for the markers is highest. Learning to mand gives a child control over his environment, and can lead to decreased frustration, which in turn leads to decreased level of inappropriate behavior (Sundberg & Michael, 2001). In addition, because mands are under the control of motivating operations, they may be more likely to occur spontaneously in the natural environment under naturally occurring conditions of wants and needs (Sundberg & Partington, 1998).

Embedded trials are a type of naturalistic teaching intervention that commonly refers to explicit, systematic instruction trials that are distributed within the naturally occurring ongoing routines of the natural environment (Johnson, McDonnell, Holzwarth, & Hunter, 2004; McDonnell, 2008). McDonnell (2008) has defined several critical features of embedded instruction. Expected learning outcomes must be clearly identified. Instruction should be designed such that it takes the availability of "natural" instruction opportunities within typical routines or activities. Instructional trials are distributed across the routines and activities of a general educational classroom. The number of trials

must be carefully planned and scheduled. Instruction should take advantage of empirically validated procedures, and instructional changes should be data-driven by individual performance.

Substantial research has shown that embedded trials are effective in inclusive preschool settings (Jennett, Harris, & Delmolino, 2008; Onar & Tekin-Iftar, 2008; Toelken, & Miltenberger, 2012) and at the secondary level (Jameson & McDonnell, 2007; Johnson, McDonnell, Holzwarth & Hunter, 2004; McDonnell, Johnson, Polychronis, & Riesen, 2002; McDonnell, Johnson, Polychronis, Reisen, Jameson & Kercher, 2006). However, there is a paucity of research using embedded instruction to teach children with ASD to mand, and no research using embedded trials to teach manding in inclusive elementary settings.

Statement of the Problem

The literature of interventions to teach language development to elementary students with ASD is devoid of any research on mand training in natural general education settings. In Massachusetts, there is limited attention to any practices designed to promote the inclusion of students with ASD with their peers without disabilities. Without the implementation of a research agenda designed to apply what the field knows about effective interventions for students with ASD to natural general education settings, true inclusion will be impossible for students with ASD. In order to increase the success of students with ASD in inclusive settings, the field needs to begin to study manding interventions in natural general education settings so that students with ASD are able to actively participate in the learning environment, and to obtain the educational benefit

mandated under the IDEA. This proposed study will investigate the impact of an embedded trials manding intervention in a natural inclusive elementary school setting.

Limited and disorganized language skills are fundamental to the learning difficulties displayed by children with ASD. This proposed research study is guided by interconnected research questions:

1. Does embedded mand training increase students with autism spectrum disorder ability to mand in the natural elementary school environment?
2. Following embedded mand training, do children with autism spectrum disorder maintain manding for 1, 2 and 4 week intervals following the intervention?
3. Following embedded mand training do children with autism spectrum disorder generalize manding to novel activities within the natural environment?
4. Do these inclusion teachers perceive embedded mand training as effective way to increase manding for children with autism spectrum disorder in their classroom?

Definition of Terms

A. *Autism Spectrum Disorder (ASD*) – A disorder in which the onset of behaviors must occur before age 3. Red flags include lack of eye contact, lack of responsiveness when name is called, limited or no attempts to engage others to satisfy wants and needs. ASD includes PDD-NOS, Autism and Asperger's Syndrome.

B. *Contrived motivation operations* – motivating operations that a interventionist arranges as part of an ongoing intervention. For example, teaching a student to get a pencil to fill out a worksheet, and then hiding the pencil. The contrived motivating operation would be the state of deprivation contrived by the missing pencil.

C. *Deprivation* – is a state of withholding or lack of access to a particular reinforcer. Deprivation can be a motivating operation, which increases the effectiveness of the reinforcer. If you offer a child a cookie for helping clean up the house and the child has skipped breakfast and snacks, the cookie is likely to become momentarily more valuable because the child is in a state of food deprivation.

D. *Discrete Trial (DTI)* – A teaching intervention that takes larger, more complex skills and breaks them down into smaller more discrete steps. Each step is taught individually and then is strategically intermixed with other acquired skills.

E. *Embedded trials (ET)* – A type of naturalistic instruction that embeds teaching trials into naturally occurring environments and situations. Teaching trails are distributed throughout the instruction, rather than massed.

F. *Embedded mand training* – A type of naturalistic instruction that embeds teaching trials to specifically teach a student to mand (request) into naturally occurring environments and situations.

G. *Functionally Related Reinforcers* - Reinforcement that is naturally connected to the behavior it follows. For example, a functionally related reinforcer for learning to bake cookies is to eat the cookies when they are finished. The cookies function as a reinforcer and are functionally related to learning to bake..

H. *Individuals with Disabilities Education Act* (*IDEA*) - A federal law enacted in 1990 and reauthorized in 1997 and 2004. It is designed to protect the rights of students with *disabilities* by ensuring that everyone receives a free appropriate public *education* (FAPE), regardless of ability.

I. *Inclusion* - A common label used to describe students with ASD attending some or all parts of a general education classroom.

J. *Least restrictive environment (LRE)* – In the Individuals with Disabilities Education Act (IDEA), least restrictive environment (**LRE**) means that a student who has a disability should have the opportunity to be educated with non-disabled peers, to the greatest extent appropriate.

K. *Mand* - The mand is the basis of all other verbal behavior. It involves requesting /asking for something with or without the item present. A mand specifies what a speaker wants and generally results in the delivery of that particular item or object.

L. *Mand training* – A type of naturalistic instruction that takes advantage of a student with ASD's momentary desires to teach them to mand (request).

Instruction is often embedded into play activities and is led by the student's interests.

M. *Motivating operations* - An environmental variable that (a) alters (increases or decreases) the reinforcing effectiveness of some stimulus, object, or event; and (b) alters (increases or decreases) the current frequency of all behavior that have been reinforced by that stimulus, object, or event.

N. *Naturalistic interventions* - A collection of practices including environmental arrangement, interaction techniques, and strategies based on applied behavior analysis principles. Naturalistic interventions more closely approximate traditional teaching and often take place outside of a structured teaching situation.

O. *No Child Left Behind (NCLB)* - requires all public schools receiving federal funding to administer a state-wide standardized test annually to all students. This means that all students take the same test under the same conditions and are held to the same standards of achievement.

P. *Operant conditioning* - Sometimes referred to as instrumental learning, is a method of learning that occurs through rewards and punishments for behavior. It encourages the subject to associate desirable or undesirable outcomes with certain behaviors.

Q. *Satiation* –is a state of excess access to a particular reinforcer. Satiation can be a motivating operation, which decreases the effectiveness of the reinforcer. If you offer a child a cookie for helping clean up the house and the child has just eaten dinner and dessert, the cookie is likely to become momentarily less valuable because the child is in a state of food satiation.

R. *Verbal behavior* – A way to describe and analyze communication coined by B.F. Skinner in 1957. Skinner broke communication down into a set of functional units, with each unit comprised of both the meaning and function of a word. The mand is the most basic functional unit within verbal behavior.

S. *Verbal operant* - Operant behavior mediated through the response of a listener; includes mands, echoics, tacts, intraverbals, and autoclitics. The main difference between the mand and the other operants is that it specifies its reinforcer while the others are reinforced by secondary or social reinforcement.

CHAPTER 2

A REVIEW OF THE LITERATURE

I conducted a review of the literature in two ways. The first was a content review that looked expressly at material included within the review including: participants, assessments, interventions, findings, generalization, and maintenance. The second half of this literature review examines the methodological rigor that was used to complete each of the articles included within the review including: participants, setting, research design, conditions, dependent variables, fidelity, social validity, maintenance, and generalization.

Introduction

Meeting the educational needs of students with Autism Spectrum Disorders (ASD) continues to provide unique challenges due to a number of factors: the characteristics of students with ASD, a need for more evidenced based instruction, and a need for increasing support for older students. Since the passage of the Individuals with Disabilities Education Improvement Act (IDEA) of 2004 schools have been charged with increasing the amount of time students with autism spectrum disorder (ASD) are included into inclusive settings, which are the natural environments for children with ASD at school. The inclusive classroom has many variables and contexts that are difficult to control and standardize. Also, as the field of early intervention becomes more refined, research is shifting to meet the needs of older students. Consequently, the field knows relatively little about interventions in inclusive settings. These factors combine to create a field of study that is far less mature than, for example, the field of ASD behavioral interventions with young students in a one on one controlled setting.

The IDEA of 2004 and the No Child Left Behind Act (NCLB) of 2002 mandate the use of both evidence based practices and educational decision making driven by individualized data. One of the basic tenets of IDEA (2004) is that students with disabilities have access to the general education curriculum; the same curriculum as that provided to students without disabilities (IDEA, 34 C.F.R. § 300.347(a)(1)(i)). The original goal of this law was to increase the expectations of educational performance placed on students with disabilities in the schools. NCLB was passed in 2002 with a purpose to promote equal opportunity for all children to receive a high-quality education and attain at least minimum proficiency on challenging State achievement standards and State assessments (IDEA, 20 U.S.C. § 6301). Taken together, these two pieces of legislation have called for an increase in time students with disabilities, including students with ASD, spend in the inclusion setting.

Despite these challenges, the field has produced relatively few evidence based practices to support classroom teachers and paraprofessionals in inclusive elementary settings. Teachers are being expected to use evidence based practices with a diverse population and with no available guidelines. The urgency of researching effective interventions for this older population of students with ASD in the naturally occurring general education classroom only grows as the prevalence of ASD diagnoses increases.

With the passage of IDEA (2004), schools have also been charged with increasing the amount of time all students with ASD are included into their natural environments. The expectations of the natural environment challenges change as students with ASD grow older. The amount of free time allowed to engage in self-driven learning decreases. Students begin to spend more time in large group lecture, with a heavy emphasis on

language abilities. The pace of instruction increases, as do the social demands placed upon the students with ASD. They are expected to become increasingly independent and take charge of their learning environments. In order to properly support these students, we must develop, study and implement evidence based interventions that have been shown to be effective within these natural classroom settings for students with ASD. These interventions will provide teachers with the tools required to meet the rigorous requirements of the IDEA of 2004 and NCLB of 2002.

Students with ASD

Autism spectrum disorder (ASD) has become one of the fastest growing disability categories in our schools (CDC, 2010). ASD causes significant social communication and behavioral challenges. (CDC, 2010). The cognition, daily living skills and self-help skills of children with ASD range in severity from minimal to highly impaired. Children with ASD may look like any other student, there are no obvious physical characteristics to set them apart. Their behavior, however, including interactions, communications and day to day actions, are very different from most other people. Teachers find the inclusion of students with ASD to be challenging due to their diverse needs and sensory issues (Simpson, 2004).

Communication

Students with ASD have communication problems that affect all areas of education and socialization (Buron, & Wolfberg, 2009). They tend to have difficulty with both expressive and receptive language. Even with support, these deficits can leave students with ASD with a limited grasp of general knowledge, which can further interfere with social communication. These difficulties are cyclical. Delays in language and

communication lead to less social communication. Less social communication leads to decreased practice and delays in language in communication. Without the development of effective language interventions, these communication problems can lead to limited independence and success in inclusive environments.

Development of communication skills

Early communication begins with echoic language (Skinner, 1957). Young children begin to use language by imitating their parents' words. First they echo back the first part of a word, and then whole words. Gradually children imitate entire phrases. Most children then develop manding behavior, or learning to request. Manding is the ability to verbalize a demand that will get an individual's needs met. For instance, a child might be thirsty and say "milk". As a response, their mother gets them milk. This is an example of an early mand leading to a communicative exchange.

Communication abilities of students with ASD

The pattern of communication and language development is different from normative development for students with ASD (Matson & Sturmey, 2011). Many students with ASD come under scrutiny around their second birthday, when noticeable language differences begin to evolve. Students may not begin to naturally develop a mand repertoire, or even language at all (Matson & Sturmey, 2011). A recent study by Wodka and colleagues (2013) indicated that by the age of 8, while 70% if children with ASD have attained the ability to speak in short phrases, only 47% of students with ASD have attained fluent speech.

Students with ASD often need individualized intensive interventions to learn to use verbal behavior. They must learn to mand, or request to get their needs met. They must learn to tact, or label the world around them. This is often a large part of a student's with ASD's early educational experience because there are so many different mands and tacts that must be learned (Sundberg, 2007). They must also learn intraverbal behavior, consisting of all of the other language concepts that are required to interact with others in the back and forth pattern that is the hallmark of our communication.

Even if a student with ASD has the ability to produce words (mands, tacts, and intraverbals), there is no guarantee that they will be able to use these words to get their needs met. A student with ASD who has been taught to communicate in one setting may not naturally generalize the skills to a new setting (Horner et al., 2005; Matson & Sturmey, 2011). For instance, if a student learns to mand within a clinic or separate setting, the skill may not generalize into a more naturally occurring setting, like the general education classroom.

Current Placement of Students with ASD

Most students with ASD retain communications deficits into grade school and beyond. This creates a dilemma with regards to how best to educate them. About 83% of students with ASD continue to be educated in the public schools (Massachusetts Government, 2013). Only about a third of these students in public schools are in self-contained classrooms. Most (51.5%) join their typical peers for some portion of the day (Massachusetts Government, 2013). Only about 17.2% of students with ASD end up in private school settings that are designed specifically to address the needs of students with limited language skills (Massachusetts Government, 2013).

There is a mature body of work on teaching ASD students that has come out of these isolated and controlled settings, satisfying the requirement for evidence based practices. Unfortunately, many of these interventions may be impossible to carry out in an inclusion setting. Elementary schools operate with an assumption that all learners have the receptive and expressive communication levels necessary to participate in a communication rich environment. This is not conducive to student with ASD, and creates challenges for teachers who lack the tools to educate these students. Also, it can be difficult to determine if skill acquired under isolated conditions will generalize to the natural environment.

While research on teaching ASD students communications skills in an inclusion setting is relatively less mature, we have already established that a significant portion of the ASD student population is spending a significant proportion of their time in inclusion settings. Therefore the need for research in the inclusive setting is clear. The first section of this chapter reviews the literature on teaching children to mand using an interrupted chains procedure. The existing literature is then reviewed for methodological rigor.

Method

Criteria for Inclusion

Studies meeting the following criteria were included in this review: the study included participants who had a diagnosis of ASD, the study took place between 1997 and September of 2014, the study was empirical and peer reviewed, the dependent variable included a measure of manding, and the researchers employed single subject design. For the purpose of this review, the diagnosis of ASD included students described

as having PDD and PDD-NOS because this research took place under the definition of ASD given by the DSM-IV, which included these terms under its umbrella.

Search Procedures

I conducted a systematic and exhaustive review of the literature to identify peer-reviewed research studies published between 1997 and September of 2014 involving interventions for using an interrupted chain of behaviors to teach children to mand for information. The year 1997 was chosen because it corresponded with the reauthorization of the Individuals for Disabilities Education Act of 1997 (IDEA, 1997). The IDEA of 1997 was important because it mandated more inclusive practices and started an increase in the opportunities for students with ASD to be included in typical general education classrooms. I included only peer reviewed published empirical studies in the database because I was only interested in reviewing studies that had been through a rigorous review procedure. Studies were identified through multiple electronic searches of the literature using several education databases, including Academic Research Complete, ERIC, PsychArticles, and PsycInfo. Multiple combinations of the following descriptors were used: ASD, PDD, mand, manding, elementary. I read the abstracts of the articles that were identified in the searches. If the title or abstract indicated the article involved teaching elementary aged or younger children with ASD to mand for information, I included if for further review. I then read the article to determine if: it included participants who had ASD, it included participants who were elementary aged or younger, if the study included an intervention to increase manding and/or requesting and if the intervention that used some type of interrupted chain procedure to teach children with ASD to mand.

My original search yielded 234 articles. Of these, 124 involved teaching elementary aged or younger children with ASD to mand for information and were reviewed in more detail. After I read the articles, I discarded 108 because they: did not included students who were elementary and/or preschool level, included interventions that examined the effectiveness of one communication topography over another when teaching mands (for example, was it easier to teach mands to a student using an IPad or picture symbols), and included another type of intervention that did not include interrupted chains. An ancestral search of the references of the articles obtained was also conducted and two additional articles were found.

A total of nineteen studies were identified (see table 2.1). These studies included a sample of 34 students with ASD. The results of these studies are discussed in terms of both the findings of the literature review and the methodological rigor of the database. Tables 2.1 - 2.4 describes the major findings of the database. Tables 2.5 – 2.16 display the methodological rigor of the articles.

Content Review

Over the last seventeen years, several researchers have developed procedures using an interrupted chain as a way to contrive a motivating operation to teach students with ASD to learn to mand. This review includes studies published between 1997 and September of 2014. The nineteen studies all included an intervention that contrived motivating operations using an interrupted chain procedure. The review examines the content of the literature in terms of the participants, assessments, settings, the

intervention and dependent variable, the results, generalization, and maintenance. The findings of the literature database are described below.

Participants

When reading research about interventions to teach students with ASD, two characteristics of the participants are especially important. These include: the age of the participants and the assessment of the participant.

Age of Participants

Research to establish interventions to teach mands are often targeted towards younger students. Seventy percent of students with ASD learn to use at least language phrases by the age of four (Wodka, 2014). There is still a need to establish manding for students who have not learned to mand by the age of eight. The youngest participant within the included studies was three years old (Jennett, Harris & Delmolino, 2008) (see table 2.1). The oldest participant was 12.4 years old (Shillingsburg et al., 2014). Ten of the 19 studies included in this review included participants who were 5.11 years old or younger (Betz, Higbee & Pollard, 2010; Endicott & Higbee, 2007; Jennett, Harris & Delmolino, 2008; Koegel et al., 1997; Koegel et al., 2010; Marion et al., 2012; Ostryn & Wolfe, 2011a; 2011b; Roy-Wsiaki et al., 2010; Williams, Donley & Keller, 2000). This age range roughly corresponds to the age most children with ASD attend preschool. Nine of the nineteen included studies had at least one participant who was between six and twelve years old (Albert et al., 2012; Lechago et al., 2010; Lechago et al., 2013; Marion et al., 2011; Shillingsburg et al., 2014; Shillingsburg & Valentino, 2011; Shillingsburg et

al., 2011; Sundberg et al., 2002; Williams, Perez-Gonzalez & Vogt, 2003). Of the total of 34 participants with ASD included in this review, 68% were under 6 years old.

Assessments

When using interventions to increase communication skills, it is important to document a student's overall functioning level. This is typically done with standardized testing, including assessments of students cognitive and verbal abilities. This testing establishes a baseline level of communicative function to document the participant's ability to communicate and ask questions and also provides an estimate of the student's overall functioning level. None of the 19 included studies included formal IQ testing (see table 2.1). Five of the 19 articles (Jennett, Harris & Delmolino, 2008; Koegel et al., 2010; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010) included formal standardized language testing. Of these, three of the five (Marion et al., 2011, Marion et al., 2012; Roy-Wsiaki et al., 2010) used the Preschool Language Scale – Revised (Zimmerman, Steiner & Pond, 2002). Jennett and colleagues (2008) were the only authors to also assess adaptive and maladaptive behavior. They used the Scales of Independent Behavior – Revised (Bruininks, Woodcock, Weatherman & Hill, 1996) a standardized test to assess adaptive and maladaptive behavior.

Description of student skills

One other way to report on overall function level is through a description of the participant's skills. Teacher reports on function level are not as reliable as standardized testing. Although they provide some indication of the participant's language skills, the

lack of standardization make it difficult to determine the level of language ability for the participants. All nineteen of the included studies provided some descriptions of the language abilities of the participants (see table 2.1) but there was variation in what was reported. Of these nineteen, thirteen authors (Albert et al., 2012; Betz, Higbee & Pollard, 2010; Endicott & Higbee; 2007; Lechago et al., 2010; Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2014; Shillingsburg & Valentino, 2011; Shillingsburg et al., 2011; Sundberg et al., 2002; Williams, Donley & Keller, 2000) reported that the participants were able to mand for basic items including reinforcement. Ostryn and Wolfe (2011a; 2011b) included participants who did not yet demonstrate any ability to mand. Two authors (Koegel et al., 1997; Koegel et al., 2010) did not provide any information on their participant's ability to mand. Jennett and colleagues (2008) were the only authors to include a true measure of manding ability. They reported their participants were able to mand at less than one mand per twenty minute observation period.

Pre-assessment of skills

An additional assessment variable necessary to complete behavior chains is the ability to actually do each step of the chain. Within the interrupted chain method of contriving MOs, there is a step that requires the student to complete a one-step direction to finish the chain. This step is often to find a missing or hidden item, or retrieve more of an insufficient quantity of an item. It makes sense then, that the researcher should determine the student's ability to attend, listen to and follow one step directions. Ten of the nineteen studies (Albert et al., 2012; Endicott & Higbee, 2007; Lechago et al., 2010;

Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Ostryn & Wolfe, 2011a; Ostryn & Wolfe, 2011b; Shillingsburg et al., 2014; Sundberg et al., 2002) included some type of assessment of listener behavior (see table 2.1). For example, Endicott and Higbee (2007) used probe trials as an assessment prior to baseline to determine if the students were able to "Go to the (toy box, shelf, or backpack). Two of their three participants were able to listen and follow this one step direction. The third participant was pre-taught the ability to follow the instructions prior to beginning baseline. Ostryn and Wolf (2011a) assessed their participants' ability to attend to the materials in the study. Although it was not a dependent variable, attending behavior was recorded during their first baseline trials and compared with normative data from 3 students without ASD matched by age. Two of the three participants had insufficient attending behavior and received pretraining prior to beginning phase one of the study.

Setting

When doing research to establish evidence based interventions for students with ASD, it is important to document the setting where the intervention took place. Students with ASD receive intervention in multiple settings. Some are taught in clinics or at home with systematic, individualized attention. Some are taught in private segregated programs with high ratio of staff to student enrollment. Still others are educated within public schools, with a continuum of inclusion services, from completely included to minimal partial inclusion for lunch, recess and specials. Because so many settings are available and in use to educate students with ASD, it is imperative that new research settings are documented to be effective within each setting (Horner et al., 1994; Mulcahy et al., 2015).

Description of setting

Eight of the 19 included articles reported the setting of their intervention with enough detail to establish both the context of the setting, and to provide a description of the setting of the ongoing intervention (see table 2.2). Of these eight studies, all but one study (Roy-Wsiaki et al., 2010) took place within a private clinic – usually described as either a University based clinic, or a private behavioral clinic. Roy-Wsiaki and colleagues (2010) used the participant's home as the setting for their study.

Six studies (Albert et al., 2012; Betz, Higbee & Pollard, 2010; Endicott & Higbee, 2007; Jennett, Harris & Delmolino, 2008; Lechago et al., 2010) did not provide enough detail to determine if the setting described was the student's only educational placement. The participants were reported as receiving private intervention at home or in a clinic, but no information was given to determine if this was the only therapy or if the student was also enrolled in an additional educational school programs. For example, Albert and colleagues (2012) reported that the students were enrolled in a private educational program offering one-on-one intensive discrete trial teaching interspersed with teaching in the natural environment. Participants attended for 2-3 hours at a time, for 2 days per week. They did not indicate if this intervention was the only therapy the students received, or if they were also enrolled in an additional education program, a local public school for example. Therefore, it was impossible to know if the student would be able to generalize the skills learned in the private clinic to an inclusion setting. Authors of three studies (Marion et al., 2011; Marion et al., 2012; Williams, Donley & Keller, 2000) reported that the study took place at home, but did not report if the students also received intervention at an additional educational setting. One author (Williams, Perez-Gonzalez

& Vogt, 2003) did not include enough detail in the study to determine context or the setting details.

Inclusion classroom

No studies were reported as taking place within an inclusive classroom (see Table 2.2). Two studies (Ostryn & Wolfe, 2011a; 2011b) reported their setting as existing within a public school. Both reported the intervention being taught within a segregated classroom or intervention setting. For example Ostryn and Wolfe (2011a) described the setting as a self-contained classroom in a public preschool for children with developmental disabilities. Some children attended a full day program, and some only a half day program. No information was given to determine if students also received education in an inclusive preschool classroom.

Intervention and Dependent Variable

The authors of all nineteen included studies taught students with ASD to mand using contrived motivating operations. The authors of seventeen of the nineteen included studies (see Table 2.3) set up a scenario that included some type of activity which the student was familiar with. For example, a scenario might be baking cookies if the student had a history of learning the steps needed to bake cookies independently. This familiarity meant that the student had an expectation of the steps within the activity and an expected result that was at least presumed to be reinforcing. The researchers all used interventions that interrupted the activity and waited for the participant to mand in order to complete the task. For example, students with ASD familiar with a chocolate chip cookie making activity would have an expectation of the steps that usually occur when making cookies.

They would therefore have knowledge of how to complete the cookie making activity to access the natural reinforcer of eating the chocolate chip cookies that occurred at the end of the activity. If during the process of making cookies the interventionist interrupted the task by hiding the chocolate chips, the student would need to mand (or ask) for the chocolate chips in order to complete the activity. This would be considered a type of interrupted chain.

