TOWARDS A MULTI-COMPONENT INTERVENTION APPROACH TO PRESCHOOL PEER MEDIATED INTERVENTIONS: EFFECTS OF SELF-MANAGEMENT AND VIDEO MODELING ON SOCIAL COMMUNICATION OF CHILDREN WITH ASD

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ABSTRACT

TOWARDS A MULTI-COMPONENT INTERVENTION APPROACH TO PRESCHOOL PEER MEDIATED INTERVENTIONS: EFFECTS OF SELF-MANAGEMENT AND VIDEO MODELING ON SOCIAL COMMUNICATION OF CHILDREN WITH ASD

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Social inclusion of children with autism spectrum disorder (ASD) within educational settings requires ongoing interactions with typical peers that are positively perceived by peers without disabilities, and the formation and maintenance of friendships within those settings (Koster, Nakken, Pijl, & vanHouten, 2009; Locke, Kang-Yi, Pellecchia, & Mandell, 2018; Stahmer & Ingersoll, 2004; Whitaker, 2004). The absence of direct intervention and peer and staff training can contribute to social isolation in children with ASD (Osler & Osler, 2002). Children with ASD who are socially excluded may experience higher levels of rejection and increased vulnerability to bullying (Cappadocia, Weiss & Pepler, 2012; Fisher, Moskowitz, & Hodapp, 2013; Symes & Humphrey, 2010). Therefore, children with ASD require effective interventions to fully benefit from inclusive educational settings (Lord, 1993; Pelicano, Bolte, & Stahmer, 2018). In order to meet the complex social needs of children with autism, social communication interventions must intervene with the child with ASD and the environment and assess the generality of social communication outcomes.

The purpose of this dissertation was to understand how current intervention strategies promote generalization and can be combined to improve social communication outcomes for young children with ASD in inclusive education settings. Three independent but related research studies presented in journal submission format follow this introduction as chapters 2-4.

Chapter 2 is a meta-analysis of the current single-case experimental design literature on the use of video based intervention (VBI) to target generalization of social communication for preschool and kindergarten children with ASD. The intent of this review was to examine potential moderating variables and to better understand generalization practices within VBI that promote generalization. Effect sizes between baseline and generalization were computed using Tau-U. This study extends previous VBI meta analytic reviews by evaluating the efficacy of VBI on generalization effects using a non-parametric effect size measure (i.e., Tau-U). Results of the synthesis demonstrate VBI studies assessing generalization of social communication for young children with ASD have an omnibus generalization effect of .83 CI95 [.75-.91]. When VBI studies program generalization this effect is higher .88 CI95 [.80-.96].

Chapter 3 evaluates a packaged peer training intervention using a component analysis approach. An add-in with reversal design was used to evaluate peer training components on peer social responses. The results of the study primarily inform the peer training strategy used in Chapter 4 as part of the multi-component peer mediated approach.

Chapter 4 examines the effects of a multi-component peer mediated intervention on the social communication behaviors of children with ASD and their typical peers during in an inclusive educational setting. A multiple probe across dyads design was used to examine the effects of the intervention (e.g., multiple-exemplar video modeling) on social initiations and social communication exchanges. The study contributes to the emerging literature on the effects of multi-component interventions on social communication among preschools children with ASD. Chapter 5 merges themes across all three publishable papers regarding social-communication, multi-component peer mediated approaches, and the use of VBI to promote generalization.

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CHAPTER 1

Introduction

The unique social needs of children with autism spectrum disorder (ASD) have been well documented within the literature. Early signs of an ASD diagnosis involve the absence of gestural bids for joint attention, eye contact, orienting to name, imitation, social smiling, and social interest and affect (Mundy, Sigman, & Kasari, 1993; Zwaigenbaum, Bryson, Rogers, Roberts, Brian, & Szatmari, 2004). Particularly, young children with ASD have difficulties in social communication—defined here as the ability to use verbal and non-verbal communication to engage in mutually beneficial interactions with others (Paul, 2003). When compared to typically developing children, those with ASD perform significantly lower on social communication behaviors such as eye gaze and point, rate of verbal communication, acts of joint attention, and conversational gestures (Wetherby, Watt, Morgan, & Shumway, 2006).

For young children with ASD, deficits in social communication impede interactions with typically developing peers (Chamberlain, Kasari & Rotheram-Fuller, 2007; Dahlgren & Gillberg, 1989; McConnell, 2002), as social communication mediates interactions during play (Paul, 2003). Typically developing children as young as three years of age use language to negotiate roles and activities, narrate actions, and plan future events during play (Paul, 2003); whereas young children with ASD tend to engage in repetitive play behaviors and avoid social communicative interactions during play with peers (Sigman & Ruskin, 1999; Wolfberg & Schuler, 1999). If left untreated, social communication deficits may impact the quality of life of individuals with ASD through adulthood (Carter et al., 2014).

Generalized Social Communication Repertoire

Despite positive social communication outcomes reported in the extant intervention literature, little is known about the generality of social communication repertoires acquired following brief periods of intervention, as few studies measure generalization effects (Bellini & Akullian, 2007; Camargo, et al., 2016; Goldstein, Lackey, & Schneider, 2014; Sutton, Webster, & Westerveld, 2019). This is problematic as the aim of social communication interventions for children with ASD is the generalization of acquired social communication behaviors across people, settings, and contexts that have social and applied value. The degree of generality of a skill can have crucial implications over the utility of the skill for a child with ASD.

Stokes and Baer (1977) first characterized and defined the following generalization programming and assessment variables from the applied behavioral analytic literature; training with sufficient exemplars, training loosely, introducing naturally occurring contingencies, sequential modifications, programming common stimuli, use of indiscriminable contingencies, mediated generalization, and training to generalize. For example, teaching to sufficient response exemplars or response generalization, involves programming various exemplars of the targeted response as part of the intervention in order to teach a class of responses that will serve the same function rather than a single response (Stokes & Osnes, 2016). A programming tactic for promoting stimulus generalization, that is, the likelihood that a response will transfer to different people, settings, or contexts is making antecedents and consequences less discriminable or training loosely. For example, Hart and Risley (1980) developed a language teaching procedure known as incidental teaching that capitalized on the naturally occurring interactions between children with developmental disabilities and their teachers. The environment incorporated a range of natural consequences for verbalizations delivered by the teacher that occurred prior to the delivery of the material, attention, or activity and occurred at different times in the day. The researchers found positive outcomes for response generalization.

When selecting social behaviors for teaching children with ASD, the environmental demand of social behaviors must be considered (e.g., school, community, and home). The type of generalization assessed may have a different degree of importance depending on the skill and on the utility of the skill in a given environment (Haring, 1988; Stokes & Osnes, 2016). For example, to a child who spends most of their day in an inclusive preschool classroom, it may be important to consider whether social initiations taught in a clinical setting generalized to the preschool playground. Relatedly, it is important to consider the quality of generalization by the degree to which the behavior has potential to contact reinforcement in other contexts, environments, and with other people that may result in maintenance of the skill (Stokes & Baer, 1977). For example, if we teach children to engage in social initiations and responses with a particular set of toys, if those toys are not available in their classroom or home, then it may be highly relevant to program stimulus generalization and assess whether stimulus generalization was achieved to familiar toys.

When programming generalization for a particular social skill and assessing whether the child generalized the skill, it may be important to consider the degree to which the acquired skill resulted in the child's ability to adapt to new situations. For example, when teaching social initiations and responses the child's ability to produce untrained responses and initiations (i.e., response generalization) may be highly important if the context and conditions change all the time. Therefore, analyzing both the type of generalization that will help the child function in that situation and the potential programming methods that are responsible for generalization are important. Unfortunately, social communication interventions have been designed to promote generalization with limited success (Camargo et al., 2015). That is, few studies assess generalization systematically and program for generalization.

Social Communication Intervention Framework

McConnell (2002) proposed a practical framework for summarizing the existing social communication intervention literature for individuals with ASD by intervention agents and environmental conditions that has been employed in subsequent literature reviews (Bellini, Peters, Benner, & Hopf, 2007; Reichow & Volkmar, 2010; Sutton, et al., 2019; Whalon, Conroy, Martinez, & Werch, 2015). The framework divides interventions into five categories: (a) *environmental modifications* are those that change the physical and social environment to promote social interactions between children with ASD and their peers, (b) *child-specific interventions* involve direct instruction of specific social behaviors, (c) *collateral skills interventions* involve training related skills in a manner that also teaches social behaviors, (d) *peer-mediated interventions* involve training typically developing peers to initiate and respond to children with ASD and, (e) *comprehensive interventions* involve social communication interventions that combine two or more of the above interventions. Of these categories, two of the most frequently used interventions in inclusive education settings are: *child-specific* and *peer mediated interventions* (Gunning, Breathnach, Holloway, McTiernan, & Malone, 2019).

Child Specific Interventions

Child-specific interventions, defined as adult-directed instructional methods that are aimed to teach specific social skills to children with ASD, tend to be adult mediated (e.g., video-modeling, scripts, or social narratives). They involve developing instructional procedures to improve social behavior of children with ASD that use adult mediated prompting and reinforcement and generalization programming. Video modeling (VM) is one type of child-specific intervention with robust results for improving a wide range of social communication (Bellini & Akullian, 2007).

Video modeling. Based on social learning theory (Bandura, 1977), VM is an intervention used to teach new behaviors through imitation of a model presented via video technology. VM is considered an evidence-based practice by the National Autism Center (NAC, 2015) and the National Professional Development Center on ASD (NPDC; Wong et al., 2015). Specifically, researchers and educators have evaluated and implemented VM to teach scripted play verbalizations to children with ASD (D'Ateno, Mangiapanello, & Taylor, 2003; MacDonald, Clark, Garrigan & Vangala, 2005; MacManus, MacDonald, & Ahearn, 2015; Palechka & MacDonald, 2010) and have involved typically developing peers (Dueñas, Plavnick, & Bak, 2019; MacDonald, Sacramore, Mansfiled, Wiltz, & Ahearn, 2009; Maione & Mirenda, 2006).

Video modeling is an intervention that can be used for programming several generalization strategies that promote response and stimulus generalization. Some examples involve the following: (a) recording several videos to model multiple response options for promoting response generalization; (b) recording various people to model social behaviors (e.g., peers, teachers, and parents); (c) recording videos in natural environments and programming naturally occurring contingencies (e.g., observing a model receive social praise for performing a behavior); (d) using common stimuli in the child's environment; and (e) using portable electronic devices that optimize implementation across settings (e.g., home, community, classrooms). Recent VM studies have shown that varying the social communication behaviors modeled in videos during play may evoke several potential responses when presented with similar play contexts (see Dueñas, et al., 2019; MacManus et al., 2015; Maione & Mirenda, 2006; Plavnick, & Dueñas, 2018). Programming multiple exemplars is an instructional strategy that may promote the acquisition of repertoires as opposed to rote responses (Stokes & Baer, 1977). This focus may help children with ASD to demonstrate more natural play interactions across varied contexts (Kasari et al., 2016). Novel social communication skills are a desired focus of social interactions between children with ASD and their peers, as predictability and rote responding are less typical among children who are not diagnosed with ASD.

Peer mediated interventions. In contrast to child specific interventions, the aim of peer mediated interventions (PMIs) is in changing features of the social environment to increase social interactions between children with ASD and their peers by preparing typical peers to be socially responsive. Typically developing peers are taught to socially initiate and respond to children with ASD in natural settings (English, Goldstein, Shafer, & Kaczmarek, 1997; Odom & Strain, 1986; Strain, Shores, & Timm,1977). PMI is a widely used and socially valid evidence-based intervention for young children with ASD in inclusive education settings (see Paynter et al., 2017; Whalon et al., 2015; Zagona & Matergeorge, 2016). PMI emerged in response to the need to provide effective strategies to young children with ASD in inclusive early childhood settings in the 1980's (Goldstein & Ferrell, 1987; Odom & Strain, 1986) and a significant amount of research has followed since then. In PMI, peers act as intervention agents to increase social interactions with their peers with ASD (Gunning et al., 2019; Zagona & Mastergeorge, 2016). Existing preschool PMI research has been shown to successfully teach typically developing preschoolers to initiate interactions, prompt and reinforce behavior, and remain in proximity to children with ASD (Laushey & Heflin, 2000; Watkins, et al., 2015).

The popularity of PMI is evident in the high knowledge and use ratings of early intervention providers over other evidence-based interventions that target play, such as VM, scripts, and social skills groups (Paynter et al., 2017). PMI is often a recommended practice in preschool programs that include children with ASD (Guralnick, 2000; McConnel, 2002; Strain & Kerr, 1981; Wolery, 2000) in part because it fits with the current practices used in inclusion and it promotes the maintenance and generalization of acquired social skills (e.g., all peers in the classroom can be trained; Harrower & Dunlap, 2001).

In particular, there are several features of PMI interventions that may promote generalization. For example, most PMIs are conducted in natural environments and across several settings, such as training typical peers in playgrounds during recess (see McFadden, Kamps, & Heitzman-Powell, 2014) and training several typical peers or an entire classroom to promote social interactions across several peers (Kamps et al., 2002). In addition, because PMI studies tend to be implemented in inclusive educational settings, they can incorporate common stimuli and program natural maintaining contingencies (e.g., a peer responding to their social initiations).

Though PMI has become one of the most efficacious and socially valid practices for children with ASD in schools (Gunning, et al., 2018; Reichow & Volkmar 2010; Wang, Cui, & Parilla, 2011; Wong et al., 2015), limited research exists that targets specific social communication skills for preschool children with ASD during extended play interactions (see Goldstein, Schneider, & Thiemann, 2007). And, little emphasis has been placed on evaluating the efficacy of peer training strategies that are nonintrusive (i.e., absent of adult facilitation, see Golstein & Wickstrom, 1986; Sainato, Goldstein, & Strain, 1992 for exceptions). In addition, little is known about the ideal peer training practices that lead to improving social communication outcomes of children with ASD. Although children with ASD benefit from PMI they may require additional child-specific interventions, such as VM to acquire a wider range of social communication behaviors with their peers, such as verbal social initiations.

Combined interventions. In response to the need to provide direct social instruction to children with ASD while training peers to be responsive social partners, researchers have begun to package PMI with child-specific interventions (Whalon et al., 2015). These interventions have yielded positive social communication outcomes for children with ASD (Kamps, et al., 2015; Kamps, et al., 2014; Kasari et al., 2016; Kent, Cordier, Joosten, Wilkes-Gillan, & Bundy, 2018). However, additional research is needed to assess the optimal combination of PMI and child-specific strategies that may result in a range of social communicative behaviors among children with ASD and typical peers, such as unscripted verbalizations and reliable responses by peers.

The present dissertation contributes to the generalized social communication repertoires of children with ASD through the investigation of a multi-component PMI. First, the researcher examined the generalization effects of video-based interventions (VBI) known to promote independent social behavior in children with ASD. Second, the researcher examined the effects of various components of a peer training package on social responsiveness of typical peers. And third, the researcher examined the combination of two effective interventions, VBI and PMI, on social communication among young children with ASD and their typically developing peers. Three independent but related research studies presented in journal submission format follow this introduction as chapters 2-4.

Chapter 2 is a meta-analysis of the current single-case experimental design literature on the use of the broader VBI literature (e.g., VM, video self-modeling, video prompting) to target generalization of social communication for preschool and kindergarten children with ASD. The intent of this review was to examine potential moderating variables, such as VBI procedures (e.g., multiple-exemplars, programming common stimuli, and training for generalization) on overall generalization effects to better understand generalization practices within VBI that promote generalization. Effect sizes between baseline and generalization were computed using Tau-U. This study extends previous VBI meta analytic reviews by evaluating the efficacy of VBI on generalization effects using a non-parametric effect size measure (i.e., Tau U). Results of the synthesis inform subsequent intervention studies regarding generalization programming and assessment.

Chapter 3 evaluates a packaged peer training intervention using a component analysis approach. An add-in with reversal design was used to evaluate peer training components on peer social responses. The results of the study primarily inform the peer training strategy used in Chapter 4 as part of the multi-component peer mediated approach. The study…

Chapter 4 examines the effects of a multi-component peer mediated intervention on the social communication behaviors of children with ASD and their typical peers in an inclusive educational setting. A multiple probe across dyads design was used to examine the effects of the intervention (e.g., multiple-exemplar video modeling) on social initiations and social communication exchanges. The study contributes to the emerging literature on the effects of multi-component interventions on social communication among preschools children with ASD.

Finally, chapter 5 merges themes across all studies regarding generalized social-communication repertoires of children with ASD and multi-component peer mediated approaches.

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CHAPTER 2

Generalization Effects of Video-Based Interventions on Social Communication of Young Children with ASD: A Meta-Analytic Synthesis of Single-Case Research

Social communication is the ability to use verbal and non-verbal communication to engage in mutually beneficial interactions with others across contexts (McConnell, 2002). When compared to typically developing children, those with autism spectrum disorder (ASD) perform significantly lower on social communication behaviors such as eye gaze and point, rate of verbal communication, acts of joint attention, and conversational gestures (Wetherby, Watt, Morgan, & Shumway, 2006). The potential long-term effects of social communication deficits among individuals with ASD can lead to isolation and bullying (Cappadoccia, Weiss, & Pepler, 2012; Carter, 2009) and educational and employment underachievement (Chen, Leader, Sung, & Leahy, 2015; White, Ollendick, & Bray, 2011). Therefore, a primary goal of early intervention research over the past two decades has been to identify effective interventions that improve social communication (Sutton, Webster, & Westerveld, 2019).

Systematic reviews of social communication interventions and of broader social skills interventions show progress for young children with ASD (Bellini, Peters, Benner, & Hopf, 2007; Goldstein, Lackey, & Schneider, 2014). In particular, when considering studies employing single case experimental design, we see positive outcomes in social communication for children with ASD over a short time period. However, several limitations exist with regards to the generality of acquired social communication skills for individuals with ASD (Jonsson, Olsson, & Bolte, 2016; Walton & Ingersoll, 2012). That is, it remains unknown whether treatment gains generalize to other people, settings, contexts, or responses (Goldstein et al., 2014; Hillier, Fish, Cloppert & Beversdorf, 2007; Mrachko & Kaczmrek, 2017).

Generalization

Generalization is categorized into two main types; stimulus and response generalization. Stimulus generalization occurs when a response taught under one set of conditions (e.g., teaching a student to say, “hello” when a teacher enters a room) is performed in the same manner under different but similar conditions (e.g., saying, “hello” when a peer enters a room). Response generalization occurs when training of one response affects the performance of other responses (e.g., teaching a child to say, “my turn” to a peer to obtain a desired toy and the child saying, “hey its mine” to achieve the same goal). In behavior analytic terms, generalization describes a phenomenon where the “control acquired by a stimulus is shared by other stimuli with common properties” (Skinner, 1953, p. 134). Researchers have concluded that children with ASD have difficulty generalizing skills to new environments (Frith,1989; Hume, Loftin, & Lantz, 2009; Koegel & Rincover, 1976).

One hypothesis for lack of generalization is that children with ASD respond to a restricted set of cues in their environment–a phenomenon called stimulus overselectivity (Lovaas, Koegel, & Schreibman, 1979; Rincover & Ducharme, 1987). Overselectivity may impact generalization in several ways, including the tendency to attend to non-relevant cues in the environment. That is, children with ASD who may be over selective to cues in the environment, may miss the necessary cues to engage in social communication and therefore have a difficult time responding to relevant cues in the novel environment (Hill, 2004; Solomon, Necheles, Ferch, & Bruckman, 2007).

A second hypothesis is that children with ASD, have a tendency to perform skills in the precise manner they were taught, and under the same environmental conditions. Studies have demonstrated that children with ASD struggle to respond to novel environmental cues and produce novel responses in settings dissimilar to training (Plaisted, 2001).

Programming generalization. For individuals with ASD who struggle to generalize acquired social communication, it is necessary to program generalization in instructional or treatment arrangements. There are numerous recommended strategies for promoting generalization, primarily stemming from reviews of behavior analytic literature (Brown & Odom; 1994; Gianoumis & Sturmey, 2012; Harring, 1988; Stokes & Baer, 1977; Stokes & Osnes, 1986). Stokes and Baer (1977) originally described eight strategies for promoting generalization: training with sufficient exemplars, training loosely, introducing naturally occurring contingencies, sequential modifications, programming common stimuli, use of indiscriminable contingencies, mediated generalization, and training to generalize. Further, Haring (1988) categorized the Stokes & Baer strategies for programming generalization by their contingency term: setting, antecedent, and consequent, and used an “other” category to describe generalization strategies that involved additional teaching arrangements (e.g., mediate generalization).

Programming various exemplars involves providing various examples for responding until untrained responses emerge. Training loosely involves varying the procedures as to minimize tight control from stimulus to a response. Introducing naturally maintaining contingencies involves transferring the maintaining consequences for desired behavior from contrived consequences to naturally occurring ones. Sequential modification involves systematically evaluating whether the intervention transferred to other people, settings, contexts and teaching in those contexts if responding did not transfer. Programming common stimuli involves using stimuli that is readily available in the individual’s environment and therefore maximizing exposure. The use of indiscriminable contingencies (i.e., unpredictable schedules of reinforcement) may be used to mimic reinforcement schedules within the environment in which we hope behaviors will generalize. Mediating generalization involves teaching students to self-record or self-monitor as it is an easy tool to transfer across environments. Finally, training for generalization is a technique in which successive approximations of generalization are reinforced.

Generalization strategies have also been extended to include training in the natural setting (Haring, 1988). Training in the natural setting includes and extends the strategy of programming common stimuli by teaching skills within the actual environments in which learners will use them. This strategy can ensure that the antecedent and consequent stimuli that were present during training are present in generalization settings. In addition, training in natural settings may inadvertently incorporate other strategies that are known to promote generalization, such as programming common stimuli, embedding naturally occurring contingencies, and embedding indiscriminable contingencies. See Table 1 for definitions of each generalization strategy and examples under these categorizations.

Programming Generalization Through Video-Based Interventions

Though numerous procedural variations exist among video-based interventions (VBIs), VBI generally involves the following components: (a) a child views a target behavior on a video screen, (b) an interventionist replicates the conditions of the video (e.g., materials, scenarios, etc.), and (c) an interventionist asks the child to imitate what is seen in the video. VBI shows promise for addressing issues with generalization of social communication among individuals with ASD as they can incorporate many of the aforementioned strategies known to promote generalization (Qi, Barton, Collier, & Lin, 2017; Wong et al., 2015). Specifically, videos allow for programming the following: (a) multiple exemplars of responses options (e.g., response generalization); (b) various people can serve as models (e.g., peers, teachers, and parents); (c) programming naturally occurring contingencies (e.g., observing a model receive social praise for performing a behavior); (d) programming common stimuli; and (e) implementation in the natural settings (e.g., home, community, classrooms). A prominent example within the VBI literature is the use of multiple exemplars to promote response generalization (Dueñas, Plavnick, & Bak, 2019; Maione & Mirenda, 2006; Plavnick & Dueñas, 2018; Wang & Koyama, 2014). In addition, researchers have demonstrated that VBI leads to higher stimulus generalization over other similar methods, such as live modeling (Charlop-Christy, Le, & Freeman, 2000). Although VBI has been established as a powerful intervention for teaching social communication (Bellini & Akullian, 2007; Wong et al., 2015), the effects of VBI on generalization as well as the particular VBI procedures that have led to generalization are less clear (Bellini & Akullian; Jones, Lerman, & Lechago, 2014).