This procedure of interrupting familiar chains of behavior (for instance, making cookies or playing with a favorite toy) was used to increase the likelihood that a student would want to get to the end of the activity to access the natural reinforcer. Another example of an interrupted chain might involve listening to music (Shillingsburg & Valentino, 2011). If a student had a history of listening to their favorite music after they went to a computer and turned it on, they may be motivated to turn on the computer when they wanted to listen to music. If this behavior chain was interrupted by muting the volume on the computer, the student would likely: go to the computer, turn on the computer, hear that there is no sound coming out, and ask how to turn on the sound. The final step of this chain is the mand ("How do I turn on the computer?") that would be naturally reinforced with the answer to the "how" question and the music being turned on.

In two of the nineteen included studies (Shillingsburg and Valentino, 2011; Shillingsburg et al., 2011) the researchers used a familiar task, but one that the student was not able to complete independently. This created a problem for the researchers because although the student still had an expectation of the natural reinforcer at the end of the activity, they had insufficient information on how to complete the steps of the

activity independently, so additional training was needed during the first phase of the intervention.

The interventions reported in the studies were organized into four categories of activity: missing item, hidden item, insufficient amounts of item and insufficient information (see Table 2.3).

Missing item

Authors of eight of the nineteen included studies (see Table 2.3) used an activity that included a chain of behavior with a missing item. In this type of intervention, a chain of behavior was taught, and then one of the items was removed from the chain. For example, Betz and colleagues (2010) used an intervention that consisted of a chain of behavior with a missing item embedded into the chain. A preference assessment was used prior to the start of each session to increase the likelihood that items used in their intervention would be preferred and therefore more likely to be motivating for the participants. They allowed their participants to play with an item for 30 seconds, and then distracted the participant while they hid the item around the classroom. They then gave the instruction, “Let’s play. Get (item).” If the student asked, “Where (item)?” they responded with the location and allowed the student to retrieve and play with the item for 30 seconds. If the student did not respond, they used an intervention consisting of repeated verbal prompts to teach the student to mand. The instruction was repeated and followed by the prompt, “Where (item)?” If the student echoed the verbal prompt, the student was reinforced verbally, “Good job asking” and the trial was repeated to allow for an independent response. If the student responded independently, he was allowed to

retrieve the item and play for 30 seconds. In the absence of an independent response, the prompt was repeated. The trial continued until the participant issued an independent response or did not respond to two consecutive verbal prompts.

Hidden object

Authors of six of the nineteen studies included in this review (see Table 2.3) used an intervention that taught children to mand with the use of a hidden object. The participant was presented with some type of bag or box containing a preferred item that was hidden from view and taught to ask, “What is it?” For example, Ostryn and Wolfe (2011) used bags to hide objects from the view of their participants. They then used a combination of verbal prompting and visual picture communication to teach the participants to first ask, “What’s that?” and then to mand for the item. Items were selected based on a preference assessment to increase the probability that student would want and be motivated to mand for the item. All students in their study learned to ask, “What’s that?” when confronted with the bag, and also learned to mand for the item when it emerged into view.

Sundberg and colleagues (2002) used a similar procedure that included both a hidden item and a missing item. They taught two young boys with ASD to mand for an item that had been hidden in an opaque container, either a bag, box, or can. During pretraining, they presented the participant with a container hiding a preferred item and told the student to “Get your (item)” from the container. The participant opened the container, took out the preferred item and was allowed to play with it for a brief time. Baseline conditions were similar to pretraining, but the item was missing from the

container. This set up a condition that would increase the likelihood that the student would mand for the item. The participant was told to “Get your (item) and given an empty container. None of the participant’s manded for the location of the missing item. In the teaching condition, the participant was once again given a container with a toy. The participant was told to “Get your (item)” from the container. He was allowed brief access to the item in the container, and then gave it back to the researcher. The participant was distracted for a moment, and the research moved the item to one of two containers about 2 m. away from the table. The researcher then told the participant to “Get your (item)” and waited briefly for a response. Following a correct response, the student was allowed 30 s. of access to the preferred item. Following an incorrect response, the student was given an echoic (imitative) prompt, “Say (or sign) where...” The echoic or imitative response was followed by immediate verbal information of where the item was hidden. Prompts were gradually faded and both participants learned to mand for the hidden item.

Studies in the third category taught students to ask for items that had been present, but that were then hidden from view (Endicott & Higbee, 2007; Koegel et al., 1997; Ostryn & Wolfe, 2011b; Shillingsburg et al., 2014; Williams, Donley & Keller, 2000; Williams, Perez-Gonzalez & Vogt, 2003). This category of intervention typically employed some type of bag or container to hide items from view. For instance, Shillingsburg and colleagues (2014) used two strategies for hiding items. In the first, the investigator hid an item under one of several opaque cups without the participant seeing the location. An empty wrapper or some other reference to the item was placed near the cups to establish a link to the item hidden, and to increase the likelihood of establishing a motivating operation for the item. The student was then taught to ask for the location of

the object, for instance, “Which cup is the skittle under?” In the second, the investigator brought in additional therapists and a highly preferred item was hidden within one of their hands. The student was then taught to ask “Who has the object?” During baseline conditions, none of the participants were able to ask either “Which” or “Who” questions. The participants were also taught to discriminate between conditions in which information had already been provided, or when they needed to request additional information, demonstrating that the interrupted chain (the hidden item) had control over the dependent variable of asking for information. All of the participants showed discrimination of the relevant information needed. Two of the participants were able to generalize the ability to mand for necessary information to novel scenarios. One participant learned to generalize the skill after the addition of structured teaching strategies.

Insufficient item

Authors of four of the nineteen studies included in this review (see Table 2.3) used an intervention activity with insufficient amounts of an item to increase the likelihood that a student would learn to mand for more of the item. This activity was also used within a study that included several different activities to generalize manding (Marion et al., 2011). Marion and colleagues (2011) developed a teaching procedure with five components: a brief preference assessment, contrived mands with scripts for consistency, a prompt fading strategy, natural reinforcement when the item manded for was delivered, and an error correction procedure. They developed two scripts, one that involved a missing item, and one that involved a hidden item. They then used two

different scripts for generalization. The first script involved setting the student up with a familiar activity. The student had access to all the items that were needed to complete the activity, but there was an insufficient amount of one item needed to complete the chain. This contrived an opportunity for the student to mand for more of the item in order to complete the chain. The second generalization script used a hidden item that was presented as a 'surprise'. For example, while the participant was playing with an activity, the researcher would hide something behind their back, or shake a wrapped present and say, "ooooh" to emphasize they had a surprise. The student demonstrated generalization of manding if he responded, "What do you have?"

Insufficient information

Authors of three of the nineteen studies included in this review (see Table 2.3) used insufficient information to motivate participants to mand (Shillingsburg and Valentino, 2011; Shillingsburg et al., 2011). Shillingsburg and colleagues (2011) presented a student with preferred activities that had been sabotaged so that the student was unable to complete the chain. For example, the sound had been muted on the computer or the talk button was not pressed on a walkie talkie. When the student voiced a problem with a step in the chain, the therapist would state how to fix the problem. Generally, the student would not have enough information to fix the problem and complete the chain. In the above examples, the student did not know how to unmute the computer and did not know how to press the right button to talk into the walkie talkie. This lack of information or knowledge served as a contrived motivating operation for the student to ask, "How do I fix the computer?" or "How do I use the walkie talkie?" The

participant in this study learned to mand during two taught scenarios, and then generalized the ability to mand to an additional four untaught scenarios.

Combined strategies

Authors of two of the nineteen included studies (see Table 2.3) used a mix of strategies within their interventions (Marion et al., 2012; Roy-Wsiaki et al., 2012). For example, Marion and colleagues (2012) set up four conditions to attempt to contrive a motivating operation. In the first, preferred items were hidden within the intervention setting. In the second, an activity was presented to the student that had an expected object missing. In the third, an item was hidden from view and the student was presented with a container containing an unknown object. In the final condition, the student was participating in a chain of behavior and they required more of an item than given to complete the chain. For example, while making chocolate chip cookies, the student was given only 3 chocolate chips, instead of enough to make the entire batch of cookies. None of the participants were able to mand during baseline, but all learned to mand following the intervention. Additionally, each participant generalized the ability to mand to novel scenarios and also maintained the ability to mand during one, two and four week follow up probes following the absence of the intervention.

Two of the included studies (Marion et al., 2011; Roy Wsiaki et al., 2010) used activities from each category of intervention within their study. For instance, both Marion and colleagues (2012) and Roy-Wsiaki and colleagues (2010) used each of the first three types of interrupted chain during their intervention and included the additional category of providing an insufficient amount of an item to complete a chain. Studies in the first

category taught students to mand for an item needed to complete a chain of behaviors (Albert et al., 2012; Lechago et al., 2010; Lechago et al., 2013; Marion et al., 2011; Shillingsburg & Valentino, 2011; Shillingsburg et al., 201l). Albert and colleagues (2012) taught three separate response chains, for instance making a sandwich or listening to music. Each chain required a sequence of at least three steps. Once students had learned the chain of behavior, materials needed to complete one step of the chain were taken from their expected location setting up a motivating operation for the student to mand for the missing item. Verbal prompting was used to teach the student to mand for the item. During baseline, none of the participants were able to mand for the missing item. Independent mands were established within 13 or less training sessions and maintained across subsequent sessions.

Results

Authors of each of the nineteen studies included in this review (see Table 2.3) reported that the interventions they used successfully increased rates of mands for students with ASD. For example, Albert and colleagues (2012) reported zero rates of responding during their baseline condition. Participants' unprompted mands for the missing items increased upon the application of their intervention: vocal prompts were provided and then eliminated using a 10 s prompt delay. During the intervention, unprompted mands stabilized in 13 or less mand training sessions and maintained across subsequent sessions. During maintenance, two of the three participants emitted unprompted mands for missing items during 100% of probes. The third participant emitted unprompted mand for 66% of probes.

Betz and colleagues (2010) also reported rates of zero manding during baseline. One of their two participants increased rates of manding following only three teaching trials done at a 1:1 table within a partitioned area. They demonstrated generalized mands in novel toys and across novel items. They were not able to generalize manding into the natural setting, the segregated preschool classroom, without a final natural setting training phase. They did report maintenance of the manding skills at 1-, 2-, and 4-week intervals.

Generalization

One challenging characteristic of children with ASD is their lack of ability to generalize from one learning situation to another (Matson & Sturmey, 2011). Children with ASD often need specific programming to teach generalization (Cooper, Heward & Heron, 2007; Kazdin, 2011). Therefore, when teaching any skill to children with ASD, it is important to assess their ability to generalize the skill to new teaching situations, new teachers, and new materials (Horner et al., 2005). Ten of the nineteen researchers (see Table 2.4) included information on some component of the participants' ability to generalize manding. Several researchers designed their study to test the generalization effects of prior interventions (Betz et al., 2010; Koegel et al., 1998; Lechago et al., 2010). Interestingly, the process for teaching generalization and what was considered generalization of skills was different for many of the included studies.

Five of the nineteen included studies defined generalization as the participant demonstrating the learned behavior in different settings, either the clinic and home setting (Koegel et al., 1998; 2010) or in other areas of the home (Marion et al., 2011; Marion et al., 2012; Williams et al., 2000). All were able to demonstrate generalization of manding

to these new settings. Endicott and Higbee (2007) demonstrated that their participants learned to use the mand "where" and were able to generalize the skill when looking for new items. Two of the three participants also generalized the skill to their homes. Lechago and colleagues (2013) demonstrated generalization across novel activities within the same setting. Ostryn and Wolfe (2011) demonstrated generalization across novel settings, people and settings.

Three authors (Betz et al., 2010; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2011) attempted to increase generalization by manipulating a feature of the intervention. For example, Roy-Wsiaki and colleagues (2010) attempted to program for increased generalization by teaching in four different settings and by using three different activities within each setting. They then successfully measured generalization to a novel setting, script, activity and to the natural home environment. They found that the participants who received this training were able to generalize their skills. Betz and colleagues (2010) developed their study to investigate the generalization effects of mands. They created a hierarchy of generalization probes to test the extent that following their intervention, manding generalized to novel toys and in novel settings with conditions similar to training. They found that the students were all able to learn to mand for information using "where", but that the response did not generalize to the natural setting where specific verbal cues to mand were absent. They speculated that this was due to procedural limitations and that the mand was under the control of the verbal cue as opposed to the situation cue of wanting to play and needing to find a toy.

Shillingsburg and colleagues (2011) taught general versus specific topographical responses to assess generalization to untreated scenarios. They began by teaching one

scenario, and then immediately probed the other requests for information. If correct responding occurred during the probes, the same scenario was probed two more times to assess mastery. If no correct responding, then the probes were discontinued. They found that 91% of the general response topographies generalized, none of the specific response topographies generalized. Each required direct teaching.

Maintenance

Manding is a life skill that will increase a student with ASD's ability to get their needs met independently. Once learned, the skill should maintain naturally, because it can be used in multiple scenarios that assess naturally occurring reinforcers. Student's with ASD have multiple opportunities to mand across a day, and when they mand correctly, they receive the item or information that they are trying to access. However, not all skills taught to students with ASD will maintain once an intervention has ended (Cooper, Heron & Heward, 2007). Therefore it is important to verify that taught skills have maintained following an intervention. Six of the studies included in this review (Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2011; Williams et al., 2000) included some measure of maintenance in their studies (see Table 2.4). For example, Lechago and colleagues (2013) trained and tested with several different interrupted chain scenarios. They then probed two novel scenarios two weeks after they terminated their study. They found that the student did maintain the ability to mand after two weeks. Three of the six studies that included maintenance data (Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010) included follow ups one, two and four weeks after the intervention. For example, Marion and colleagues (2011) administered the contrived motivating operations one, two, and

four weeks following the completion of their teaching procedure. The three activities that were used in teaching were presented to the participant, and he was given a choice of completing one of them. The participant had 4 s to respond by using the mand "What?" If the participant manded correctly, then his question was answered. Otherwise, no error correction procedure was used. All three participants continued to use the mand "What" during the follow up probe trials.

Methodological Review

The results of the study are a replication of a paper by Mulcahy and Krezmien (2015). The authors were interested in the methodological quality of the body of research on interventions for improving math performance for students with emotional and behavioral disorders (EBD). In order to determine the methodological rigor used in prior studies, they developed a protocol using standards that had been previously identified by Horner et al. (2005), Kratochwill et al. (2010), and the CEC (2014). The protocol included a set of nine standards, with a range of 1-6 operationally defined components within each standard (see Table 2.5). Specifically, the authors evaluated studies on the following standards: participants, context and setting, research design, description of conditions, dependent variables and outcome measures, experimental control, fidelity of implementation, data analysis, and social validity.

In order to determine the methodological rigor of the studies included within this literature review, I have replicated the procedures used by Mulcahy and colleagues (2015). Each study included in this review has been analyzed based on the standards outlined by Mulchaey and colleagues (2015). The results of the current findings are described relative to each standard (see Table 2.6). When applicable, samples of

individual studies are included as examples and non-examples of studies that met the particular standard.

Standard 1: Participants

To be considered rigorous, SSD research requires an operational definition of the participants that includes both the disability and the method used to document the disability and a clearly described process for selecting participants to allow replication (CEC, 2014; Horner et al., 2005). Mulcahy and colleagues (2015) identified nine components associated with the *Participants* standard that should be present in rigorous SSD research (see Table 2.5). These components were broken down into essential and supplemental components. The essential components included: labeling and/or describing the disability, describing the method of determining the methodology or risk factors, and description of the process used to select participants (see Table 2.5). The supplemental components included descriptions of: age, race, gender, IQ scores, and achievement scores (see Table 2.7). In order to meet the *Participants* standard criteria, Mulcahy and colleagues (2015) determined the authors needed to include each of the three essential components and at least four of the six supplemental components (see Table 2.5).

Essential components

No studies met both essential and supplemental criteria for the *Participants* standard (see Table 2.7). Authors of five of the included studies met the criteria for the essential components of the participants. For example, Koegel et al. (2010) specified that all of the participants in their study had received a diagnosis of ASD by an outside agency, and that all exhibited symptoms consistent with the DSM IV-TR. They further

qualified the selection process by reporting that the first three children who they assessed that did not demonstrate the use of the targeted question were selected to participate in the study.

Described disability or risk status

A clear description of the disability or risk status is necessary to develop an understanding of the characteristics of the participants. The intervention may include components that are specifically designed to meet the needs of the participants, or the characteristics of the disability may affect the outcome of the intervention or the ability to replicate the study. Authors of all nineteen of the included studies (see Table 2.7) included a clear description of the disability or risk status. For the research included within this review, each of the nineteen authors used participants who had been diagnosed with ASD and all provided a description of the abilities of the participant (See Table 2.2).

Included method for determining disability

To understand the exact nature of the disability, the method for determining the disability should be included. This allows for increased confidence that the description of the participants was accurate. Authors of eleven of the nineteen included studies (see Table 2.7) included information on the method for disability or risk status.

Included method for determining participation

Understanding how participants were selected for a research study can help determine whether or not there was any selection bias for any of the participants. Authors of six of the included studies (see Table 2.7) included information on the methods they used for participant selection.

For example, Ostryn and Wolfe (2011) reported the criteria they developed to select participants. It included: a formal diagnosis of ASD or the diagnosis written into the IEP or defined by placement into the ASD classroom, the ability to use pictures to communicate and as their main form of communication, had never been taught to use the mand, "What's that?" Shillingsburg and colleagues (2011) used a simpler method that called for them asking partners and teachers to identify students who exhibited limited to no mands for information in the home or school setting.

Supplemental components

None of the studies within this literature review included the recommend four of the six supplemental components (see Table 2.7).

Age, gender and race

A description of the age of the participant allows for an understanding of the targeted population for the intervention. Authors of all nineteen of the included studies (see Table 2.7) identified the age of their participants.

Understanding the gender and race of the participant can help to identify variables that might inadvertently confound the results of the study. If the initial selection draws from one gender or racial group but not another, it could indicate a selection bias. It also

makes it clear for people who want to replicate the study with variations on the race and or gender of the participants. Authors of all nineteen of the included studies included the gender of their participants, but none of the authors included information on the race of their participants (see Table 2.7).

Grade

A general indication of the grade of the participants can be an important factor that will also have implications for understanding the effects of the intervention. Replication with variation also requires an understanding of the grade of the participants. Authors of three of the included studies (see Table 2.7) included information on the grade of their participants. Betz and colleagues (2010) and Ostryn and Wolfe (2011a; 2011b) reported that their students were in a preschool classroom.

IQ score and achievement scores

Information on the cognitive abilities of included participants is useful when understanding both the components and effects of the intervention. This information can allow the reader predict how the participants may respond to the intervention which will help with analysis of the results. Authors of none of the included studies (see Table 2.7) included information on IQ scores. Authors of five of the included studies included achievement test scores.

Summary of participants

While none of the authors of the nineteen included studies met the standard for both essential and supplemental criteria of the *Participants* standard within their report, authors of five of the nineteen included studies (see Table 2.7) met the criteria for the

essential components of the participants. None of the authors included at least four of the six criteria for the supplemental information.

Authors of only ten of the nineteen studies included the method for how the disability was determined (see Table 2.7). Authors of four of the included studies (Jennett, Harris & Delmolino, 2008; Marion et al., 2011; Marion et al., 2012; Sundberg et al., 2002) specified the criterion used to select participants. For example, Marion and colleagues (2011) reported their inclusion criteria to be displaying the ability to mand, tact, use some type of communication device, and to have expressive and receptive language of at least 24 months based on standardized language assessments. Leaving out essential components can make it difficult to gain a full understanding of who the participants are and can create questions about selection bias.

All of the studies included both the age and gender of the participants, although Endicott and Higbee (2007) reported only the range of their participants age, not the individual ages of the participants. The grade of the participants was included by three authors (Betz, Higbee & Pollard, 2010; Ostryn & Wolfe, 2011a; 2011b), however each of these studies used preschool students as participants. None of the studies included race or IQ score. Five of the included studies (Jennett, Harris & Delmolino, 2008; Koegel et al., 2010; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010) reported standardized speech scores as a means of documenting student achievement. A dearth of information about the characteristics of participants can create about selection bias and can also make it difficult to replicate the study with variations.

Standard 2: Context and Setting

Critical features of the context and physical setting must be described with replicable precision to meet the standard of a rigorous study (Mulcahy, 2015). A single component (and criterion) represented the *Context and Setting* standard: a thorough description of the setting (see Table 2.5). In order to understand the exact nature of the setting, there needs to be both a complete description of the context of the setting, for example, the type of school, classroom, or clinic setting where the research took place. In addition, an actual description of the contents of the research setting should be provided to allow for replication.

Context of the setting

Authors of seven of the eleven studies that did not meet criteria for context and setting (see Table 2.9) included information about context. For example, the authors included information about the type of school or a home setting, but no further details about the setting. For instance, Albert and colleagues (2012) reported their participants "were all enrolled in a private educational program offering one-on-one intensive teaching in the form of discrete trial training interspersed with teaching in the natural environment, which was facilitated through play based activities." (p. 68).

Content of the setting

Authors of four of the included studies (see Table 2.9) included detailed information on the content of their settings. Betz, Higbee and Pollard (2010) included some details about the setting, for example a description of the participants private learning cubicle that was partitioned from the rest of the classroom and included a table,

two chairs, preferred toys and a video camera, but they did not include enough information about the context to determine placement.

Summary of context and setting

Authors of eight of the included studies (see Table 2.9) met the criterion for Context and Setting, including both a description of the context that allowed the reader to determine placement and a thorough description of the intervention setting (Koegel et al., 1997; Koegel et al., 2010; Lechago et al., 2013; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2014; Shillingsburg & Valentino, 2011; Shillingsburg et al., 2011; Sundberg et al., 2002). For example, Koegel and colleagues (2010) described both the context, a small clinic room on a University campus, and the described features of the setting: the clinic room contained a table, chairs, video camera and toys. Baseline and generalization were done in ether the child's home, or a clinic room set up to look like a living room with toys, a sofa, large chairs and a coffee table. Authors of three of the included studies (Albert et al., 2012; Jennett et al., 2008; Lechago et al., 2010) did not provide enough information to determine context or setting. For example, Albert and colleagues (2012) described the student's enrollment in a private educational programing offering one-on-one intensive teaching interspersed with teaching in the natural environment. But not enough information was given to discern if the program included peers other than those who had similar disabilities. Williams, Pérez-González & Vogt, (2003) did not specify context or setting.

Standard 3: Research Design

Single-case research designs vary, but share five essential principles that must be sufficiently described in order to be considered methodologically rigorous (CEC, 2014;

Horner et al., 2005). Mulcahy and colleagues (2015) proposed five essential components of the *Research Design* standard which included: a clearly identified research question or hypothesis, use of one of the single case designs, a small number of participants, the use of repeated measures over time and graphing and visual analysis of data (see Table 2.5). The authors of eighteen of the 19 studies (see Table 2.10) met all of the criteria for the *Research Design* standard.

Clearly identified research question

A clear, thorough research question provides the reader with a quick understanding of what the research should be about. It is a type of roadmap for the study. Authors of all 19 included studies included a clearly identified research question (see Table 2.10). For example, Koegel and colleagues (1998) identified several techniques from prior research that might affect generalization of manding to different settings. They identified their research question as "assessing whether the use of these variables would increase the use and generalization of child-initiated question-asking in children with ASD" (p. 348). This lead the reader to expect that specific variables were manipulated and their effects on generalization was assessed.

Single subject design can also replicate and extend the findings of prior research. The research question should still be clearly identified. For example, Marion and colleagues (2011) wanted to replicate a study done by Roy-Wsiaki (2010). They described his study in the introduction and placed it in context with other research teaching demands. They gave a rationale for replicating the research, that the study was the only study to date that had taught "what is it" while engaging in an activity with a child. They expressed they would replicate the study, and also identified the major

differences that would take place within their study. In this case, Marion and colleagues would add body gestures and vocalizations to replace a vocal script used as a prompt strategy and slightly change the procedure for hiding materials. This leads the reader to expect similar results to the first study, with a critical eye towards the variables that were different and how they may have affected the outcomes.

Use of single case design

There are several single subject designs that are used within SSD research. The authors of all nineteen of the included studies used a multiple baseline design (see Table 2.10). Several different activities, participants, or settings were identified as conditions and baseline responding was established in each. The intervention was then introduced to the different baselines conditions (either participants, activities, or settings) at staggered times. This allowed for the effect of the intervention on each baseline condition to be measured and examined. If rates of responding change after the intervention was introduced for each condition, we attribute the change in responding to the intervention rather than to extraneous events (Kazdin, 2011; Tawney & Gast, 1984).

Multiple baseline across participants

One way to demonstrate effects over time when using multiple baseline is to introduce the intervention to multiple participants. Authors of ten of the nineteen included studies (see Table 2.10) used multiple baseline across participants. For example, Betz and colleagues included three participants in their study. They implemented baseline conditions with all three participants. After 6 sessions, the first participant was exposed to the intervention while the second and third participant were kept in baseline conditions. Once the first participant demonstrated increased manding (after 5 more sessions), the

second participant was introduced to the intervention while the third remained in baseline conditions. The second participant needed a booster session to bring his responding up to criterion levels, but did demonstrate criterion level responding after 10 trials. At this point, the third participant was introduced to the intervention. She demonstrated criterion responding after 12 sessions. This study also had other conditions that were introduced once the criterion was met following the intervention. Following the intervention, a second intervention that introduced novel activities and then generalization and maintenance conditions were also introduced in a staggered format.

Jennett and colleagues (2008) used a variation on multiple baseline across participants. They included three participants in their research. All three were introduced to baseline, but only the first participant had baseline responding measured in concurrent sessions. The second and third participant's rates of responding in baseline were probed across the baseline. The first participant's rate of responding was probed once at the start of the study, and then baseline was introduced for 5 sessions when the first participant met criterion responding. The third participant's rate of responding during baseline conditions was also probed once when at the start of baseline, once when the criterion was met for the first participant, and then probed for 6 sessions when criterion was met for the second participant, just before the participant was introduced to the intervention. This multiple probe design is an acceptable design when zero rates of responding are occurring during baseline conditions. If zero rates of responding occur during the probes, one can assume that the intervention has not affected baseline responding. Jennett and colleagues (2010) did have one participant demonstrate a slight increase in requesting during their second baseline probe. They extended the probe for two more sessions and

demonstrated zero rates of responding. Therefore, it remains likely that requesting was under the control of the intervention.

Lechago and colleagues (2010) used a non-concurrent multiple baseline design across participants, a variation of multiple baseline. This means they applied treatment to their participants at delayed intervals, but did not use the effects of the intervention to guide the length of each baseline. This design is often used in educational settings because it can increase flexibility around recruiting participants. The authors used a concurrent baseline within each participant to evaluate the effects of mand training on their target variable.

Multiple baseline across activities

Another way to determine the effects of the intervention over time is to introduce the participant to multiple activities within the intervention. This can be useful when you have only one or two participants, or to identify how the intervention will work across different activities. The authors of five of the nineteen studies (see Table 2.10) used multiple baseline across activities. For example, Shillingsburg and Valentino (2011) used a multiple baseline across "how" scenarios. They had one participant, and they began by measuring his behavior across several activities. They introduced the intervention to one of those activities, while continuing to take baseline data within the other scenarios. Once the participant responded in the first scenario, they introduced the intervention in a second scenario. The authors continued to stagger the introduction of the intervention until it had been introduced across all scenarios.

Multiple baseline across settings

Another way to measure the effects of an intervention using multiple baseline is to stagger it across settings. Roy-Wsiaki and colleagues (2010) was the only author of the nineteen included studies to use a modified version of this design. The research included a baseline that reported the participants' ability to mand (ask "What") across three scripts in four different settings. The participant did not demonstrate the ability to mand during this condition, so the author introduced the intervention in the first setting. Once the participant mastered the mand in the first setting, he entered a generalization condition with a different script in a new setting. If the participant did not generalize the skill, baseline was conducted for the next setting. This created a non-concurrent multiple baseline across settings.

Number of participants

When conducting single subject research, it is important to have a small number of participants to keep the study manageable and timely (Horner et al., 2005). Within this literature review, authors of the nineteen included studies (see Table 2.10) involved between 1 and 6 participants. Authors of two of the nineteen studies (Roy-Wsiaki et al., 2010; Shillingsburg & Valentino, 2011) included only one participant. Authors of three of the nineteen (Shillingsburg et al., 2011; Sundberg et al., 2002; Williams et al., 2000) included two participants. All five of these authors (Roy-Wsiaki et al., 2010; Shillingsburg & Valentino, 2011; Shillingsburg et al., 2011; Sundberg et al., 2002; Williams et al., 2000) chose to use a multiple-baseline design that allowed them to demonstrate experimental effects of the intervention across multiple activities or settings with only one participant.

Authors of twelve of the nineteen studies (see Table 2.10) included three participants. Including at least three participants allows for greater flexibility when using multiple baseline design. Researchers can choose to use multiple baseline across participants, activities or settings and still demonstrate the three effects needed to indicate control of the dependent variable by the intervention. Endicott and Higbee (2007) included four participants within their design and Jennett and colleagues (2008) included six participants within their design.

Use of repeated measures over time

Single-subject designs require the repeated measurement of a dependent variable. The dependent variable is measured prior to the start to the intervention, within a baseline condition. It is then measured again during the intervention, using regular time intervals, whether the intervals are hours, days, weeks, or months. Ideally, continued measures occur during generalization and maintenance conditions following the withdrawal of the intervention. Authors of all nineteen of the included studies (see Table 2.10) used repeated measures across both baseline and intervention conditions.

For example, Williams and colleagues (2003) used a multiple baseline across questions. They initially measured the levels of their participant's ability to ask "What's that?", "Can I see it?" and "Can I have it?" during baseline conditions. They demonstrated zero rates of manding any of these questions. They then took repeated measures of the dependent variable during their intervention sessions which each included 10 trials lasting 20 seconds apiece. The frequency of the dependent variable was measured and reported during consecutive sessions across the length of the study.

Graphing and visual analysis

Researchers who use SSD include graphs of the repeated measures of the dependent variable across all conditions. These graphs allow visual analysis of the effects of the intervention across conditions. Visual analysis is the process of looking at a graph of the data points to determine that the intervention has effected the performance of the dependent variable. Authors of all nineteen studies (see Table 2.10) included graphs that allowed for visual analysis within their reported results.

For example, Ostryn and Wolfe (2011) included graphs of each of their intervention conditions. They chose a multiple baseline across participants design, with a separate graph reflecting each participant's performance. Each graph included data for both baseline and intervention conditions. Each baseline reported no responding, which was represented visually with a flat level and trend of the data path during baseline, and no variability. Each baseline lasted at least 3 data points. During the intervention, two participants required only one teaching session to acquire the ability to mand, "What's that?", and was represented by only one data point. The third participant required three sessions to reach criteria, which was represented by an increasing trend and level with little variability. All three subjects then entered a condition where they were taught to discriminate when to ask "What's that?" vs. "Where is it?" All three participants remained in this condition until they demonstrated at least three data points that had a high level of responding, with a level trend and no variability.

Summary of research design

Authors of eighteen of the nineteen included studies (see Table 2.5) met all five of the included criteria for research and design. For example, Betz, Higbee & Pollard (2010)

sought to extend the research on teaching mands for information by assessing the degree of generalization of mands for information taught using verbal discriminative stimuli and contrived establishing operations with young children with ASD. They used a multiple baseline across three participants which was an appropriate way to assess the effects of the intervention on the dependent variable, the mand for information. The researchers collected measures repeatedly across sessions and included a clearly labeled graph that allowed visual analysis of the results of the study.

Shillingsburg and Valentino (2011) met four of the five criteria for the research design standard, however they did not fully execute their chosen experimental design. The authors reported using a multiple baseline across "how" scenarios, but they only applied the intervention across two of the "how scenarios". They measured responding in the remaining four scenarios, and the participant began to respond with correct "how mands" before the application of the intervention. While this does not allow for three experimental effects to be measured, and is not a correct implementation of a multiple baseline design, it can also be interpreted as a powerful intervention that has good potential for generalization to untaught mands.

Standard 4: Description of Conditions

To ensure methodological rigor, baseline and intervention conditions must be described with replicable precision (Mulcahy et al., 2015). Complete descriptions of the materials used and the qualifications and training required for interventionists and students allows for precise replication of research (Horner et al., 2005). Mulcahy and colleagues (2015) reported five essential components necessary to meet criteria for methodologically rigorous description of conditions: description of the procedures,

description of the baseline condition, description of the intervention condition, description of the materials used within the study and description of the necessary training and qualifications of the intervention staff (see Table 2.5).

Description of procedures

One of the best ways to understand a published research study is through the description of the procedures provided by the researchers. The procedures should provide details that allow them to be used as a blueprint when designing a replication study. Authors of eighteen of the nineteen included studies (see Table 2.5) met the criteria for a complete description of the procedures for their study.

For example, Koegel and colleagues (2010) included a separate section for the particulars of their procedures. They identified the context of the sessions conducted, how often the intervention was introduced, and how long each session lasted. They described how they had conducted language samples during baseline and how they had later analyzed the videotaped samples. They also described probes that had been used as a pre-assessment tool with the participants. This information helps to supplement the description of the baseline and intervention conditions when trying to gain a deep understanding of the study.

Endicott and Higbee (2007) included some details about their procedures, but their explanation was brief. There was no section that detailed the session length or implementation schedule. Although a brief stimulus preference assessment procedure was described, the actual components of the baseline condition were not. This lack of particulars makes it hard to determine what variables were included in the baseline

condition so they can later be analyzed and ruled out as appropriate when measuring the effects of the intervention.

Description of baseline conditions

The baseline phase is the length of time prior to the introduction of the intervention. It documents a measurement of the dependent variable prior to the intervention which then serves as a comparison when determining effects of the intervention. It is important to include a thorough description of the baseline condition. This provides an understanding of what variables are present prior to the introduction of the intervention and also allows for another researcher to replicate the condition easily.

Authors of fifteen of the included studies (see Table 2.11) included a clear description of the baseline condition. For example, Koegel et al. (1998) included a section on the baseline condition. Within the section, they described where and under what conditions they collected the baseline data. They gave a rationale for their procedure. And they included a brief description of a pre-assessment of verbal behavior included to make sure the participant had the skills necessary to mand.

Description of intervention conditions

A complete description of the intervention condition is as important as the description of the baseline condition. This description allows for the understanding of the independent variable. Reading it should allow for an understanding of what exactly was done that might be responsible for a change in levels of the dependent variable. Authors of fifteen of the included studies (see Table 2.11) provided a clear and detailed description of the intervention condition.

For example, Ostryn and Wolfe (2011) provided a simple, yet complete description of their intervention. They labeled the most important piece of their intervention as the prompting procedure used to teach the student to mand "What's that?" and "Where is it?" They listed and described the five levels of their prompting procedure in the order they were implemented. They included a description of the 2-s response interval that was used prior to implementing the prompt, and the 2-s response interval used prior to implementing the next level of prompting if the participant still did not give the correct response. In other sections they clearly listed materials that were used and described the setting so that a complete picture of their intervention emerged, allowing for analysis and replication if desired.

Description of materials used in the study

The materials within a study should be clearly identified. This information sometimes warrants its own section, or is sometimes included within the body of the description of the independent variable. Authors of seventeen of the nineteen included studies (see Table 2.11) included information on the materials they used within their study.

The materials can be described in different ways. For example, Jennett and colleagues (2008) included a table that listed each of the materials she used when teacher her students to mand for an item. She further broke each of the items into two sets and clearly represented which part of which item was included within each set. Roy-Wsiaki and colleagues (2010) also used a table to describe their materials. They first described a set of activities that included Hide and seek and items missing within an activity. They then described the different scripts used within intervention and generalization and how

the activity was used. This clear description allows for continued understanding of the intervention.

Described the necessary training of intervention staff

One final criteria included within the description of the conditions is an explanation of the training or skills needed for training the intervention staff. This allows a researcher to plan ahead, to train skills as necessary, or to select interventionists based on pre-determined qualifications. Only two of authors included in this study (Lechago et al., 2013; Ostryn & Wolfe, 2011a) reported detailed information on the training or skills needed by the interventionists. For example, Lechago and colleagues (2013) described who would be carrying out their intervention and what if any qualifications they needed to have. They also provided a complete description of the teaching procedures that would be used with the interventionists to teach them how to implement the intervention.

Summary of the descriptions of conditions

A complete description of the conditions serves as a blueprint for the study. Each of the five criteria included by Mulcahy and colleagues (2015) underscores an important component of the description. Taken together, they represent the gold standard of condition descriptions. Authors of two of the included studies (Lechago et al., 2013; Ostryn & Wolfe, 2011a) met each of the five criteria for the standard for *Description of Conditions* (see Table 2.5). Both authors reported clear descriptions of their general procedure, as well as any specialized instructions for baseline and the intervention. In addition, they provided clear descriptions of the materials that were used within the studies. They also provided information on who conducted the experiment and what training or qualifications were needed by the experimenters. Authors of nine of these

studies reported on four of the five criterion. For example, Jennett and colleagues (2008) described their general procedures, baseline condition, intervention condition and the materials they used, but they failed to include an adequate description of the training and qualification procedures used in their study.

Authors of five of the studies met all but two components (Betz et al., 2010; Koegel et al., 2010; Marion et al., 2012; Roy-Wsiake et al., 2010; Shillingsburg et al., 2011). For example, Albert and colleagues (2012) described their procedures, baseline condition and materials, but failed to describe their intervention condition and the qualifications of the trainers in their study. Two of the authors (Koegel et al., 2010; Shillingsburg et al., 2011) failed to describe the materials they used adequately as well as not providing thorough descriptions of the training and qualifications used in the study. Roy-Wsiaki and colleagues (2010) failed to fully report on the baseline procedures that were used during the study and also did not provide full descriptions of the training and qualifications used in the study. Shillingsburg and colleagues (2011) failed to report fully on three of the components in their description of conditions: baseline procedures, intervention procedures and the training and qualifications used in the study.

Standard 5: Dependent Variables and Outcome Measures

Clearly described, operationalized and measurable dependent variables (DV) are also required to ensure fidelity in high quality SSD studies, and measures must have use a procedure that generated a quantifiable index (CEC, 2014; Horner et al., 2005). In order to meet criteria for the *Dependent Variables and Outcome Measures* standard, Mulcahy and colleagues (2015) included seven essential components the authors must have clearly defined: dependent variable measured systematically, dependent variable operationalized,

dependent variable has a quantifiable index, inter-observer agreement collected for each phase, inter-observer agreement collected for 20% of sessions, inter-observer agreement reported at 80% or higher and the precise description of instruments and measures (see Table 2.5)

Dependent variables measured systematically

The dependent variable within a SSD study is the behavior that is targeted to change. Therefore, it is important that precise measure of the dependent variable happens across the entire research study. Authors of each of the nineteen included studies (see Table 2.12) met the criteria for measuring the dependent variable.

For example, Ostryn and Wolfe (2011a) described their dependent variable as the "participant's unprompted pictorial communication of "What's that?" in response to the presentation of a hidden toy in a bag or box." (pg 179). They measured and reported on the level of this dependent variable within their baseline condition. They measured the level of this dependent variable within the intervention condition, and again through maintenance. This allows for the analysis of the change in the level of the dependent variable across the different conditions.

Dependent variables are operationalized

To operationalize a dependent variable means to describe it in precise observable and measureable terms. The definition should allow another observer to read it and then to identify when they have observed the occurrence of the behavior. Authors of eighteen of the nineteen included studies (see Table 2.12) included an operationalized definition of the dependent variable.

For example, Williams and colleagues (2003) specified that their dependent variable was the first self-initiated question of each response form. They defined the response forms as “What’s in the box?”, “Can I see it?” and “Can I have it?” They clearly identified that these were the only acceptable response forms. They specified that subsequent questions that followed each response (for example, “Can I see it? Can I see it?” were not counted. Sundberg and colleagues (2002) also provided an operationalized definition of their dependent variable. They defined the dependent variable as the emitted whole word “where?” and the name of the item or the complete sign “where?” They gave an example of an approximation as emitting part of the word or sign “where?” or a failure to identify the item. They also gave an example of an incorrect response being the failure to emit any response within 10s or to emit only the name of the missing item. This clear description allows for the raters to easily score the dependent variable during the study.

Dependent variable has quantifiable index

The dependent variable must be measureable with a quantifiable index. To increase the quality of SSD research, the research must have included a description of how the dependent variable will be quantified. Authors of nineteen of the included studies (see Table 2.12) included a dependent variable that had a quantifiable index. For example, Sundberg and colleagues (2002) gave a description of the dependent variable and then quantified the dependent variable as each correct response. Williams and colleagues (2003) quantified the dependent variable as only the first correct dependent variable for each trial.

Inter-observer agreement (IOA) collected for each phase

Once a dependent variable has been identified and operationalized, and given a quantifiable index, measurement can occur. It is important to make sure of the accuracy of the measure of the dependent variable by collecting inter-observer agreement (IOA). The procedure for this is simple. Two raters observe the condition (baseline, intervention, etc.) and record the level of occurrence of the dependent variable for each trial. The two then compare their answers. They divide the number of agreements they share by the total number of trials and then multiple the quotient by 100% to get a percent level of agreement. IOA should be collected and reported on for each phase of the study to demonstrate that the data is reliable.

Authors of thirteen of the included studies (see Table 2.13) reported IOA for each phase of the study. For example, Williams and colleagues (2000) reported that they collected IOA on 30% of all sessions. They calculated agreement by dividing the lower frequency of the questions by the higher frequency and multiplying by 100%. They then reported both the mean and the range of inter-observer agreement across all phases of their study. This allows the reader to judge the reliability of their data.

Percent of IOA collected

To be considered reliable, IOA should be collected for at least 20% of sessions across the entire research study. By taking IOA on one fifth of the data taken, the likelihood that the data will be reliable is increased. Authors of seventeen of the nineteen included studies (see Table 2.13). Sundberg and colleagues (2002) reported IOA data for just over 18% of sessions. But because they reported their range and mean IOA data was over 80%, there is increased confidence that the data is reliable. Shillingsburg &

Valentino (2011) reported that they collected data for only 7.4% of sessions. They reported their IOA to be at 100% across all of these sessions which increases our confidence that all of the data is reliable, but the small amount of collected data still decreases the reliability of the overall study.

Percent of agreement reported

To be considered reliable, IOA should equal at least 80%. This means that two independent observers agreed in eight out of every ten opportunities. If agreement is lower than 80%, it calls into question the heart of the research. Reliability is often reported as both a mean score (the average reliability across the study) and a range score. It is not uncommon to see some scores in the range that are below 80%, especially if the frequency of the dependent variable is low. However, mean reliability under 80% decreases the quality of the final research considerably. Authors of all nineteen of the included studies (see Table 2.13) reported their overall IOA to be at least 80%.

Instruments and measures precisely described

One final component of dependent variables and outcome measures is the inclusion of a precise description of the instruments and measures of the dependent variable. This variable is a further reflection on how clearly the dependent variable has been operationalized. It also includes any information on the topography of the dependent variable and how that topography will be measured. For the purposes of this literature review, authors of nineteen of the included studied (see Table 2.12) included a dependent measure of a mand. They were all successful in describing how the mand would be measured: either verbally, signed or pictorially. They included descriptions of the instrument when necessary.

Summary of dependent variables and outcome measures

Authors of twelve of the nineteen included studies (see Table 2.5) met the criteria for *Dependent Variables and Outcome Measures*. Marion and colleagues (2012) operationalized the dependent variable as any utterance that contained the word "where". To further clarify the definition, they provided an incorrect example of the dependent variable as any utterance that did not include the word "where". They then described their scoring procedures. Inter-observer agreement (IOA) was taken across 50-100% of all conditions by a second observer and reported as both an average IOA of (88%-100%) and the range of agreement for responding (75%-100%).

Authors of six studies (Betz et al., 2010; Endicott & Higbee, 2007; Marion et al., 2011; Oystern & Wolfe, 2011a; Shillingsburg et al., 2011b; Sundburg et al., 2002) met six of the seven included criteria. Authors of five of these studies (Betz et al., 2010; Endicott & Higbee, 2007; Marion et al., 2011; Oystern & Wolfe, 2011a; Shillingsburg et al., 2011b) failed to report if IOA was taken across all conditions of the study. Sundberg and colleagues (2002) reported IOA across all conditions, but only during 18% of sessions, failing to hit the minimum criteria set at 20% of collected data. Shillingsburg and colleagues (2011a) reported IOA across only 7.4% of sessions, and also did not indicate if the IOA occurred repeatedly over time across all sessions.

Standard 6: Experimental Control

For SSD research to be considered rigorous, Mulcahy and colleagues (2015) have determined that they must demonstrate control within both the research design and in the implementation of the research activities. Mulcahy and colleagues (2015) recommend seven components that must be included to ensure that the standard for *Experimental*

Control has been met: demonstrated control of the (IV), included no intervention during the baseline condition, included at least three data points within baseline reported stable baseline data for each participant, reported at least 3 data points for each phase, controlled threats to internal validity, and demonstrated at least three experimental effects (see Table 2.5).

Control of the independent variable (IV)

To demonstrate control of the independent variable, visual analysis of the data should show a significant difference in the level of the dependent variable between the baseline and the intervention conditions. The quicker and farther the levels of the DV differentiate, the better control the researcher can assume.

Authors of all nineteen of the included studies (see Table 2.13) demonstrated control of the dependent variable. For example, Marion and colleagues (2012) reported baseline levels of their dependent variable as zero responses. Within their first intervention condition, all three of their participants emitted correct mands at 100%. They demonstrated this mastery with a range of 3-16 sessions. This quick acquisition of the target variable provides a good indication that the intervention was effective.

Baseline condition does not contain the intervention

To be a true measure of baseline responding, the baseline condition cannot contain any pieces of the intervention. If it did, the baseline responding could be artificially inflated, or there could be an changing trend to the data as the student responds to the intervention. Authors of seventeen of the nineteen included studies (see Table 2.13) described baseline conditions that did not include elements of the

independent variable. The baseline condition should also remain the same over repeated exposures.

Ostryn and Wolfe (2011a) documented zero rates of responding during baseline, and then introduced their independent variable, teaching the students to ask "What's that?" They found the students were responding to verbal prompting, which made their use of a picture communication unnecessary. Therefore, after only one training session using both pictures communication and verbal prompting, they ceased the use of the picture communication, and found that their intervention still effected the dependent variable, and produced generalization to novel settings, materials, and people. Because the intervention was different from baseline, the criteria for robust *Experimental Control* was not met. However both the explanation for the change in procedure and the data reported during treatment provide convincing evidence that the intervention did effect the dependent variable.

Roy-Wsiaki and colleagues (2010) used different baseline conditions following different conditions. They collected baseline of one script across all settings, but then collected baseline on two different scripts prior to beginning training in a new setting. This odd use of baseline still demonstrated effects, but does not meet the criteria for experimental control.

Number of data points within baseline

Baseline conditions must all contain between three and five data points (Cooper, Heron & Heward, 2007). This number has been set because it allows demonstration of stable level, trend and variability within the baseline condition. Authors of eighteen of the nineteen included articles (see Table 2.13) included at least three data points within the

baseline condition. Roy-Wsiaki and colleagues (2010) used a variation on multiple baseline called multiple probe. Within this variation, baseline performance can be probed periodically when the intervention is being applied to other conditions. It is useful when there is a long intervention (and thus a long baseline condition) and when rates of responding are near zero. These researchers indeed did initially demonstrate zero rates of responding during the intervention. Generally, during a multiple probe baseline, the researcher still reports data on the level of the dependent variable for at least three days prior to the introduction of the intervention condition. Roy-Wsiaki and colleagues did not take data for three days prior to introducing the intervention. Additionally, following the maintenance condition of the first activity, the rates of responding in baseline increased across the other three activities. For example, the rate of responding increased in activity two from zero to 27% correct responses. This was similar for activity three, and at closer to 45% for activity four. These increased rates during baseline create a need for additional data points to assess the level, trend and variability in order to determine the level of control the independent variable had over the dependent variable.

Stable baseline performance

Data within the baseline phase must be stable and on a neural or opposite trend to that desired during the intervention. Authors of eighteen of the nineteen included studies (see Table 2.13) demonstrated stable baselines before moving ahead with their interventions. Roy-Wsiaki and colleagues (2010) and Shillingsburg and Valentino (2011) showed increased responding during baseline, which resulted in the student learning to mand for information across all scenarios included in their study. While this pattern of responding during baseline does not document rigorous experimental control, it does

suggest that the intervention is powerful and will result in generalization to new situations.

Number of data points for each phase

Similar to baseline, each phase should include at least three data points to allow the visual analysis of level, trend and variability. Authors of sixteen of the nineteen included studies (see Table 2.13) included at least three data points for each phase of their studies.

Authors of three studies, (Ostryn & Wolfe, 2011b; Roy-Wsiaki et al., 2010; Williams, Perez-Gonzalez & Vogt, 2001) did not include at least three data points across all conditions of their study. For example, Williams, Perez-Gonzalez and Vogt (2003) chose to use a multiple baseline design across stimuli with three participants. They were able to meet six of the criteria set up by Mulcahy and colleagues (2015). They demonstrated stable rates of responding for an extended baseline across all of their participants and questions asked. They demonstrated experimental effects following the introduction of their initial treatments. However, the authors only reported one or two data points for some of the later phases of treatment. Standards require that each treatment phase has at least three data points to assess for stability and level of responding. Two few data points result in a less convincing demonstration that intervention has had an effect on the dependent variable. However the pattern of responding demonstrated by the multiple stimuli and multiple participants strengthens the author's demonstration of experimental control.

Controlled threats to internal validity

Rigorous research requires researchers to demonstrate control of all threats to internal validity. Repeated measures taken during the baseline phase control several threats to internal validity. Specifically, problems of maturation, instrumentation, statistical regression, and testing may be controlled by repeated measurement because patterns that speak to these threats to internal validity should become evident in the baseline. When baseline measures are stable lines, these threats may be ruled out. Authors of eighteen of the nineteen included studies (see Table 2.13) adequately controlled threats to the internal validity of their studies. Roy-Wsiaki and colleagues (2010) had several previously identified problems with their baseline, including not enough data points and an increasing trend to the data that not only did not control for threats to internal validity, but in the case of the increasing trend, might actually be documenting a problem with internal validity.