Bellini and Akullian (2007) conducted one of the most cited meta-analytic reviews of VBI for children and adolescents with ASD. The meta-analysis of 23 single-subject design studies examined the generalization and maintenance effects on social communication, functional skills, and behavioral functioning. Of the 23 studies only seven studies collected and graphed generalization and showed low to moderate generalization effects across participants and settings. The generalization effects for VBI were difficult to interpret as there was wide variation among studies and a low number of single-case experimental studies that measured generalization effects.

Since the publication of Bellini and Akullian (2007) a number of meta-analytic syntheses have emerged assessing the effects of VBI, evaluating the methodological quality (Hong et al., 2016; Mason, Ganz, Parker, Burke, & Camargo, 2012; Qi et al., 2017; Wong et al., 2015), establishing whether VBI studies meet evidence-base standards (Wong et al.), and examining the potential sources of variability in responding to VBI (Mason, et al.). VBI reviews have also evaluated its efficacy on social communication for individuals with ASD (Qi & Lin, 2010; Wang, Cui, & Parrilla, 2011). Although recent meta-analytic reviews have continued to find statistically significant differences in the efficacy of VBI both between and within subjects, these reviews have not examined effects of VBI on generalization.

Purpose of the Current Synthesis

To date, Bellini and Akullian (2007) published the only systematic review of VBI that included generalization effects on social communication for individuals with ASD. Given the extensive intervention research for individuals with ASD over the subsequent decade, an updated review is needed. Generalization is a critical measure of positive outcomes and adaptable behavior change (Stokes & Osnes, 2016). When assessing improvement in social communication for individuals with ASD it is important to consider social communication outside the instructional setting, with a variety of people, and in response to various contexts. The purpose of this meta-analytic review is to update and expand previous meta-analytic syntheses of VBI for social communication skills in young children with ASD by examining the generalization effects of VBI studies. Particularly, we seek to understand the overall effect of VBI on stimulus and response generalization. A moderator analysis will also provide nuanced information about the factors that may influence generalization effects.

To understand the state of the VBI literature regarding generalization of social communication skills for young children with ASD, we examined the extent of generalization across studies, the strategies used for generalization, and the potential sources of variability on generalization effects. Specifically, we were interested in answering the following research questions: (a) What are the overall generalization effects of VBI on social communication of young children with ASD? (b) Do studies that program generalization have better generalization effects? (c) Is there a difference in generalization effect size when considering generalization strategies used within VBI? and (d) Is there a difference in effect among studies that measure response versus stimulus generalization?

Method

Search Procedures

The article search was conducted in five phases. The first phase of the literature search involved the use of a central multidisciplinary database, ProQuest, conducted in February 2018 with combined search terms of (1) “autis* OR “intellectual disabilities” OR “developmental disabilities”; (2) AND “experiment” OR “intervention”; (3) AND “video modeling” OR “video self-modeling” OR “videotape modeling” OR “videotape self-modeling” OR “video-prompting” OR “video technology” OR “video feedback.” The search was limited to peer reviewed articles published in English. The electronic search yielded 624 articles. Second, a hand search was conducted of *Focus on Autism*, *Journal of Autism and Developmental Disorders, and Exceptional Children* from 2006-2018. These titles were selected because they aligned with the journals that were hand searched by Bellini and Akullian in 2007. The hand search yielded 11 additional articles, for a total of 635. Third, the researcher conducted an ancestral search of 29 systematic and meta-analytic reviews of VBI and social communication interventions yielded in the electronic and hand search. The ancestral search involved reviewing the references of articles that meet our inclusion criteria. The ancestral search yielded 13 additional articles. Fourth, the researcher conducted an ancestral search of all the articles that met our inclusion criteria for any additional articles. Finally, the researcher consulted with two experts on VBI by asking them to evaluate the final list of articles and note whether any additional articles met the criteria. No additional articles were found during these final two stages.

The researcher conducted all phases of the search and a second coder served as independent observer for interrater reliability (IRR) of screening, hand search of journals, and ancestral searches. Cohen's kappa was used to measure interrater reliability in order to account for possible chance agreement, kappa scores range from -1 to +1 (Cohen, 1960). IRR for electronic search was 99%, Cohen's k = .95, for hand search was 99%, Cohen's k = .88, and IRR for ancestral search was 98% Cohen's k = .92. For a flow chart of all phases of the search and results in each phase see Figure 2.1.

Inclusion Criteria

Articles were screened for inclusion criteria by reviewing the title and abstract and, if needed, method sections. The researcher reviewed articles for the six inclusion criteria: (a) articles had to evaluate video modeling, video self-modeling, or video prompting as an independent variable; (b) articles had to have at least one participant with autism spectrum disorder, including high-functioning autism (HFA), and pervasive developmental disorder non-otherwise specified (PDD-NOS); (c) participant's had to be of preschool to kindergarten age (24-72 months); (d) the study had to evaluate outcome variables that included non-verbal or verbal social communicative behaviors; (e) the study had to use a single-case experimental design to evaluate the video based intervention and display data in graphical form in order to extract data for further analysis; and (f) the article had to asses generalization. An independent observer screened all articles, IRR was 99%, Cohen's k= .95.

Extraction of Descriptive Information

The following variables were extracted for review: (a) complete reference, (b) number of participant(s), (c) age(s), (d) gender, (e) type of ASD diagnosis, (f) setting, (g) social communication skill taught (i.e., dependent variable), (h) type of video modeling used (i.e., independent variable), (i) whether additional behavioral tactics were used (i.e., prompting, reinforcement, etc.), (j) the single case experimental design used, (k) whether inter-observer agreement (IOA) was obtained, (l) whether procedural integrity (PI) was obtained, (m) whether social validity was obtained, (n) whether maintenance data were collected, and (o) whether generalization data were collected. For evaluating additional intervention components that may have moderated the effects of generalization the following variables were extracted: (a) type of generalization measured (e.g., stimulus or response), (b) whether generalization was programmed, and (c) the type(s) of programmed generalization (e.g., sequential modification, natural maintaining contingencies, training sufficient exemplars).

Application of design standards. This quantitative review involved extracting data from generalization conditions only, therefore we wanted to measure methodological rigor of studies in order to make conclusions based on scientifically sound methods. Studies were removed if they did not meet standards with reservations. That is, we reviewed the methodological rigor and not the overall effect of each study, as to not bias the review in favor of positive effects. Studies were coded for six basic criteria of single case experimental design standards developed by the What Works Clearinghouse classified as (a) *Meets Design Standards*, (b) *Meets Standards with Reservations*, and (c) *Does not Meet Standards* (WWC; Kratochwill, Hitchcock, Horner, Levin, & Odom, 2013). The six basic criteria were: (a) whether the independent variable (i.e., intervention) was systematically manipulated (i.e., the researcher, rather than some naturally occurring event determined when and how changes in the independent variable occurred); (b) whether the outcome variable was measured systematically over time by more than one assessor; (c) whether interobserver agreement (IOA) was documented on the basis of an accepted measure of agreement (e.g., percentage of agreement); (d) whether the study met IOA threshold of 80%; (e) whether the study included at least three attempts to demonstrate an intervention effect at a different point in time (i.e., replication); and (f) whether phases included a minimum of three data points. If any of these standards were not met then the study was classified as *Does Not Meet Standards*. Studies that employed multiple baseline design had to have a minimum of six points in each phase to be classified as *Meets Standards*, if not these were classified as *Meets Standards with Reservations*. Studies that employed an alternating treatment design required at least five repetitions of alternating sequence to *Meet Standards*.

The researcher and the independent coder independently reviewed all codes and corresponding definitions and reviewed a set of studies for practice until 100% reliability was achieved. Then, the third author reviewed 50% of the articles, selected at random, to code for IRR with the researcher. If any disagreements occurred among codes the entire article was coded as a disagreement. IRR between the first and the third author was 81.25%, Cohen’s k= .478, which is considered moderate agreement. All disagreements across any of the codes were discussed until consensus was achieved.

Calculation of Generalization Effect Size

Because the focus of this review was on single-case methodology, a non-parametric test of effect size (ES) was used to evaluate the efficacy of VBI in preschool children with ASD. Tau-U is an ES measure that tests the degree of non-overlap between points. Tau-U was preferred over other non-overlap methods as it controls for baseline trend (Parker, Vannest, &

Davis, 2011; Parker, Vannest, Davis, & Sauber, 2011). A Tau-U score ranges from -1.00 to 1.00; a positive score between 0.0 and 1.0 indicates the level of improvement between baseline and intervention and a negative score indicates a negative relationship between baseline and intervention. The ES can be interpreted as small (0.65 or lower), medium-to-large (0.66–0.92), and large (0.93–1.0) (Parker, Vannest, & Brown, 2009; Rakap, 2015).

Graphclick (Arizona Software, 2008) was used to extract data points between phases for all graphs. We extracted generalization data from baseline (A phase) and during generalization probes (B phase). If generalization probes were not conducted in baseline, we extracted baseline data for the A phase. Tau-U calculations for each individual A-B phase or observation was completed using the original online software (http://www.singlecaseresearch.org/calculators/tau-u; Vannest, Parker, & Gonen, 2011). The same software aggregated A-B observations to give one generalization ES for each participant and study.

To ensure accuracy of data extraction and ES calculation, IRR was obtained. The researcher and a trained graduate student reviewed the method for extracting data and calculating ES and were calibrated until 100% reliability was achieved. Then, the researcher randomly selected 33% of the articles to extract data and calculate ES for IRR. Agreement between the researcher and graduate student was 76%, Cohen's k = .561. Disagreements were extracted once again by both observers until consensus was achieved.

Statistical Significance and Moderator Analysis

The statistical significance of Tau-U values was determined using a 95% confidence interval (CI95). A 90%–95% confidence interval is standard when determining whether change is reliable, indicating a 5–10% likelihood of error (Nunnally & Bernstein, 1994). A random effects model was estimated using STATA statistical software to determine the overall generalization ES of VBI yielded in this review. A random effects model assumes the observed estimates in treatment effects vary across studies because of real differences in the treatment effect, thus the variance among studies is defined as the variance within-studies and the variance between-studies (Borenstein, Hedges, & Rothstein, 2007). The combined ES of studies is not an estimate of one value but as the average of a distribution of values. Rather than giving equal weights to each ES the model allows for relative weights assigned depending on the sample size. Because these are single-case experimental design studies with small sample sizes, weights were assigned based on A-B comparisons within each study. To conduct the moderator analysis and determine whether statistically significant differences existed across categorical variables (e.g., studies that assessed stimulus vs. response generalization) a random effects metaregression model was employed using the *admetan* and *metareg* packages in STATA.

Results

Descriptive Results

The final number of articles was 31 after screening and after one study was removed based on not meeting single case experimental design (SCED) standards, see PRISMA diagram for details (Liberati et al., 2009). The total number of participants was 76. Of these, 17 were female and 59 were male. The majority of studies reported that children had a diagnosis of ASD (n=27), two participants were diagnosed with PDD-NOS and two participants were classified as having HFA. The primary focus of studies was the use of VBI to address social-communicative behavior during play, for example vocal initiations and responses (n=16). The remaining studies employed VBI to improve social skills more generally, (e.g., naming facial expressions; n=9), language and communication, (e.g., requesting items; n=3), and imitation, (e.g., gestural imitation; *n*=3). Approximately half of the studies were conducted in clinical settings (*n*=17), such as early intensive behavior intervention (EIBI) clinics. Fourteen studies were conducted in natural settings, such as inclusive classrooms (*n*=1), playgrounds (*n*=1), self-contained classrooms (*n*=5) and in the participant's home (*n*=5). And a small number of studies were implemented in a combination of research room and afterschool program or community setting (*n*=2). Thirteen studies employed a multiple baseline design across participants to evaluate the dependent variable. The second most utilized SCED was multiple baseline across behaviors (*n*=6), followed by alternating treatment design (*n*=4), multiple probe across behaviors (*n*=3), multiple probe across participants (*n*=2), and a combination of alternating treatment and multiple baseline design (*n*=3). Half of the studies assessed social validity and used a questionnaire as the primary method. Over half of studies (*n*=20) measured procedural integrity for VBI using a checklist.

Only one study used video self-modeling (VSM), the majority of studies employed a video modeling (VM) approach where an adult or peer serves as the model in the video. More than half of the studies investigated the use of VM in combination with other behavioral strategies, VM and reinforcement (*n*=8), VM and systematic prompting (*n*=3), VM, reinforcement, and prompting (*n*=3), VM and feedback (*n*=1), and VM and error correction (*n*=1). Fifteen studies employed VM alone.

In addition, studies were reviewed for whether they met methodological standards outlined by Kratochwill and colleagues (2013), 14 meet standards with reservations and 17 studies met standards.

Generalization

Of the 31 studies, approximately one half of the studies (*n*=17) assessed more than one type of generalization (e.g., stimulus, people, setting, and response). The remaining studies assessed only one type of generalization (*n*=14).

Slightly over half of the 31 studies (*n*=18) incorporated a strategy known to promote generalization. The remaining studies assessed generalization but did not program for generalization. The strategies used in the extant VBI literature were multiple exemplars, training in the natural setting, sequential modification, and training to generalize. The most popular method of promoting generalization was the use of multiple exemplars (*n*=11). Table 2 shows all studies that programmed generalization, the type of generalization assessed, and the type of generalization strategy that was programmed.

Tau-U Analysis of Generalization

Raw data for the 31 articles evaluating generalization effects for 110 A-B contrasts across 76 participants with ASD were used for this analysis. The omnibus Tau-U generalization ES across all studies was .83 CI95 [.75-.91], $p < 0.000$. The results indicate that VBI studies that improve social communication of young children with ASD have overall medium to large generalization effects. See Figure 2.2 for a forest plot of all studies.

Moderator Analysis

Programming generalization. Data were analyzed for whether there was a difference among studies that programmed for generalization versus studies that did not. Tau-U scores of generalization effects were higher for studies that programmed a strategy known to promote generalization .88 CI95 [.80-.96] than studies that did not program generalization .77 CI95 [.61-.93].

Type of generalization strategy programmed. The type of generalization strategy programmed was also analyzed for whether it moderated the effects of generalization for VBI studies. On average, studies that employed sequential modification (i.e., systematically evaluated whether the intervention transferred to other people, settings, and contexts and then taught in those contexts if responding did not transfer) had a higher Tau-U score .95 CI95 [.80-1.10] than studies that programmed other strategies coded in this review (e.g., training in natural setting, multiple exemplars). However, this difference was not statistically significant, in part due to to the small sample size within this category (i.e., n=4). No difference was found for other programming strategies, see results of sub-group analysis for other strategies in Table 3.

Stimulus vs. response generalization. We analyzed ES generalization data for whether there was a difference among studies that assessed response versus stimulus generalization. Tau-U ES scores were higher .92 CI95 [.85-.98] for studies that assessed stimulus generalization (materials, people, and setting), than for studies that assessed response generalization .71 CI95 [.53-.89]. See figures 2.2-2.5 for forest plots.

Discussion

This meta-analysis synthesized the findings from single-case research studies to evaluate the effectiveness of VBI on generalization of social communication among young children with ASD. Several recent advances have been made since the publication of Bellini and Akullian (2007) that marked the need for an updated status of the VBI literature with regards to generalization effects. VBI as a treatment for social communication deficits has grown exponentially (Qi et al., 2017; Shukla-Mehta, Miller, & Callahan, 2010) and researchers have begun to focus on the effects of social communication interventions on generalization for children with ASD (Hume et al., 2009). Findings provide overall support for stimulus and response generalization of social communication of young children with ASD using VBI. This speaks to the robust effects of VBI on generality of newly acquired social communication behavior. These findings differ from Bellini and Akullian (2007) who found that VBI interventions resulted in low to moderate stimulus generalization effects of social communication skills.

Programming Generalization

The current VBI literature supports the long-standing hypothesis that programming generalization strategies may promote generalization (Haring, 1988; Stokes & Osnes, 2016; Stokes & Osnes, 1989; Stokes & Baer, 1977). Specifically, we found a difference in generalization ES among VBI studies that programmed generalization, versus those that tested generalization but did not program for it. Of the 31 studies in this review, 14 assessed generalization but did not program for it, thus demonstrating VBI researchers believe generalization of outcomes is important, but continue to train and hope. Goldstein and colleagues (2014) speculate that the implementation setting of studies may be impacting generalization. That is, programming generalization may be overlooked when studies are implemented in the natural setting, where they hope the behavior will occur. One other possibility is that researchers are simply not outlining the generalization programming strategies that they employed in their study.

Generalization Strategies

We coded the type of generalization strategy used among VBI studies in order to examine whether a difference in generalization ES was observed depending on the generalization strategy used. We did not find a significant difference for whether studies employed any of the coded strategies (e.g., multiple-exemplars, sequential modification, programming common stimuli). In some cases, the small number of studies within each category did not allow us to perform an analysis. For example, we only found one study that trained to generalize. Among studies that programmed generalization, those that used multiple-exemplar instruction, did not have a significantly higher ES than those that did not, see subgroup analysis Table 3.

Training in the natural setting. Approximately half of the studies were conducted in natural settings (e.g., home, school, and community). Moderator analysis revealed that studies that were implemented in the natural setting did not result in significantly higher ES than those that were conducted in clinical settings. These findings are surprising given the vast social skills intervention literature that speaks to the advantages of implementing interventions in the natural setting (Brown & Odom, 1994; Schreibman et al., 2015; Snyder, Rakap, Hemmeter, McLaughlin, Sandall, & McLean, 2015).

Sequential modification. Though only four studies employed sequential modification, a higher ES was observed for studies that sequentially assessed generalization of VBI until transfer of social communication was observed in other settings, with other people, and other stimuli. For example, Paterson and Arco (2007) taught two preschool aged boys with ASD to play appropriately with toys using VBI. They conducted continuous generalization probes for two other toys while they intervened with one toy. Stimulus generalization was observed for one participant who was presented with toys that had similar physical components to toys used during intervention. This was hypothesized to be due to the less discriminable features of the generalization toys and toys used during intervention, as well as potential natural reinforcement from automatic properties of the toys (e.g., flashing lights and sounds).

Response vs. Stimulus Generalization

Since the publication of Bellini and Akullian (2007), we have seen an increase in studies evaluating the use of VBI to teach social communication skills to young children with ASD. However, most VBI studies continue to primarily assess stimulus generalization and few studies assess response generalization. This may be due to the difficulties of programming response generalization because it can be time consuming and may require that researchers and practitioners use more advanced procedures, such as multiple exemplar training and matrix training. However, social communication is a skill that requires that children vary their social communicative responses depending on the context and is an important feature of intervention outcomes. Among studies that assessed response generalization, the primary strategy used was multiple exemplar training. This strategy demonstrates potential for increased variation in social communicative responses with young children with ASD (Akmanoglu, 2015; Charlop-Christy & Daneshvar, 2003; Charlop & Milstein, 1989; Dueñas et al., 2019; MacManus, MacDonald & Ahearn, 2015; Maione & Mirenda, 2006; Reeve et al., 2007; Tetrault & Lerma, 2010).

Despite the importance of response generalization, the moderator analysis in the present meta-analysis revealed that studies that assessed response generalization had a lower ES than studies that assessed stimulus generalization. However, the average ES of studies assessing response generalization was still in the medium range, according to Tau-U ES interpretations (Parker & Vannest, 2009; Rakap, 2015). Lower ES was mitigated if studies programmed generalization. This finding supports the view that response generalization is much more difficult to produce than stimulus generalization, as it requires responding differently to a range of antecedent stimuli. But, if a generalization strategy (e.g., matrix training and multiple exemplars) is programmed, then results are much more positive.

Implications for Future Research

This review highlights a few key considerations for future research with regard to generalization effects of VBI on social communication of young children with ASD. One clear gap in the VBI literature is the assessment of response generalization. This review yielded 12 studies that assessed response generalization. This is quite surprising, given one of the main goals of early intervention programs is to improve novel responding in children with ASD. Existing studies show promise with the use of multiple exemplar training and matrix training. For example, MacManus and colleagues (2015) combined video modeling and matrix training to create play scenarios that were arranged in a 3-dimensional matrix to produce a specific kind of response generalization called recombinative generalization (Goldstein & Mousetis, 1989). All participants learned verbalizations and actions depicted in videos, and combined verbalizations and actions across videos. However, more research is needed with regards to the application of multiple exemplar instruction to a variety of social communication behavior, including non-verbal social communication.

Researchers often employed several strategies to promote generalization which limits our ability to understand the potential programming variables that are responsible for generalization of social communication outcomes. Additionally, this makes it difficult for practitioners to discern which generalization programming strategies to use, and may contribute to a trend in using overusing strategies or a trial and error approach to producing generalization. In addition, the match between the type of generalization assessed and the generalization programming strategy was not always apparent. For example, Sherer, Pierce, Paredes, Kisacky, Ingersoll, and Schreibman, (2001), taught conversation skills to two preschool aged children with ASD in their home and assessed generalization across responses, setting, and with peers. However, it is unclear if or how the researchers hypothesized that training in the home would result in generalization to peers at school.

In order to advance an understanding of the VBI literature and its use to promote generalization, future studies should provide both a clear rationale for the type of generalization assessed (i.e., response vs. stimulus) and the generalization strategy that will promote that specific type of generalization. As future studies begin to report this information in more detail, we may be able to better understand the specific variables associated with positive generalization outcomes. We did not code whether studies offered a hypothesis or rationale for generalization strategies programmed, however, one study clearly stated a hypothesis in their methods. Plavnick and Ferreri (2011) describe the specific features in their procedures that they hypothesized may contribute to positive generalization outcomes; that is, selecting target responses that are likely to be reinforced in the natural setting, multiple stimulus exemplars, and a natural intervention agent.

In addition, future meta-analytic researchers may look at the VBI literature more broadly in order to understand the state of the VBI literature with regards to stimulus and response generalization across skills and across the life span. Though we coded articles on various social communication skills (e.g., verbalizations during play) there was an insufficient number of articles within a particular skill to conduct a moderator analysis. Previous meta-analytic syntheses of VBI have found differences in ES across skills and across the life span (Mason, Ganz, Parker, Burke, & Camargo, 2012). For example, future studies may look at whether generalization ES differs among VBI studies that teach verbal vs. non-verbal forms of social communication.