Demonstrated at least three experimental effects

The effectiveness of an intervention is enhanced when it demonstrates at least three experimental effects. This is one of the reasons why multiple baselines typically introduce the intervention to at least three conditions. Replication of effects increase our confidence that an intervention is effective. Authors of eighteen of the nineteen included studies (see Table 2.13) demonstrated at least three effects of their intervention. Roy-Wsiaki and colleagues (2010) did provide evidence that the training procedure worked. However, with the problems identified with baseline, documentation of the three effects are not possible. Still, the results should be considered in light of this flaw.

Summary of experimental control

Authors of thirteen of the nineteen included studies (see Table 2.5) employed designs that met all the component of the *Experimental Control* standard (Mulcahy, 2015). For example, Endicott and Higbee (2007) demonstrated with a multiple baseline design that their independent variable had an effect on their dependent variable. They began with three subjects in baseline which documented zero rates of the dependent variable (manding for information). The first participant received treatment for six sessions, with the last four sessions at 100% manding "Who has it?" when presented with the teaching scenario. After the first participant had demonstrated an increase in responding (following session four), the second participant received treatment. He demonstrated a response to the treatment on session seven, and demonstrated 100% responding for the last three recorded sessions. The final participant continued to have zero rates of responding in baseline. He received the treatment on session nine, once participant two had shown an effect, and demonstrated a response to the treatment immediately on session ten, with 100% responding for the last three sessions.

Authors of three studies (Marion et al., 2011; Roy-Wsiaki et al., 2010; Shillingsburg & Valentino, 2011) chose to use multiple baseline across scenarios, and were not able to document stable baselines for at least three scenarios. Marion and colleagues (2011) chose to use a multiple baseline design across situations. They began their intervention for the first situation with only two data points in their initial baseline. The authors used continuous methods to document an effect on the dependent variable during their treatment phase. During the second situation, the participant demonstrated one session with an increase in responding from zero rates to about 35% correct

responses. On the next session, the rates had reduced to zero rates and treatment was begun. Baselines for scenario two and three were done using probes instead of continuous reporting. An effect during the fourth baseline situation was documented on session ten, and increased responding during baseline (to 100%) was also noted during both the third and fourth scenarios.

Standard 7: Fidelity of Implementation

The methodological rigor of a study is enhanced when authors measure the fidelity of implementation of the intervention they employed, and document continuous direct measurement for each relevant interventionist, participant, and phase (CEC, 2014; Horner et al., 2005). In order to meet the Fidelity of Implementation standard, Mulcahy and colleagues (2015) required authors to include three essential components: fidelity assessed through continuous measurement, fidelity reported for adherence, and fidelity assessed for each interventionist, phase, and condition (see Table 2.5).

Fidelity assessed through continuous measurement

Fidelity assesses how consistently the interventionist implemented the conditions throughout the study. To assess fidelity, there needed to be some measure of what the interventionist should be doing within each phase of the study. This was often a checklist that a second observer could fill out while watching the interventionist. Authors of ten of the included research studies (see Table 2.14) documented the continued measure of fidelity across their research study.

For example, Jennett and colleagues (2008) reported that an independent observer completed a checklist of items specifying the exact procedures that they should be doing for 10% of randomly observed sessions across participants and training sessions.

Fidelity reported for adherence

It is not enough to simply document that fidelity observations occurred. Fidelity agreement should also be reported. Specific disagreements should be documented so they may be analyzed to determine where the errors occurred. It might be that the interventionist did not understand what they were supposed to do, or the intervention itself may have some problems. Authors of five of the included studies (Betz et al., 2010; Jennett et al., 2008; Lechago et al., 2010; Ostryn & Wolfe, 2011a; 2011b) reported adherence to fidelity. For example, Jennett and colleagues (2008) reported their main procedural component that was not consistently implemented: the time allowed for reinforcement. They further specified that reinforcement periods were occasional 5-10 seconds longer than the procedures called for and were dependent on the student's behavior. This allowed the reader to understand where the procedures broke down, and make assessment as to how the fidelity discrepancy might have impacted the overall results of the study.

Fidelity assessed for each interventionist, phase and condition

To further determine consistency of the application of the intervention, fidelity results should be broken down by interventionist, phase and condition. This will allow for error analysis when applying the intervention. Authors of eight of the nineteen included studies (see Table 2.14) assessed fidelity across all phases of their study. For example, Lechago and colleagues (2010) reported that a second observer was present and recorded antecedents and consequences delivered by the experimenter on each trial throughout the behavior chain training, baseline, mand for information training, and generalization probes for a total of 96% of trials.

Summary of fidelity

Authors of three studies (Jennett, Harris & Delmolino, 2008; Lechago et al., 2010; Ostryn & Wolfe, 2011b) included the all three of the essential components for the *Fidelity of Implementation* standard: fidelity was assessed continuously, across all conditions of the study, and inaccuracies were reported to ensure adherence of implementation. For example, Jennett and colleagues (2008) reported they used a checklist with two recorders to determine the fidelity of implementation for 10% of sessions across their study. They reported adherence at 97.1% and elaborate that the one variable not adhered to was reinforcement periods were set at 30s, and they ran over to 35-40s for a small percent of trials.

Authors of seven of the nineteen included studies (Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Ostryn & Wolfe, 2011a; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2014) met two of the three requirements. Five of the authors (Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2014) failed to report if fidelity was taken across interventionists, participants and phases. Two of the authors (Betz et al., 2012; Ostryn & Wolfe, 2011a) did not report where the adherence difficulties occurred. Nine of the authors (see Table 2.5) did not meet the standards for any of the criteria included in *Fidelity of Implementation* standard.

Standard 8: Data Analysis

Single case research primarily uses systematic visual analysis to analyze data (Kazdin, 2013; Kratchowill et al., 2010; O'Neill et al., 2011). Occasionally, statistical analysis may be used to interpret SSD result, researchers are required to provide graphs

of each dependent variable though all phases of their study. Graphs are analyzed in terms of level, trend and stability to determine whether a functional relationship exists between the independent and dependent variables (Kazdin, 2013; Horner et al., 2005). None of the studies included in this review used statistical techniques to analyze the findings, so I have only included components for visually analyzed data. Mulcahy and colleagues (2015) identified five essential components that are required to meet criteria for the *Data Analysis* standard: unit of analysis is a single score, effects are reported for each DV, data is reported graphically for each DV, data is analyzed through visual analysis, and demonstration of the functional relationship between the DV and IV (see Table 2.5).

Unit of analysis is a single score

In order to determine the individual effects of the DV, each DV should be quantifiable with a single score. Authors of all nineteen of the included studies (see Table 2.15) met the criteria for reporting the DV as a single score.

Effects are reported for each DV

To determine the effects of the intervention on the DV, it is important to report the effects individually. Authors of all nineteen of the included studies (see Table 2.15) reported the effects for each DV. For example Koegel and colleagues (2010) reported the level of manding that occurred prior to baseline (zero rates) and then following the intervention (a range from 70%-100% of unprompted questions asked when an object was hidden). They displayed the data path in their graph to allow the reader to understand how quickly the participant demonstrated the increased DV and how many trials it took achieve criterion responding for the DV. They also represented the data path of the DV

during a generalization condition to demonstrate the effect of the intervention generalize to new materials.

Shillingsburg and colleagues (2014) reported the effects of his dependent variable in a cumulative record over time. Cumulative records are graphs that allows the user to see the sum of all incidences of the behavior as a function of the time. This is an acceptable way to report the effects of SSD research as it allows the reader to analyze the included graphs to determine the slope of the data path (Cooper, Heron & Heward, 2007). This provides information on how soon after the introduction of the intervention the participant demonstrated an increase in the DV as well as the speed of the acquisition and eventual mastery of the DV.

Data is reported graphically for each DV

A graphic display of each DV allows the reader to do their own analysis of the effects of the intervention on the DV. Authors of all nineteen of the included studies (see Table 2.15) reported the data path of the DV graphically.

Data is analyzed through visual analysis

Visual analysis is the process of looking at a graph of the data points to determine that the intervention has effected the performance of the dependent variable. Authors of eighteen of the nineteen studies (see Table 2.15) included graphs that allow for visual analysis. These graphs allow visual analysis of the effects of the intervention across conditions. Roy-Wsiaki and colleagues (2010) did not meet this criterion because they included a graph that was not clearly labeled and required the reader to go to the text of the study to aid interpretation.

Demonstration of the functional relationship between the DV and the IV

The determination of a functional relationship is an accumulation of necessary components. There must be a quality baseline that meets criterion standards. There also must be standards met in the number of data points and the magnitude and direction of the change between the DV and the IV. Authors of eighteen of the included studies (see Table 2.15) demonstrated a functional relationship between the DV and the IV. Roy-Wsiaki and colleagues (2010) did not include enough data points in each phase of their study to allow for a clear demonstration of a functional relationship.

Summary of data analysis

Authors of eighteen of the nineteen studies met criteria for the *Data Analysis* standard (see Table 2.5). For example, Betz and colleagues (2010) reported data on the number of correct independent mands used during their intervention (n=3). They provided a graphical display allowing visual analysis of the data path for each participant. They demonstrated a clear functional relationship between baseline and the intervention.

Roy-Wsiaki and colleagues (2010) included three of the five essential components. They reported data for the dependent variable for each scenario and provided a graphic display for interpretation. However, the graph was not clearly labeled and required going back to the text to interpret. Further, the authors failed to demonstrate a functional relationship between the dependent and independent variables.

Standard 9: Social Validity

One of the most important criteria for SSD research is the importance that is placed on both the social significance and the practicality of the studies. (Horner et al., 2005). To be deemed rigorous, SSD must include and report socially important outcomes,

be cost effective, and implementable by typical intervention agents (CEC, 2014; Horner et al., 2005). Mulcahy and colleagues (2015) identified two essential components required to meet criteria for the Social Validity standard: outcome is socially valid and magnitude of the change of the DV is socially important (see Table 5). Authors of all nineteen of the included studies (see Table 2.5) met the criteria for social validity.

Outcome is socially valid

A hallmark of SSD research is to look at variables that are considered to be socially valid. In order to be considered socially valid, the research must choose a DV that clients and their supporters understand, they must also admire the goals, outcomes and methods of an intervention (Cooper, Heron & Heward, 2007). Authors of all nineteen of the included studies (see Table 2.16) included both DV and IV that are considered socially valid. Each of the authors included in this study developed interventions to teach participants to mand, which will increase their ability to get their needs met independently.

Magnitude of the change of the DV is socially important

It is not enough to simply develop socially valid measures and interventions. The magnitude of the change in the DV must also be large enough to reflect a socially significant change for the participant(s). Authors of each of the nineteen studies included in this review (see Table 2.16) included demonstrated a change in the DV that is considered socially valid. For instance, Shillingsburg and colleagues (2014) reported that their students did not engage in any mands during baseline condition, but following the intervention, they engaged in 10-20 mands during the 30-minute session.

Summary of social validity

Authors of all nineteen studied included in this review (see Table 2.5) met the criteria for social validity. Each author demonstrated socially valid outcomes and sufficient magnitude of the change in the DV to be considered socially important.

Summary of the Methodological Review

The literature included in this review is comprehensive of the research that contrived motivating operations to teach children with ASD to mand. Each of these studies contrived a motivating operation to increase the likelihood that a student would mand. The authors used four distinct interventions, but each caused an interruption in a known chain of behaviors that created a motivating operation for the student to ask for the item to complete the chain. This is an elegant way of increasing a student with ASD's motivation to mand. It is simple, and can be done every day, across all settings. Students with ASD complete many chains of behavior each day, for instance coming into school and putting their backpacks, coat, and boots away. The potential to interrupt these chains to increase a student's motivation to mand are almost endless. Parents were easily trained to interrupt these chain of behaviors at home. Interrupting students with ASD when they are completing a chain of behaviors is an effective and relatively effortless way to increase opportunities to teach and generalize manding. Because there are so many opportunities, and because a student is naturally reinforced when they mand, it is also very likely that the manding will maintain.

One of the most important findings from this review was the lack of research done within inclusive settings. Although the IDEA of 2004 has called for an increase in educating students with ASD with their peers, no studies included in this review used the

inclusion classroom as a setting to teach children with ASD to mand. Several researchers (Koegel et al., 2010; Marion et al., 2011, Marion et al., 2012; Williams et al., 2000) regarded generalizing to the natural environment, but the only natural environment used was the home environment. No researchers addressed the possibility of generalizing the skill into a school environment.

The quality of the reporting on the setting of the environment was also an issue. It was not always clear if students were educated in schools, or if they spent their entire day in clinics and the home. Setting is significant because students should be generalizing their skills into natural environments. For example, if they are in a public school as either a primary or supplemental placement, this school counts as a natural environment.

The decreased rigor used by the researchers when reporting on placement created difficulty in interpreting the results. In order to truly understand the results of a study, one must understand the context of the study, or where the study took place (Horner et al., 2005). Only eight of the nineteen included studies that reported on both context and placement (see Table 2.9). A clear description of the setting strengthens internal and external validity. There are many different settings used to teach children with ASD. It was often unclear where the students in the included research spent the majority of their days. Several of the included studies used home programs as a study (Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010). If the students were programmed at a public school during the day, the opportunity to generalize the results into the schools would have been available. But it was impossible to determine if this was an option or not.

A limitation to the methodological rigor of this literature base was the inconsistencies across the researchers reporting verbal ability. Throughout the entire database, there was limited standardized testing and no commonality in reporting language abilities. Manding is a skill that all students with ASD must learn in order to reach independence. Even students with good verbal ability may not have the ability to mand independently across all settings. One could assume that students with more sophisticated verbal ability might learn to mand with less time and effort. We know that 70% of students with ASD will learn to at least use some functional phrases to communicate (Wodka, 2013). Researchers must attempt to reach some common way to report the language ability of their participants so that we can truly compare their research.

Another finding of this literature review was the lack of maintenance across studies. Only six of the studies included in this review (Lechago et al., 2013; Marion et al., 2011; Marion et al., 2012; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2011; Williams et al., 2000) included some measure of maintenance in their studies. Because the intervention takes advantage of naturally occurring motivation and then uses the actual item requested as a reinforcer, it is possible that maintenance occurred. However, it is dangerous to make this type of assumption. If the initial training occured in a clinical setting that didn't replicate the details of the natural classroom environment, skills may not have generalized into the classroom. The context of a clinical or home setting are very different from an active inclusion elementary classroom. Maintenance of skills can be difficult for students with ASD (Matson & Sturmey, 2011). To ensure that a quality intervention was in place, maintenance must be demonstrated and replicated.

The age of the students in this sample ranged from three years old (Jennett, Harris & Delmolino, 2008) to 12.4 years old (Shillingsburg et al., 2014). Nine of the nineteen included studies included at least one participant who was between six and twelve years old (Albert et al., 2012; Lechago et al., 2010; Lechago et al., 2013; Marion et al., 2011; Shillingsburg et al., 2014; Shillingsburg & Valentino, 2011; Shillingsburg et al., 2011; Sundberg et al., 2002; Williams, Perez-Gonzalez & Vogt, 2003). This range is important because it does demonstrate successful attempts to teach older students who have not yet learned to mand a way to express themselves and get their needs met. We know that preschool is not a magic window that closes for students with ASD, so it is important and valuable that the manding literature spans a wide range of ages.

Each of the nineteen interventions used within this body of literature was seen as socially valid. Although not always assessed outright, social validity was deemed successful if the outcome of the behavior changed was seen as socially important, and if the magnitude in the change of the dependent variable was socially important. Manding, or learning to make requests, is one of the most socially important language skills. It is needed to both get needs met and to interact with others. It is one of the foundational skills that we teach students with ASD. Using contrived motivating operations was an easy, socially valid intervention to increase student with ASD's ability to mand. Although not one of the qualifiers used in this review, it would be interesting to demonstrate that those involved in the intervention also found it to be socially valid.

Although the interventions were all socially valid, none of them met all nine of our standards for methodologically rigorous investigations. One study (Jennett, Harris & Delmolino, 2008) met seven of the standards. Six of the nineteen studies (Koegel et al.,

2010; Lechago et al., 2010; Lechago et al., 2013; Ostryn & Wolfe, 2011b; Shillingsburg et al., 2014; Sundberg et al., 2002) met six of the standards. Five of the nineteen studies (Albert et al., 2012; Koegel et al., 1998; Marion et al., 2010; Ostryn & Wolfe, 2011a; Williams, Donley & Keller, 2000) met five of the standards. The remaining seven studies (Betz, Higbee & Pollard, 2010; Endicott & Higbee, 2010; Marion et al., 2011; Roy-Wsiaki et al., 2010; Shillingsburg et al., 2011; Shillingsburg & Valentino, 2011; Williams, Perez-Gonzalez & Vogt, 2003) met less than five of the nine standards. In general, the quality of the research was not consistently sufficient to establish or contribute to an evidence base for interventions to teach manding using motivating operations. Yet this sample remains important because it does give a good start to understanding how best to use contrived MOs as interventions.

None of the studies were conducted in inclusive settings, consequently there is no finding that suggests types of interventions that may be effective for improving manding within the inclusive public school environments. This is problematic because the law mandates inclusive practices. The field must examine the public school setting as a place to teach students with ASD. The variables in these setting are different from those found in clinics and at student's homes, and there are many more uncontrolled context and factors. These settings will more closely approximate the variables that students with ASD are likely to encounter across their entire lifetime. Learning to mand in an inclusive environment is the only way to determine if a student can develop communication in schools. This is critical if students are to develop any level of level of independence. The inclusive setting should be examined and held to the same rigorous standards as are clinics and home settings.

Despite the overall lack of methodological rigor across the studies, we found some relative methodological strengths (see Table 2.5). Social validity was high. The research designs chosen were effective and useful for demonstrating control over manding behavior. The data analysis done by the authors was sound.

Implications for Research

It is clear that these researchers have established an intervention that can increase a student with ASDs ability to mand. It is also clear that we have a need to expand this research to the inclusive elementary school environment. We are mandated by IDEA (2004) and NCLB (2002) to educate students with ASD in their natural environment. Children with ASD have the right to be treated like all students with disabilities. To teach them to mand only in clinics, in 1:1 settings, and in their homes implies that these students will never have a need to mand in less controlled settings, for example, out in the community where multiple distractions will be present. We must find a way to examine interventions within the natural general education setting for children with ASD.

Students with ASD are spending increasing time in public school inclusion classrooms. Every attempt should be made to document effective interventions for the teachers of these students. Otherwise, we run the risk of students who receive state of the art teaching when they are in specialized clinics, but not for those who are not lucky enough to live near one of these clinics, or to have need for this level of intervention. We know the benefits of inclusion for students with ASD. Therefore, there is a need to identify, study, and prepare guidelines for effective interventions to teach children with ASD within the natural general education setting.

CHAPTER 3

METHOD

Single subject research is designed to be replicated and to produce a body of work that can be used to understand interventions for each unique variable that is studied (Cooper, Heron, & Heward, 2011). Because single subject research is implemented with small numbers of individuals, it is critical to explicitly and discretely describe the participants, setting, materials, dependent variable, and independent variable.

Participants

Single subject research requires a detailed description of the participants in order to recruit and replicate a similar set of participants (Horner, 2005). It is important to provide information on several different variables of the participant, including their age, grade, race, SES standing, diagnosis and how the diagnosis was provided (Mulchaey, Krezmien, & Travers, in press). It is also important to understand how the participants were selected (Horner, 2005).

Participant Selection

Parents/guardians of each of the six students in the potential participant pool were sent a consent form (Appendix A) providing information about the nature of the intervention in order to make an informed decision regarding participation in this study. This consent form include a description of what participation entailed, including any known risks, inconveniences or discomforts that might have occurred while students were

participating in the interventions. Two copies of the consent form were signed by the parent, with one copy retained by the investigator and one by the participant's parents. The first two students whose parents responded by signing the consent forms for the intervention were selected for participation. The students were then assessed with both the VB Mapp and two 20-minute language samples. Students who qualified for participation had significant language delays defined by decreased performance on Manding Behavior on the VB Mapp and manding in independent language samples at a rate of less than one mand per minute.

Our recruitment process resulted in two students who fit the criteria for inclusion in the study. Benjamin was the first student whose parent returned the consent form and he also qualified as significantly language impaired to need manding intervention within his inclusion classrooms. The second student whose parent responded was found to have mastered most of the manding repertoire on the VB Mapp. His manding rate in the classroom was 10 mands during the 20 minute observation. He did not qualify to participate in this manding intervention. The third student whose parent responded with a signed consent form was Eva. Assessment indicated that she qualified as significantly language impaired and would likely benefit from manding intervention within the inclusion environment.

Participant One

Benjamin was a 7-year-10-month white male placed in a 2nd grade inclusion classroom. Benjamin did not receive free and reduced lunch. He had been diagnosed with Autism Spectrum Disorder (ASD) by a medical doctor and was receiving services from the school district under the IDEA of 2004. Benjamin was non-verbal and used a speech-

generating device (SGD). This consisted of an IPad with Pro-lo-quo-2-go loaded on as an application. Benjamin had a behavior plan in place for aggressive and other inappropriate behaviors across the school day and across all school settings. He was out of the classroom, educated in an intensive needs classroom, for the majority of the school day.

Benjamin's use of the SGD to engage in verbal behavior was assessed across several domains using direct observation and assessment under relevant environmental conditions. Results of the VB-MAPP (Sundberg, 2008) reported that using the SGD, Benjamin could emit 2 word phrases but required echoic imitative or other prompts. He could emit at least 4 mands without prompts, with the item present. He could generalize 6 mands across 2 people, 2 settings and 2 different examples of a reinforcer. He could not spontaneously emit 5 mands, even with the item present. Benjamin could tact at least 25 items when asked, "What's that?" He could not generalize tacts, tact actions, or tact 2-component interactions. These results indicated his ability to mand corresponded to that of a student who was younger than 18 months and his ability to tact was younger than 30 months of age. Two 20-minute language samples were taken, one in the classroom during math and one in the classroom during language arts. Benjamin requested independently only once during these language samples, which indicates a rate of less than one independent request per 20-minute language sample.

Participant Two

Eva was a verbal, 9-year-4-month white female placed in a 4th grade inclusion classroom. She did not qualify for free and reduced lunch. She had been diagnosed with Autism Spectrum Disorder (ASD) by a medical doctor and was receiving services from the school district under the IDEA of 2004. Eva's verbal behavior was assessed across

several domains using direct observation and assessment under relevant environmental conditions. Results of the VB-MAPP (Sundberg, 2008) reported that Eva could mand within routines in the ILC classroom. She could mand to stop an activity and could use some adjectives when she manded. She was not able to give directions or instructions or to mand for others to attend to her own behavior. Eva was able to tact color, shape and function. She could tact using prepositions and adjectives, using 4 or more words. Her tact vocabulary was thought to be at least 1000 words. These results indicated her ability to mand and tact corresponded to that of a student who was between 30 and 48 months. Two 20-minute language samples were taken, one in the classroom during math and one in the classroom during language arts. Eva had one independent mand during the first 20-min language sample, and none during the second language sample which indicates a rate of independent manding less than one independent mand per 20-minute language sample. Additionally, Eva had a behavior plan for some minor, inappropriate behavior (for example – added reinforcement for remaining on task). She was out of the classroom, educated in the ILC classroom, for the majority of the school day.

Interventionist

The intervention was implemented by the primary investigator, with no fee for services. This study was approved by the University of Massachusetts Institutional Review Board (IRB). The primary investigator of this study served as the interventionist for both participants during baseline, intervention, and generalization/maintenance sessions. The investigator was a 46-year-old white female who was fulfilling the partial requirements of her doctoral dissertation. She had 27 years of experience working with students with ASD in both public and private school settings. In addition, IOA and

validity data were collected by two research assistants. The first research assistant was a 25-year-old Turkish woman who was enrolled as a student in a doctoral program. She had 4 years of experience working with students with ASD. The second research assistant was a 19-year-old white/native American woman who was enrolled at a University as an undergraduate student. She had 2 years of experience working with students with ASD.

Setting

Single subject research requires a detailed description of the research setting to allow for replication (Horner et al., 2005). Each setting included in the study should be described in a way that allows the reader to visualize the setting, and to set up a similar environment during replication. This study included three settings: the general education classroom, the Intensive Learning Center (ILC); and the summer school classroom.

General Education Classroom

Participants were recruited from a public elementary school located in a diverse town in western Massachusetts. The district had 4 elementary schools, which consisted of kindergarten through sixth grade. Each school had 2-3 classrooms of students per grade. Classrooms in the school were about 20’ by 30’, with large windows and florescent lighting. Each classroom was similarly broken into several learning areas. Each had a 5’ by 5’ open space containing a white board, flip chart and teaching materials where students could engage in group lessons with the teacher. Another section of the class had small tables and chairs grouped together in front of a smart board for both individual seat work and group instruction. One to three small study carrels were located around the perimeter of the room for individual and 1:1 work. The room contained several

bookshelves and file drawers containing teaching materials and supplies and a teacher desk with a computer.