The current meta-analytic synthesis revealed that studies that were implemented in the natural setting, yielded overall higher ES. Previous VBI researchers have reported that the following inherent factors in VBI may increase feasibility and acceptability in natural settings: (a) unlimited presentation of videos (Mechling, 2005); (b) increasing availability and usability of digital video equipment increases their probable use (Ayres & Langone, 2005); (c) presentation of videos in socially acceptable technologies such as iPods, iPads that do not limit the individual's opportunities to interact with peers (Shane, Laubscher, Schlosser, Flynn, Sorce, & Abramson, 2012); and (d) cost and time effectiveness (Charlop- Christy, Le, & Freeman, 2000). Though none of these factors have been empirically evaluated, they may influence the likelihood that VBI interventions will continue to be delivered in natural settings which may contribute to the generalization effects of VBI.

Limitations

The present quantitative review is limited in several ways. One significant limitation is with the interpretation of the findings. We coded articles for whether they programmed known strategies to promote generalization. These data were extracted based on the authors' report of their use of these strategies. This is problematic for at least two reasons. First, journal word limitations may result in authors omitting important information with regards to the types of generalization strategies employed. Second, authors may be inaccurate in their explanations of the generalization strategies used. Therefore, the information gathered around current generalization programming practices may not be fully accurate.

In cases where studies assessed generalization post intervention only, we extracted baseline data for this analysis (A=baseline, B=generalization probe post intervention vs. A= generalization probe at baseline B= generalization probes post intervention). The same was done in Bellini & Akullian (2007), though not specifically discussed. That is, not all the studies included in their analysis probed generalization at baseline. A critical feature of single case experimental design research is the stable demonstration of behavior over time, without assessing the presence or absence of behaviors in generalization conditions prior to intervention, we have a difficult time making accurate comparisons across conditions. Most studies in this review probed generalization during baseline, however, some studies did not. Of the studies that did not probe generalization during baseline, a few assessed response generalization. Therefore, baseline conditions would be an appropriate condition to assess response generalization. However, for studies that assessed stimulus generalization, though behaviors were absent or low during baseline conditions, we cannot assume that the behavior was not observed in different settings, across people, and contexts without baseline generalization probe data. That is, the Tau-U metric may not be accurately measuring change in generalization from pre to post intervention for those studies. See Table 2 for details of studies that did not probe generalization at baseline.

As stated earlier, reviewed studies used several strategies to promote generalization. This impedes a clear interpretation of generalization effects of this review because it is difficult to trace which generalization strategy resulted in positive generalization outcomes. This is particularly the case with studies employed in the natural setting. Many researchers used several strategies in combination with training in the natural setting. Therefore, there may be an overlap effect of generalization strategies that we are not able to discern in the present analysis. For example, four of the studies that were implemented in the natural setting also used multiple exemplar instruction (Dueñas, Plavnick, & Bak, 2018; Gena, Couloura, & Kymissis 2005; Kleeberger, 2010; Plavnick & Ferreri, 2011). Conversely, studies also assessed multiple sub types of stimulus generalization (see Table 2). In some studies, stimulus generalization was assessed across people, settings and contexts, all in a single generalization probe. Thus, stimulus generalization data represents outcomes for all subtypes of stimulus generalization assessed. This makes the ES interpretation of stimulus generalization difficult. All together, these limitations make it difficult to make accurate conclusions about the state of the VBI literature with regards to generalization effects of social communication in young children with ASD.

A disadvantage of meta-analytic syntheses of SCEDs is that there is no best practice for calculating effect sizes (Shadish, Hedges, Horner, & Odom, 2015. This review used Tau -U as it allows the individual values of all data points to be considered in a pair-wise comparison across phases (Park et al., 2011) and accounts for trends in baseline. However, this metric does not account for the strength or magnitude of the relation between independent and dependent variables (Kazdin, 1982; Kennedy, 2005; Kratochwill & Levin, 1992) as it primarily yields a percentage of non-overlap across phases and not a metric of the direction of change.

One additional limitation common to meta-analyses is publication bias. We limited our search to peer reviewed publications and did not include dissertations or theses. Therefore the data in this review do not represent all the research that has been conducted in generalization of social communication for young children with autism. The sample of studies yielded in the systematic search was primarily published studies, which tend to favor positive results.

This meta-analysis provides an update on the state of the VBI literature on the generalization of social communication of young children with ASD. Overall, the omnibus generalization effect was medium to large among VBI studies for this population. Variation was found among studies with regards to generalization assessment (stimulus vs. response) and programming trends. Multiple-exemplars and matrix training are promising strategies for promoting response and stimulus generalization. This quantitative synthesis provides further support for the need for careful programming of generalization strategies when planning VBI.

APPENDIX

Table 2.1. Strategies for Programming Generalization

Generalization Strategy	Definition	Example
Train and Hope	Providing instruction and hoping that generalization will occur (i.e., absence of generalization strategy)	Assessing setting generalization without embedding a strategy to promote generalization.
Setting *Train in the Natural Setting*	Providing instruction in a setting where the behavior or response is beneficial to the student.	Teaching bids to play at the playground.
Sequential Modification	Systematically evaluating whether the intervention transferred to other people, settings, and contexts and teaching in those contexts if responding did not transfer.	After teaching, assessing whether object labeling transfers to home and teaching in that setting if they fail to transfer.
Antecedent *Program Common Stimuli*	Using stimuli that is readily available in the student's environment and therefore maximizing exposure.	Teaching object labeling with items commonly seen in the home, classroom, or community.
Multiple Exemplars	Providing various examples for responding	Using several videos to model potential target responses given a certain social situation.
General Case Programming	A range of stimuli are considered for teaching that include stimuli in the presence of which a response should occur, stimuli in the presence a response should not occur, and stimuli that should not effect the response but may inappropriately do so.	Teaching empathy skills to a student by teaching them appropriate scenarios for which empathy should be demonstrated, scenarios for which statement may not be appropriate.
Consequent *Natural Contingencies*	Transferring the maintaining consequences for desired behavior from contrived ones to naturally occurring ones.	Teaching a student to respond to their name by providing artificial reinforcement (e.g., candy, tokens) contingent on correct responses, then fading the use of the reinforcer to a caregiver or teacher saying, "Hi, there!" and smiling.

Table 2.1. (cont'd)

Use Indiscriminable Contingencies	Delivering unpredictable schedules of reinforcement to mimic the environment in which we hope behaviors will generalize.	Teaching a student to respond to their name, and varying the consequence by following the response with a request to comply to a direction (i.e., no reinforcement), and sometimes delivering a desired toy (i.e., reinforcement).
Train to Generalize	Training successive approximations of generalization by reinforcing new forms of a response.	Reinforcing verbalizations during play that are new or different from previously taught ones.
Other *Train Loosely*	Varying the procedures as to minimize tight control from stimulus to a response is another popular strategy	Allowing a range of correct responses when teaching responding to social questions.
Mediate Generalization	Teaching students to self-record or self-monitor, as it is an easy tool to transfer across environments.	Teaching students to use a picture activity schedule or video activity schedule to engage in appropriate play activities.

*Adapted from Haring, 1988; Stokes & Baer, 1977; Stokes & Osnes, 2016

Table 2.2. Summary of Studies that Assessed Generalization and Programmed Generalization

	Type of Generalization Assessed				Generalization Strategy (ies) Programmed	Generalization Probes Post-intervention Only
Study	Stimulus (e.g., object material)	People	Setting	Response		
Akmanoglu (2015)	✓				Multiple Exemplars	X
Cardon (2012)	✓				Train in Natural Setting	X
Charlop-Christy & Daneshvar (2003)	✓				Multiple Exemplars	
Charlop & Milstein (1989)	✓	✓	✓	✓	Multiple Exemplars	
Dueñas, Plavnick, & Bak (2018)		✓		✓	Multiple Exemplars, Train in Natural Setting, Natural Reinforcer	
Dupere, MacDonald, & Ahearn (2013)			✓		Sequential Modification	
Gena, Couloura, & Kymissis (2005)		✓			Train in Natural Setting, Multiple Exemplars	
Jones, Lerman, & Lechago (2014)	✓	✓	✓		Sequential Modification	X
Kleeberger (2010)				✓	Train in Natural Setting, Multiple Exemplars	
MacManus, MacDonald, & Ahearn (2015)				✓	Multiple Exemplars (Matrix Training)	
Maione & Mirenda (2006)				✓	Multiple Exemplars	X

Table2.2. (cont'd).

Paterson & Arco (2007)	✓				Sequential Modification	X
Plavnick & Ferreri (2011)			✓		Natural Contingencies, Train in the Natural Setting, Multiple Exemplars	X
Reeve, Reeve, Townsend, & Poulson (2007)	✓				Multiple Exemplars, Natural Contingencies	
Sancho, Sidener, Reeve, & Sidener (2010)	✓	✓	✓	✓	Train to Generalize	
Sansoti & Powell-Smith (2008)			✓		Train in Natural Setting	
Sherer, Pierce, Paredes, Kisacky, Ingersoll, & Schreibman (2001)		✓	✓	✓	Train in Natural Setting	X
Tetrault & Lerma (2010)	✓				Multiple Exemplars	X

Table 2.3. Between Study Heterogeneity

	Between Study Heterogeneity				
	Effect Size	Lower	Upper	Statistic	p-value
Programmed Generalization					
Programmed	0.882	0.802	0.962	–	–
Not Programmed	0.770	0.610	0.930	4.88	.027*
Response vs. Stimulus Generalization					
Response Generalization	0.707	0.527	0.886	–	–
Stimulus Generalization	0.915	0.853	0.978	7.6	0.006**
Type of Generalization					
Multiple Exemplars	0.870	0.773	0.968	1.53	0.216
Natural Setting	0.850	0.740	0.959	1.05	0.305
Sequential Modification	0.956	0.805	1.106	1.49	0.223
Program Common Stimuli	0.882	0.770	0.995	1.44	0.230

Figure 2.1. PRISMA Chart

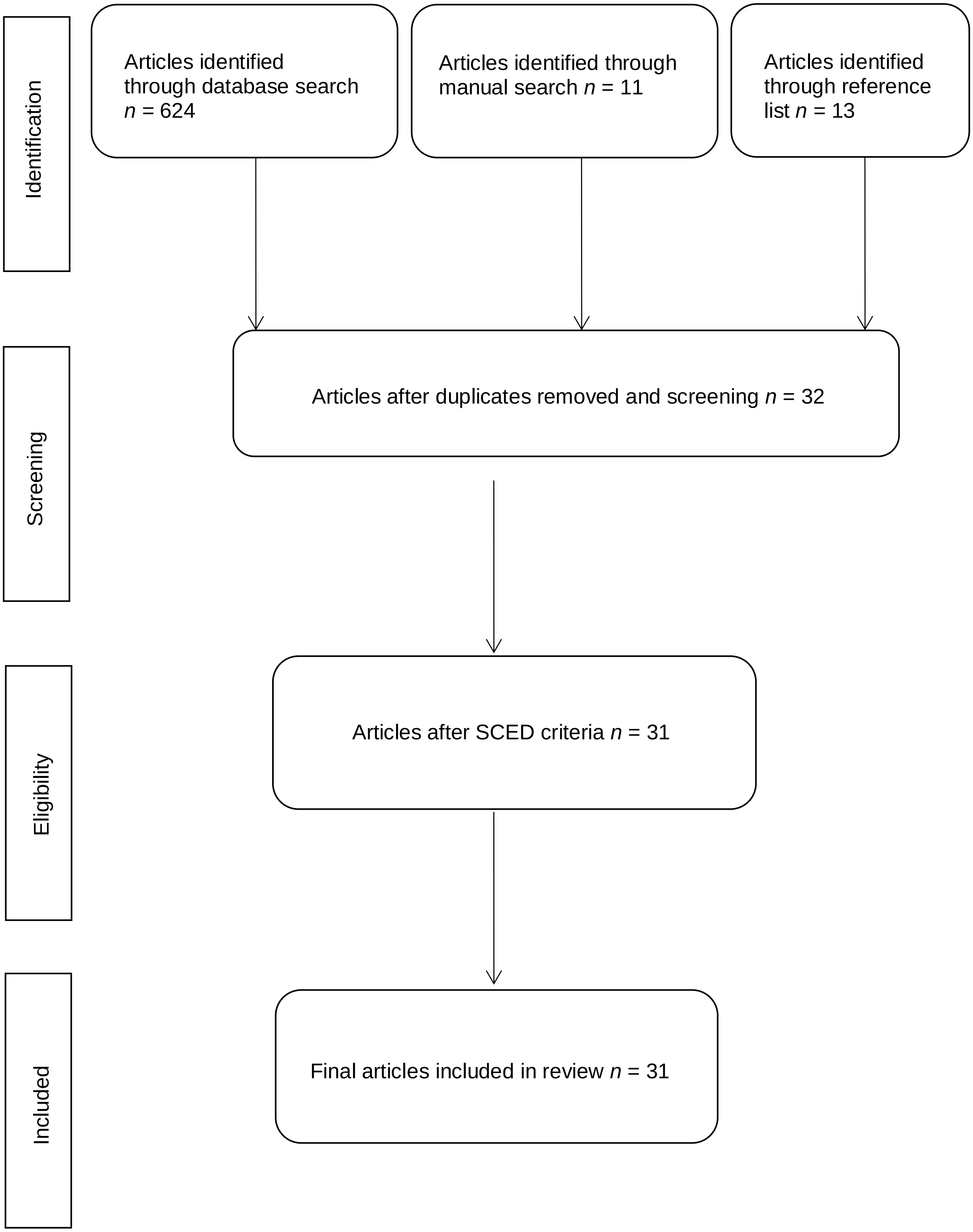


Figure 2.2. Forest Plot of Tau-U Omnibus Effect

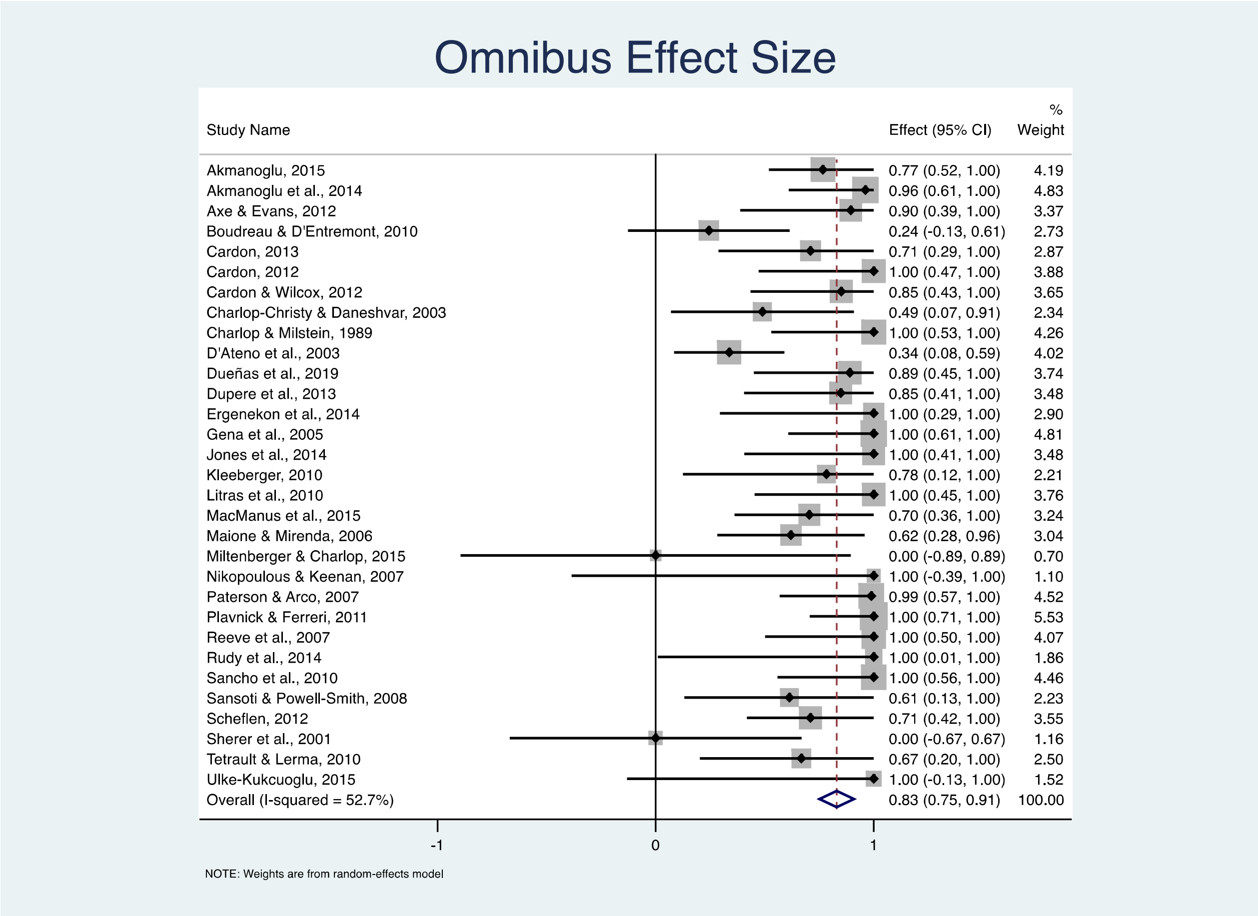


Figure 2.3. Forest Plot of VBI Studies by Response Generalization as Subgroup

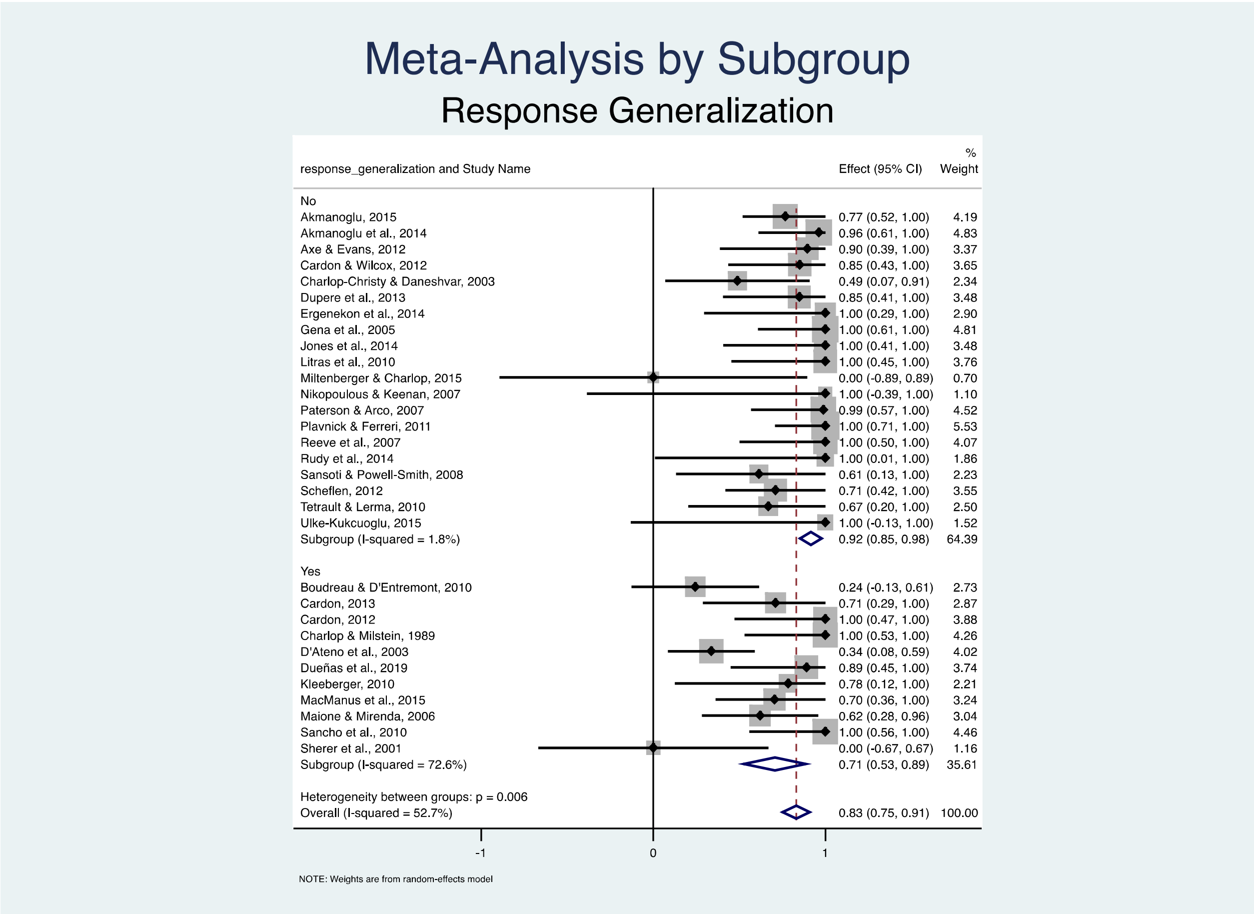


Figure 2.4. Forest Plot of VBI Studies by Setting

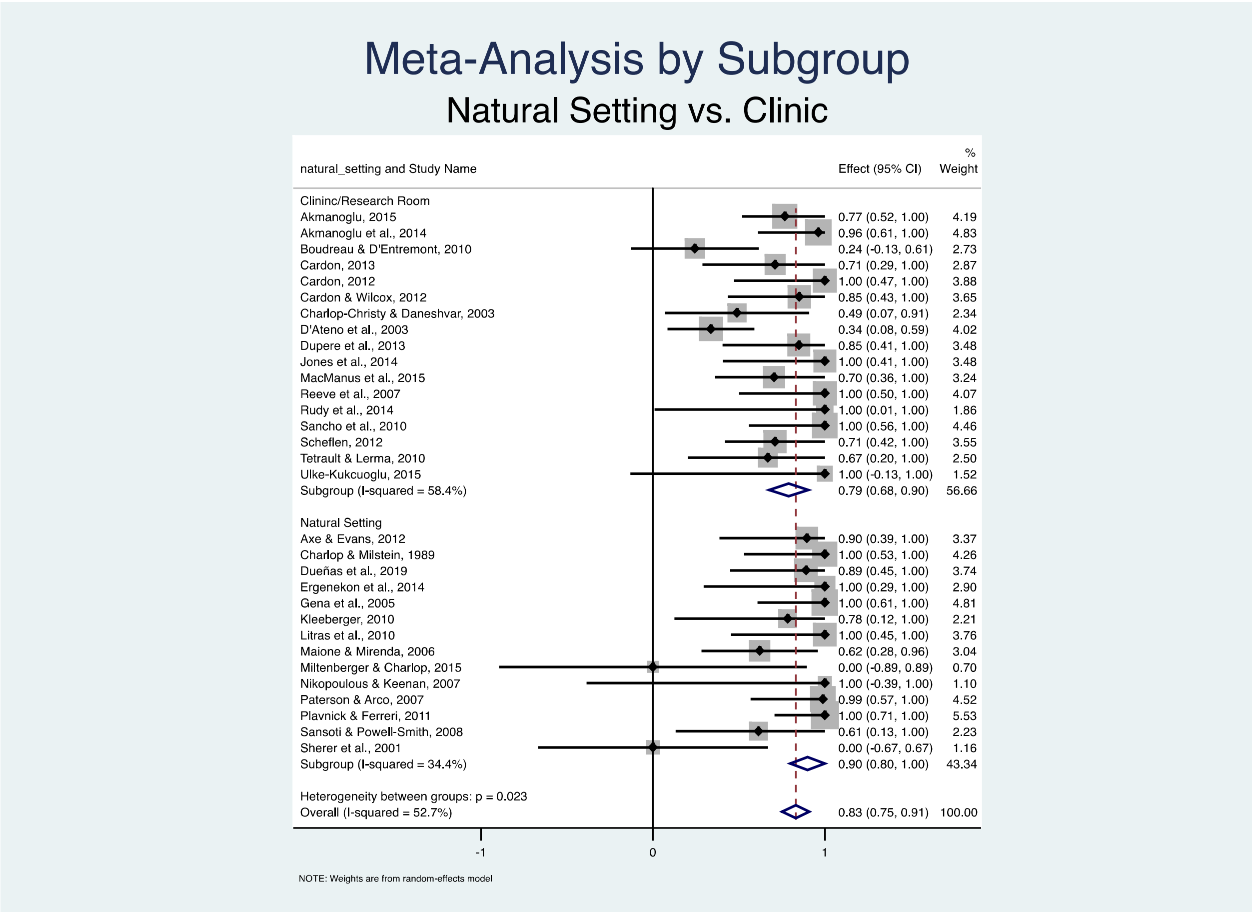
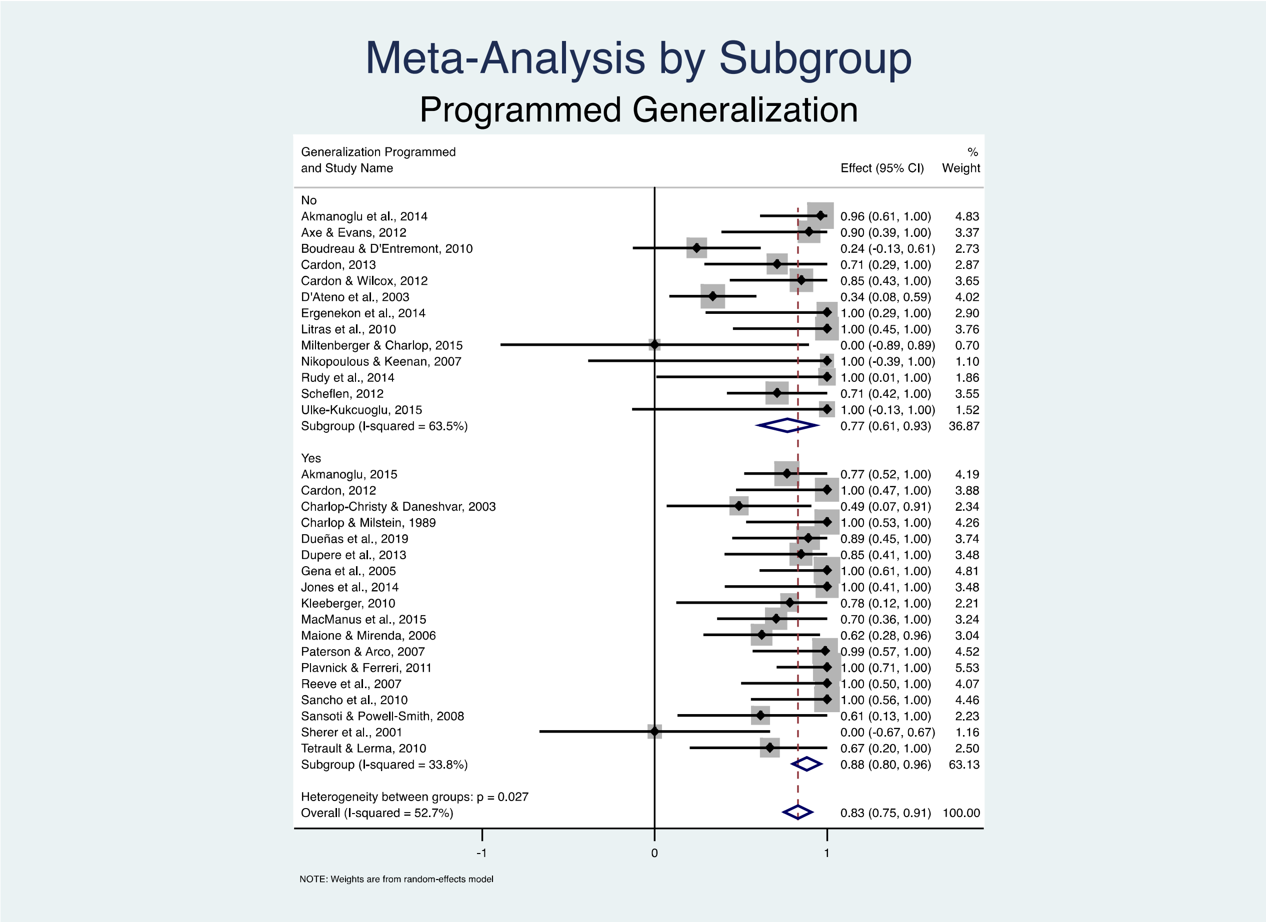


Figure 2.5. Forest Plot of VBI Studies by Generalization Programming as Subgroup



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CHAPTER 3

Component Analysis of a Peer Training Program for Teaching Social Responsiveness to Preschoolers

Early childhood inclusive settings provide opportunities for children with autism spectrum disorder (ASD) to interact with typically developing peers. However, opportunities alone are insufficient at promoting social interactions among children with ASD and their typically developing peers (McConnell, 2002; Myles, Simpson, Ormsbee, & Erickson, 1993). For preschoolers with ASD, deficits in social communication impede extended play interactions (e.g., pretend play) that involve more complex social communication. Children with ASD require additional supports that target deficits in social communication and social reciprocity (Osterling, Dawson, & Munson, 2002; Werner, & Dawson, 2005; Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004). One approach to improving social communication deficits among children with ASD is to teach typically developing preschoolers to be socially responsive communication partners (Chamberlain, Kasari & Rotheram-Fuller, 2007; Dahlgren & Gillberg, 1989; Goldstein, Schneider, & Thiemann, 2007; McConnell 2002; Strain & Odom, 1986).

Peer-mediated intervention (PMI) studies show that preschool children can be taught to interact with children with ASD via modeling, prompting, and reinforcement (Whalon, Conroy, Martinez, & Werch, 2015). Over two decades of research has demonstrated the effectiveness of PMI (Chang & Locke, 2016; Kasari et al., 2016; Thiemann & Goldstein, 2004; Whalon et al, 2015; Zagona & Mastergeorge, 2016) and its acceptability in early childhood settings (Paynter et al., 2017). Most PMI studies focus on preparing and teaching typically developing peers to be responsive social communication partners using some or all of the following components: (a) priming children by preparing them around their role as peer-mediators by reading a story and teaching attention-gaining strategies to use with children with ASD during interactions; (b) introducing typically developing peers to specific strategies for interacting with their peers with ASD, such as staying in proximity, initiating interactions, prompting, reinforcing, and persisting; (c) teaching specific strategies by providing role play, in-vivo modeling, and feedback opportunities in settings separated from children with ASD; and (d) providing on-going coaching by using visual supports, prompting, and reinforcement during ongoing practice sessions with children with ASD in natural settings. Following training, typical peers then interact with children with ASD with continued adult delivered guidance, prompting of behavior, and reinforcement (Gunning, Breathnach, Holloway, McTiernan, & Malone, 2019; Zagona & Mastergeorge, 2016).

Thiemann-Bourque, McGuff, and Goldstein (2017) recently reported on the social initiations and responses of typically developing peers before and during training. Before interactions were arranged, researchers taught typical preschool children to use a speech-generating device (SGD) and to *Stay-Play-Talk* (see English, Goldstein, Shafer, & Kaczmarek, 1997) with a child with ASD during three, 30-min sessions using role-play, feedback, prompts, and reinforcement. The interventionist coached typically developing peers using the following components: (a) reviewing the social activity and instructions on a laminated *Stay-Play-Talk*-card that outlined what to do with their partner with ASD, (b) modeling the use of the SGD, (c) shadowing the child by sitting behind them during the 5-min interaction, and (d) providing least-to most prompting to either or both children if a 30-s lull in interaction occurred. Altogether, the combined elements of the peer training led to an increase in initiations, and reciprocal communication exchanges between the two children. However, the researchers noted that typically developing children increased spontaneous initiations directed to children with ASD but their responses to initiations by children with ASD remained low. Given the difficulty of teaching children with ASD to initiate social interactions, ensuring typically developing peers are reliable responders is an important area of future research.

Self-management is one strategy that is used extensively to promote independence in changing behavior when applied to practitioner training. Self-management is defined here as the self-application of some or all components of behavior change strategies that result in change in desired behavior (Cooper, Heron, & Heward, 2007; Mace & Kratochwill, 1988). Though various applications of self-management strategies exist, one type of self-management involves an individual: (a) observing and recording some aspect of their behavior targeted for change (i.e., self-record); (b) comparing performance to some performance standard (i.e., self-evaluate) ; and (c) delivering reinforcement based on performance to themselves or by another. Specifically, researchers have demonstrated that self-management may be an effective strategy for teaching typically developing preschoolers to be responsive social partners to children with developmental disabilities (e.g., Goldstein & Ferrell, 1987; Sainato, Goldstein, & Strain, 1992).

Sainato and colleagues (1992) found that when typically developing children were taught to self-evaluate on four strategies (i.e., getting your friend's attention, getting your friend to play, sharing with your friend, and talking back to your friend), their social behaviors with children with ASD increased and teacher delivered prompts decreased. In earlier studies employing self-management strategies, researchers have also pointed to the effectiveness of correspondence training to promote independence in preschool children when teaching social initiations (Odom & Watts, 1991).

Correspondence training is a feature of some self-management procedures that may enhance accurate responding, where children state the behavior in which they will engage in and then are reinforced for actually performing the behavior (Karlan & Rusch, 1982; Risley & Hart, 1968). Specifically, the *do-say procedure* provides typical peers an opportunity to engage in a specific behavior ("do" component) and then reinforcement is delivered by researchers if peers engaged in the target behavior and accurately reported engaging in that behavior ("say" component). One self-management strategy that incorporates the features of correspondence training is *Self and Match* (Bulla & Frieder, 2017; Salter & Croce, 2014). In *Self and Match* the teacher or instructor responds to whether the behavior was performed by the child. If the teacher and the student match in their evaluation, then the child is reinforced. Surprisingly, self-management strategies have not been applied to teaching typical peers to be responsive social partners since those earlier studies (Goldstein & Ferrell, 1987; Odom & Watts, 1991; Sainato et al., 1992). Rather, recent studies have used adult-monitoring and feedback on the responsiveness of typical peers and noted changes in interaction rates between typical peers and children with ASD (Thiemann & Goldstein, 2004).

Modeling is another strategy that is known to promote responding that has been extensively used within PMI to teach desired behaviors for successful interaction (e.g., gaining attention, commenting, initiating). Modeling involves providing opportunities for typically developing preschoolers to observe an in vivo model of the desired behavior, an opportunity to demonstrate the modeled behavior, and feedback on accurate demonstrations of that behavior. A researcher typically models behaviors before and when typically developing preschoolers are paired with children with ASD (Katz & Girolametto, 2013; Kohler, Greteman, Raschke, & Highnam, 2007; Thiemann & Goldstein, 2004; Trembath, Baladin, Togher, & Stancliffe, 2009). Although modeling has consistently been incorporated within PMIs, it appears insufficient for producing independent behavior change among typical peers (Gunning, et al., 2019). Researchers conducting preliminary studies suggest video modeling may help promote independent interactions between children with ASD and their typical peers. And has shown improvement in extended play interactions among children with ASD and their typically developing peers without the need for ongoing prompting from an adult (Dueñas, Plavnick, Bak, 2019; Maione & Mirenda, 2006; MacDonald, Sacramone, Mansfield, Wiltz, & Ahearn, 2009).

Since a primary role of PMI is to situate typical peers as the central intervention agents, it is worthwhile to evaluate peer training procedures that may reduce adult mediation. However, because PMI is already a complex intervention, it would be beneficial from a feasibility perspective to empirically test the relative benefit of intervention components within a peer training system. Doing so could reduce potentially effortful and unnecessary components and help identify which components are responsible for treatment gains (Goldstein, 2002; Ward-Horner & Sturmey, 2010). One way of identifying the key components that lead to behavior change is by conducting a component analysis. In a component analysis, the individual components of a treatment are systematically applied and assessed for change in behavior to determine components that purveyors must be trained in (Ward-Horner & Sturmey, 2010; Wolf, 1978).

Therefore, the purpose of this case study was to inform the development of a multi-component procedure for teaching peers to reliably respond to initiations of children with ASD. Such an approach is useful when selecting specific intervention components from two or more options while attempting to develop an intervention that is feasible for practitioners to eventually administer (Ward-Horner & Sturmey, 2010). The component analysis was conducted as a preliminary evaluation of two potentially useful components; self-management and video modeling, on the independent responses of typically developing preschoolers towards their peers with ASD. These components were evaluated in isolation, and in combination with reinforcement, as reinforcement is often an essential component of any behavioral intervention. The component analysis posed the following research questions:

1. Which peer training components are necessary to teach typically developing children to respond to peers with ASD?

2. Is video modeling alone or video modeling with reinforcement sufficient for typically developing preschoolers to respond greater than 80% of the time?

3. Is self-management alone or self-management with reinforcement sufficient for typically developing preschoolers to respond greater than 80% of the time?

4. Is there a change in social initiations of children with ASD as typically developing children begin to respond reliably?

Method

Typically Developing Preschoolers

Typically developing preschoolers included two 4-year-old children; one girl and one boy who attended the same inclusive preschool classroom as the participants with ASD. The researcher asked the head teacher to nominate peers that fulfilled the following prerequisites based on previous PMI research (see Katz & Girolametto, 2013): (a) the child had a history of either positive or neutral interactions with children with ASD, (b) the child demonstrated age appropriate social skills, (c) the child followed adult directives, (d) the child was well liked by other peers, and (e) the child demonstrated consistent school attendance.

Hank was a 4-year-old boy who attended the preschool approximately 45 hrs per week for 11 months prior to the present investigation. He demonstrated age appropriate social skills, followed adult directives, and participated in classroom activities. His teacher described him as an extroverted child who was eager to help others. He was often observed approaching children with ASD in the classroom and offering assistance.

Eva was a 4-year-old girl who had attended the preschool classroom forty-five hours per week for two weeks at the time of the study. She demonstrated age appropriate social skills, followed adult directives, and often volunteered to assist in the classroom. Her teacher described her as a shy student who had a preference for pretend play with dolls and art activities.

Participants with ASD

Participants with ASD were two boys, Otis and Elvin who attended an early intensive behavior intervention (EIBI) program housed within a community early learning center. The participants were admitted to this program based on an outside diagnosis of ASD made by an independent psychologist using the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 2000).

Children with ASD were included in the present study because they were observed to display appropriate play behaviors with a range of toys. Though they were observed to engage in pretend play behaviors with adults in the EIBI classroom they did not display these behaviors in the inclusive classroom with their peers. The researcher assessed the following prerequisite skills prior to participation in the study: (a) ability to attend to a video for 60 s, (b) ability to verbally imitate 50% of what was modeled in the video when told “Do you what you saw in the video”, and (c) ability to parallel play with a peer for a minimum of 3 min without displaying aberrant behavior.

Otis was 3 years and 8 months at the time of the study. He spent approximately 6 hrs in the EIBI classroom and 2 hrs in an inclusive preschool classroom for typically developing 4-year-old children per day. Observations of Otis in the inclusive preschool classroom revealed he joined peers during preferred activities (e.g., snack, car, and truck toys) but did not respond to or make social initiations during these activities. Otis responded to bids for attention from peers during unstructured play (e.g., Look, Owen!) by looking in the direction of peers and saying, "No" following peer initiations.

Elvin was 4 years and 10 months at the time of the study. He spent approximately 4 hrs per day in the EIBI room and 4 hrs in the same classroom for typically developing 4-year-old children. Observations of Elvin in the inclusive preschool classroom revealed he independently joined peers during preferred activities (e.g., sand table or trucks). He engaged in sustained parallel play with peers and accepted items from peers during contrived interactions. However, he did not make or respond to social initiations with peers or make eye contact, unless prompted by an adult. Hank was paired with Otis and Eva was paired with Elvin based on the child with ASD's time spent in the early childhood general education classroom.

Setting

All baseline and intervention play sessions were conducted in a community preschool classroom for 4-year-old children that was part of a comprehensive early learning center that housed multiple early childhood programs (e.g., early childhood special education, early intensive behavior intervention, and great start readiness). Peer training sessions were conducted in a room adjacent to the children's classroom that was used by the occupational therapists in the building. The inclusive preschool classroom had one lead teacher, an assistant teacher, and two behavior technicians, assigned to deliver applied behavior analytic therapy to the two participants with ASD. The student to adult ratio was 1 to 4. The room was organized in stations that included a section for large group, four tables for small group instruction, a reading area, a pretend play area, and an art area. All play sessions were conducted in the pretend play area during a portion of the day that allowed children to choose their play activities.

Materials

A wooden tree house play-set from *Imaginarium* was used. The play set was 60 cm tall and contained a toy table with two stumps, a ladder, a toy bunny, a toy fox, a toy owl, a toy raccoon, a slide, a bed, a hammock, and swing. Researchers used a *Hero 4 Go Pro™* action camera to record sessions to obtain measures of dependent variables. Video models of social initiations and responses were edited using iMovie and loaded onto an Apple iPad in an application called *My Pictures Talk* for viewing. Children with ASD used headphones to listen to the video models. For peer training, a self-management paper checklist and marker was used.

Videos. A total of 10 videos were created. Five 30-s video models contained ten social initiations with the play set and five 30-s videos modeled the corresponding social responses. Only the toy figurines and adult hands holding the figures were shown in the video; the same male and female adults modeled the audio scripts. The social initiations were derived from observations of typically developing preschoolers in the early childhood classroom playing with the same playset and from a previous study (see Dueñas, et al., 2019). Table 1 depicts the social initiations and responses. The video clips showed adults modeling a range of social initiations and responses when acting as agents for the toy figures. The videos varied with regards to the modeled play action, modeled verbalization, and stimuli (e.g., toy fox vs. toy bunny). All verbal social initiations were three-word utterances. The five video exemplars were created to support the potential emergence of novel responding (MacManus, MacDonald, & Ahearn, 2015; Maione & Mirenda, 2006) by children with ASD.

Measurement

The main dependent variable was the percentage of typical preschoolers' responses to social initiations of children with ASD; this data was collected from video-recorded sessions by the researcher. Responses to social initiations were defined as vocal responses occurring no more than 3-s following a vocal social initiation, in the form of answers to questions (e.g., “What do want to eat?”, *“I want Pizza!”*), comments or acknowledgements (e.g., “I’m going on the swing!”,*“Ok, me too”*), or offering assistance (e.g., “Help, I’m falling!”, *“I’ll help you Bunny”).* These could, though need not, be accompanied by motor movements or gestures (e.g., pointing, tapping on shoulder, or actions with toys as agents).

The second dependent variable was the frequency of social initiations of children with ASD. Social initiations were defined as a vocal statement not followed by a previous vocalization that was either a request for another to perform an action (e.g., “Push me Bunny!”), requests for an object (e.g., “I want the owl”), or a vocal label of the child’s action that occasioned a response (e.g., “Help, I’m falling”).

Interobserver Agreement

An independent observer coded 50% of randomly selected videos evenly distributed across all conditions and participants to assess interobserver agreement (IOA). The independent observer was blind to the purpose of the study and was trained to 90% reliability with the researcher using training videos. An event was scored as an agreement if both observers recorded the same social initiation and whether it was followed by a response from the peer. To be counted as an agreement, both observers had to agree on the verbal social initiation and on whether the peer responded, as they are interdependent. Percentage of agreement was calculated by dividing the number of total agreements by the number of total possible agreements plus disagreements and multiplying by 100. Mean IOA between the researcher and independent observer during baseline for Hank was 82% (range: 72-90%), during intervention was 80%

(range: 70-92%). For Eva, mean IOA during baseline was 98% (range: 90-100%) and during intervention was, 80% (range: 65-100%).

Experimental Design

An add-in with reversal design (Ward-Horner & Sturmey, 2010) was used to evaluate the effects of the three components and combination of components on the percentage of social responses of typically developing preschoolers and social initiations by children with ASD. The add-in with reversal design allows for systematic assessment of individual components by adding them individually and in combination, and assessing whether individual components are sufficient or whether the entire treatment package is necessary for the desired change in behavior. The ordering of components was different for each participant. Eva received video modeled responses first and Hank received self-management first. Following demonstration of a stable baseline, participants were introduced to the pre-determined first component of the intervention and dependent measures were collected to assess the pattern of change in social responses for that condition. When stable responding was demonstrated under the first component or when criteria were met, the component was withdrawn in a return to baseline condition and dependent measures were collected to assess the pattern of change in social responses when the treatment component was removed. Decisions to move from one condition to the next (i.e., reversal to treatment, treatment to reversal, and add-in) were made when participants' social responding was at or above 75%, or below 75% for three consecutive sessions. Following baseline, Hank's peer training components were added in the following order (a) self-management, (b) self-management and reinforcement, (c) self-management, reinforcement, and video modeled responses. Following baseline, Eva's peer training components were added in the following order: (a) video modeled responses, (b) video modeled responses and reinforcement, (d) video modeled responses, reinforcement, and self-management, and (e) self-management and reinforcement. In between each add-in all components were withdrawn, in a return to baseline condition.

The effect of treatment conditions was assessed visually for stability of the dependent variable during baseline and change in the dependent variable based on magnitude of change during the intervention phase. The effect was determined by visual inspection of the immediacy of the effect, the pattern of that change (i.e., trend), and the overall level of change (e.g., mean difference) as compared to baseline.

Procedures

Baseline. The purpose of baseline was to assess the frequency of verbal responses to social initiations when typically developing peers interacted with children with ASD, but before typically developing peers had received the training. During baseline, video modeling was presented to the child with ASD only as a procedure to prompt children with ASD to engage in social initiations. Presentation of video models to children with ASD was kept constant during all phases of the study. Video exemplars were rotated across sessions to ensure each exemplar was presented as close to an equal number of times as possible, given the unknown number of PMI sessions.