Intensive Learning Center

The intensive learning center (ILC) was located within one of the district elementary schools. It consisted of two classrooms. Each classroom was approximately 15 by 20 feet long and included attached bathrooms for the students. The ILC was broken down into independent learning centers which included a small 2 by 3 foot table and two chairs for both independent and 1:1 work. These centers included shelves to store student work materials and school supplies. There was a larger table in each room, set in front of a white board that could be used for group instruction. A small, 4 by 4 foot space was identified by a couch, rug and shelf of toys and books for students to use to take breaks. The room was climate controlled and had several large windows that look out into a courtyard with bird feeders.

Summer School Classroom

Summer school for this district took place at a different elementary school from the natural school setting for both participants. The summer school program consisted of two classrooms, each approximately 15 by 20 feet long. Each classroom was broken into several learning areas. Each had a 5’ by 5’ open space containing a white board, flip chart and teaching materials where students could engage in group lessons with the teacher. Another section of the classroom had small tables and chairs grouped together in front of a smart board for both individual seatwork and group instruction. One to three small study carrels were located around the perimeter of the room for individual and 1:1 work.

The room contained several bookshelves and file drawers containing teaching materials and supplies and a teacher desk with a computer. The room was climate controlled.

Materials

When teaching a student to mand, it is important to have materials that a student wants and is motivated to acquire. One way to increase the likelihood that a student wants a material is to manipulate the student's motivation (Shafer, 1995). For instance, just because a student is in the classroom and it time to read, we cannot be sure that the student is motivated to read. However, if we use the student's preferred reading material, and present them a book on tape but no tape recorder, we can assume that we have likely increased the student's motivation to ask for a tape recorder. The manipulation of the tape recorder is an example of a contrived motivating operation (CMO) using an interrupted chain.

Motivating operations

Motivating operations are environmental variables that influence the effectiveness of a reinforcer. Motivating operations can make a reinforcer more or less desirable. Deprivation and satiation are two ways that we can clearly see the effects of a motivating operation on a reinforcer. For instance, food is often thought of as a reinforcer. In a state of deprivation, when one is hungry, food as a reinforcer might be highly effective. In a state of satiation, following dinner or a large snack, food may not be as effective a reinforcer.

Motivating operations have been described as a type of environmental variable that set the occasion for learning by both altering the value of an item as a reinforcer or punisher, and by altering the frequency of behaviors that have been followed by that stimulus, object or event (Cooper, Heron, & Heward, 2007; Sundberg & Michael, 2001). One way to create learning opportunities in an inclusion classroom is to capture and

contrive motivating operations that occur in a student's natural environment (Shafer, 1994). For example, one could create a learning opportunity for a student to mand (request) by creating a state of deprivation in the classroom and taking advantage of this opportunity to teach the student to request the item it wants. If one wanted to teach a student to request a pencil, they could hide the pencil, and then, when the student was looking for the pencil, they could teach the student to mand (request) for the pencil. Receiving the pencil would both end the state of deprivation and increase the likelihood that the student would mand for a pencil the next time they did not have one.

Contrived motivating operations (CMO)

A CMO occurs when the environment is manipulated to either increases or decreases the reinforcing effectiveness of some stimulus, object, or event, and alters (increases or decreases) the current frequency of all behavior that have been reinforced by that stimulus, object, or event. In order to teach manding within the natural inclusion environment, the use of CMOs will increase the likelihood that the participant will want to mand for an item.

For this study, in order to increase the likelihood that we had CMOs, the manding intervention used an interrupted chain procedure. The materials consisted of toys and activities that were made of two parts. Both parts needed to be present for the activity to be functional, such as paper and crayons, or juice and a straw (Jennett, Harris, & Delmonlino, 2008). The student had a history of using both parts, and therefore had an expectation that both halves of the item would be present. This is a "missing item" interrupted chain. If the student indicated they would like to do an activity, and half of that item was not present, we were likely to create a CMO. For example, if a student had

a juice box, but no straw, we may have created a need state (CMO) for the straw, and the participant was more likely to mand in order to access the straw.

Mand items

As shown in Table 3.1 and 3.2, a standard pool of 24 two-part items was selected for each participant based on activities that were traditionally found within the inclusion classroom the students attended. This group of two-part items was broken down such that each item had one of its two pieces in each of two sets. Set A consisted of one member from each pair, and Set B consisted of the other member from the pairs. For example, to break the juice and the straw into different sets, the juice went into Set A, and the straw went into Set B. To break the dice and printed numeral cards into two different sets, the dice went into Set A, and the printed numeral cards into Set B. This created two similar sets of materials. During each of the experimental conditions, the student was allowed to access the items in one set, which should have set up a CMO for the item in the other set.

Preference assessment

Manding is more likely to occur when a student wants something. We increased the chance of a participant wanting something by using a CMO in the natural environment. We created CMOs by using high preference items as intervention materials (Shafer, 1995). To determine that we had high preference items, 24 items selected for inclusion within the intervention were used in a preference assessment for each participant. The items were randomly placed into three groups for preference assessment, and the preference assessment procedures were run on each group individually.

The preference assessment was based on the procedures of Carr and colleagues (2000). The first group of eight items were placed in front of the participant. The

participant was told to select an item, and allowed 10 seconds to make his selection. After 10 seconds with no selection, the direction was repeated. Once the student made a selection, he was given 20 seconds to play with the item or to do one trial with the item, then that item was removed from the array on the table and a new trial began with the remaining seven items. Attempts to reach for more than one stimulus item would have been blocked and the direction would have been repeated, however this did not happen during the assessment. After an item was selected, the remaining items were repositioned in a quasi-randomized manner. The process was continued until all items had been selected. The procedure was then implemented two more times for each group of eight items on the same day, during 3 different sessions.

In order to assess which items were the highest preferred, the items were given a score that depended on their selection position. For instance, the item selected first, was scored as a 1. The items that was selected second was scored with a 2, until the eighth item selected was finally scored an 8. This was done for each of the three preference sessions for each participant. Then, for each item, the three assigned scores were averaged, with the resulting average used to rank order the items. For both participants, the items with the highest preference ranking within each condition were selected for use in the study (see Table 3.1 and 3.2). There were several exceptions to this rule. For Benjamin, the spinner was ranked as a higher preference item than some of the other materials in the math items. However, when Benjamin had the spinner, he used it to flick and also tried to pull the spinner off the card. It was decided to not use the spinner and go with the next highest preference item. In Benjamin's ELA condition, a book was used twice, once with pictures and once with sight words. Both were ranked as highly

preferred. Because Benjamin was using the books with the pictures in his ELA instruction within the classroom, this item was kept. The book with words was considered too similar for use in the intervention, so it was taken out of the pool and the next highest preferred item was selected. Eve also had one substitution. Her preference rankings indicated that she highly preferred the white board with items used in both the ELA and Enhancement conditions. These items were deemed to be too similar, so the white board was taken out of the ELA condition and the next highest preferred item was selected for inclusion in the study.

Experimental Design

This study employed a single case multiple baseline across activities design with a replication with a second participant. In a multiple baseline across activities design, a functional relationship between the intervention and the dependent measure is demonstrated when there is a change in level and trend from baseline to the intervention phase, and when the change in level and trend is observed for three activities (Tawney & Gast, 1984). The magnitude of the change represents the strength of the intervention. A replication is demonstrated when a functional relationship between the intervention and the dependent measure is demonstrated for a second participant.

Dependent Variable

When using multiple baseline design, data on the responses across all conditions should be collected and plotted separately to provide a graphic representation of the effects of each condition on the dependent variable(s) (Tawney & Gast, 1984). The response requirements for this experiment were different for each of the participants selected and correspond to their verbal abilities. Eva was able to respond with short

sentences and was required to use a full sentence, for example, “Can I have the X.” or “I want item”. Benjamin used a SGD and was asked to respond using a one button press. He had pictures of the item used in each condition on a pro-lo-quo-2-go page on his SGD, and he needed to press the picture on his SGD that corresponded with the item, and then push the button that made the SGD speak the selection.

The dependent variable for the intervention was the percentage of correct trials per 10-minute session. This is a standard measure in single-subject research and yielded information on how quickly the participant forms concepts (learns to learn) (Tawney & Gast, 1984). A trial in the embedded mand session consisted of the delivery of a discriminative stimulus (SD), a response or correction, and the delivery of a consequence. The student received natural reinforcement for correct responding (receiving the item requested) and a correction procedure for incorrect responding using a least to most prompting strategy.

A correct response was comparable across conditions. Specific requirements were determined based on the verbal repertoire assessed prior to selection of the participants. Requirements for Benjamin were that he use his SGD to request the name of the item. Requirements for Eva were that she use a full spoken sentence, “I want …” Participants were marked as manding correctly if they responded within 5 seconds to the presentation of the item from Set A with a mand for the corresponding item in Set B. Participants were marked as incorrect if they did not respond to the mand after 6 seconds or if they manded for something other than the item. If a correction procedure was implemented, that trial was marked as incorrect, and no data was recorded for the correction.

Independent Variable

The independent variable was a manding intervention. Each participant received 1:1 instruction from the lead researcher during daily sessions of embedded mand training. All sessions were 10 minutes in length and no more than two sessions were conducted on a single day. All sessions took place in the natural inclusion classroom, during ongoing classroom instruction. Procedures are described in detail below.

Experimental Conditions

When doing single subject research, it is important to carefully describe each of the conditions so that another researcher would be able to systematically replicate the condition with precision (Horner et al., 2005). In this experiment, I based the mand training session on one described by Jennett, Harris, and Delmolino (2008). The mand session was embedded directly into ongoing classroom activities. When a participant was in a mand training session, all the materials from one of the two sets (either set A or B) were placed around the table within arm's reach of the participant. Items from the alternating set were also present, but were kept in an opaque box, just out reach of the student. The participant initiated a trial by indicating a desire to have an item by touching the item in any way, or by saying the name of the item. Correct responses were naturally reinforced with access to both items (from Set A and B) and one academic teaching trial being run. For example, if the item from Set A was juice, the participant initiated a trial with juice by picking up the juice box. The teaching trial focused on the straw (which is an item from Set B). Once the student correctly manded for the straw, he had access to both the juice box and straw for one sip of juice. If the participant initiated a trial during the ELA condition by picking up a book (which is an item from Set A), the teaching trial

would focus on the matching picture cards. If the student made a correct mand for the picture cards, the researcher read one page of the book, and then asked the student to do one matching trial before removing the materials and waiting for the next initiation. Trials continued for the full 10-minute session.

Baseline

Prior to the introduction of the intervention, baseline data was collected. It was important to have a baseline phase at the start of each condition. This phase allowed the measurement of the dependent variable prior to the intervention. In addition, repeated measures during the baseline phase provided comparison data collected within the intervention phase, which helped to identify patterns of responding across the different conditions of the experiment (Horner et al., 2005).

For this research, baseline procedures were similar to the baseline condition procedures used by Jennett, Harris, and Delmolino (2008). Baseline was collected within the inclusion classroom. Items identified as high preference were placed around the table or desk of the participant. Once the participant indicated an interest in one of the items, the instructor presented the paired target item and manipulated it briefly, and then hand the initial item back to the participant. The instructor then held onto the paired item, waited for 5 seconds without prompting, and gave the item to the participant if he or she made a correct mand for the item. The participant was allowed to do one academic trial with the item (or in the case of the juice/straw and popcorn/plate, to have one sip of juice or two pieces of popcorn). If the participant did not make a request but still demonstrated an interest in the item, the instructor waited 5 seconds and then handed the participant the

item and allowed them to do one academic trial with the item, but this was not considered a correct response.

Tact training intervention

During the first intervention for Eva, rates of responding remained at zero. Although the materials were familiar to the student, and the student had a tact repertoire of over 1000 items, the researcher and research assistant realized the participant may not have been able to tact the names of the items that were used within the intervention as parts of each activity. A one-time intervention was given that consisted of Eva being taught to tact the names of the four items used within the math intervention. The intervention consisted of the materials being presented to her in a discrete trial format. Each item was held up and she was asked, "What is this?" If she answered, she received a token for correct responding. After 10 tokens, Eva traded in for a small piece of edible (a cookie, or piece of chip). If she made an error, she was told the correct name and asked to repeat it. She was given praise for repeating the correct name. The session lasted approximately 10 minutes. At the end of the session, Eva was able to correctly name all the items that were used in the first intervention condition. On the following day, the researcher presented the items to Eva and asked her what they were. She was able to correctly label the items on the first presentation. Therefore, the intervention condition was resumed.

Intervention

Following stable rates of responding in baseline, an intervention to teach mands was implemented. This intervention was similar to the mand training procedures used in the research done by Jennett and colleagues (2008). During this phase, items identified as

high preference were put out around desk or table of the participant. Once a participant indicated an interest in one of the items, the instructor presented the paired target item, and manipulated the item briefly. The instructor held onto the paired item, waited for up to 5 seconds without prompting, and gave the item to the participant if he or she correctly manded for the item. The participant was allowed to use the item for one academic trial.

If the participant did not make a request but still demonstrated an interest in the item, the instructor continued to hold onto the item and modeled a correct response (e.g., "I want X") using either verbal language or the SGD. Correct prompted mands were followed up with the naturally occurring reinforcement of receiving the requested item, and allowing the participant to manipulate the item for one academic trial.

If the participant still did not make a request after the modeled respond, but still indicated a desire to have the item, the instructor offered a second, more restrictive prompt (e.g., "say, I want X"). After 10 seconds with no response, the next level of prompt (a point prompt) was used with Benjamin. If he still did not mand, the instructor modeled the correct response using the SGD. Although a similar prompting hierarchy had been developed for Eva, she did not need a more intrusive prompt level than, "Say, I want X."

Prompt fading

Following two correct responses to the modeled prompt, the interventionist waited for the participant to approach another item. Once the approach was made, the instructor presented the paired target item, manipulated the item briefly, and then waited for up to 5 seconds for the student to mand for the item. If the participant did not mand during this second trial, the instructor implemented a prompt fading procedure. The

instructor followed the prompting procedure described prior to prompt mands for the item, then allowed access to the activity for one academic trial. This was scored as a prompted response. If the participant still demonstrated an interest in the item, but did not provide a prompted correct response, the interventionist waited, continuing to play with the item, and repeated the prompt hierarchy every 7 seconds until the participant made a correct response or lost interest in the material.

Training exceptions

The instructor planned to respond to different training exceptionalities by systematically replicated the response of Jennett and colleagues (2008). If a participant only indicated interest in one item across two consecutive sessions, the item would be removed from the array for the remainder of the training. Another highly preferred item chosen from the pool of items initial assessed would be selected as a replacement item for the remainder of the training, and would have been reported in the final results. Although Benjamin showed an intense interest in popcorn, he always manded for at least one other item and sometimes all four of the available items during the enhancement condition, so popcorn was not replaced with another high preference item. No other item was preferred exclusively during the intervention conditions for either participant.

If a participant played with one of the target items, but did not express interest in the paired target item, the item would have been removed from the participant, but returned into the array of items within 15 seconds. The instructor would then attempt to interest the participant in some of the other items. If the participant returned to the item and played with either appropriately or engaged in self-stimulatory behavior for 2 consecutive minutes, the item would have been removed from the array for the remainder

of the training session, but would be returned for the following day's session. Both participants expressed interest with the paired targeted items throughout each of the intervention conditions.

If a participant did not indicate interest in any of the items, the instructor would have played with items in an attempt to engage the child and stimulate interest. Both participants did indicate interest in items throughout each of the intervention conditions.

Natural reinforcement

Manding is a way to access materials. Access to materials requested is likely to serve as natural reinforcement. In this study, we used an activity that needed two parts to be functional, and provided the student with one part of the activity. A participant with one half of a preferred two part activity was likely to mand for the second half of the activity. If the student manded, we assumed that a CMO had been created for the second half of the activity. Therefore, giving the student what they wanted, the second half of the activity they requested, likely served as natural reinforcement. Natural reinforcement has been defined as pairing a response with a reinforcer that is functional to that response (Ferster, 1967). The use of natural reinforcement has been shown to increase rate of responding over arbitrary, contrived artificial reinforcers (Koegel & Williams, 1980; Williams et al., 1981).

During the embedded mand training intervention, the items chosen as intervention activities consisted of two parts. Access to one part likley created a CMO for the second part. Thus, access to the second item functioned as a natural reinforcer, and there was not a need for additional reinforcement. For example, if a student had a juice box but no straw, there was a CMO created for the participant to mand for the straw. Once the

student received the straw, he was allowed to consume a sip of juice. The consumption of the juice served to naturally reinforce the mand used by the participant.

Maintenance

Students with ASD often have difficulty maintaining new skills. Using CMOs and natural reinforcement to teach participants to mand for academic items found within the natural general education classroom was planned to lead to increased maintenance of manding within the classroom. To measure the interventions maintenance, follow up intervention probes took place in the classroom at one- two- and four week intervals. In addition, two follow up language probes were taken within the natural inclusion classroom for each participant. If the skill maintained, we would expect two things: the rate of manding should remain similar to the rate of manding recording during the final phase of the intervention, and rate of manding within the classroom should have increased over the language samples taken prior to baseline.

Generalization

Generalization is demonstrated if we teach a student a skill with one set of items, people and settings and then they perform the skill with a different set of novel activities, with novel people, and/or in a novel setting. To understand if a skill has generalized within the classroom, this study used a 20-minute language sample at the end of the study at a time of day different from the ELA, Math, and Enhancement period. Additionally, a data probe was taken four-weeks after the end of the intervention to measure the student's use of mands within a novel classroom environment - the summer school classroom. If the skill had generalized, we expected to see the rate of manding within this novel school environment was similar to rates of responding demonstrated within the inclusion

classroom and that the rate had also increased over rates of manding during language samples taken prior to baseline.

Inter-Observer Agreement

When doing single-subject research, it is important to collect inter-observer agreement to demonstrate the validity of the results (Richards, Taylor, & Ramasamy, 2014, Tawney & Gast, 1984). For this research, inter-observer agreement (IOA) was collected on all variables (see Attachment 3.2). In order to conduct the inter-observer agreement, a second observer was present for at least 28% and as much as 45% of sessions across all conditions. Both the researcher who was running the intervention and the research assistant took data on the student's manding behavior. The results of the data were compared and scored for agreement and disagreements. IOA was assessed using event recording (IOA= (smaller frequency/larger frequency) x 100) and was used to assess the agreement on correct manding across both participants and all conditions. Total inter-observer agreement ranged from 90% to 100% agreement across all conditions.

IOA was analyzed for each variable. For Benjamin, overall agreement across the study was 97% with a range of 81%-100% (see Table 3.3). Overall, agreement on occurrence was 96% (range 92%-100%) and agreement on nonoccurrence was 100% (range 75%-100%). Total agreement on independent manding was 98% (range 83%-100%). Total agreement on the occurrence of an independent mand was 99% (range 86%-100%. Total agreement on the nonoccurrence of an independent mand was 98% (range 78%-100%). Total agreement on prompted mands was 99% (range 88%-100%). Total agreement on the occurrence of prompted mands was 99% (range 83%-100%).

Total agreement on the nonoccurrence of prompted mands was 100%. Total agreement on no response was 99% (range 88%-100%). Total agreement on the occurrence of no response was 99% (range 82%-100%). Total agreement on the nonoccurrence of no response was 98% (range 75%-100%). Total agreement on prompted engagement was 100% across all sessions.

For Eve, overall agreement across the study was 96% with a range of 60%-100% (see Table 3.4). Overall, agreement on occurrence was 96% (range 55%-100%) and agreement on nonoccurrence was 97% (range 66%-100%). Total agreement on independent manding was 99% (range 90%-100%). Total agreement on the occurrence of an independent mand was 100%. Total agreement on the nonoccurrence of an independent mand was 99% (range 90%-100%). Total agreement on prompted mands was 99% (range (50%-100%). Total agreement on the occurrence of prompted mands was 100%. Total agreement on the nonoccurrence of prompted mands was 97% (range 90%-100%). Total agreement on no response was 97% (range 60%-100%). Total agreement on the occurrence of no response was 96% (range 96%-100%). Total agreement on the nonoccurrence of no response was 97% (range 66%-100%). Total agreement on prompted engagement was 100% across all conditions.

Treatment Fidelity

Treatment fidelity ensures that the intervention is done the same way each time, which provides increased reassurance that the intervention is the reason for any change in the dependent variable (Kazdin, 2011). Procedural reliability was obtained to ensure that the procedures for embedded mand training sessions were implemented as planned. An independent observer used a fidelity checklist outlining the exact order of steps in the

treatment to be followed (see Appendix B). For Benjamin, fidelity data was gathered for at least 14% and as much as 22% of all sessions in most conditions. The first baseline condition was an exception, no fidelity was taken during this condition. Fidelity was 100% across all the other conditions. For Participant Two, fidelity data was gathered for at least 14% and as much as 40% of sessions throughout each condition. Fidelity was 100% across all conditions.

Social Validity

Social validity is a procedure following an intervention that measures the interventions worth to society (Kazdin, 2011). Interventions should be planned that are relevant to everyday life. The procedures used within the intervention should be acceptable to the consumers, and they should seem reasonable to replicate with other students. The outcomes of the interventions should also be deemed important for the participant. Social validity can be tested using subjective evaluation (Kazdin, 2011). Persons who are familiar with the participant can be in a position to judge the effectiveness and social validity of the intervention.

Manding is a behavior important to everyday life. This behavior was chosen because of its social validity and importance to children with ASD who are in the inclusion classroom. Social validity was measured using a brief questionnaire, with 10 simple questions scored using a 5-point Likert rating scale. This allowed for the subjective collection of educator's data. Following the completion of this intervention, the classroom teachers associated with each participant were provided with this questionnaire to assess the social validity of the procedure (see attachment 3.4). Each question was rated on a scale of 1 (not at all) to 5 (very much) and a column for "I don't

know” was also included. The dimensions included student enjoyment, ease of implementation, appropriateness of intervention, appropriate communication, and whether the teachers and paraprofessionals would recommend the use of either of the procedures again in the future. Results of social validity are reported within the results.

CHAPTER 4

RESULTS

As shown in Figures 4.1 and 4.2, both participants manded at near zero rates while within the inclusion classroom baseline conditions. During the intervention, both participants increased their rates of manding behavior to at or near 100% of opportunities. The manding rates maintained following 1, 2, and 4 week manding probe sessions. Additionally, the manding behavior generalized into a new condition during summer school.

Baseline

Stable rates of responding are necessary during baseline to allow for the measurement of the dependent variable prior to the intervention. Repeated measures during the baseline phase provide comparison data collected within the intervention phase, which help to identify patterns of responding across the different conditions of the experiment (Horner et al., 2005).

Participant 1

During the first and second baseline conditions, Benjamin had zero rates of manding (see Figure 4.1). In the final condition, he had zero rates of responding for the first ten sessions. During session 11, his rate of manding increased to 30%. It returned to zero rates of responding in session 12.

Participant 2

During the first and second baseline conditions, Eva also had zero rates of manding (see Figure 4.2). During her third baseline condition, she had zero independent

mands during the first 8 sessions. However, her rates of independent manding systematically increased over the next four sessions to 100% of trials.

Intervention

Both students demonstrated systematic increased manding during the embedded mand intervention. Benjamin increased his manding from zero (or near zero) rates in baseline to at or near 100% of trials by the end of the intervention. Eva increased her rates of manding to at or near 100% of trials by the end of the intervention. An intervention phase was not implemented with Eva in her third experimental condition because she began to demonstrate increasing rates of manding during baseline which continued to climb until they reached 100% of opportunities.

Participant 1

Following zero rates of responding during the baseline of the first condition (enhancement), Benjamin demonstrated an increase in his rate of independent manding to 33% in the first mand intervention session (see Figure 4.1). These rates continued to systematically increase to 50%, 69%, 86%, and 93% over the next 6 sessions to a final average of 100% of session trials. Baseline was continued in the second condition (math) until Benjamin had stable responding during baseline and responding within the first intervention condition had reached at least 50% (see Figure 4.1). During the first session of the intervention, Benjamin's rate of responding increased to 25%. The rate dropped to 11% in the second session, and then continued to increase systematically across the next four sessions to 100% of trials. Benjamin's third intervention condition (language arts) was begun once baseline was stable and responding had reached at least 50% responding during the second condition (see Figure 4.1). Rates of independent manding increased to

20% during the first intervention condition. Rates continued to increase to 93% by the third intervention condition, and reached 100% until the 6th session of intervention.

Participant 2

Following zero rates of responding during the baseline of the first condition (math), Eva's rates of responding remained at zero rates for the first two sessions of intervention. A quick, one session tact training intervention was implemented. Following this intervention, Eva's rates of independent responding increased to 16% during the third session of the intervention. Rates of responding systematically increased to 55%, 70%, and then reached 100% on the 6th session of the intervention. Baseline was continued in the second condition (enhancement) until Eva had stable responding during baseline and responding within the first condition had reached at least 50% (see Figure 4.2). During the first session of the intervention, Eva's rate of responding increased to 60% and continued to increase systematically across the next two session to 100% of trials. Eva's rate of independent manding during the third baseline was stable until the 8th session. This corresponded with Eva manding at 20% in the first condition. As manding behavior continued to increase in Conditions One and Two, Eva's baseline rates of responding also increased until it reached 100% of trials in the 12th baseline condition.