A play session began when the interventionist approached the child with ASD and asked the child to "Come watch a video." The child viewed the video on an iPad with headphones. The interventionist showed the video twice and redirected the child to watch the video if he looked away. After the child with ASD viewed the video twice, the interventionist stated "Play like you saw in the video," The typical peer approached the child with ASD and led them to the play area where the playset had been setup by the researcher. The children were given 3 min to play with the playset. If the child with ASD attempted to leave the play area, he was physically prompted to play. If the typically developing child attempted to leave the area, or became distracted by other children in the room, they were verbally prompted to continue playing.

Intervention. Following baseline**,** the researcher conducted a one-time, 20-min training with typically developing peers. The training involved: (a) confirming they wanted to be friendship leaders by writing their name on a document that stated, "I (typically developing peer) agree to be a friendship leader for (child with ASD) by helping him play, take turns, and use his words; (b) talking to the typically developing peer about the child with ASD in their classroom (e.g., child with ASD's favorite activities, toys etc.); (c) reading a children's book titled, *Pete the Cat and the New Guy* (Dean & Dean, 2014) that discussed themes about friendships and accepting differences in others; (d) showing a 30-s video clip that depicted the following behaviors adapted from previous peer training studies (see Stay, Play, Talk; English et al., 1997), *Eyes on your friend*, *Stay Close*, *Listen to you friend*, and *Answer Fast*; and (e) providing opportunities for rehearsal and feedback with an adult until children demonstrated the above skills to mastery with the researcher (i.e., 90% twice).

Intervention sessions were identical to baseline except that peer training occurred prior to play sessions. Typical peers received the peer training components described below. Two play sessions were conducted daily, and occurred 20 min apart during a one hr child choice period. See Figure 3.1 for a sequence of procedures.

Self-management. The self-management system was modeled off *Self & Match* from Salter & Croce (2014). During the self-management condition, play session were identical to baseline. However, 15 min prior to the play session, the researcher brought the typical peer into a quiet room adjacent to their classroom and explained to the typically developing child that they were going to view themselves playing with their friend with ASD and see if they followed the rules. Then, the researcher restated the rules (i.e., *Eyes on your friend*, *Stay Close*, *Listen to Your Friend*, and *Answer Fast)* and placed a self-management checklist in front of the child (see Figure 3.2), and explained they were going to play a game called, *Match for Yes!* The researcher explained the rules of the *Match for Yes* game, in which the peer would color a happy face if they saw themselves performing each behavior or would color a sad face if they didn't see themselves performing the behavior from the video and that the researcher would do the same. If the child matched for yes with the researcher, they would get one point, if they matched for no, they would get ½ a point, and if they didn't match, they would get zero points. Then, the researcher practiced with two videos or until the child demonstrated accurate self-management (i.e., accurately noted when they did or did not do something); videos were shown up to three times.

During ongoing self-management sessions, the researcher did the following: (a) placed the self-management checklist, a laptop, and a marker in front of them and asked the child to state the rules for being a friendship leader (*Eyes on your friend*, *Stay Close*, *Listen to Your Friend*, and *Answer Fast*); (b) showed them a video clip of the first social initiation from the child with ASD from the previous play session; (c) asked the typical preschooler to color in yes or no (i.e., happy or sad face) if they observed or did not observe themselves performing each of the behaviors on their self-management checklist; (d) went through each behavior and colored in yes or no if they observed the child performing those behaviors; and (e) counted the total points that matched for yes and matched for no, and stated these out loud. During each self-management session, the peer observed and rated his or her behavior for the first and last initiation from the child with ASD, from the previously recorded play session.

Video modeled responses. The video modeled responses component involved showing typical peers one 30-s video clip of responses to the initiations that the child with ASD would make for that session. For example, if the child with ASD said, "Help me Fox!" the modeled response was, "I'm coming Bunny!" The researcher explained to the typical preschoolers that they were going to see a video of what they could say to their friend. The video was paused after every response and the typical peer was instructed to imitate the response, by saying, "You say it." Video models were shown twice before play sessions.

Reinforcement. This component involved delivering reinforcement contingent on matching for yes during self-management condition and responding to a peer with ASD during video modeling condition. A brief multiple-stimulus without replacement (MSWO; Carr, Nicolson, & Higbee, 2000) was conducted with the peer to identify a terminal reinforcer that was exchanged when the typical peer obtained all their points. When reinforcement was paired with the self-management system, typical peers could earn up to eight points per session and exchanged points for terminal reinforcement when they accumulated 20 points, often after three sessions. When reinforcement was paired with video modeled responses, points were delivered contingent on performing the social responses modeled in the video. The typical peers obtained 1 point if they responded all the time, ½ a point if they responded sometimes, and zero points if they did not respond to their peer with ASD. Typical peers exchanged points for terminal reinforcement when they earned five points, often after three sessions.

Procedural Integrity

The researcher created and used a checklist that matched the steps involved in typical peer training implementation described above. Checklists were created for baseline and intervention play sessions and for components of training sessions.

A behavior technician assigned to the child with ASD, collected in vivo procedural implementation data from 50% of the play sessions. A trained independent observer collected implementation fidelity for 30% of the training sessions conducted by the researcher from video. The mean percentage of steps implemented accurately during baseline sessions was 100%. The mean percentage of steps implemented accurately during typical peer training for Hank was 82.5% (range: 75-90). The mean percentage of steps implemented accurately during typical peer training for Eva was 87% (range: 75-100).

Results

Percentage of social responses by Eva and frequency of social initiations by her partner with ASD (Elvin) are depicted in Figure 3.3 Figure 3.4 depicts the percentage of social responses by Hank and frequency of social initiations by his partner with ASD (Otis).

Eva. During baseline, Eva responded to 0-20% of Elvin's social initiations. During video modeling, Eva's social responses initially and rapidly increased to 60%, then decreased to 10%, with a mean of 32% responding. When video models were removed, Eva's social responses continued to decrease to 0%. When video models with reinforcement were administered, Eva's social responses increased to 100% in five sessions, with a mean of 80% during this condition. When both components were removed to return to baseline, Eva's social responses show an immediate decrease to an average of 25%. When the full intervention package was administered (i.e., video modeled responses, self-management, and reinforcement), Eva's social initiations increased to 100% in four sessions. After all components were removed once again, Eva's social initiations dropped to an average of 30% per play session. Finally, when self-management and reinforcement were administered, Eva's social responses increased to 100% within three sessions.

Elvin. During baseline, Elvin initiated an average of six times during each play session. After social responses were modeled to his peer, Elvin's social initiations increased to 18 initiations, followed by a decrease to eight initiations; Elvin initiated at a mean of 11 during this condition. When his peer partner no longer viewed the video models, Elvin's social initiations decreased slightly to an average of eight. When video modeled responses were reinstated and reinforcement was added, Elvin's social initiations remained at an average of eight per session. When both components were removed to return to baseline, Elvin's social initiations show an increase to 12 initiations per play session. When self-management was added to the intervention package, Elvin's social initiations decreased slightly to an average of 11 per play session. After all components were removed once again, his social initiations remained at an average of 11 per play session. Finally, Elvin's social initiations remained at an average of 11 per play session during self-management and reinforcement.

Hank. During baseline, Hank responded to 0-18% of Otis's social initiations. When self-management was introduced, Hank's social responses increased to a mean of 29%. After self-management was withdrawn, Hank's social responses decreased to 18% per play session. When video modeled responses was added to self-management in the subsequent phase, Hank's mean level of responding was 63% and he reached 100% in nine sessions. When the intervention components were withdrawn, Hank's social responses decreased to an average of 17%. When self-management and reinforcement were introduced, Hank demonstrated an immediate increase in responding with a mean of 83% while reaching 100% responding in three sessions.

Otis. During baseline, Otis initiated an average of eight times during each play session. After his peer partner received self-management, Otis's social initiations increased slightly to 10 per play session. After self-management was withdrawn, Otis's social initiations increased to 12 per play session. When his peer partner received self-management and video modeled responses, Otis's social initiations remained at an average of 12 per session with high variability and a range between 8 and 18 initiations. When the intervention components were withdrawn, Otis's social initiations also decreased slightly to an average of 10 initiations per play session. The last condition of the intervention was self-management and reinforcement. During this condition Otis's social initiations increased to an average of 13 per play session.

Discussion

The primary aim of this preliminary investigation was to determine the minimal components needed to promote independent social responses by typically developing preschool children. The component analysis conducted with two preschoolers revealed that neither self-management nor video modeling alone were sufficient to teach children to consistently respond to peers with ASD. However, when reinforcement was added to self-management and video modeling, both interventions improved independent social responses of typical preschoolers.

Eva was first introduced to video modeled responses. This component alone did not lead to sustained change in her responsiveness to her partner with ASD. However, video modeled responses and reinforcement was effective. Similarly, for Hank video modeling alone was insufficient but video modeling and self-management were effective, though it took Hank a total of nine sessions to reach 100% responsiveness. A limited number of studies have examined the use of video modeling with typically developing preschoolers; however, this finding is similar to that of MacDonald and colleagues (2009) who found that video modeling alone was ineffective at improving typical peer verbalizations. In their study, two typical peers required additional coaching to imitate video models and initiate and respond to children with ASD. But the authors were not explicit about the type of coaching that was provided and whether this involved reinforcement.

Hank was first introduced to self-management. This condition did not lead to clear changes in responding, yet was effective when paired with reinforcement. During self-management and reinforcement, Hank was asked to follow four rules (i.e., *Eyes on your friend, Stay Close*, *Listen to Your Friend*, and *Answer Fast)* and was reinforced for accurate performance and reporting. This component of the adapted *Self and Match* procedure may have strengthened the relationship between what he said he would do and what he actually did (Bulla & Frieder, 2017; Odom & Watts, 1991), as he received more points for being accurate. Our findings were similar to Sainato and colleagues (1992) who found that self-management strategies were quite effective at changing social behaviors of typical peers with children with ASD, and extend their findings by demonstrating that teacher delivered prompts may not be needed. Although it is difficult to say with certainty whether the mechanism in effect for changing typical peer behavior was receiving reinforcement for accurate performance, for reporting, or for both. Additionally, although self-management and reinforcement were effective for Eva, the ordering of components made it difficult to say with certainty that the effects of the video models did not carry over. It is unlikely that Eva unlearned the responses modeled in the video.

We were also interested in whether the peer training had an effect on children with ASD. That is, whether children with ASD initiated differently depending on the components that their typical peer partner was exposed to. Very few PMI studies have explicitly measured typical peers' responsiveness to children with ASD (see Haring & Lovinger, 1989; Thiemann-Bourque et al., 2017 for exceptions). Unlike Haring and Lovinger (1989) who found that when children with developmental disabilities were taught to initiate, the responses of typically developing children increased, we found that teaching children with ASD to initiate was not sufficient. However, for participants with ASD (Elvin and Otis), we observed an increase in the frequency of initiations once typical peers became more responsive. This is an important contribution of this study as it demonstrates that having a responsive peer partner may alter the social initiations of children with ASD and non-responsiveness may result in a decrease in social initiations. Interestingly, when typical peers demonstrated less responsiveness following withdrawal of intervention, children with ASD continued to initiate to their peers. A review of videos of play sessions revealed that children with ASD demonstrated some persistence in initiations when their peers we not responsive. For example, Otis repeated initiations by saying, "Come on, I said__," when his peer would not respond. This may explain the increase in social initiations in some cases. Overall, children with ASD demonstrated a higher frequency of initiations than initial baseline conditions prior to peer training.

A primary goal of this study was to determine the least number of components necessary to effect change in typical peers. Because self-management and video modeling with reinforcement were both effective, it may be helpful to look outside of effectiveness to determine what peer training procedure is ideal. One consideration is the potential feasibility and acceptability of components when determining the likelihood that practitioners will adopt interventions (Locke et al., 2017). Both video modeling and self-management interventions require some level of staff training prior to implementation, time to create materials, and time to implement prior to play sessions. The need to create additional video models that correspond to the social initiations modeled by children with ASD for typical peers may be taxing to practitioners, while needing to record play sessions for self-management in this procedure may also be an added burden. Future studies should consider measuring social validity as an additional indicator of effectiveness (Wolf, 1978).

An additional consideration that may make self-management more attractive over video modeling is the potential generalizability of the strategy. Although data were not collected on whether the initiations made by children with ASD were scripted (i.e., modeled from video) or unscripted (i.e., did not correspond to the video), video observations revealed that Otis's social initiations tended to deviate from scripts toward the end of the intervention. This departure from scripted responses is a desirable outcome for children with ASD, but may make video models potentially no longer useful to the typically developing peers. On the other hand, the self-management strategy taught the peers to follow four rules (i.e., *Eyes on your friend*, *Stay Close*, *Listen to Your Friend*, and *Answer Fast)* that may be useful no matter what the child with ASD says. In addition, self-management is a strategy known to promote generalized responding, as children learn a set of rules to govern their own behavior (Stokes & Baer, 1977). This strategy may be especially useful to typical peers as they learn to respond appropriately and differently across contexts.

Limitations

We employed an add-in component analysis to answer our primary research question around the relative efficacy of components on peer responses. A major limitation of this design is that the sequencing makes it difficult to detect the effects of components that are evaluated toward the end of the analysis (Ward-Horner & Sturmey, 2010). Different components were introduced to each participant first, such that one student received self-management and the other received video models; however, both students received self-management and reinforcement as the last condition. This makes it difficult to say exactly what components were most effective for promoting social responsiveness, as both children were previously exposed to the video models.

Though baseline conditions show the behavior did not persist in the absence of intervention, the experimental design cannot control for potential carry-over effects. That is, it is unlikely that the typical preschoolers unlearned the social responses acquired from video. However, the main purpose of the case study was to inform the process of intervention development. This case study allowed us to understand the components of the peer training package that were needed to effect change in typical peer behavior.

A second limitation is that the data from the current component analysis are preliminary and do not account for the potential long-term effects of the intervention components. It is clear from withdrawal conditions that the intervention components did not persist, which could be problematic for practitioners who attempt to teach peers to independently interact with children with ASD. That is, how much training is needed for sustained responsiveness and how long should practitioners need to reinforce typical peers to sustain behavior. Future research may fade intervention components systematically in order to evaluate the extent to which the intervention implemented over an extended period of time can then be maintained. In particular, researchers and practitioners may evaluate fading schedules of reinforcement and ensure conditioned reinforcers are in effect (e.g., peer responses to children with ASD) to sustain behaviors over time. That is, playing successfully with children with ASD may become a learned reinforcer that sustains behavior over time.

Last, we defined social responses discretely, and therefore cannot account for the quality of sustained interactions among children with ASD and their typically developing peers. Though typically developing children learned to respond reliably to their peers, we cannot say whether this improved the overall quality or the level of enjoyment during interactions. Other measures of social engagement such as smiling, eye contact, and joint attention may yield additional information about intervention components.

Conclusion

The two four-year-old preschoolers in this study increased independent responses toward children with ASD during play interactions when self-management and video modeling were implemented with reinforcement. The results of the component analysis were helpful in understanding necessary components to include in peer training during PMI. In addition, qualitative aspects of the observed outcomes suggest self-management with reinforcement may be an optimal approach for teaching typical children a broad response repertoire that is sufficient for responding to varied initiations made by their peers with ASD. In addition, both peer training strategies were effective in altering social initiations of children with ASD. In conclusion, the results point to potentially beneficial effects of using self-management with reinforcement with typical peers as part of peer-mediated interventions. Though additional research with strong experimental designs is needed to confirm such a recommendation.

APPENDIX

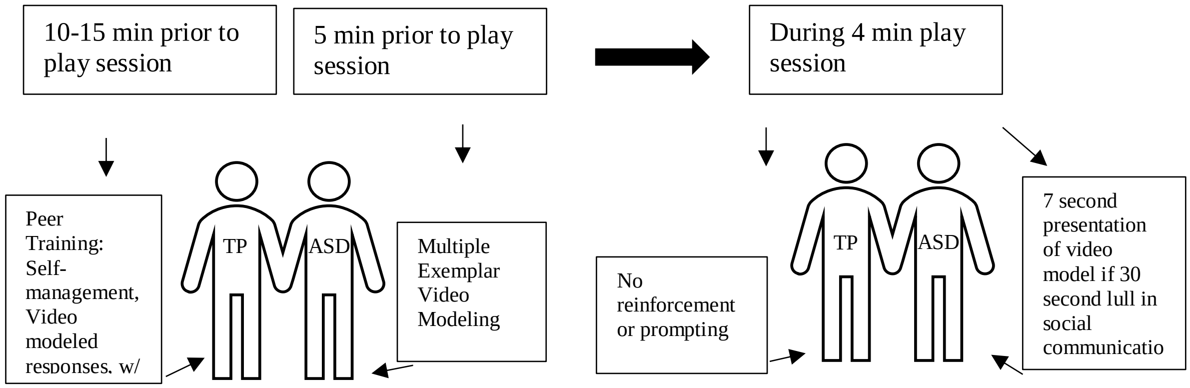


Figure 3.1. Illustration of Intervention Procedures Delivered to Each Child in Sequential Order. TP = typical peers, ASD=autism spectrum disorder

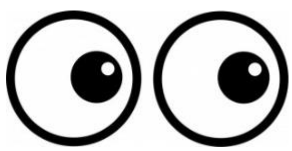
Date:		
	Student Name:	**Teacher**
Eyes on your friend 	☺ ☹	☺ ☹
Stay close 	☺ ☹	☺ ☹
Listen to your friend 	☺ ☹	☺ ☹
Answer fast 	☺ ☹	☺ ☹

Figure 3.2. Self-management Checklist Adapted from Salter & Croce, 2014

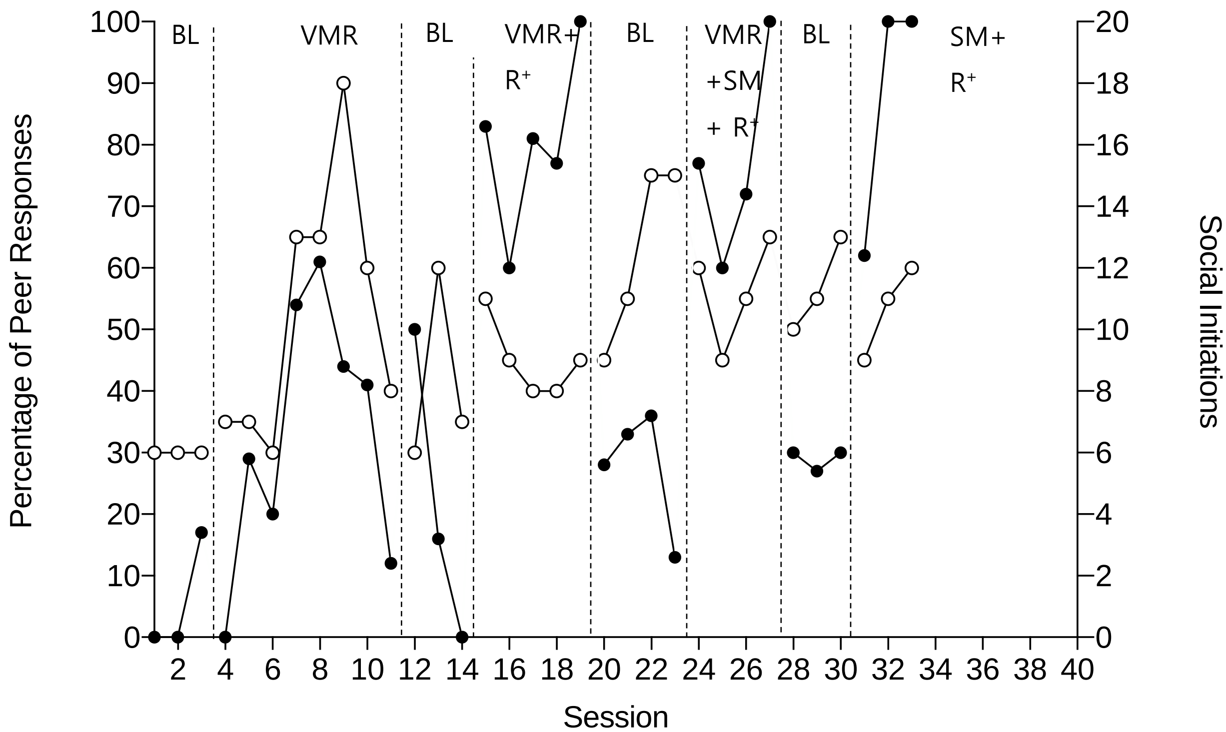


Figure 3.3. Component Analysis Graph Depicting Results for Eva and Elvin. In closed circles are the percentage of typical peer (Eva) responses, in open circles are the frequency of social initiations of child with ASD (Elvin) across conditions. BL = Baseline, VMR = video modeled responses, R^+ = reinforcement, and SM = self-management.

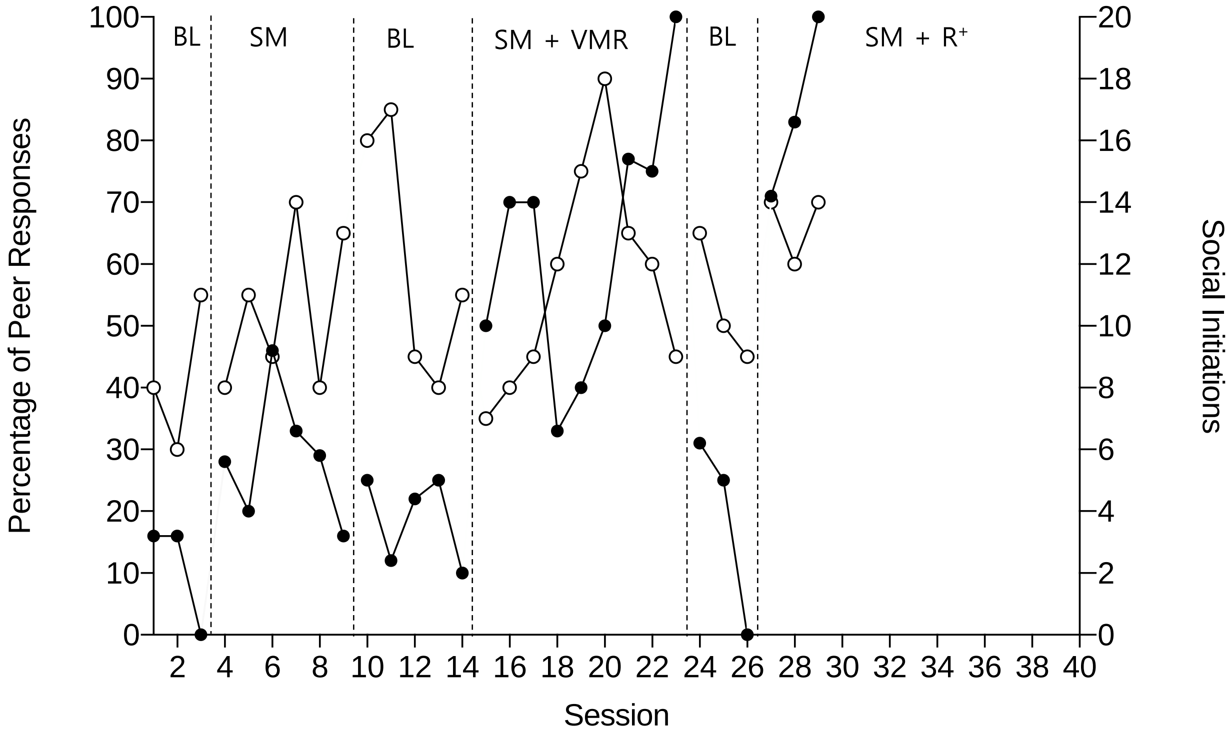


Figure 3.4. Component Analysis Graph Depicting Results for Hank and Otis. In closed circles are the percentage of typical peer (Hank) responses, and in open circles are the frequency of social initiations of child with ASD (Otis) across conditions. BL = Baseline, VMR = video modeled responses, R+ = reinforcement, and SM = self-management.

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CHAPTER 4

Effects of a Multi-Component Intervention on Social Communication of Preschoolers with Autism Spectrum Disorder

Young children with autism spectrum disorder (ASD) must display socially competent behaviors with peers to be successful social members of inclusive early childhood environments. Social competence is said to involve reciprocal peer interactions that lead to the formation and maintenance of relationships (Stitchter & Conroy, 2006). Play is a dominant activity of early childhood programming during which children socially interact. Reciprocal and pretend play sets the stage for social emotional and language development in young children (Singer, Singer, Plaskon, & Schweder, 2003). Through play, children experience positive social interactions such as laughing, verbalizing, smiling, and making eye contact (Gardner & Bergen, 2006). The amount of time that young children spend in these activities is said to be significantly dependent on their language ability (McEwen et al., 2007).

For individuals with ASD, whose defining characteristics are a deficit in social communication and reciprocity (American Psychological Association, 2013), effective play-based social communication interventions are necessary for successful social interactions with peers. Four critical behaviors impact the social communication and competence of children with ASD: verbal initiations, verbal responses, nonverbal communicative attempts, and joint attention (Murdock, Cost, & Tieso, 2007). Therefore, developing interventions that teach these behaviors as part of inclusive educational settings may improve social communication of children with ASD (Sutton, Webster, & Westerveld, 2019; Whalon, Conroy, Martinez, & Werch, 2015).

Researchers have recently found that multicomponent interventions consisting of child-specific (i.e., direct intervention to child with ASD) and peer mediated interventions (PMI) promote substantial gains in total communication acts and lead to reduced isolation in nontreatment settings (Kamps, et al., 2014; Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012; Thiemann-Bourque, Brady, McGuff, Stump, & Naylor, 2016; Thiemann-Bourque, McGuff, & Goldstein, 2017). A multi-component PMI approach combines indirect strategies, such as peer-training, with child-specific strategies in order to maximize social communication outcomes of children with ASD (Kamps, et al., 2015; Kamps, et al., 2014; Kasari et al., 2012; Kent, Cordier, Joosten, Wilkes-Gillan, & Bundy, 2018; Wolfberg, DeWitt, Young, & Nguyen, 2014). The combination of highly effective child-specific strategies with PMI may increase the likelihood children with ASD improve social communication behaviors and contact naturally occurring consequences such as peer responding (Kasari et al., 2012).

Kasari and colleagues (2012) conducted one of the first empirical investigations to demonstrate the combined effects of direct and indirect social skills intervention strategies. The researchers demonstrated the additive value of peer involvement in a social skills intervention for school age children with ASD by randomly assigning children to one of two treatment groups (Kasari et al., 2012). One group received direct social skills intervention and another received direct social skills intervention with peer-mediation. Kasari and colleagues (2012) observed statistically significant differences in class-wide peer nominations, teacher report of improved social skills, and reduction of observed solitary engagement on the playground for children with ASD who had received both direct intervention and PMI. The results of the study were promising and supported a shift towards multi-component interventions where the involvement of peers may promote peer interaction outside the treatment environment. However, the specific social-communicative outcomes of children with ASD in the study were unknown, as the observational measures obtained did not specify social engagement at this level.

Recently, Thiemann-Bourque and colleagues (2016; 2017) have demonstrated promising outcomes in the social communication of children with ASD and their peers using a multi-component peer mediation approach. Specifically, these investigations have shown support for the combined use of child-specific interventions (e.g., alternative and augmentative devices, picture exchange communication system (PECS®; Bondy & Frost, 1998) and PMI to improve social communication (e.g., initiations and responses) among young children with ASD and their typically developing peers. In one study, Thiemann-Bourque and colleagues (2016) explored the relationship between a multi-component intervention and reciprocal communication exchanges across contexts for both children with ASD and typically developing peers. Results showed moderate effects for children with ASD in social communication that centered on requesting desired items during snack, and less in other contexts using other important social-communicative functions such as, commenting, asking questions, and securing attention during play (Thiemann-Bourque et al., 2016). Outcomes for social-engagement were mixed, with some dyads increasing social-engagement only during snack when the children were requesting from peers, and variable social-engagement during sensory and play activities.

To achieve social-engagement and reciprocal social communication, researchers have used multi-component interventions to teach increased initiations and responses by both children (Gunning, Breathnach, Holloway, McTiernan, & Malone, 2018). Despite positive outcomes in some social contexts, there are aspects of multi-component interventions that have yet to be investigated. Many researchers include adult support within the interventions, with very few studies incorporating self-management strategies for peer partners. Additionally, most studies investigate the extent to which children with ASD respond to peer initiations, with limited research on initiations other than requests by children with ASD.

In a recent investigation, Dueñas, Plavnick, and Bak (2019) demonstrated that multiple-exemplar video modeling was a promising intervention for teaching scripted and unscripted social communication during pretend play with typically developing peers in an inclusive early childhood setting. This multi-component intervention combined child-specific intervention with PMI. Video models were presented to both children prior to play sessions as a way to prompt children to engage in verbalizations during pretend play interactions. Although children with ASD increased scripted and unscripted verbalizations towards peers, participants with ASD in the study all responded differently to the intervention. Dueñas and colleagues (2019) hypothesized that as children with ASD began to deviate from scripts, typically developing peers were not responding consistently. Typically developing peers did not receive specific training on being responsive to children with ASD, other than the video models.

Since a critical component of multi-component interventions is peer training, further experimental research is needed to explore the social communication improvements among children with ASD and their peers that are functionally related to peer training. Two peer training strategies, self-management and video modeling, were previously examined on their effects on independent responses of typically developing preschoolers towards their peers with ASD (see Chapter 3). In Chapter 3, prior to peer training, children with ASD were exposed to video models that taught them to socially initiate to their typically developing peers during play. However, typically developing peers demonstrated low levels or no responding. When reinforcement was added to self-management and video modeling, both interventions improved independent social responses of typically developing preschoolers. However, self-management is a strategy that may teach typically developing preschoolers to respond reliably to the social initiations of children with ASD across contexts and when children deviate from scripts.

The current study examined a self-management peer-training package to teach typically developing children to independently respond to children with ASD during pretend play activities. The child-specific component of the treatment used multi-exemplar video modeling to promote unscripted initiations of children with ASD (see Dueñas et al., 2018).

We asked the following research questions:

1) What are the effects of a multi-component intervention (i.e., video modeling and peer self-management) on the social communication exchanges and social engagement of typically developing preschoolers and children with ASD?
2) What are the generalization effects of the multi-component intervention on social communication and social engagement across play activities?
3) What is the frequency of verbal scripted and unscripted social initiations and responses of children with ASD?
4) Is the multi-component intervention acceptable by typically developing preschoolers and do social communication exchanges and social engagement improve as compared to normative typically developing peer data?

Method

Participants

Participants were recruited from a community-based early intensive behavior intervention (EIBI) program affiliated with a university. Participants included three students with ASD who received inclusive programming alongside typically developing children. The children with ASD were paired with three typically developing students into dyads for the duration of the study. Dyadic pairings were decided by the board-certified behavior analyst (BCBA) and the general education teacher, based on their knowledge and observations of the children in the classroom. Wilmer was paired with Malik and Olin was paired with Olga. When pairings were decided

Titus's inclusion teacher was out ill and the teaching assistant nominated two different typical peers, Aria and Genevieve. During initial baseline, Titus was tentatively paired with both typical peers. After the fifth baseline Titus's was officially paired with Genevieve. After baseline session nine and during peer training, Genevieve refused to participate in the study. Baseline was reinstated with Aria and Titus was switched to Aria.

Children with ASD. To participate in the study, children with ASD had to receive a minimum of 2 hr of instruction in the inclusive classroom including unstructured time that allowed children to choose their play activities. Additionally, the children had to meet the following criteria: (a) a confirmed diagnosis of ASD by a licensed clinical psychologist, (b) observed ability to imitate vocal models from video by the researcher, (c) observed ability to attend to a video for 20 s, (d) observed ability to play functionally with toys by the researcher, (d) observed use of two- to three-word phrases to communicate by the researcher, and (e) limited peer interaction skills as demonstrated by observations in the inclusive classroom during unstructured play.

Wilmer was 4 years and 8 months at the time of the study. He spent approximately five hours in the EIBI classroom and 3 hr per day in an inclusive preschool classroom for typically developing 4-year-old children. Observations of Wilmer by the BCBA, who supervised his program in the inclusive preschool classroom, revealed he joined peers during routine activities (e.g., snack, structured play, art) but did not initiate or respond to peer invitations to play or bids for attention. Wilmer was also observed sustaining parallel play with peers but was not initiating interactions with peers during play.

Olin was 4 years and 3 months at the time of the study. He spent approximately four hours in the EIBI classroom and 4 hr per day in an inclusive preschool classroom for typically developing 4-year-old children. Observations of Olin by the BCBA, who supervised his program in the inclusive preschool classroom, revealed he joined peers during preferred activities (e.g., snack, car, and truck toys) but responded inconsistently to peers' social initiations during these activities. Olin was not observed to engage in sustained play with a peer.

Titus was 3 years and 7 months at the time of the study. He spent approximately six hours in the EIBI classroom and 2 hr per day in an inclusive preschool classroom for typically developing 4-year-old children. Observations of Titus by the BCBA, who supervised his program in the inclusive preschool classroom, revealed he was not joining peers during any activities in the classroom but instead would roam the room and engage in solitary play. Titus was not observed to engage in sustained play with peers and was not responsive to initiations by peers.

Typically developing peers. Typically developing peers were nominated for this study by their teachers as meeting the following criteria: (a) well-liked by peers, (b) positive social partner with the focal child, (c) generally compliant with adult directives, (d) able to attend to a task or activity for at least 10 min, (e) willing to participate, and (f) able to attend school on a regular basis. These criteria were adopted from previous studies using peers as intervention agents (e.g., Katz & Girolametto, 2013).

Malik was a 4-year-old boy who had attended the university-based preschool classroom 45 hr per week for approximately one year. He demonstrated age appropriate social skills, language and communication, and play skills. He followed adult directives, and often volunteered to assist in the classroom. His teacher described him as creative, outgoing, and inquisitive.

Olga was a 5-year-old girl who had attended the preschool classroom 45 hr per week for approximately one year. She demonstrated age appropriate social, language and communication, and play skills. She followed adult directives, and often volunteered to assist in the classroom. Her teacher described her as outgoing, sometimes bossy, and always willing to help other students.

Aria was a 3-year-old girl who had attended the preschool classroom 40 hr per week for 6 months. She demonstrated age appropriate social, language and communication and play skills. She followed adult directives, and often volunteered to assist in the classroom. Her teacher described her as shy and soft spoken.

Genevieve was a 4-year-old girl who had attended the preschool classroom 45 hr per week for approximately one year. She demonstrated age appropriate social, language and communication, and play skills. She followed adult directives but was sometimes inconsistent. Her teacher described her as shy, sometimes stubborn, and creative.

Setting

The participant dyads in the study came from three different inclusive early childhood classrooms located in three different buildings that housed the EIBI programs; one of the early childhood centers had six different early childhood programs including the EIBI program. The other was housed within a university-based child development program and the third was housed within a Head Start program. The inclusive classrooms had a one-adult to eight-student ratio and were organized in stations that included a section for large group, four tables for small group instruction, a reading area, a pretend play area, and an art area. All study sessions were conducted in the pretend play area of the classrooms and peer-training sessions were conducted in a quiet room adjacent to the children's classroom. However, Titus' and Aria's sessions were conducted in an unoccupied classroom adjacent to the children's classroom upon the request of the lead teacher due to other children in the classroom constantly requesting to be part of the intervention.

Materials

A total of three play sets were used during play sessions between the children. Various play sets were selected to ensure motivation and to promote generalization across toys for children with ASD. The play sets included a wooden tree house play set from *imaginarium*, a wooden rocket ship play set from *Hape*, and a wooden castle from *Melissa & Doug*. The play sets were 40-60 cm tall and contained 8 to 10 smaller pieces, for example the tree house contained, a toy–table, ladder, bunny, fox, slide, bed, hammock, and swing. See Table 1 for a full list of play sets and corresponding stimuli. Researchers used a *Hero 4 Go Pro*™ action camera to film sessions for later coding and for use during self-management training sessions with peers. An *Apple iPad* was used to view videos with an application called *My Pictures Talk*. Children also used headphones to listen to the video models. For peer training, a self-management checklist, token board, identified reinforcers, marker, and laptop was used to view videos.

Videos. A total of six videos were created, two videos for each of the three play sets. Multiple video exemplars that modeled variations of social initiations were used to increase the likelihood of novel social communication among children with ASD. The 30-s videos modeled 10 social initiations with the play set. Only the toy figurines and adult hands holding the figures were shown in the video and the same male and female adults modeled the audio scripts. Social initiations modeled in the videos were derived from observations of typically developing children in the early childhood classroom (see Dueñas, et al., 2019). The video clips showed adults modeling a range of social initiations: (a) request for another to perform an action (e.g., “Dance Bunny!”); (b) requests for an object (e.g., “Let’s trade”); or (c) a vocal label of one’s own actions that elicited a response (e.g., “I’m going to sleep”). The videos varied with regards to the modeled play action, modeled verbalization, and stimuli (e.g., toy fox versus toy bunny). All verbal social initiations were two-three-word utterances. See Table 2 for examples of social initiations.

Measurement

A trained independent observer coded and counted dependent variables from the 4-min videos of play sessions. The primary dependent variable was frequency of social communication exchanges. The secondary dependent variable was the percentage of intervals with social engagement. The third dependent variable was the frequency of unscripted social initiations and responses by children with ASD.

Social communication exchanges. Social communication exchanges were defined as independent verbal exchanges among children with ASD and their peers. A verbal communication exchange involved a verbal social initiation from either child and a matching verbal response from the communication partner (social initiation + social response) and had to occur within 5 s of each other.

Social initiations were defined as independent vocal statements that were either a request for another to perform an action (e.g., “Push me Bunny!”), requests for an object (e.g., “I want the owl”), or a vocal label of one’s own actions that elicited a response (e.g., “Bunny, I’m falling”). Social initiations marked the beginning of a new interaction by not being related to a previous verbal statement. For example, if a child says, “Help, I’m falling” and another responds, “Ok, I’ll catch you”, followed by, “Let’s dance!” The last verbalization would count as a social initiation.

Responses to social initiations were defined as vocal statements that occurred within 3 s following a vocal social initiation and had to explicitly react to the content or context of the preceding social initiation. These could be answers to questions (e.g., What do want to eat? "*I want Pizza!"*), comments or acknowledgements (e.g., Going on the swing! and *"Ok, me too."*), or offering assistance (e.g., "Help, I'm falling" and *"I'll help you Bunny").* Responses could be accompanied by motor movements or gestures (e.g., pointing, tapping on shoulder, actions with toys as agents), though this was not a requirement to be counted.

Social engagement. The secondary dependent variable was the percentage of 5-s partial intervals of social engagement during play sessions. An occurrence of social engagement was marked if any social engagement behaviors (described below) occurred at any time within the 5-s interval. Social engagement was defined as making eye contact, jointly attending to an object, smiling and or laughing, responding and initiating verbally, orienting bodies toward peer, exchanging toys with peer, and imitating actions of another. Non-examples of social engagement included yelling at a peer partner (e.g., "No, that's my toy!"), facing a peer partner in an attempt to take a toy, push, or hit, or engaging in repetitive or stereotypical behaviors. Parallel play (i.e., playing side by side with no interaction) did not count as social engagement.

Unscripted verbalizations. The frequency of social initiations and responses were further categorized as scripted or unscripted. If social initiations did not match with statements modeled in the video by more than conjunctions, articles, prepositions, or pronouns, they were counted as unscripted social initiations. All responses by the child with ASD to the typically developing peer were counted as unscripted verbalizations, as these were not directly taught or modeled.

Interobserver Agreement

The researcher trained two coders who were blind to the intervention on dependent variables of interest. To establish interobserver agreement the two coders were trained using sample videos of play sessions from a different study. Interobserver agreement was achieved when both coders agreed on whether the type of verbal social communication occurred (e.g., social initiation, social response) and whether a social communication exchange had occurred. Interobserver agreement training was conducted with videos from the current study but not used for IOA until 90% agreement was achieved. For social engagement, interobserver agreement was calculated by counting the number of intervals for which observers agreed on the occurrence or non-occurrence of social engagement. Interobserver agreement was calculated by dividing the number of agreements by the total number of disagreements plus agreements to yield a percentage. Interobserver agreement was calculated for 30% of randomly selected videos across conditions and participants. Mean IOA between the two coders during baseline and generalization for social communication exchanges was 100%, for social initiations was 100%, for social responses was 100%, and for unscripted verbalizations was 100%, across all participants. Mean IOA during intervention and maintenance for social communication exchanges was 84% (range: 63-100), for social initiations was 87% (range: 60-100), for social responses was 87% (range: 50-100), and for unscripted verbalizations was 75% (range: 50-100), across all participants. Disagreements among the two independent coders were resolved by the researcher.

Experimental Design

To assess the effects of the multi-component intervention on social- communication exchanges between children with ASD and their peers, a multiple probe design across dyads was employed (Horner & Baer, 1978). The multiple probe design allows for a demonstration of a functional relationship between intervention (i.e., peer-training) and dependent variables (such as social communication); by establishing stable baseline-responding and systematically introducing the intervention across dyads to assess whether change in participants' social communication behaviors occurred when the intervention was introduced and remains stable in its absence. The intervention was kept at 15 sessions across dyads. The frequency of social communication exchanges was used to evaluate the effects of the intervention and make decisions regarding the introduction of treatment to subsequent tiers.

Procedures

Initial peer training. The researcher conducted a one-time, 20-min training with typically developing peers. The training involved: (a) typically developing peer assent to intervention by writing their name on a document that stated, "I [*name of typically developing peer*] agree to be a friendship leader for [*name of child with ASD*] by helping him/her play, take turns, and use words; (b) reading a children's book titled, *Pete the Cat and the New Guy* (Dean & Dean, 2014) to introduce the value of playing with those who may behave differently or have different abilities; and (c) showing a 30-s video clip that showed the rules for playing with your friend that depicted the following behaviors: *Eyes on your friend*, *Stay Close, Listening Ears On*, and *Answering Fast*, adapted from *Stay, Play, Talk* (English et al., 1997).

Baseline. During baseline, the typically developing peer invited the child with ASD to play and led them to the play set previously set up by the researcher on the floor of the pretend play area, as was taught during initial peer training. The children were instructed to "Play together" and given 4 min, while the researcher remained 1 m way. If the child with ASD attempted to leave the play area, the researcher walked over and physically prompted them back to the play set. If the typically developing child attempted to leave the area, or became distracted by other children in the room, they were verbally prompted to continue playing.

Intervention. During intervention, the same procedures as baseline were followed except self-management was delivered to the typically developing peers 15 min prior to the first play session of the day (see below), and the child with ASD was shown a video model immediately before every play session. Two play sessions were delivered daily, four times per week, and occurred 20 min apart during a 1 hr child-choice period. To assess the magnitude of social communication change across dyads, the intervention was delivered for 15 sessions for all participants. This would allow us to assess the magnitude of change given a relatively short dosage that may be accessible to potential practitioners.

Peer training. A self-management system was modeled from *Self & Match* by Salter and Croce (2013). The typically developing children were taught to self-monitor the extent to which they responded appropriately to initiations of their peers with ASD from a video of the previous play session. For the first self-management intervention, a video was shown from the final baseline play session. For subsequent self-management intervention sessions, a video was shown from the previous intervention session. The behaviors that were self-monitored were: (a) looking in the direction of the child with ASD when the child socially initiated (*Eyes on Your Friend*); (b) staying within arm's length distance (*Stay Close to Your Friend*); (c) listening to their friend (*Listening Ears On*); and (d) responding to their friend within 5 s of a social initiation (*Answer Fast*).

For self-management, the researcher brought the typically developing peer into a quiet room adjacent to their classroom and explained that they were going to view themselves playing with their friend with ASD and see if they followed the rules for playing with their friend. Second, the researcher restated the rules (i.e., *Eyes on your friend*, *Stay Close to Your Friend*, *Listening Ears On*, and *Answer Fast)* and explained they were going to play a game called, *Match for Yes!* Third, the researcher explained the rules of the *Match for Yes* game — the peer would color a happy face if they saw themselves performing each behavior or would color a sad face if they did not see themselves performing the behavior from the video and the researcher would do the same. If they matched for yes with the researcher, they would get one point, if they matched for no, they would get half a point and if they did not match, they would not get any points. Points were exchanged for reinforcers that were assessed prior to the start of the study. Fourth, the researcher modeled the use of the self-management checklist with a video model from a baseline session for practice (this happened during the first self-management training session only).

Once the child received two opportunities for practice, two video segments were selected from the previous 4 min play session, one following the first initiation by the child with ASD and one following the last initiation from the child with ASD. The researcher showed the 5 to 7 s video segment, paused the video to ask if the child observed themselves performing the behavior or did not observe themselves perform the behavior, and asked the child to color in yes or no (i.e., happy or sad face), the researcher also colored yes or no, based on what was observed. This was repeated for each of the behaviors on the self-management checklist. Since the *Listening Ears* behavior was not observable, this was given as a free point to ensure typically developing peers received reinforcement during the acquisition phase. Finally, once all videos were shown, the number of matched happy faces were counted and points were totaled and tracked across sessions. Once a child earned 20-points, they exchanged points for a terminal reinforcer. Following self-management, children returned to the classroom and play sessions were conducted.