Sessions to criterion

Benjamin's rate of responding rose gradually during the first four sessions of the intervention to 80% independent mands and then reached 100% after a total of six sessions. In the math condition, rates of responding did not go above 80% until the sixth session of the intervention, when they reached 100%. During the third condition (language arts), the participant rates of responding were over 80% by the third session,

however they rose gradually over the next three session, again reaching 100% during the sixth session.

During condition one (math), Eva's rate of responding was at zero rates for two sessions until a tacting intervention was implemented. Following the tacting intervention rates of responding rose to only 16% during the third intervention session, and gradually rose to 100% by the sixth intervention session. During the second condition (enhancement), rates of responding rose to 60% when the invention was first introduced, to 80% independent responses during the second intervention session, reaching 100% during the third intervention session. Eva began independently manding during the baseline phase of the third condition (ELA), and no intervention was needed to increase rates of responding to 100%.

Maintenance

Maintenance probes were collected at one, two and four week intervals. Both participants maintained their high rates of responding during all maintenance probes (see Figures 4.1 and 4.2).

1-week

Maintenance data was collected one week after the end of the intervention. Both participants maintained high rates of manding during the 1-week maintenance probe. Benjamin maintained responding in the first condition (enhancement) at 100%. He maintained independent responded in the second and third condition (math and ELA) for 95% of trials. Eva maintained independent manding rates for 100% of trials during each of the three condition's maintenance probes (math, enhancement and ELA).

2-week

Maintenance data was collected again two weeks subsequent to the end of the intervention. Both participants maintained 100% independent mands for each of these 2-week maintenance probes with the exception of condition one for Eva. Her rates decreased slightly to 94% of trials during this condition.

4-week

Final maintenance data was collected at least 4-weeks following the end of the intervention condition. Because of the timing of the intervention and the end of the school year, the only 4-week probe that was conducted in the inclusion classroom was the first condition for Benjamin. During this probe, Benjamin maintained 100% responding. The other conditions were run in the summer school classroom. During this 4-week probe, all rates of responding maintained at 100% with the exception of condition one for Eva. Her rates decreased slightly to 92%.

Generalization

Generalization was assessed by collecting the final 4-week probe at the summer program for all but one condition. Benjamin had a four-week probe run at the school, so an additional probe was run 7-weeks after the end of his first condition. During the generalization probe, both participants maintained high rates of responding throughout all conditions. Benjamin showed a slight decrease in responding from 100% down to 96% of trials in condition one, and maintained 100% responding in conditions 2 and 3. Participant Two showed a slight decrease in responding from 94% in Probe 2 down to 92% in the generalization probe, and maintained 100% responding in conditions 2 and 3.

Language probes were taken in the inclusion classroom in the last week of the school year. This was not quite 4-weeks after the end of the intervention for most conditions, but was done early due to the impending end of the school year. Both participants had increased rates of independent manding during the generalization probes. Benjamin manded using his SGD 5 times during the first 20-minute language observation and 2 times during the second 20-minute language sample for an average over the two sessions of 3.5 independent mands. This was a small but significant increase for this non-verbal student. Eva's rate of manding increased to 4 independent mands during the first language observation and to 2 independent mands during her second language probe.

Social Validity

A social validity questionnaire was given to the two participating classroom teachers at the end of the study (see Appendix C). This questionnaire consisted of 10 statements about the study. The teachers were asked to rank their agreement with each statement using a 5-point Likert scale from "fully agree" to "fully disagree" and one category for "I don't know". Both participating teachers agreed with 7 of the 10 questions. They agreed that student enjoyed the intervention and that the intervention was focused on an important behavior. They also agreed that the intervention was easy to incorporate into the classroom, with reasonable requirements that they believed did not disrupt the classroom. They both agreed they would use the intervention again. Only one participant agreed that the intervention was easy to implement, the other stated that they didn't know if the intervention would be easy to implement. One participant was neutral on whether the intervention increased the number of requests the student made, the other

didn’t know if the number of requests increased. Both participants responded that they didn’t know if they could implement the intervention accurately in the classroom.

In addition, both teachers talked to the researcher about the student’s behavior during the intervention. Although these are anecdotal reports, it is worth noting that Benjamin’s classroom teacher commented about her perception of Benjamin’s increased engagement during the intervention. She also commented that he seemed to enjoy the activities he completed during the intervention and that he appeared to be focused and on task. Eva’s classroom teacher also made anecdotal comments that he enjoyed having Eva in the classroom, and that Eva seemed to have enjoyed her time working during the intervention.

CHAPTER 5

DISCUSSION

This study showed that two students with autism spectrum disorder were able to increase their ability to mand in the inclusive, general education environment following an embedded mand training intervention (see Figure 4.1-4.2). Both students were able to increase their rates of manding from near zero rates of independent manding to high rates ranging from 92%-100%. The changes in manding are similar to the changes observed in studies that teach students with ASD to mand at clinics and segregated settings (Alberto et al., 2012; Betz, Higbee & Pollard, 2010; Endicott & Higbee, 2007; Jennett, Harris & Delmolino, 2008; Koegel et al., 1998; 2010; Lechago et al., 2010; 2013; Marion et al., 2010; 2013; Ostryn & Wolfe, 2011a; 2011b; Roy-Wsiaki et al., 2010; Shillingsberg et al., 2014; Shillingsberg &Valentino, 2011, Shillingsberg et al., 2011; Sundburg et al., 2002; Williams, Donley & Keller, 2000; Williams, Pérez-González & Vogt, 2003). The results from this study represent the first evidence that teaching manding in inclusion settings results in improved independent manding. The findings suggest the field should engage in more extensive and rigorous investigations of mand training in natural inclusive environments.

Manding levels maintained for both students in 1, 2 and 4 week follow up probes (between 92 and 100% for all maintenance sessions), consistent with prior research that tracked the maintenance of manding following embedded mand training. Benjamin demonstrated novel manding during each intervention condition and his rates of independent manding within the general education classroom on a follow up language sample showed modest improvement. He went from one mand during two 20-minute

language samples to a total of 6 mands across two 20-minute language samples. Eva began to mand prior to the start of the intervention in the third condition. This could be interpreted as a potential limitation of the multiple baseline design, or as potential generalization of the manding skill due to a powerful intervention. She also demonstrated increased independent mands during a follow up language sample. During her first 20-minute language samples, prior to the intervention, Eva only manded one time independently. During her follow up 20-minute language sample, she increased her manding to four incidences during the 20-minute language sample.

Both participants generalized their high rates of responding to a new setting that included both new students and a new time of day. This finding was consistent with prior research done outside of the natural teaching environment (Lechago et al., 2013; Marion et al., 2011; 2012; Williams Donley & Keller, 2011). Initial follow up probes were collected during the school year, within the classroom environment. Initial sessions for all conditions for both participants happened at times of the day that corresponded with the curriculum delivered. For instance, condition one for Benjamin happened during enhancement. Enhancement in the first grade classrooms occurred in the late afternoon, around 2:30. Therefore, both the baseline and intervention for condition one was delivered each afternoon around 2:30 during the school day. For Benjamin, condition two happened during math, which was held during math instruction during the general education classroom lesson. The same was true for Eva. Condition one, the math condition, was held in the morning, during math instruction. Condition three, the ELA condition, was held in the afternoon during the general education classroom's ELA instruction.

The end of the academic school year also allowed for a generalization probe to be done during summer school programming. The summer school program took place within a separate elementary school within the same town. The program took place in classrooms within this new school building that were similar to the classrooms where the behavior was trained. Both Eva and Benjamin showed high rates of manding in this new environment during novel times of the day.

During the intervention, there was evidence of generalization. Novel manding was observed for Benjamin during all three conditions. Although no manding was demonstrated during any of his three baseline conditions, he did begin to mand for items outside of those used during the intervention phase of condition one. During session 6 of condition one's intervention phase, he manded for goldfish crackers. He continued to mand for items during 29% of sessions during condition one. He manded for crackers, the movement room and chips. He also manded for the same or similar items during the intervention phase of condition two and condition three. At a follow up probe given in a different location and at a different time of day, Benjamin demonstrated independent manding for the items included in the intervention between 95 and 100% of opportunities. Follow up language samples in the classroom given to Benjamin at the end of the school year resulted in a total of 4 mands during the first 20 minute sample, and two mands during the second 20 minute sample. This was a modest gain over the first language sample.

Eva did not demonstrate generalized manding for materials that were outside of those used during the intervention condition. However, she did demonstrate generalized manding when she was in the summer school program. During a probe that occurred in a

separate setting, during a separate time of the day, Eva manded for 100% of opportunities for items that had been taught during condition one, condition two and condition three. A follow up language probe given in the classroom documented four independent mands in the first 20-minute language sample, and another 2 independent mands in the second language sample. While this number remains low, it is an improvement over the rate of manding she displayed within the classroom prior to the start of the intervention.

This study was guided by three research questions. Each question was answered through data analysis of each of the research interventions, follow up language probes, teacher surveys, and follow up conversations with the classroom teachers.

Research Question 1

With respect to research question 1, "Does embedded mand training increase students with autism spectrum disorder ability to mand in the natural elementary school environment?" I found that embedded mand training did increase manding for both participants with ASD in the natural elementary school environment. Benjamin demonstrated independent manding at 33% during the first intervention session in the first condition. He manded for 100% of opportunities by the 6 session during condition one. During condition two, Benjamin manded independently during 25% of opportunities during session one of the intervention phase. He was manding for 100% of opportunities by session 6. Interestingly, Benjamin also showed immediate independent manding during the intervention phase of condition three, manding independently in 20% of opportunities. He was at 100% of opportunities by the sixth intervention session during condition three. An additional anecdotal finding was that Benjamin's IEP team noted on his next IEP that he had increased his independent manding during this IEP cycle and

they created a new IEP benchmark that called for him to mand two new words a month with 80% accuracy.

Eva also demonstrated increased independent mands after the embedded mand training intervention. During condition one, Eva did not immediately demonstrate manding. However, after a brief targeted intervention to teach her the names of the materials that were used in the intervention, she manded at 16% during the third session of the intervention in condition one. She was manding during 100% of opportunities by the sixth session. During condition two, she manded at 60 % during session one of the intervention, and then was manding for 100% of opportunities by the third session. Eva learning curve indicated that she learned to ask to get her needs met in the classroom, as she began to mand for intervention items from condition 3 during session 9 of the third baseline. By the twelfth baseline session, she was manding for intervention materials 100% of opportunities.

These findings support that this embedded mand intervention did teach two children with ASD to mand for academic materials within the general education classroom environment.

Research Question 2

With respect to research question 2, “Following embedded mand training, do children with autism spectrum disorder maintain manding for 1, 2 and 4 week intervals following the intervention?” I found that manding did maintain for 1, 2, and 4 week intervals following the intervention. Both participants maintained levels of manding in 1, 2 and 4 week follow up probes between 92% and 100% for all maintenance sessions. Benjamin maintained his rates of manding during probe conditions during each

intervention condition and his rates of independent manding within the general education classroom on a follow up language sample showed modest improvement. He went from one mand during two 20-minute language samples to a total of 6 mands across two 20-minute language samples. Eva began to mand prior to the start of the intervention in the third condition. She maintained manding for items taught in each of the three conditions for 1, 2, and 4 week follow up maintenance probes from between 92% and 100% of opportunities.

Both Benjamin and Eva also demonstrated maintained independent mands during a follow up language sample over their first language sample. During Benjamin's language sample, taken following the intervention in the classroom, he manded using his SGD 5 times during the first 20-minute language observation and 2 times during the second 20-minute language sample for an average over the two sessions of 3.5 independent mands. During Eva's follow up 20-minute language sample, she maintained and increased her manding to 4 times during the language sample, an increase of 300%. While these changes cannot be directly attributed to the intervention, they are an important practical change to recognize.

These findings indicated that this embedded mand training not only taught two children with ASD to mand, but also that the manding behavior maintained for at least one month when the students were in both their general education classroom environment and a second summer school environment.

Research Question 3

With respect to research question 3, "Following embedded mand training do children with autism spectrum disorder generalize manding to novel activities within the

natural environment?", I found that manding did generalize to novel items within the classroom environment, and also that manding generalized to a new classroom setting during a new time of the day. During generalization conditions, some generalization probes took place in the inclusive classroom environment. The school year ended, creating a need for maintenance probes to occur in a second setting, the summer program. During this program, individual students were doing their own individualized instruction, based on IEP objectives. There was no pre-programmed time for individual subjects. Therefore, sessions were run regardless of the activity being taught, and all during the morning hours of the summer program. Benjamin's generalization data was 95-100% of opportunities across all conditions both those in the inclusive environment, and the summer program. Eva's generalization data probes were 92-100% of opportunities across all conditions. These findings suggest that teaching a student to mand in the natural environment using contrived motivating operations may increase the likelihood that the student will generalize manding in the natural environment.

Additionally, Benjamin demonstrated zero rates of independent novel manding during each of the first baseline condition. However, during the first intervention condition, Benjamin demonstrated increased independent mands for materials and activities that were not part of the intervention. During intervention condition one, once Benjamin had demonstrated independent manding at a rate of 100% during session 6, he manded for an item that was not part of the intervention. Specifically, he used his SGD to request goldfish crackers. At other times during condition one, he used his SGD to request the movement room and the slide. In total, during condition one, Benjamin demonstrated a novel mand during 29% of sessions. During baseline two and baseline

three, Benjamin did not demonstrate any manding. However, during both intervention conditions two and three, Benjamin used his SGD to intermittently mand for both the intervention materials and other, novel mands that had not been targeted. During condition two, Benjamin manded for at least 2 novel stimulus during 57% of sessions during sessions, including the swing, a cracker and the movement room. During condition three, Benjamin manded for at least one item in 71% of sessions. This condition was the ELA condition, which was considered Benjamin's least favorite subject. During condition three, he used his SGD to mand for math materials (considered his most favorite subject) that were used in condition two. Finally, during the 2-week follow up probe during condition two, the student manded using his SGD for a book. When told he needed to wait until after his work, he took his SGD and used three different buttons to type out, "I want book, please". Given the length and novelty of his utterance in this setting, he was allowed access to a book for one minute during this sessions. After all, the point was to teach the student to mand for the material he wanted. The generalization of independent manding for materials and activities not included in the study by Benjamin provide initial evidence that the use of contrived motivating operations generalized to novel items within the room. It appeared that Benjamin generalized his ability to use his SGD to mand for items that were not included in the intervention.

Eva also showed generalized manding prior to the full intervention. She began to demonstrate independent manding for items included in the intervention during the first intervention condition. At the end of the second baseline condition, Eve made one mand for an item included within the intervention prior to the introduction of the intervention.

She then returned to zero rates of independent manding until the second intervention condition was introduced. However during the third baseline condition, Eva began to mand for the third set of intervention items during the third baseline condition. She continued to increase her independent manding for these items until she reached independent manding for 100% of available opportunities. Thus, the third intervention condition was unnecessary and never introduced.

This clearly highlights a limitation of multiple baseline across activities design. We saw that Eva generalized a skill across a phase, potentially threatening the design. Verification of the intervention effects rely on the levels of the dependent variable behavior not changing until the independent variable is introduced (Kazdin, 2011; O'Neill et al., 2011; Twaney & Gast, 1984). While the change in levels of the dependent variable during Eva's third condition limit the control demonstrated within the study, it also speaks to the power of the intervention to teach a student to independently mand for materials they would like to use while doing academic work within the classroom.

These findings support that this embedded mand intervention taught two students with ASD to mand for academic materials within the general education classroom environment, and that the manding skill generalized to novel settings and times of the day. Manding for items outside of the intervention conditions provide further evidence that the intervention taught a skill that might maintain naturally in the classroom environment.

Research Question 4

With respect to research question 4, "Do the inclusion teachers perceive embedded mand training as effective way to increase manding for children with autism

spectrum disorder in their classroom?" I found that overall, the general education teachers perceptions of this study were positive. Both the survey results and the anecdotal comments shared during the experiment indicated that the intervention was reasonable for the general education environment. Both participating classroom teachers agreed that the student enjoyed the intervention and that the intervention focused on important behaviors. Both agreed that the intervention was easily incorporated into the classroom, and that the time needed to complete the intervention was reasonable. They agreed that the intervention did not interrupt the classroom. Most importantly, they agreed that the intervention increased student engagement and that they would use the intervention with other students in their classrooms.

Both teachers talked to the researcher about the intervention during the process. Benjamin's classroom teacher made several comments about her perception of Benjamin's increased engagement during the intervention. She commented that he seemed to enjoy what I was doing, and that he appeared to be focused and on task. Eva's classroom teacher also commented that he enjoyed having Eva, and that she seemed to enjoy her time working during the intervention. This would provide anecdotal evidence that the student's seemed to enjoy this intervention as well.

These findings provide preliminary support that two elementary general education teachers perceived embedded mand training to be an effective way to increase manding for children with ASD within their general education classrooms.

Additional Unanticipated Findings

In addition to the findings related to the three research questions, I also observed possible changes in other student behavior. Both participants demonstrated unexpected

behavior during baseline conditions. Benjamin demonstrated aggressive behavior, both towards the researcher and the research assistant collecting IOA. Eva demonstrated self-stimulatory behavior throughout most baseline intervals.

Aggression

Benjamin had a history of aggressive behavior prior to the start of the intervention. His IEP included an individualized behavior plan with interventions targeting reductions in rates of aggressive behavior. Although aggression was not tracked within this study, he did demonstrate aggressive behavior on several occasions during baseline sessions. Twice, baseline sessions were ended early because of aggressive behavior that I was not able to redirect. However, there were no incidents of aggressive behavior during any intervention session, or during any follow up probe. This is likely due to the choice the student had to engage in preferred academic activities as well as learning to request materials using his SGD within the classroom environment. Even when he requested materials that he was not allowed to access (for instance, asking to go to the movement room and being told he needed to wait until after he finished his work), he did not engage in aggressive behavior. He instead turned back to his work, requested one of the work activities, and continued to engage in academic tasks. Although sometimes behavioral problems are used as an argument for keeping students with ASD programmed in a separate environment from their typically developing peers, Benjamin displayed only limited aggression during baseline session, and none at all during intervention and follow up probe sessions. Twice, following the end of our session he remained seated with his classmates, even when prompted to join me to walk back to the ILC. Once, when his peers rose at the end of the session, he rose and joined them in the

large group space where a large group lesson was about to begin. Although it is impossible to determine what the student learned while listening to the lesson, his improved behavior during this academic intervention within the classroom suggests that programming for Benjamin should increase within the inclusion setting.

Stereotypic behavior

Eva demonstrated high rates of stereotypic behavior during baseline, spending most of the entire 10-minute sessions staring at her fingers. During baseline conditions, Eva did not mand at all. This was somewhat surprising, given that she was verbal and able to tact more than 1000 items, was familiar with all of the material that we were using, and had demonstrated some manding during her language sample prior to the start of the study. Instead, while seated at the table with all of the academic material placed around her, she opted to engage in self-stimulatory behavior. Specifically, Eva would put her hands in front of her face, wiggle her fingers and move her hands around as she continued to look at them. Although Eva has a history of engaging in stereotypy, she did not have an individualized behavior plan for this behavior, because the rates of this behavior were considered to be low while she was at school. Therefore, it was unexpected that she would do nothing for the entire 10-minute baseline session but engage in this behavior.

Once involved in the intervention, Eva immediately ended all stereotypy. She was completely focused on the academic tasks. It seems likely that without having the skill to mand within the inclusion environment, Eva didn't know how to ask for materials to become engaged. She was dependent on a second person, usually a paraprofessional, to tell her what to do. As she became engaged, first with the prompt of the interventionist,

and then later through her own independent requesting of materials, her stereotypic behavior was replaced with functional skills. This may suggest that when we teach functional communication for students to request breaks, we should also teach students to ask for work materials of high interest.

Academic engagement

A second unexpected finding was that the students seemed to master academic skills through this language intervention. At the start of the experiment, materials and activities were chosen based on what the student was working on for IEP objectives within their everyday academic programming. During each session of this experiment, the student worked on these academic tasks. Because the study was focused on teaching the student to mand, data were not taken on the accuracy of responding within the sessions. However anecdotally, the researchers and the ILC classroom teachers both noticed that Benjamin and Eva demonstrated mastery of at least one academic task that was used during the course of the study.

Benjamin had several math tasks during condition two. They included: sequencing numbers in an inset puzzle, 1:1 correspondence with matching clips to dots on a card, matching configurations of Lego, and identity matching using un-identical quantities of dots. These activities were reserved for the intervention during this research study. At the start of the study, he did the inset puzzle in random order. However, during sessions 4 and 5, he began to point to the places on the puzzle in numerical order. When matching un-identical sets of quantity cards to the dots on a dice at the start of the study, Benjamin needed prompting to make a correct response. In this activity, Benjamin rolled a large dice. He then was given 3 cards with quantities of stars on them. Each sample set

had one correct matching card. For instance, if he rolled a six on the dice, one of the cards in the sample set had 6 stars on it. The other two cards might have one, two, three, four, or five stars on it. The student was then required to select the card that had the number of dots that corresponded to the dots on the dice. Initially, the study was given a point prompt to help him select the correct matching card. However, as the sessions progressed, Benjamin began to select the correct card prior to the introduction of the prompt. By the end of the math intervention sessions, he was able to select quantities even when given a sample set that contained cards with similar quantities on them. For instance, he could match the number five on the di with a card with five stars on it, even if the other two cards in his response set had four and six stars on them. It was also noted from his teacher in the ILC classroom that he had really begun to enjoy math, and seemed to be showing an increase in his understanding of 1:1 correspondence. Because this variable was not isolated or tracked, it is impossible to say if this was a simple correlation or a by-product of the math activities that were in place. However, it was interesting that the student seemed to increase his math abilities while working on language interventions within the inclusion classroom.

Eva showed similar gains in academic abilities within her academic tasks. For instance, at the start of the enhancement condition, matching color cards to printed color words was selected as a task. She had not demonstrated the ability to match the color words to the color cards. When she selected color cards to work on, she was given two color cards and asked to match the correct printed word to the color. At the start of the enhancement condition, Eva needed prompting to match the words correctly. By the end of the intervention condition, she could match the printed words to each of the color

cards, and would call out the word on the card as soon as she saw it held up. She also had an increase in her ability to do math problems. One academic task she did during the math condition involved a card with a math subtraction fact on it. She then placed clips on the card to correspond to the math problem, took the correct number of clips off, and then counted the clips that remained to solve the problem. When the math intervention condition started, Eva could not do any of the problems independently, and needed to be prompted to say the problem aloud, as well as to count the number of clips correctly. By the end of the intervention, she was able to set up the card independently with the right amount of clips, and then "subtract" the clips by removing them. She then would count the remaining amount and say the problem with the correct answer

Although they needed to do work that was significantly different from the work of their peers, both Benjamin and Eva were able to complete academic work at either a desk or table within the learning environment of a general education classroom, often with one or two peers sitting directly next to them. This allowed these students to be members of their classes, allowed the other students in their class to see them as hardworking and productive students, and seemed to result in academic gains as well as an increased ability to mand.

This finding provides additional support for teaching children with ASD within the inclusion classrooms. There is often an argument made that children with ASD need specialized instruction that should be carried out within a separate setting. However, both of these students appeared to make academic gains given these very simple academic tasks. One could see it as simply an extreme example of differentiated instruction. Given

the requirements of IDEA, these students should be allowed to do this type of work within the inclusion environment.

Limitations

When doing single subject research, it is important to have control of all variables. When Eva began the intervention during the first condition, the expectation was that she would learn to mand quite quickly. She did not, and it was observed that she may not know the names of the materials used in condition one, hindering her ability to request. She used these materials each day within the ILC, and the assumption was made that she would know what they were called. After a brief intervention to teach her the names of the items, Eva did indeed begin to mand for the items. This makes it likely that the delay in her manding had do to with her ability to tact the materials, and was not a direct limitation of the intervention.

Doing research in an elementary school that was not set up as a research facility had challenges. One of the most difficult was procuring a second observer. Within this general education elementary school, there were generally not extra staff around each day, so finding a second person to take IOA and fidelity data was difficult. This impacted Benjamin's first baseline condition. Horner and colleagues (1994) discuss the importance of having IOA and fidelity as a quality indicator. I did not have fidelity data for Benjamin's first baseline condition. The strength of both the IOA and fidelity data for the remainder of the study does enhance the likelihood that the baseline data were accurate. Especially given replicated zero rates of manding behavior in Benjamin's second and third baseline conditions, which did have IOA data.

One hypothesis of this study was that contrived motivating operations could be manipulated to set up a state of deprivation for an academic activity. By providing a student with only part of the activity to use belief, it was conjectured that the student would want the other half, and then request it. It was clear when Eva began to request, especially after the brief intervention in condition one, that she had learned the names of the materials and that she was motivated to mand for the missing activity component that would allow her to complete each academic task. It was not as clear for Benjamin. Although he did learn to use his SGD to request, he may only have learned to request the materials, not the second part of the material. A posttest that asked Benjamin to label the names of the materials, or that required him to mand for the items within a different context could increase our confidence that he was using the SGD to request items and not the activity as a whole. However, because he did use his SGD to mand, and this in turn effected his rates of manding, and also levels of engagement and inappropriate behavior, we can remain fairly confident that not having the materials available to complete the entire task did set up a CMO that in turn increased the likelihood that Benjamin would mand.