Video modeling presentation. Children with ASD were presented with video models corresponding to each play set. Video exemplars were rotated across sessions to ensure each play set and video was presented, five times across 15 sessions. That is, during the first intervention session the child with ASD saw the first video that corresponded to the first play set, during the second session the child with ASD saw the first video that corresponded to the second play set, during the third session, the child saw the first video corresponding to the third play set, during the fourth session the child saw the second video corresponding to the first play set. Video presentation continued until all videos were shown and then were repeated. The researcher presented a video model to the child with ASD that corresponded to the play set, as a procedure to prompt social initiations immediately before each play session and during play sessions, if needed (see below).

Play sessions. After the typically developing child received self-management and immediately following video modeling for children with ASD a play session was conducted. During play sessions, the typically developing child was told to set up the toys while their friend watched the video. Once the child viewed the video, the typically developing child was told to invite their friend to play. As in baseline, the children were given 4 min to play, while the researcher remained 1 m away. If children with ASD did not verbally initiate after 30 s, the researcher walked over to the child and said, “Play like you saw in the video”. If after this initial verbal prompt, the child with ASD still did not initiate, the 4-min play session was paused, and the researcher represented one social initiation from the video model to the child on the *iPad* using headphones and said, “Play like you saw in the video.” No additional prompts were delivered to either child.

Maintenance. Three maintenance probes were conducted three weeks after children completed their 15th intervention session. Same conditions as in baseline were presented during maintenance probes to assess whether treatment gains persisted beyond intervention sessions and in the absence of video models and peer training.

Stimulus generalization. Generalization probes were conducted once during baseline, after four or five sessions of intervention, and once after maintenance. Generalization probes were conducted using play sets that were available in the preschool classroom and varied for each dyad (e.g., pretend veterinary kit, *Lego*^{TM} people, and baby dolls). As in baseline, the children were instructed to, "Play together" for 4 min. No further prompting was delivered. Generalization probes were conducted to assess whether participants with ASD and typically developing peers generalized social communication behaviors with materials dissimilar to intervention. The researcher hypothesized that the rotation of three play sets may promote generalization across stimuli.

Procedural Integrity

The researcher created two checklists, one that captured the steps required for implementation of the direct intervention (i.e., multiple exemplar video modeling) and one that captured steps for implementation of the peer training (e.g., self-management and token economy). A behavior technician in the inclusive classroom, blind to the purpose of the study, was trained to use both checklists and completed procedural integrity checks on 30% of randomly selected sessions across conditions and participants (See Table 3).

Social Validity

To evaluate the social validity of the multi-component intervention we assessed two main social validity constructs: whether the intervention was acceptable to typically developing peers and whether the intervention was above normative data collected from typically developing peer dyads (see Wolf, 1978). We used subjective evaluation (e.g., questionnaire) to assesses typically developing peer perceptions of the intervention (see Kennedy, 2002) and observation and coding from video of typically developing peers playing with a known typically developing peer in their classroom (see Chan et al., 2011).

Teaching assistants facilitated the completion of a 6-item questionnaire that asked typically developing peers: (a) how much they liked helping their friend to play, (b) how much they liked watching the videos, (c) how much fun they had playing with their friend, (d) how they felt about helping their friend play again, (e) how hard it was to play with their friend, and (f) how they felt about having to leave their classroom. The teaching assistant sat across from the typically developing peers and asked them to circle their response after reading each item to them. Responses were measured on a 5-point Likert-scale illustrated by happy-to-sad face gradations. The typically developing peers responded to the questionnaire once after three sessions of intervention, after the ninth intervention session, and after the three-week follow-up.

We collected additional data in order to compare the social communication exchanges of participants with ASD with typically developing peers to those of two typically developing peers. The teacher in the inclusive classroom nominated an additional peer in the classroom who played with the typically developing peer participant during five 4-min play sessions once with all three play sets and twice with the generalization toys.

Results

Social Communication Exchanges

The main dependent variable was social communication exchanges consisting of corresponding social initiations and responses between children with ASD and typically developing peers. Figure 4.1 shows the frequency of independent social communication exchanges across dyadic pairs during baseline, intervention, maintenance, and generalization probes.

Wilmer and Malik. During baseline, social communication exchanges between Wilmer and Malik averaged approximately one exchange per play session. Effects of the multi-component intervention were slow and gradual. During intervention, their social exchanges increased to an average of four (range: 0-13) and maintained at an average of five social communication exchanges per play session at three weeks post intervention. Social communication exchanges also generalized to a different set of toys in their classroom, from once at baseline to an average of four exchanges during generalization (range: 0-6).

Olin and Olga. During baseline, social communication exchanges between Olin and Olga averaged three exchanges per play session. Effects of the multi-component intervention on social communication exchanges were immediate for this dyad. During intervention, their social exchanges increased to an average of 13 (range: 7-22) and maintained at an average of 17 social communication exchanges per play session at three weeks post intervention. Social communication exchanges did not generalize to a different set of toys in their classroom, eight exchanges were observed at baseline and an average of seven exchanges were observed during intervention (range: 0-9).

Titus, Aria, and Genevieve. During baseline, Titus displayed an absence of social communication exchanges with both Aria and Genevieve. Baseline sessions one through five represent data with Aria, six and seven represent data with Genevieve and eight and nine represent data with Aria. Effects of the multi-component intervention were also immediate for Titus and Aria. During intervention, their social exchanges increased to an average of 10 exchanges (range: 4-16) and maintained at an average of nine social communication exchanges per play session at three weeks post intervention. Social communication exchanges also generalized to a different set of toys in their classroom, though the average frequency during this condition was much lower than intervention, from zero at baseline to two exchanges per play session (range: 0-5).

Social Initiations and Responses of Children with ASD

The frequency of independent social initiations and responses by children with ASD were also coded. Figure 4.2 shows the frequency of independent social initiations and responses by children with ASD during baseline, intervention, maintenance, and generalization probes.

Wilmer. Prior to video modeling, Wilmer averaged three social initiations per play session. During intervention, Wilmer initiated an average of seven times per play session (range: 2-13). However, effects of the intervention were not immediate and there was high variability across play sessions. Social initiations maintained at an average frequency of seven (range: 5-9), three weeks post intervention. Wilmer’s social initiations to his peer also generalized to a new set of toys from the inclusive classroom. His average social initiations during generalization probes improved to seven from only three at baseline (range: 1-11).

Prior to video modeling, Wilmer was not responding to his typically developing peer. Effects of the intervention were very low for social responses, and increased to an average of once per play session (range: 0-4). During maintenance probes, Wilmer maintained a slightly higher frequency of social responses at three weeks post intervention, an average of three per play session. Social responses did not generalize to a new set of toys.

Olin. Prior to video modeling, Olin averaged four social initiations per play session (range: 1-10). During intervention, Olin initiated an average of 15 times per play session (range: 3-24). Effects of the intervention were not immediate and there is some variability across play sessions. Social initiations maintained at an average frequency of 13 (range: 9-16), three weeks post intervention. Olin's social initiations to his peer also generalized to a new set of toys from the inclusive classroom. Average social initiations during generalization probes were 11 from eight during baseline (range: 8-18).

Olin responded an average of three times to his peer during baseline. During intervention, responses only increased to an average of four responses per play session (range: 0-12). Effects of the intervention for social responses were very low with high variability. During maintenance probes, Olin responded slightly more consistently at an average of nine times (range: 7-10). However, these did not generalize to a new set of toys in the inclusive classroom. During baseline generalization probes, he responded three times and he continued to respond an average of three times during intervention (range: 2-6).

Titus. Prior to video modeling, Titus initiated an average of once to his peer during play sessions (range: 0-2). During intervention, Titus initiated an average of 17 times per play session (range: 10-23). However, effects of the intervention were not immediate and there was some variability across play sessions. Social initiations maintained at an average frequency of 14 (range: 11-17), three weeks post intervention. Titus' social initiations to his peer also generalized to a new set of toys from the inclusive classroom. However, average social initiations during generalization probes were lower than intervention at five per play session from zero during baseline generalization probe (range: 2-6).

Titus did not respond to his peer during baseline. During intervention, responses remained low at an average of one response per play session (range: 0-6). There were no effects of the intervention on social responses. During maintenance and generalization probes, Titus responded at similar levels (range: 0-3).

Social Engagement

The secondary dependent variable was social engagement consisting of acts of joint attention, smiling, laughing, imitation, and non-verbal communication (e.g., handing objects to one another) between children with ASD and typically developing peers. Figure 4.3 shows the percentage of intervals that the dyadic pairs were socially engaged during baseline, intervention, maintenance, and generalization probes.

Wilmer and Malik. During baseline, Wilmer and Malik displayed social engagement (i.e., joint attention, smiling, laughing) on average during 29% of 5-s intervals. During intervention, social engagement increased gradually to an average of 54% social engagement (range: 31-86%). Social engagement between Wilmer and Malik maintained at 63% post intervention (range: 56-70%). During generalization probes, social engagement was low at 33% social engagement on average.

Olin and Olga. During baseline, Olin and Olga displayed social engagement on average during 38% of 5-s intervals. During intervention, social engagement increased slightly to an average of 52% social engagement (range: 31-75%). Social engagement between Olin and Olga maintained at 76% post intervention (range: 70-79%). During generalization probes, social engagement remained at 54% social engagement on average from 45% at baseline (range: 40-62%).

Titus, Genevieve, and Aria. During baseline, Titus displayed social engagement on average during 0% of 5-s intervals with both Genevieve and Aria. During intervention, social engagement increased immediately to an average of 49% social engagement (range: 33-62%). Social engagement between Titus and Aria maintained at 59% post intervention (range: 52-

68%). During generalization probes, social engagement was lower at 13% social engagement on average from 0% at baseline (range: 0-35%).

Unscripted Verbalizations

We were also interested in whether children with ASD began to deviate from scripts across play sessions. Figure 4.4 shows the frequency of unscripted verbalization during baseline, intervention, maintenance, and generalization probes across participants.

Wilmer. Prior to intervention, Wilmer's unscripted verbalizations were two (range: 0-3). There was no effect on the number of unscripted verbalizations during intervention. On average, his unscripted verbalizations remained at the same frequency as baseline but slightly increased towards the end to six and four and maintained at five post intervention (range: 3-7). An increasing trend occurred from three at baseline to 12 post intervention during stimulus generalization probes.

Olin. Prior to intervention, Olin's unscripted verbalizations were seven (range: 2-13). During intervention, unscripted verbalization increased to 12 (range: 5-18) and maintained at 17 on average post intervention (range: 15-19). His unscripted verbalization generalized to a new set of toys at an average frequency of 14 (range: 11-20), however, during the baseline generalization probe his unscripted verbalizations were 11.

Titus. Prior to intervention, Titus' unscripted verbalizations were once per play session (range: 0-2). Titus' unscripted verbalizations increased during intervention followed by a decreasing trend; on average his unscripted verbalizations were three (range: 0-8). Unscripted verbalization maintained at eight per session (range: 5-11). During stimulus generalization probes, his unscripted verbalizations were five per play session (range: 2-8).

Tau-U Effect Sizes

To supplement visual analysis, we calculated a Tau-U effect size metric for main dependent variables of interest (i.e., social communication exchanges, social initiations and responses and social engagement). Tau-U offers non-parametric effect sizes by calculating the nonoverlap of data between baseline and intervention phases while controlling for possible trends during baseline (Parker & Vannest, 2009; Rakap, 2015). A web-based Tau-U calculator (see http://www.singlecaseresearch.org/calculators/tau-u) was used for calculations was used.

Weighted Tau-U for social communication exchanges across dyads was .89, 95% CIs [.58, 1], $p < .001$; the weighted Tau-U for social engagement was .81, 95% CIs [.50, 1], $p < .001$; the weighted Tau-U for social initiations of children with ASD was .88, 95% CIs [.59, 1], $p < .001$; and the weighted Tau-U for social responses was .36, 95% CIs [.05, .67], $p < .02$.

Social Validity Results

Typically developing peer survey. Three teaching assistants in the inclusive preschool classrooms facilitated the completion of the 6-item survey with the three typically developing peer participants. Typically developing peers rated the extent to which they enjoyed different features of participation in the study (e.g., leaving their classroom for training, watching videos, and playing with a child with ASD) and on whether they would like to participate in the future. See Table 4 for a summary of responses for surveys conducted at the beginning, middle, and end of the study. Overall, typically developing peers rated the intervention positively at the beginning of the study but two participants rated features of the intervention less favorably towards the end of the study. Particularly, Olga's response to whether she enjoyed helping her peer partner with ASD changed from *a lot* to *not at all* and Aria's from *a lot* at the beginning and *middle to somewhat* at the end. When children were asked why by the teaching assistants, both children stated that their play partner with ASD was not sharing toys.

Normative comparison data. The second form of social validity assessed the clinical significance of social communication exchanges by comparing baseline and intervention levels of participant dyads to those of two typically developing peers in the same classroom. Typically developing peer comparison data is reported in Figure 4.1. On average, typically developing peers in the study and their partners engaged in five social communication exchanges per play session (range: 1-12). This is comparable to the average social communication exchanges observed during intervention between Malik and Wilmer, his peer partner with ASD. However, this is lower than the average social communication exchanges between Olga and Olin during intervention, (M = 13; range: 7-22) and lower than 10 social communication exchanges observed between Aria and Titus during intervention.

Discussion

The multi-component peer-mediated intervention led to an increase in verbal social communication exchanges and social engagement between children with ASD and typically developing children with minimal adult mediation during play sessions. Children with ASD also increased social initiations directed to their typically developing peers. In addition, two dyads generalized social communication exchanges to toys in the inclusive classroom. However, experimental effects were low for social responses of children with ASD and the observed effect for response generalization (unscripted verbalizations) was minimal.

Social Communication Exchanges

The intervention improved social communication exchanges of children during play by intervening with both typically developing preschoolers and children with ASD. In the present investigation we specifically taught children with ASD to initiate during play. The current PMI intervention literature has documented that teaching children with ASD to socially initiate can be especially difficult during play (Dotson, Leaf, Sheldon, & Sherman, 2010; Dueñas et al., 2019; Thiemann-Bourque et al., 2017). Video modeling shows promise as part of a multi-component PMI for teaching children with ASD to initiate to peers. Conversely, typically developing peers in this investigation were taught to self-manage their responses to children with ASD. This study expands the use of video modeling to promote social initiations of children with ASD in Dueñas et al. (2019) by specifically training typically developing peers to respond to children with ASD. As a whole, the self-management and video modeling package shows promise as an intervention to promote verbal social communication exchanges during play. In addition, the intervention was conducted in only 15 play sessions that spanned approximately two weeks, and effects were maintained three weeks post intervention.

Social Initiations and Responses

Social initiations of children with ASD increased but their responses to their peers did not. Review of social initiation and response data show children with ASD were primarily initiating but not responding (see Figure 4.2 for frequency of responses by children with ASD). Though the desired effect of the intervention was achieved, an unintended effect was that children with ASD were primarily initiating and being responded to. By presenting video models to children with ASD that specifically taught initiations, the intervention taught children with ASD to be initiators and taught typically developing peers to be responders. Participants only learned to perform the social behaviors they were specifically taught, and not to engage in the skill that was taught to their partner. This has important implications for the design and measurement of future PMI studies. When designing a multi-component PMI, it may be necessary to teach both children to respond and initiate. In addition, social communication exchanges as a measure of reciprocity may capture some degree of balance between interactions but the direction of this interaction (i.e., who responds and who initiates) may also be critical to achieve full balance. Unlike previous studies, we focused the child-specific intervention on teaching children with ASD to initiate to their peers during play. Therefore, our findings differed from Thiemann et al., 2016 and 2017 where social initiations by children with ASD occurred at lower rates and initiations of typical peers occurred at higher rates. In addition, the intervention focused on teaching other forms of social communication other than requesting desired items.

One less evident explanation for low responding in children with ASD may be the infrequent opportunities that children with ASD had to respond to their typically developing peers, as there was variability across typically developing peers' frequency of social initiations. Typically developing peer data are not presented in graphical form but were coded for initiations and responses. Wilmer's peer partner Malik initiated on average four times during intervention (range: 2-6), Olin's peer partner Olga initiated on average 10 times during intervention (range: 3-19), and Titus' peer partner Aria, initiated on average five times (range: 0-13). Interestingly, Olin demonstrated a higher frequency of responses than Wilmer and Titus. There may be an effect on the frequency of responses of children with ASD associated with the frequency of social initiations made by typically developing peers. That is, the number of initiations made by typical peers presents a different number of opportunities for children with ASD to respond. These findings are similar to other PMI studies that have noted differences in the verbalization of children with ASD that may be associated with verbalizations displayed by typically developing peers (Dueñas et al., 2019; Goldstein, Schneider, & Thiemann, 2007). In addition, preschool PMIs *have* explicitly focused on teaching typically developing peers to initiate and have been successful (Whalon et al., 2015). These findings may indicate that it may be important to teach both children with ASD and typically developing peers to respond and initiate–and that neither one is achieved if not directly taught.

Social Engagement

Social engagement in this study was measured as the percentage of 5 s partial intervals in which verbal and nonverbal forms of social engagement occurred. Though results were positive for two dyads (Wilmer and Malik, and Titus and Aria), results are less clear for Olin and Olga who displayed similar levels of social engagement from baseline to intervention. Joint attention, imitation, and other forms of nonverbal social communication, such as performing an action requested by a peer (e.g., making a toy bunny sit at a table when a peer says, "Come eat"), are important measures of social communication but may be difficult to capture accurately (Murdock et al., 2007). In this study, though children were verbally initiating and responding, the 5 s interval sometimes failed to capture verbal communication, as interactions would begin at the end of an interval and continue to the next interval and verbal communication was not counted if an initiation was not followed by a response.

Stimulus and Response Generalization

Generalization across stimuli was observed for social communication exchanges for two dyads and social initiations for two children with ASD. Though generalization is measured infrequently in PMI (Goldstein, Lackey, & Schneider, 2014; Gunning et al., 2018), our findings are similar to recent studies which have found generalization effects to be mixed within the PMI literature (Whalon et al., 2015). The results suggest the play sets in this study may have exerted some stimulus control over the social communication of children with ASD.

The stimuli selected for generalization probes within this study may have impacted the results of generalization, as children played with toys that were available in the pretend play area of their classroom and were not necessarily selected based on preference or degree of similarity with intervention materials. The researcher chose materials available in the classroom as this may impact the likelihood that social communication exchanges would maintain in that environment and see social communication generalize to those materials. Mixed generalization results may also be due to the degree of difference in stimuli from intervention to generalization probes. For example, Olin and Olga played with a veterinary set that had one stuffed dog and materials associated with the veterinary profession (e.g., stethoscope, thermometer, ointment, tongue press, and syringe), while play sets were also thematic, they involved two figurines (e.g., two astronauts) that children gave agency to.

We also hypothesized that the use of multiple-exemplar video instruction would promote unscripted verbalizations of children with ASD, however, effects of the intervention were minimal for response generalization across dyads. Unlike other studies that found positive results on the use of multiple exemplar videos for promoting novel responses, the current study shows little to no effects of multiple exemplar videos on novel responding (Dueñas, et al., 2019; MacDonald, Sacramone, Mansfield, Wiltz, & Ahearn, 2009; Maione & Mirenda, 2006). This may be due to the number of video exemplars each dyad was exposed to. A total of six different videos were made for this study, as opposed to three video exemplars used in previous studies (Dueñas et al., 2019; MacManus, MacDonald, & Ahearn, 2015) and children with ASD were exposed to each video two or three times. The number of video presentations were lower in this study compared to previous studies. Video exposure may be a factor impacting response generalization as children with ASD may be focused on learning scripts from video before beginning to deviate from scripts.

Social Validity

The study also contributes to the social validity of PMI by measuring the acceptability of the intervention by typically developing peers using subjective evaluation (Kennedy, 2002; Wolf, 1978) and collecting normative data from typically developing peer dyads during play with the same toys used for intervention. A recent PMI literature review noted only 28% of studies in their review assessed social validity and none of the studies assessed social validity of peers (Gunning et al., 2018). Overall, children reported intervention features positively for leaving their classroom for training, watching videos, and reported playing with their peer with ASD was not difficult. Survey results also reveal a change in the perception of typically developing peers over time regarding playing with children with ASD. In particular, two typically developing children changed their responses from positive at the beginning of the study to negative in the middle and end of study. Children reported that their peers with ASD were not always sharing toys and that this made playing with them less enjoyable. This finding is particularly interesting in light of the aim of the study to reduce adult facilitation during play. That is, although adult feedback and reinforcement may be intrusive during play, adult facilitation may still be needed to ensure positive interactions among children with ASD and their peers (Reiter & Vitani, 2007). Although changes in typical peer's perception changed over time, interestingly, typical peers were always ready to play with peers with ASD and never refused when requested to participate.

The intensity of the intervention may have also contributed to the typically developing peer's potential burnout, as sessions were conducted twice a day, every day, for at least two weeks. Previous PMI studies have modified peer training methods by training all members in a classroom rather than dyadic pairs (Laushey & Heflin, 2000). This may have helped reduce typically developing peer burnout and may eliminate the need to single out children with ASD in a classroom by teaching all children to interact. Another strategy to help with potential burnout is to intervene throughout the day and at different times in the day, so the expectation to play with a peer with ASD is less predictable.

Finally, one typical peer in this study, Genevieve, dropped out of the study during training. When the procedures of the intervention were explained to her, that is, the rules of playing with a child with ASD and how to earn points and exchange for reinforcers, she responded that her mother could buy her the reinforcers she would earn during the study and that she did not want to participate. Although assents were obtained for typical peer participants in the study, it is clear that for some participants more information about the study was needed in order to make an informed decision. For Genevieve, playing with a child with ASD during baseline was potentially perceived as too high a cost that was not offset by the potential to receive reinforcement (Goldstein et al., 2007).

Normative data collected in this study also highlight an important social validity consideration within PMI. The normative data in this study provide a reference point for the clinical significance of the intervention. In all cases, participant dyads outperformed the social communication exchanges of typical peer dyads during intervention. The probes were conducted at baseline prior to the participants' receiving intervention, this also provides evidence that two of the three the participant dyads in the study were engaging in social communication exchanges below their classmates and therefore intervention was warranted. Similar to Chan et al., 2011, we found that the intervention far exceeded the performance of typically developing peers. This suggests that we may exceed our expectations of social communication during play for children with and without disabilities. Finally, a wide range in frequency of social communication exchanges was observed among typically developing peer dyads that is consistent with previous literature. That is, rates vary considerably depending on several factors that may influence interaction, for example, the type of materials, adult supervision, the age of participants, and familiarity with play partners (Goldstein et al., 2007).

Limitations

There are several important limitations to this study and directions for future PMI research with preschool children with ASD. Though results were positive for social communication exchanges and social initiations, it is likely that children with ASD needed to be explicitly taught to respond to their peers, as no improvement was observed on their responses to peer initiations. In addition, data suggests that some typically developing children needed to be explicitly taught to initiate to their peers. Future multi-component PMI studies may need to teach both children to verbally initiate and respond, which could be done in several ways. One approach might involve having children switch roles, being initiator and responder and/or exposing both children to video models and self-management strategies, such as was done in Laushey and Heflin (2000).