One other limitation of this study was that the research was implemented by a researcher instead of either the classroom teacher or a paraprofessional. Horner and colleagues (1994) suggest that having interventions carried out by typical intervention agents will increase the social validity of a study. The use of typical intervention agents increase the likelihood that the intervention will be used after the researcher has withdrawn from the classroom. There was however, no research available on how best to implement manding interventions within the general education environment. When doing

a novel research task, having the lead researcher available to carry out the intervention ensures that the study was implemented without potential flaws. This was documented in this study by the extremely high fidelity reported. Further research should continue to investigate the use of manding interventions in the general education environment using classroom paraprofessionals or general education teachers.

Practical Implications

There is a wide body of research that identifies the benefits of mand training. This study adds to that research by documenting the effectiveness of using mand training within the general education environment. Learning to ask for materials within the classroom generalized to other classrooms and materials, and also maintained for follow up probes. Although no formal data was taken, appropriate behavior increased. Both participants engaged in academic tasks during the entire 10-minute session. They asked for academic work materials, and demonstrated increased ability to complete many of the tasks and activities used within the different conditions. Inappropriate behavior (both stereotypy and aggression) decreased. This highlighted the importance of teaching functional communication strategies (Carr & Durand, 1985). Teaching students to mand for items that they are interested in gives them a way to ask to be engaged. This is by definition, a functional communication that can help them get their needs met. Functional communication training has already been shown to be an effective intervention to decrease aggressive behavior (Carr & Durand, 1985).

This study also demonstrates that is possible to embed mand training into ongoing lessons. Teaching students with limited language to ask to get there needs met should be one of the first things we do. The development of manding increasingly allows children

to get their needs met independently (Sundberg & Partington, 1998). This power over the environment results in an active control or influence over one's world and the behaviors of others in that world. If we are able to teach students with ASD to mand in the inclusion intervention using a researcher, it is likely that we can use the intervention with typical intervention agents and embed mand training across the entire school day.

Realities of Research in Inclusion Settings

There are challenges that arise from research in the inclusion setting. When research occurs in a clinic, there are increased abilities to control variables. Horner (1994) states that that the ability to control threats to the internal validity by controlling all external variables will allow for the validation of a functional relation. There were many variables that were impossible to control within the inclusion setting. For example, there were fire drills that occurred that made it impossible to complete a session. Likewise, author celebrations, snow days and field days interrupted the flow of instruction within the classroom, which prevented sessions from being run. Without a controlled environment, there were other confounding variables. For instance, one day, Benjamin left his SGD at home, preventing sessions from being run. On another day, Benjamin's speech therapist installed a new program over his old program, without regard for the language needed during intervention sessions. Consequently, no sessions were run for two days while the error was corrected.

During sessions, there were also numerous interruptions. The classroom teacher interrupted Benjamin's session one day to have him run his classroom job. The interventionist decided that following the lead of the classroom teacher was as important as the intervention, and stopped the session for 4 minutes, continuing the session after the

job had been completed. Classroom peers also interrupted the session: to have the interventionist tie their shoe, to talk with the student, and once to ask for help with an assignment. These are all typical and expected interruptions that students with ASD face every day within the normal classroom environment. Both students also had illnesses within the course of the study, delaying sessions. Finally, April vacation occurred, which created a weeklong break in the sessions. Even with these potential confounding variables, the intervention was so powerful that both students with ASD learned to mand within this setting.

Future Directions

The findings from this research highlight the need to extend the results of using embedded mand training to teach children with ASD to increase their ability to mand within inclusion settings. This study used a researcher as an interventionist, a next logical step would be to replicate the intervention using typical intervention agents (Horner, 1994). The effects of the study were robust, even in the face of unexpected challenges. It is likely that the findings would stand with a different intervention agent, either the student's paraprofessional or the general education classroom teacher. This would increase the usability of the study, and bring effective, evidence-based treatments into the inclusion classroom, increasing the social validity of this treatment. Replication should also occur in different class settings. If we can teach students with ASD to mand within the inclusion classroom, we should also be able to teach them to mand across all areas of a school environment, leading to possible increased generalization of skills into natural environments.

Benjamin and Eva engaged in no inappropriate behavior when they were engaged in the intervention conditions. This was an interesting finding because both engaged in inappropriate behavior while in baseline, and both engaged in moderate to high rates of inappropriate behavior while in their typical special education programming. It is unclear why this occurred. It may be the behavior was a result of increased engagement that occurred naturally during the manding intervention. Students who are engaged may demonstrate lower levels of inappropriate behavior. It could also be that learning to mand led to increased expected behavior and decreased inappropriate behavior. It is also possible that having a choice of academic materials lead to more appropriate classroom behavior. Further investigation could help to tease out which, if any, of these variables played an effect, which could lead to further rates of increased engagement and decreased behavior problems for students with ASD who are integrated into general education classrooms.

The educators in this study were removed from the actual intervention. While they both acknowledged it was nice to have the student spend additional time in the classroom, and both also commented on the high rate of engagement, neither felt that they had a good understanding of what the intervention was. They did not feel they could carry out the intervention. This is likely a factor of the blind nature of this experiment. When beginning to introduce a new intervention, it is important to keep the variables clean. Therefore, the only one who knew the nature of the intervention was the interventionist. This was an attempt to make sure the intervention was not carried out at times other than the experiment, which might have introduced a confound into the intervention. It will be important to continue to investigate the ability for practitioners,

including general education classroom teachers, to deliver this investigation. This will allow for a better understanding of the extent which educators could embed mand training into typical class activities without disruption to class wide instructions. This would also allow for further investigation of the extent to which learned manding is acknowledged and attended to by educators in real life settings. The main reason to teach students with ASD to mand is to increase their eventual independence. Students who can ask to get their needs met are likely to demonstrate higher rates of independence and lower rates of inappropriate behavior.

Conclusion

This embedded manding intervention resulted in an increased ability to mand for two elementary aged students with ASD within the general education environment. This is the first manding intervention that has been demonstrated to be effective within the elementary inclusion environment. There were many challenges associated with this environment. However, the effects of the intervention were so robust that they withstood all the uncontrolled variables and potential confounds. The students were able to increase their ability to mand within the general education environment, the effects maintained over time, and they generalized into a new environment.

Seventy-seven percent of Massachusetts students with ASD are educated within public elementary schools. Most of these students are included for at least part, if not the whole school day. The inclusion environment closely approximates the environment that students with ASD will meet when they leave school, and join the real world environment as adults. To be able to ask to get their needs met is a critical skill that will lead to further inclusion opportunities as well as maximal independence in later life. This

is the environment that matters. This intervention was able to increase this ability for two student with ASD which is promising. We can and should develop a pool of evidence-based instruction within the inclusion classroom.

Table 1: Specifics about the Variables within the Participants and Assessment Sections of the Included Literature

Study	Participants		Assessments		
	Diagnosed with ASD	Age	Formal Assessment	Description of student's abilities	Pre-assessment of listener behavior
Albert (2012)	1	1	0	1	1
Betz (2010)	1	1	0	1	0
Endicott (2007)	1	1	0	1	1
Jennett (2008)	1	1	1	1	0
Koegel (1998)	1	1	0	1	0
Koegel (2010)	1	1	1	1	0
Lechago (2010)	1	1	0	1	0
Lechago (2013)	1	1	0	1	1
Marion (2011)	1	1	1	1	1
Marion (2012)	1	1	1	1	1
Ostryn (2011a)	1	1	0	1	1
Ostryn (2011b)	1	1	0	1	1
Roy-Wsiaki (2010)	1	1	1	1	0
Shillingsburg (2014)	1	1	1	1	1
Shillingsburg (2011a)	1	1	0	1	0
Shillingsburg (2011b)	1	1	0	1	0
Sundberg (2002)	1	1	0	1	1
Williams (2000)	1	1	0	1	0
Williams (2003)	1	1	0	1	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 2: Type of Intervention Setting as Specified within the Included Literature

Study	Setting				
	Home	Clinic	Specialized School	Public School – pull out	Public School – inclusion
Albert (2012)	0	0	1	0	0
Betz (2010)	0	0	1	1	0
Endicott (2007)	0	0	1	0	0
Jennett (2008)	0	0	1	0	0
Koegel (1998)	0	1	0	0	0
Koegel (2010)	0	1	0	0	0
Lechago (2010)	-	-	-	-	-
Lechago (2013)	0	1	0	0	0
Marion (2011)	1	0	0	0	0
Marion (2012)	1	0	0	0	0
Ostryn (2011a)	0	0	0	1	0
Ostryn (2011b)	0	0	0	1	0
Roy-Wsiaki (2010)	1	0	0	0	0
Shillingsburg (2014)	0	1	0	0	0
Shillingsburg (2011a)	0	1	0	0	0
Shillingsburg (2011b)	0	0	1	0	0
Sundberg (2002)	0	0	0	0	0
Williams (2000)	0	0	0	0	0
Williams (2003)	0	0	0	0	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article. - = the variable was not identified within the article so it was impossible to determine the setting for this article.

Table 3: The Type of Intervention, Dependent Variable and Results of each Study Included within the Literature Review (continued onto next few pages)

Study	Intervention (IV)	Dependent Variable (DV)	Results
Albert (2012)	Missing item	Independent vocal mand for missing item	Increased use of mand + maintained
Betz (2010)	Missing Item	Independent mand including vocal "where (+ item name)"	Increased ability to mand "where (item)" generalized to novel toys and novel toys in novel setting, but did not generalize to natural behavior chain.
Endicott (2007)	Missing Item	Independent mand including vocal "where (+ item name)"	Increased ability to mand "where (item)" to 100%.
Jennett (2008)	Hidden Item	Independent and prompted (echoic) requests. Also eye contact and challenging behaviors	Increased ability to mand, required fewer sessions to meet criteria in the mand training condition than in the DTI condition, regardless of the order of the training sessions. Two participants had more challenging behavior in DTI sessions, the remaining four had approximately equal levels across conditions.
Koegel (1998)	Missing Items	Independent use of mand, and number of stimulus items labeled correctly	Increased ability to ask "what's that" + averaged 6 new expressive noun labels each week.

Study	Intervention (IV)	Dependent Variable (DV)	Results
Koegel (2010)	Hidden Items	Independent mand including “where” and number of prepositions/original markers correctly produced	Two of the three increased ability to mand
Lechago (2010)	Missing Items	Independently mand where (+ name of item)	Increased ability to mand and generalized
Lechago (2013)	Missing Item	Independent mand “How” and completion of behavior chain	Increased ability to mand
Marion (2011)	Insufficient Item	Independent mand with and w/out script	Increased ability to mand and generalized
Marion (2012)	Hidden Item	Independent mand containing "where"	Increased ability to mand and generalized
Ostryn (2011a)	Insufficient information	Independent mand “what’s that”	All three mastered “what’s that”, generalized + maintained
Ostryn (2011b)	Missing item	Independent mand "what's that" if item couldn’t be identified, and "where is it" if item was hidden	All three discriminated to use the correct mand
Roy-Wsiaki (2010)	Hidden item	Independent mand "what" across all training procedures	Independent mand use, generalized
Shillingsburg (2014)	All Three	Independent mands "which _?" and "who has it" or "who"	Independent mand use + maintained
Shillingsburg (2011a)	Hidden Item	Independent mand containing "how"	Independent mand use + generalized
Shillingsburg (2011b)	Insufficient information	Independent mand containing “who” “where” and “when	Independent mand use, generalized + maintained

Study	Intervention (IV)	Dependent Variable (DV)	Results
Sundberg (2002)	Missing Item, insufficient information	Independent mand containing "where (+ item)	Increased ability to mand
Williams (2000)	Missing item	Frequency of independent mands	Increased ability to mand
Williams (2003)	Hidden Item	First independent self-initiated question of each response form	Increased ability to mand + maintained

Table 4: Specific Information about the Generalization and Maintenance Phases of the Included Literature

Study	Generalization		Maintenance
	Included	To -	
Albert (2012)	0	NA	0
Betz (2010)	1	Novel toys, novel toys in novel setting (in classroom), natural behavior chain	0
Endicott (2007)	1	Self-contained to home	0
Jennett (2008)	0	NA	0
Koegel (1998)	1	Novel items, clinic to home	0
Koegel (2010)	1	Clinic to home	0
Lechago (2010)	0	NA	0
Lechago (2013)	1	Familiar activity	1
Marion (2011)	1	Familiar activity	1
Marion (2012)	1	Familiar activity	1
Ostryn (2011a)	0	Novel activities, people, setting (in preschool)	0
Ostryn (2011b)	0	NA	0
Roy-Wsiaki (2010)	1	Novel script, novel setting (home to home), novel script with novel setting (home to home)	1
Shillingsburg (2014)	0	NA	0
Shillingsburg (2011a)	0	NA	0
Shillingsburg (2011b)	1	Familiar activities	0
Sundberg (2002)	0	NA	0
Williams (2000)	1	From bedroom to other rooms in home	1
Williams (2003)	0	NA	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 5: Methodological Standards, Components, and Criteria for Single-Case Research (Mulcahy et al., 20015) (continued onto next few pages)

Standard	Components		Criteria
	Essential	Supplemental	
1. Participants	(1) Disability or risk status is described, (2) Method for determining disability or risk status is described, (3) Process for selecting participants is described with replicable precision.	(4) Age, (5) Race, (6) Grade, (7) Gender, (8) IQ score, (9) Achievement score	All essential components & at least four supplemental components
2. Context and Setting	(1) Setting description is described with replicable precision		All essential components
3. Research Design	(1) The study includes clearly defined causal research questions *or* hypotheses, (2) Employs one of the single case designs, (3) Includes a small number of participants, (4) Collects repeated measures over time, (5) Includes graphing and visual analysis of data		All essential components
4. Description of Conditions	(1) Procedures are described with replicable precision, (2) Baseline conditions were clearly described with replicable precision, (3) Intervention conditions were described with replicable precision (4) All materials are described with replicable precision, (5) All training or qualifications associated with implementation of the intervention are described with replicable precision		All essential components

Standard	Components		Criteria
	Essential	Supplemental	
5. Dependent Variables and Outcome Measures	(1) DVs are systematically measured repeatedly over time, (2) IOA is collected in each phase, (3) IOA is collected on 20% of sessions, (4) IOA meets 80% standard for each dependent variable, (5) All DVs are operationalized, (6) Each DV is measured with a procedure that generates a quantifiable index, (7) Instruments and measures were described with replicable precision,		All essential components
6. Experimental Control	(1) The researcher controls and manipulates the IV, (2) Evidence that the intervention was not available in baseline, (3) The baseline includes at least three data points, (4) The baseline data are stable for each participant or condition, (5) There are at least three data points for each phase, (6) Threats to internal validity are adequately controlled, (7) There are three demonstrations of experimental effects at three different points in time		All essential components
7. Fidelity of Implementation	(1) Fidelity is assessed through continuous direct measurement, (2) Fidelity is reported for adherence, (3) Fidelity is assessed for each interventionist, participant, and phase		All essential components

Standard	Components		Criteria
	Essential	Supplemental	
8. Data Analysis	(1) Unit of analysis is an individual (group) whose performance creates a single score, (2) Effects are reported for each DV, (3) Data are reported graphically for each DV, (4) Data are analyzed through visual analysis, and (5) Demonstrates a functional relation between IV and DV.		All essential components
9. Social Validity	(1) Outcome is socially important, (2) Magnitude of change in the DV is socially important.		All essential components

Table 6: Summary of the Methodological Rigor of Single Case Studies

Lead Author	Standards										Number of standards Met
	1		2	3	4	5	6	7	8	9	
	E	S									
Albert (2012)	1/3	2/6	0/1	***5/5***	4/5	***7/7***	***7/7***	0/3	***5/5***	***2/2***	5
Betz (2010)	1/3	3/6	0/1	***5/5***	3/5	6/7	***7/7***	2/3	***5/5***	***2/2***	4
Endicott (2007)	2/3	1/6	0/1	***5/5***	3/5	6/7	***7/7***	0/3	***5/5***	***2/2***	4
Jennett (2008)	***3/3***	3/6	0/1	***5/5***	4/5	***7/7***	***7/7***	***3/3***	***5/5***	***2/2***	7
Koegel (1998)	2/3	4/6	***1/1***	4/5	4/5	***7/7***	***7/7***	0/3	***5/5***	***2/2***	5
Koegel (2010)	***3/3***	3/6	***1/1***	***5/5***	3/5	***7/7***	0/7	0/3	***5/5***	***2/2***	6
Lechago (2010)	2/3	2/6	0/1	***5/5***	4/5	***7/7***	***7/7***	***3/3***	***5/5***	***2/2***	6
Lechago (2013)	1/3	2/6	***1/1***	***5/5***	***5/5***	***7/7***	***7/7***	2/3	***5/5***	***2/2***	6
Marion (2011)	2/3	3/6	0/1	***5/5***	4/5	6/7	5/7	2/3	***5/5***	***2/2***	3
Marion (2012)	2/3	3/6	0/1	***5/5***	4/5	***7/7***	***7/7***	2/3	***5/5***	***2/2***	5
Ostryn (2011a)	***3/3***	3/6	0/1	***5/5***	***5/5***	6/7	5/7	2/3	***5/5***	***2/2***	5
Ostryn (2011b)	***3/3***	3/6	0/1	***5/5***	4/5	***7/7***	6/7	***3/3***	***5/5***	***2/2***	6
Roy-Wsiaki (2010)	1/3	3/6	***1/1***	***5/5***	3/5	***7/7***	1/7	2/3	3/5	***2/2***	4
Shillingsburg (2014)	1/3	2/6	***1/1***	***5/5***	4/5	***7/7***	***7/7***	2/3	***5/5***	***2/2***	6
Shillingsburg (2011a)	2/3	2/6	***1/1***	4/5	2/5	5/7	6/7	0/3	***5/5***	***2/2***	3
Shillingsburg (2011b)	2/3	2/6	***1/1***	***5/5***	3/5	6/7	***7/7***	0/3	***5/5***	***2/2***	4
Sundberg (2001)	***3/3***	2/6	***1/1***	***5/5***	4/5	6/7	***7/7***	0/3	***5/5***	***2/2***	6
Williams (2000)	1/3	2/6	0/1	***5/5***	4/5	***7/7***	***7/7***	0/3	***5/5***	***2/2***	5
Williams (2003)	2/3	2/6	0/1	***5/5***	4/5	***7/7***	6/7	0/3	***5/5***	***2/2***	4
# met standards	5	0	8	17	2	12	12	3	18	19	

Note. E = Essential Component, S = Supplemental Components: All numbers that are bold and in italics represent a study that met the criteria for that specific standard

Table 7: Standards 1 and 2: The Essential Components of Participants and Setting for Included Literature

Study	Essential		
	Described disability or risk status	Included method for determining disability or risk status	Included method for determining participation
Albert (2012)	1	0	0
Betz (2010)	1	0	0
Endicott (2007)	1	1	0
Jennett (2008)	1	1	1
Koegel (1998)	1	1	0
Koegel (2010)	1	1	0
Lechago (2010)	1	1	0
Lechago (2013)	1	0	0
Marion (2011)	1	0	1
Marion (2012)	1	0	1
Ostryn (2011a)	1	1	1
Ostryn (2011b)	1	1	1
Roy-Wsiaki (2010)	1	1	0
Shillingsburg (2014)	1	0	0
Shillingsburg (2011a)	1	0	0
Shillingsburg (2011b)	1	1	0
Sundberg (2002)	1	1	1
Williams (2000)	1	0	0
Williams (2003)	1	1	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 8: Standard 1: The Supplemental Components of the Participants within the Included Literature

Study	Supplemental					
	Age	Race	Grade	Gender	IQ score	Achieve-ment Score
Albert (2012)	1	0	0	1	0	0
Betz (2010)	1	0	1	1	0	0
Endicott (2007)	1	0	0	1	0	0
Jennett (2008)	1	0	0	1	0	1
Koegel (1998)	1	0	0	1	0	0
Koegel (2010)	1	0	0	1	0	1
Lechago (2010)	1	0	0	1	0	0
Lechago (2013)	1	0	0	1	0	0
Marion (2011)	1	0	0	1	0	1
Marion (2012)	1	0	0	1	0	1
Ostryn (2011a)	1	0	1	1	0	0
Ostryn (2011b)	1	0	1	1	0	0
Roy-Wsiaki (2010)	1	0	0	1	0	1
Shillingsburg (2014)	1	0	0	1	0	0
Shillingsburg (2011a)	1	0	0	1	0	0
Shillingsburg (2011b)	1	0	0	1	0	0
Sundberg (2002)	1	0	0	1	0	0
Williams (2000)	1	0	0	1	0	0
Williams (2003)	1	0	0	1	0	0

Note 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 9: Standard 2: The Essential Components of the Setting of each Study Included within the Literature

Study	Setting	
	Described the type of setting	Described the contents of the setting with replicable precision
Albert (2012)	0	0
Betz (2010)	0	0
Endicott (2007)	0	0
Jennett (2008)	0	0
Koegel (1998)	1	0
Koegel (2010)	1	1
Lechago (2010)	0	0
Lechago (2013)	1	1
Marion (2011)	1	0
Marion (2012)	1	0
Ostryn (2011a)	1	0
Ostryn (2011b)	1	0
Roy-Wsiaki (2010)	1	0
Shillingsburg (2014)	1	0
Shillingsburg (2011a)	1	0
Shillingsburg (2011b)	0	1
Sundberg (2002)	1	1
Williams (2000)	0	0
Williams (2003)	0	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 10: Standard 3: The Essential Components of the Single Case Design Variable within the Included Literature

Study	Clearly defined research question	Employs Single Case Design: Multiple Baseline	Small number of participants	Repeated measures over time	Graphs and visual analysis
Albert (2012)	1	1 (Activities)	1 (3)	1	1
Betz (2010)	1	1 (Participants)	1 (3)	1	1
Endicott (2007)	1	1 (Participants)	1 (4)	1	1
Jennett (2008)	1	1 (Participants)	1 (6)	1	1
Koegel (1998)	1	1 (Participants)	1 (3)	0	1
Koegel (2010)	1	1 (Participants)	1 (3)	1	1
Lechago (2010)	1	1 (Participants)	1 (3)	1	1
Lechago (2013)	1	1 (Activities)	1 (3)	1	1
Marion (2011)	1	1 (Activities)	1 (3)	1	1
Marion (2012)	1	1 (Participants)	1 (3)	1	1
Ostryn (2011a)	1	1 (Participants)	1 (3)	1	1
Ostryn (2011b)	1	1 (Participants)	1 (3)	1	1
Roy-Wsiaki (2010)	1	1 (Setting)	1 (1)	1	1
Shillingsburg (2014)	1	1 (Participants)	1 (3)	1	1
Shillingsburg (2011a)	1	1 (Activities)	1 (1)	1	1
Shillingsburg (2011b)	1	1 (Questions)	1 (2)	1	1
Sundberg (2002)	1	1 (Questions)	1 (2)	1	1
Williams (2000)	1	1 (Questions)	1 (2)	1	1
Williams (2003)	1	1 (Questions)	1 (3)	1	1

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article. For the category Employs Single Case Design , the word in () defines the type of multiple baseline intervention that was used within that study. For Small Number of Participants, the number in () denotes the actual number of participants within the study.

Table 11: Standard 4: Essential Components of the Description of the Conditions Included within the Literature

Study	Conditions				
	Described procedure with replicable precision	Described baseline condition with replicable precision	Described interven-tion condition with replicable precision	Described materials used with replicable precision	Described training of interven-tion staff with precision
Albert (2012)	1	1	0	1	1
Betz (2010)	1	1	0	1	0
Endicott (2007)	0	1	0	1	0
Jennett (2008)	1	1	1	1	0
Koegel (1998)	1	1	1	1	0
Koegel (2010)	1	1	1	0	0
Lechago (2010)	1	1	1	1	0
Lechago (2013)	1	1	1	1	1
Marion (2011)	1	1	1	1	0
Marion (2012)	1	0	1	1	0
Ostryn (2011a)	1	1	1	1	1
Ostryn (2011b)	1	1	1	1	0
Roy-Wsiaki (2010)	1	0	1	1	0
Shillingsburg (2014)	1	1	1	1	0
Shillingsburg (2011a)	1	0	0	1	0
Shillingsburg (2011b)	1	1	1	0	0
Sundberg (2002)	1	1	1	1	0
Williams (2000)	1	1	1	1	0
Williams (2003)	1	1	1	1	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 12:Standard 5: Essential Components of the Dependent Variables (DV), Inter-observer Agreement (IOA) and outcome measures

		Dependent Variables					Out-come meas-ures
Study	DV mea-sured over time	IOA collect-ed in each phase	IOA collect-ed for >20% of condi-tions	IOA meets >80% stan-dard for each DV	DV are oper-ation-alized	DV measure creates quantify-able index	Instrume nt and measures de-scribed with precision
Albert (2012)	1	1	1	1	1	1	1
Betz (2010)	1	0	1	1	1	1	1
Endicott (2007)	1	0	1	1	1	1	1
Jennett (2008)	1	1	1	1	1	1	1
Koegel (1998)	1	1	1	1	1	1	1
Koegel (2010)	1	1	1	1	1	1	1
Lechago (2010)	1	1	1	1	1	1	1
Lechago (2013)	1	1	1	1	1	1	1
Marion (2011)	1	0	1	1	1	1	1
Marion (2012)	1	1	1	1	1	1	1
Ostryn (2011a)	1	0	1	1	1	1	1
Ostryn (2011b)	1	1	1	1	1	1	1
Roy-Wsiaki (2010)	1	1	1	1	0	1	1
Shillingsburg (2014)	1	1	1	1	1	1	1
Shillingsburg (2011a)	1	0	1	1	1	1	1
Shillingsburg (2011b)	1	0	0	1	1	1	1
Sundberg (2002)	1	1	0	1	1	1	1
Williams (2000)	1	1	1	1	1	1	1
Williams (2003)	1	1	1	1	1	1	1

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 13: Standard 6: The Essential Components of the Experimental Control Conditions for Each Study Included within the Literature

Study	Demo-nstrate control of DV	Experimental Control					
		No inter-vention in baseline	At least 3 data points in base-line	Baselin e data stable for each partici-pant	At least three data points for each phase	Threats to internal validity are control-led	Three demon-stration s of effects
Albert (2012)	1	1	1	1	1	1	1
Betz (2010)	1	1	1	1	1	1	1
Endicott (2007)	1	1	1	1	1	1	1
Jennett (2008)	1	1	1	1	1	1	1
Koegel (1998)	1	1	1	1	1	1	1
Koegel (2010)	1	1	1	1	1	1	1
Lechago (2010)	1	1	1	1	1	1	1
Lechago (2013)	1	1	1	1	1	1	1
Marion (2011)	1	1	1	1	1	1	1
Marion (2012)	1	1	1	1	1	1	1
Ostryn (2011a)	1	0	1	1	0	1	1
Ostryn (2011b)	1	1	1	1	1	1	1
Roy-Wsiaki (2010)	1	0	0	0	0	0	0
Shillingsburg (2014)	1	1	1	1	1	1	1
Shillingsburg (2011a)	1	1	1	1	1	1	1
Shillingsburg (2011b)	1	1	1	1	1	1	1
Sundberg (2002)	1	1	1	1	1	1	1
Williams (2000)	1	1	1	1	1	1	1
Williams (2003)	1	1	1	1	0	1	1

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 14: Standard 7: The Essential Components of the Fidelity Measures Included within the Literature

Study	Fidelity		
	Fidelity assessed through continuous direct measures	Fidelity reported for adherence	Fidelity assessed for each interventionist, participant, and phase
Albert (2012)	0	0	0
Betz (2010)	1	1	0
Endicott (2007)	0	0	0
Jennett (2008)	1	1	1
Koegel (1998)	0	0	0
Koegel (2010)	0	0	0
Lechago (2010)	1	1	1
Lechago (2013)	1	0	1
Marion (2011)	1	0	1
Marion (2012)	1	0	1
Ostryn (2011a)	1	1	0
Ostryn (2011b)	1	1	1
Roy-Wsiaki (2010)	1	0	1
Shillingsburg (2014)	1	0	1
Shillingsburg (2011a)	0	0	0
Shillingsburg (2011b)	0	0	0
Sundberg (2002)	0	0	0
Williams (2000)	0	0	0
Williams (2003)	0	0	0

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 15: Standard 8: The Essential Components of the Data Analysis Performed on the Included Literature

Study	Data Analysis				
	Unit of analysis is a single score	Effects reported for each DV	Data reported graphically for each DV	Data analyzed through visual analysis	Demon-strated functional relation between IV and DV
Albert (2012)	1	1	1	1	1
Betz (2010)	1	1	1	1	1
Endicott (2007)	1	1	1	1	1
Jennett (2008)	1	1	1	1	1
Koegel (1998)	1	1	1	1	1
Koegel (2010)	1	1	1	1	1
Lechago (2010)	1	1	1	1	1
Lechago (2013)	1	1	1	1	1
Marion (2011)	1	1	1	1	1
Marion (2012)	1	1	1	1	1
Ostryn (2011a)	1	1	1	1	1
Ostryn (2011b)	1	1	1	1	1
Roy-Wsiaki (2010)	1	1	1	0	0
Shillingsburg (2014)	1	1	1	1	1
Shillingsburg (2011a)	1	1	1	1	1
Shillingsburg (2011b)	1	1	1	1	1
Sundberg (2002)	1	1	1	1	1
Williams (2000)	1	1	1	1	1
Williams (2003)	1	1	1	1	1

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 16: Standard 9: The Essential Components of the Social Validity of the Included Literature

Study	Social Validity	
	Outcome is socially important	Magnitude of change in DV is socially important
Albert (2012)	1	1
Betz (2010)	1	1
Endicott (2007)	1	1
Jennett (2008)	1	1
Koegel (1998)	1	1
Koegel (2010)	1	1
Lechago (2010)	1	1
Lechago (2013)	1	1
Marion (2011)	1	1
Marion (2012)	1	1
Ostryn (2011a)	1	1
Ostryn (2011b)	1	1
Roy-Wsiaki (2010)	1	1
Shillingsburg (2014)	1	1
Shillingsburg (2011a)	1	1
Shillingsburg (2011b)	1	1
Sundberg (2002)	1	1
Williams (2000)	1	1
Williams (2003)	1	1

Note. 1 = the variable was included within the article. *0* = the variable was not included within the article.

Table 17: List of materials used in preference assessment for embedded mand training intervention for Benjamin. Items are ranked by assessed preference. Items used in the intervention are marked with an asterick (*).

Activity	Set 1	Set 2	Preference Ranking
Math	Puzzle inset frame*	Number puzzle pieces*	1.0
	Symmetry puzzle*	Puzzle piece*	4.0
	Spinner	Math card	4.7
	Quantity cards*	Clips*	5.3
	Dice*	Square quantity cards*	5.3
	Dominoes	Numeral cards	6.0
	White board	Marker	7.0
	Unifix cubes	Pattern cards	8.0
Enhancement	Juice*	Straw*	1.3
	Plate*	Popcorn*	2.3
	Puzzle inset frame*	Animal puzzle piece*	3.3
	Pattern cards*	Legos*	4.3
	Color cards	Color words	4.3
	Shapes manipulatives	Shape cards	4.6
	Chips	Napkin	6.7
	White board	Markers	7.0
ELA	Book*	Matching cards*	2.3
	Letter lotto*	Lotto cards*	2.3
	Book	Word cards	4.0
	Coloring Sheet*	Crayons*	4.7
	Word cards*	Manipulative letters*	5.3
	Picture card	Matching word	5.3
	Site Word Card	Site word card	6.0
	Word cards	Words	7.0

Table 18: List of materials used in preference assessment for embedded mand training intervention for Eva. Items are ranked by assessed preference. Items used in the intervention are marked with an asterisk (*).

Activity	*Set 1*	*Set 2*	*Preference Ranking*
Math	Quantity cards*	Clips*	2.7
	Dice	White board	3.0
	Calculator*	Math problem cards*	4.0
	Dominoes*	Printed numerals*	4.0
	Spinner*	Blank paper*	4.3
	Unifix cubes	Pattern cards	5.0
	Shapes	Shape cards	6.0
	Paper clips	Subtraction cards	7.3
ELA	Blank paper*	Spelling words*	2.6
	Writing work sheet*	Pencil*	3.0
	Book*	Comprehension sheet*	3.0
	Sight word card*	Letters*	3.0
	Short vowel game	Game pieces	5.3
	Sight words	Picture match	5.0
	Cloze sentence	Pencil	5.7
	Sequencing strip	Sequencing cards	6.0
Enhancement	Crayon*	Paper*	1.6
	White board*	Marker*	2.6
	Color cards*	Printed color word cards*	3.0
	Picture puzzle piece*	Word puzzle piece*	3.0
	Word dice	Paper	5.7
	Puzzle	Inset pieces	5.7
	Symmetry lotto	Symmetry cards	6.0
	Letter bingo	Bingo chips	6.7

Table 19: Interobserver Agreement (IOA) results for Benjamin. Results are reported in terms of the overall study agreement as well as for each variable, followed by the range of agreement.

	Total Agreement (range)	Occurrence Agreement (range)	**Non-occurrence Agreement (range)**
Overall Agreement	97% (81%-100%)	96 (92%-100%)	**100 (75%-100%)**
Independent Mands	98% (83%-100%	99% (86%-100%)	**98% (78%-100%)**
Prompted Responses	99% (88%-100%)	99% (83%-100%)	**100%**
No Responses	99% (88%-100%)	99% (82%-100%)	**98% (75%-100%)**
Prompted Engagement	100%	100%	**100%**

Table 20: Interobserver Agreement (IOA) results for Eva. Results are reported in terms of the overall study agreement as well as for each variable, followed by the range of agreement.

	Total Agreement	Occurrence Agreement	Non-occurrence Agreement
Overall Agreement	96% (60%-100%)	96% (55%-100%)	97% (66%-100%)
Independent Mands	99% (90%-100%)	100%	99% (90%-100%)
Prompted Responses	99% (50%-100%)	100%	97% (90%-100%)
No Responses	97% (60%-100%)	96% (96%-100%)	97% (66%-100%)
Prompted Engagement	100%	100%	100%

APPENDIX A

SAMPLE CONSENT FORM

Consent Form for Participation in a Research Study
University of Massachusetts Amherst

Researcher(s): Jennifer McIntire, doctoral candidate, Michael Krezmien, Ph.D. faculty sponsor
Study Title: Teaching Manding to students with Autism Spectrum Disorder in the natural inclusion classroom

1. WHAT IS THIS FORM?

We are inviting your child to take part in an inclusive behavioral intervention to increase his or her ability to make requests. This intervention has been developed as part of a dissertation project. We intend to use the knowledge that we acquire as a result of this intervention to improve our instruction when teaching children with autism within elementary school's inclusion classrooms.

Briefly, here is why we think this project may be of interest to you and your child. Many students with autism are educated for at least part of the day in the regular classroom environment. While some interventions have been developed to teach children with autism within the regular classroom environment, this curriculum is still in the formative stage. We will be examining an intervention to increase your child's ability to request items within the classroom. Although the intervention has been shown to be effective in both the clinic and home settings, it remains to be tested as effective in an inclusion environment.

This consent form will give you the information you will need to understand why this study is being done and why your child is being invited to participate. It will also describe what you will need to do to allow your child to participate and any known risks, inconveniences or discomforts that your child may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to sign this form and you will be given a copy for your records.

2. WHO IS ELEGEBLE TO PARTICIPATE?

This study is seeking to recruit children with autism with limited requesting skills. We are specifically looking for elementary aged students of either gender, who do not independently request to get their needs met within the inclusion classroom.

3. WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this research study is to examine instructional practices for children with autism that take place within the natural classroom environment. Specifically, we would like to demonstrate that students with autism can learn to mand while in the inclusion classroom surrounded by their typical peers.

4. WHERE WILL THE STUDY TAKE PLACE AND HOW LONG WILL IT LAST?

Participants will be taught to request items in their natural inclusive classroom. Two intervention sessions will take place each day. Your child would be taught to request preferred items while in engaged in naturally occurring activities within the classroom Sessions will last about 10 minutes each and will continue for 3-4 weeks. A plan to follow up to assess maintenance of manding skills includes a one-, two- and four-week follow up assessment of continued manding in the inclusion classroom. There is no plan to contact your child in the future, however a survey indicating your satisfaction will be disseminated at the conclusion of the study, and you will be asked to provide your feedback on the procedures.

5. WHAT WILL I BE ASKED TO DO?

If you agree to take part in this study, you will be asked to allow your child to receive this intervention in the natural inclusive classroom to increase their ability to request.
Once consent to participate has been given, your child will be screened to make sure that they meet the criterion for inclusion in this study. Screening tools will include the VBMapp criterion based assessment to document the verbal abilities of your child and also a 20 minute language sample to document your child's current level of manding within the classroom.
Once your child has met the criteria for inclusion in this study, he will be given a preference assessment to determine high preference pairs of items, for instance markers and paper or juice and a cup. These items will be rank ordered and then used as sets of paired items that your child will be taught to request.

The actual study sessions will take place in your child's classroom in two sessions a day. Within the embedded trial instruction, several of the high preference paired items will be available around the classroom during a naturally occurring activity. When your child expresses interest in the item, he or she will be shown the second paired item, and then be prompted to request the item.

6. WHAT ARE MY BENEFITS OF BEING IN THE STUDY?

While we cannot guarantee any personal benefit your child will gain, our expectations are that your child will enjoy the individual attention and the time in the inclusive classroom. We also expect that your child will demonstrate an increased ability to request preferred items within natural environments. Participation is however, completely voluntary and your child can stop participation at any time. We are hoping that this intervention will contribute to our

understanding of how to effectively teach children with autism in their inclusive elementary classrooms.

7. WHAT ARE MY RISKS OF BEING IN THIS STUDY?

We do not know of any personal risk or discomfort your child will encounter from taking part in this intervention, however a possible risk may be that your child does not like one of the teaching interventions being used and may demonstrate an increase in inappropriate behavior that functions as an escape.

8. HOW WILL MY PERSONAL INFORMATION BE PROTECTED?

Information produced by this intervention will be confidential and private. All materials collected from you or your child will contain pseudonyms' for any identifying information, and all materials will be kept in a secure, locked file cabinet. Only the research staff will have access to this information. All data collected from your child will be coded and kept electronically in a secure, password protected account. Personal identifying information will be kept in a drawer separate from the coded data. All data will be destroyed 5 years after the close of the study. At the conclusion of this study, the researchers may publish their findings. Information will be presented in summary format and you will not be identified in any publications or presentations.

10. WHAT IF I HAVE QUESTIONS?

We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher(s), Jennifer McIntire (XXX) XXX-XXXX or Dr. Michael Krezmien, (XXX) XXX-XXXX. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at (413) 545-3428 or humansubjects@ora.umass.edu.

11. CAN I STOP BEING IN THE STUDY?

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

13. SUBJECT STATEMENT OF VOLUNTARY CONSENT

When signing this form I am agreeing to voluntarily enter this study. I have had a chance to read this consent form, and it was explained to me in a language which I use and understand. I have had the opportunity to ask questions and have received satisfactory answers. I understand that I

can withdraw my child at any time. A copy of this signed Informed Consent Form has been given to me.

_____	_____	_____
Participant Name:	Print Name:	Date:
_____	_____	_____
Parent Name:	Print Name:	Date:

By signing below I indicate that the participant's parent has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

_____	_____	_____
Jennifer McIntire	Print Name:	Date:

APPENDIX B

FIDELITY CHECKLIST, USED TO DOCUMENT THAT THE RESEARCHER IMPLEMENTED THE INTERVENTION AS CALLED FOR IN THE STUDY

Treatment Fidelity

Participant Initials: Date: Activity:

Please Circle One: Primary IOA

Trial:	1	2	3	4	5	6	7	8	9	10
Teacher within 2 feet of student.										
Tasks within eyesight of student										
Tasks within arm's reach of student										
Student independently mand for task										
Researcher praise student and give material										
Student performs 30 s of work										
Researcher removes task material										

IF DOESN'T START TASK (prompting procedure)										
If no initiate for 5 seconds, tell student to "make a choice"										
PROMPT: if task not begun within 5 s of "make a choice" (**hand on elbow**)										
PROMPT: if task not begun within 5 s of elbow prompt (**hand on wrist, direct hand to task**)										
PROMPT: if task not begun within next 5 s of hand on wrist, direct hand to task prompt ("**get to work"**)										
If no mand, wait 5 seconds and present new material										

ONCE ENGAGED IN TASK – IF NO SPONTANEOUS MAND										
Wait 5 s for spontaneous mand										
PROMPT: no mand within 5 s say(**what do you want"**)										
PROMPT: no mand within 5 s say(**"say I want *task item*")**										

PROMPT: no mand within 5 s say(**press button on talker**)										
PROMPT: no mand within 5 s say(**press button on talker again**) and give material										

APPENDIX C

SAMPLE OF SOCIAL VALIDITY QUESTIONNAIRE THAT WILL BE HANDED OUT TO PARENTS, TEACHERS AND PARTICIPANTS OF THE STUDY

Name: Date:
Role in this study: Teacher
Please answer the following questions to the best of your ability. If you have additional comments, please record them on the back of this sheet.
Thank you!

Question	Fully agree	Agree	Neutral	Disagree	Fully disagree	I don't know
The student enjoyed the intervention.	1	2	3	4	5	DN
The intervention was easy to implement.	1	2	3	4	5	DN
The intervention increased the number of requests the student makes.	1	2	3	4	5	DN
This intervention focuses on an important behavior.	1	2	3	4	5	DN
The intervention is easily incorporated into the classroom.	1	2	3	4	5	DN
I believe that I can accurately implement this intervention in the classroom.	1	2	3	4	5	DN
The time requirements of this intervention are reasonable.	1	2	3	4	5	DN
I have the necessary materials to implement this intervention accurately.	1	2	3	4	5	DN
I would use this intervention with other students in my classroom.	1	2	3	4	5	DN

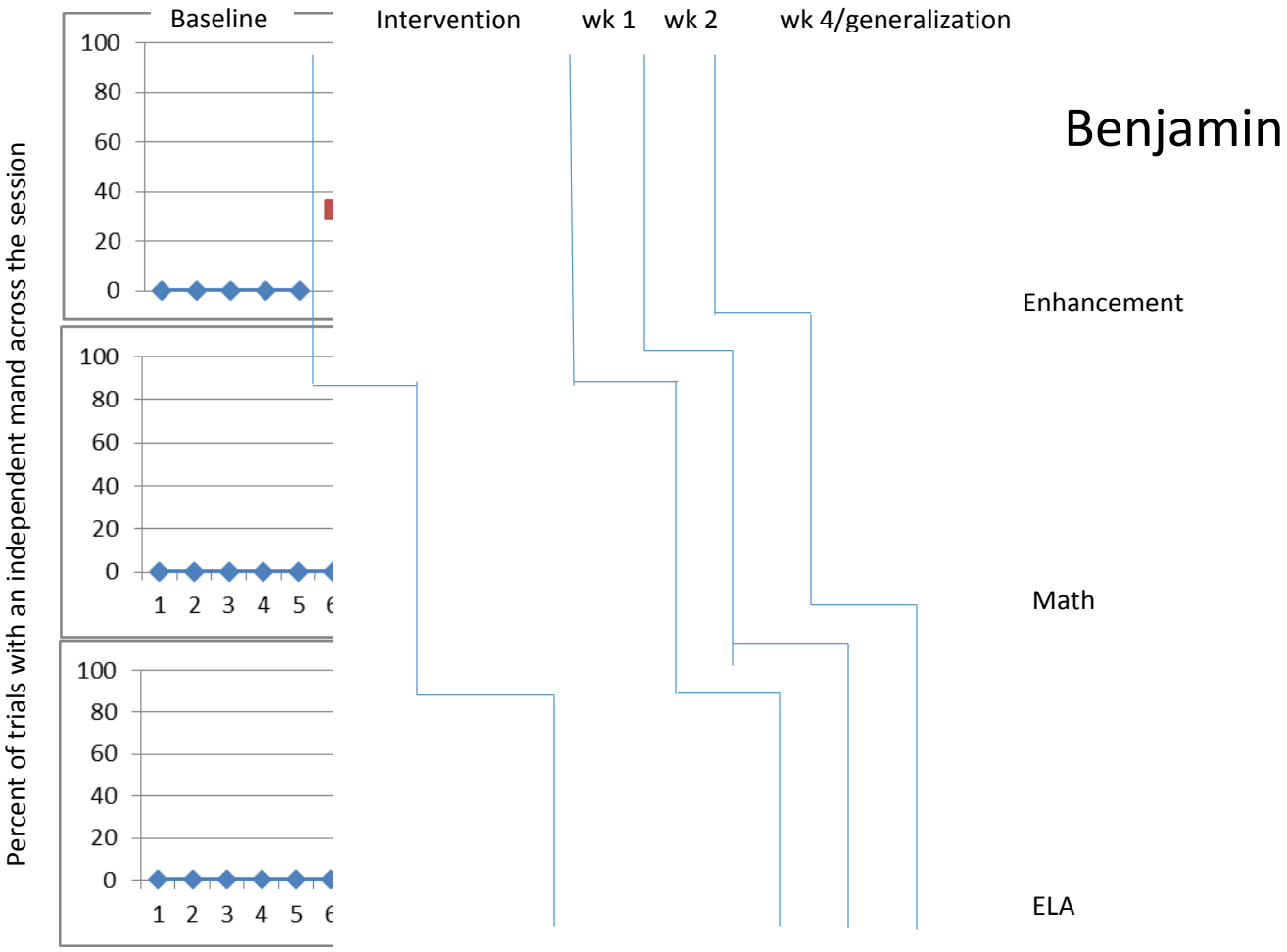

Figure 1: Percent of opportunities that Benjamin manded independently across a 10-minute session within the general education classroom.

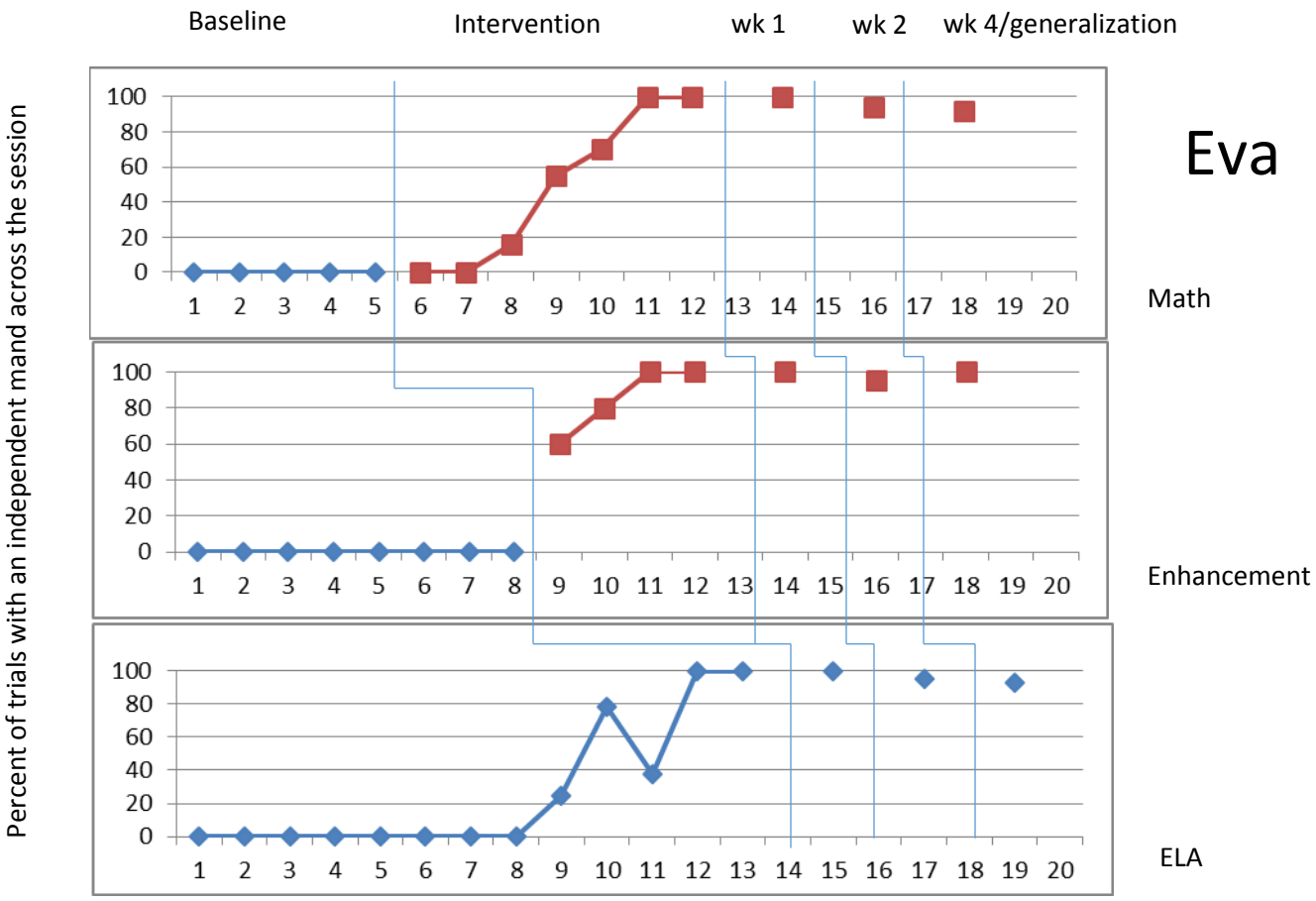

Figure 2: Percent of opportunities that Eva manded independently across a 10-minute session within the general education classroom.

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