The measurement of social engagement was also a limitation of this study. It is possible that the operational definition of social engagement may have been too stringent, that is, requiring verbal initiations and responses to occur in 5-s intervals. This may have resulted in an under estimation of the total social engagement, (e.g., verbal and nonverbal social communication among dyads). Though evaluating effective measurement systems of social engagement is out of the scope of this study, it is possible that the size of intervals and operational definitions impacted the validity of these data.

A third limitation was that we did not collect data on the frequency of video modeling presentations delivered to children with ASD during 30 s lulls in social communication. These data would be useful in understanding the overall effects of video modeling on the social initiations of children with ASD, and how long interventionists may need to follow this procedure before fading it completely. In addition, during initial intervention sessions, presentation of video models may have disrupted social engagement, as the presentation of videos on average took 7 to 10 s. Future studies using repeated presentation of video modeling should collect data on the number of presentations needed per session in order to better measure progress over time.

A final limitation of the study is that the intervention was delivered by the researcher and intervention-developer and not by practitioners (e.g., speech pathologists or special education teachers). Though the intervention was delivered in the inclusive classroom and teachers were involved in peer selection, material selection, and social validity data obtained for typically developing peers, we know little about the feasibility and acceptability of the intervention in inclusive preschool classrooms when implemented by practitioners. Therefore, future research that involves training and supporting practitioners in the implementation of the intervention is needed to examine the likelihood that practitioners would adopt the intervention.

Overall, the multi-component PMI involving the use of self-management and video modeling demonstrates children with ASD can learn to initiate to typically developing peers during play with minimal adult facilitation. And typically developing peers can learn to respond to their peers reliably with self-management. Consistent with previous investigations evaluating multi-component PMI, combining interventions that target both children with ASD and their peers may result in improved social communication between children during play.

APPENDIX

Table 4.1. Play Sets and Pieces

Play Set Brand and Name	Toy figurines and Toy
Imaginarium; Forest Friends Treehouse	Toy bunny Toy fox Ladder Hammock Bed Table Stumps (2) Slide Swing
Melissa & Doug; Folding Medieval Castle	Horse King Queen Treasure Chest Bed Table Bench (2) Throne Bath
Hape; Space Ship Rocket	Alien Robot Astronaut Elevator Solar Panel Flag Emergency Kit Computer Bed

Table 4.2. Sample Scripted Social Initiations from Video

Video Exemplar	Social Initiations
1	"Let's eat" "Help, I'm falling!" "Hey, copy me" "Chase me" "Come, slide" "Going to sleep" "Follow me!" "Hide and seek" "Climb up" "Get in the car!"
2	"Knock, who's there?" "Jump to the top" "We can fly!" "Hide, it's raining!" "Hey, let's dance" "Climb the rope" "Good morning, Bunny" "A monster's coming!" "Oh, my leg broke!" "Help, I'm stuck!"

Table 4.3. Procedural Integrity Checklist

Procedural Integrity Form (Intervention)				
Before Play Session (Video Modeling)				
Date	**Session**	**Initials**	**Data**	
1. Asks typical peer to invite their friend to play after they see a video			Y	N
2. Asks child with ASD to come watch a video			Y	N
3. Shows correct video model (video is rotated, matches play set)			Y	N
4. Shows video model twice			Y	N
5. Ensures child is watching video			Y	N
6. Says, "Go play like the video" After peer invites child to play			Y	N
During Play Session				
7. Remains 3 feet away			Y	N
8. Does not deliver ANY prompts during play			Y	N
9. If 30 s lull in interaction, represents 5 s of video clip and says "Play like the video"			Y	N
10. If children leave the play area, prompts them back to play area			Y	N
11. Ends play session after 4 minutes			Y	N
TOTAL			/11	
Typical Peer Self Monitoring				
1. Reviews rules for being a good play partner			Y	N
2. Tells child that they are going to watch a video of themselves playing			Y	N
3. Plays video clip of FIRST social initiation by child with ASD			Y	N
4. Asks child whether they performed each behavior			Y	N
5. Notes whether child performed the behavior			Y	N
6. Goes through each behavior and notes matches and states points received			Y	N
7. Asks child to count points			Y	N
8. Plays video clip of LAST social initiation by child with ASD			Y	N
9. Asks child whether they performed each behavior			Y	N
10. Notes whether child performed the behavior			Y	N
11. Goes through each behavior and notes matches and states points received			Y	N
12. Asks child to count points			Y	N
13. Transfers points to point chart			Y	N
TOTAL			/13	

Table 4.4. Typical Peer Survey Results.

	Typically Developing Peers								
	Malik			Olga			Aria		
Item	Beginning	Middle	End	Beginning	Middle	End	Beginning	Middle	End
How much do you like helping (peer with ASD)?	1	1	1	1	5	5	1	1	3
How much do you like watching the videos?	1	1	1	1	1	1	1	1	1
How much fun do you have playing with (peer with ASD)?	1	1	3	1	3	3	1	1	2
Would you help (peer with ASD) play again?	1	1	3	1	5	4	1	1	1
How hard was it to play with (peer with ASD)?	5	1	1	5	5	4	5	5	3
How much did you like leaving your classroom?	1	1	1	1	4	1	1	1	1

Note: 1=A lot/Very much will 2= Liked it/Yes, 3=Somewhat/Maybe 4=A little/Probably won’t, 5=Not at all/Definitely won’t; *n* = 3

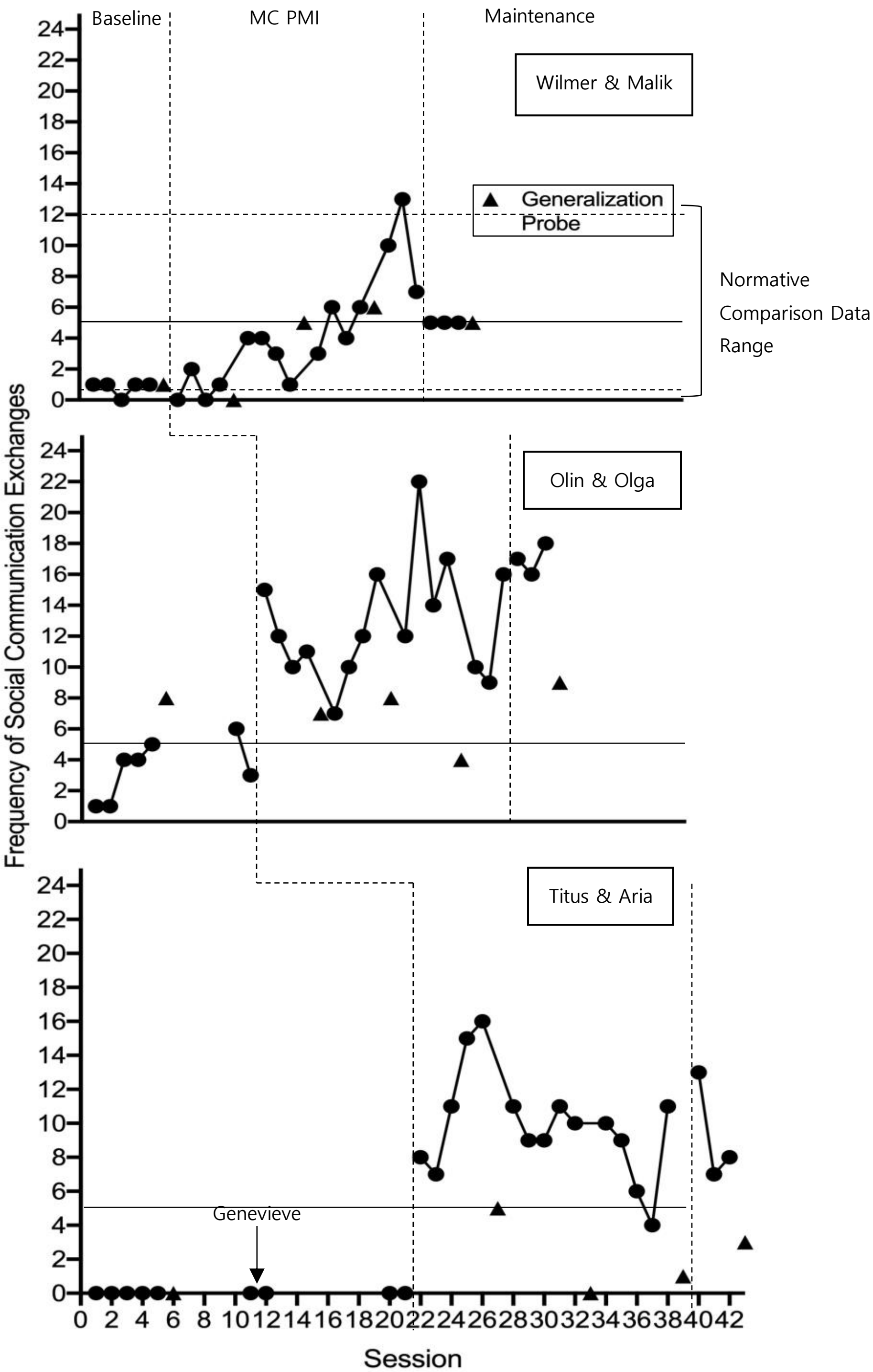

Figure 4.1. Multiple Probe Graph Depicting Frequency of Social Communication Exchanges. The frequency of independent social communication exchanges across dyads are shown during baseline, intervention, and maintenance in closed circles. Generalization probes during baseline, intervention, and maintenance are depicted in closed triangles. Mean normative comparison of social communication exchanges is shown on the solid vertical line and dotted lines represent the upper and lower range of normative comparison data. MC PMI= multi-component peer mediated intervention.

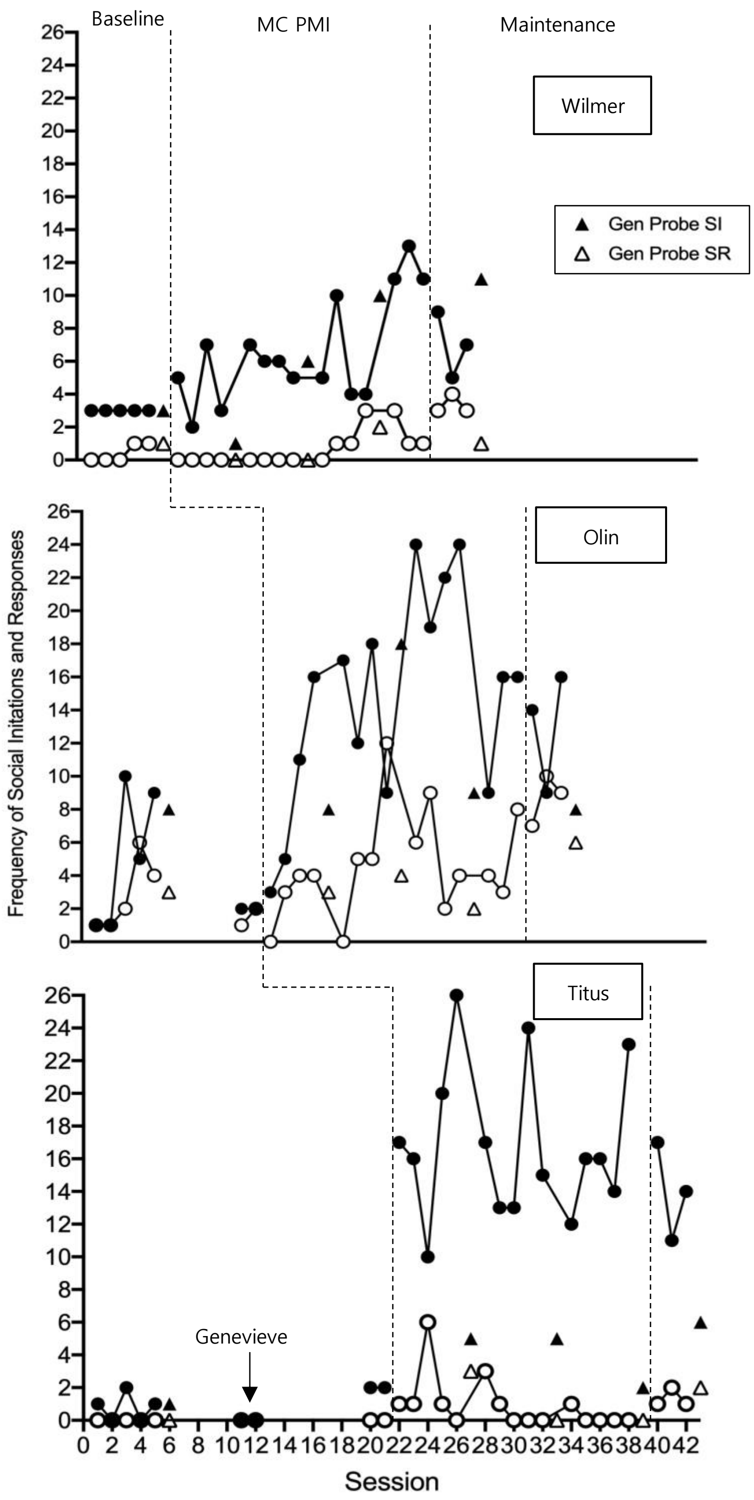

Figure 4.2. Multiple Probe Graph Depicting Frequency of Social Initiations and Responses. The frequency of independent social initiations are shown in closed circles, social responses are shown in open circles across baseline, intervention, and maintenance by children with ASD. Generalization probes are depicted in closed triangles for social initiations and open triangles for responses across baseline, intervention, and maintenance. MC PMI= multi-component peer mediated intervention.

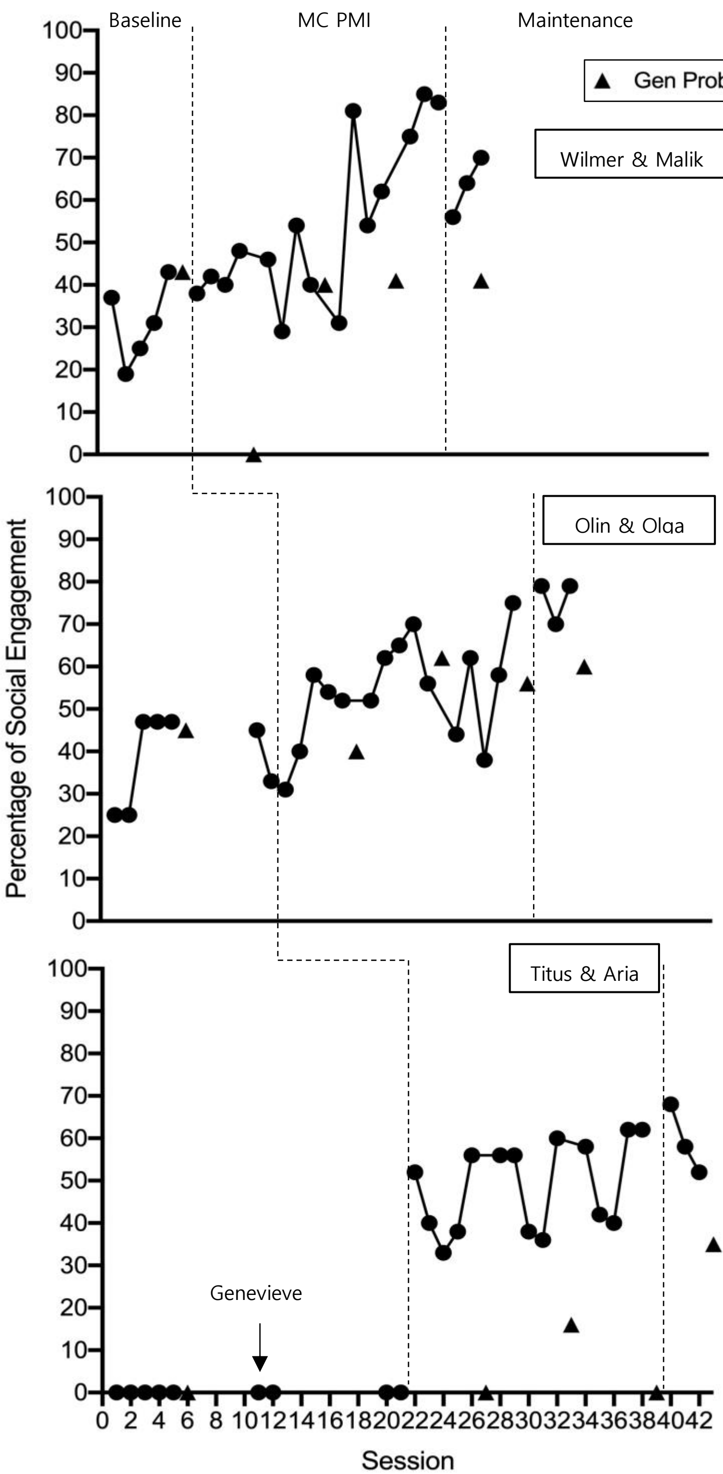

Figure 4.3. Multiple Probe Graph Depicting Frequency of Social Engagement. The percentage of 5s intervals of social engagement are shown in closed circles during baseline, intervention, and maintenance across dyads. Closed triangles depict generalization probes during baseline, intervention, and maintenance. MC PMI= multi-component peer mediated intervention.

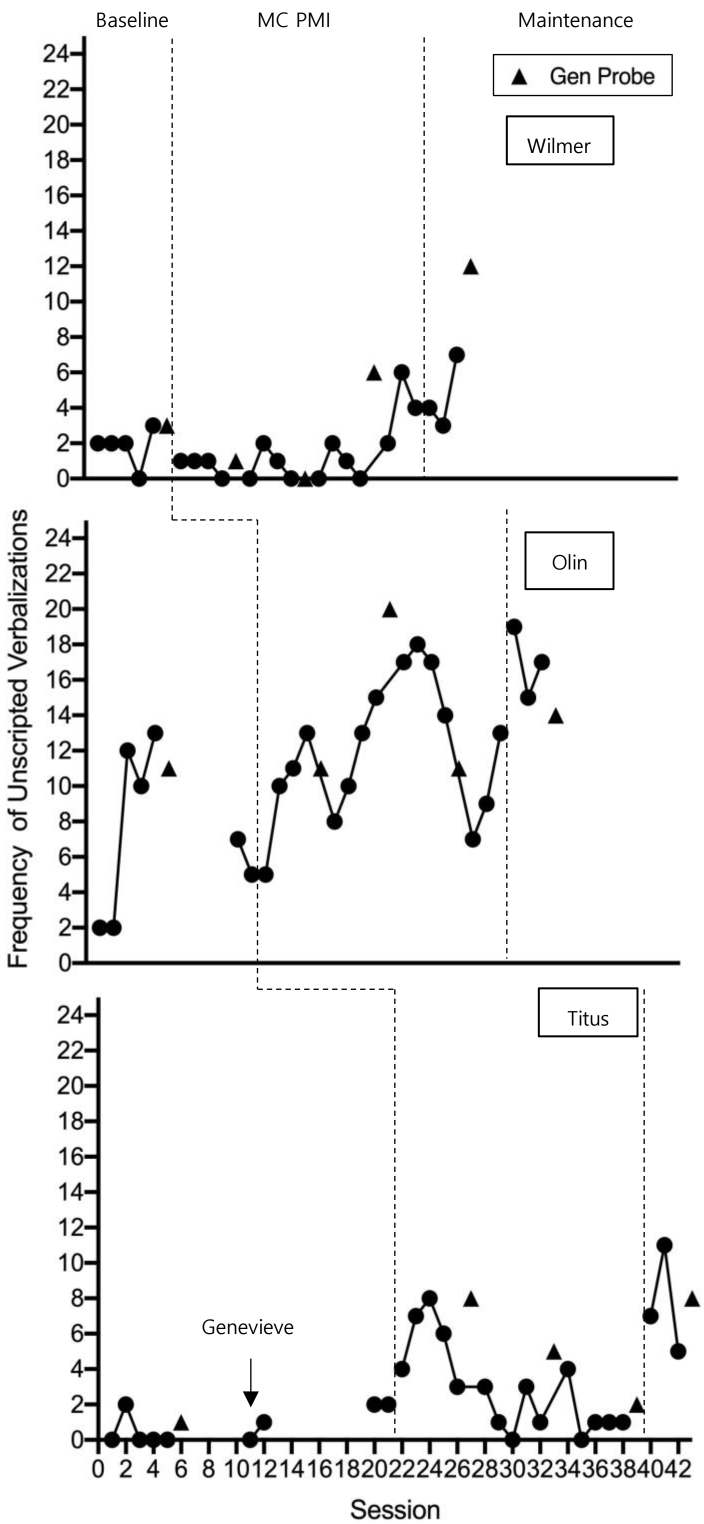

Figure 4.4. Multiple Probe Graph Depicting Frequency of Unscripted Verbalizations. The frequency of unscripted social initiations and responses are shown in closed circles during baseline, intervention, and maintenance across participants. Generalization probes during baseline, intervention, and maintenance are depicted in closed triangles. MC PMI= multi-component peer mediated intervention.

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CHAPTER 5

Discussion

Social communication is a complex behavior that requires both non-verbal and verbal behaviors, reciprocity with a communication partner, and shared engagement (Murdock, Cost, & Tieso, 2007; Paul, 2003; Plavnick, Sam, Hume, & Odom, 2013). The social ability-gap among individuals with ASD and typically developing peers tends to widen as social demands increase when children approach adolescence and adulthood (Klin et al., 2007). Without intervention, children with ASD are at higher risk of educational and employment underachievement (Chen, Leader, Sung, & Leahy, 2015; White, Ollendick, & Bray, 2011) and social isolation and bullying (Cappadoccia, Weiss, & Pepler, 2012; Carter, Davis, Klin, & Volkmar, 2005). Therefore, extensive research over the past two decades has focused on improving social communication outcomes for this population.

This dissertation presented three studies that sought to examine the existing social communication intervention research for young children with ASD, and evaluate the effectiveness of a multi-component intervention that merged peer mediated intervention (PMI), video modeling, and self-management for promoting generalization. Collectively, these chapters sought to analyze current approaches, specifically related to generalization, in order to identify intervention components that have the potential to improve generalized social repertoires for children with ASD.

In Chapter 2, a meta-analytic review was conducted to evaluate single case research of video-based instruction (VBI) for social communication among young children with ASD. Results of this meta-analysis build support for the use of video modeling to promote social communication of young children with ASD. It served as a basis for examining VBI effects in promoting novel social communication in children with ASD in Chapters 3 and 4. . Tto evaluate the peer training strategies that would inform the multi-component intervention in Chapter 4, a component analysis of procedures was conducted in Chapter 3. Video modeling and self-management, when paired with reinforcement, were both viable interventions for improving the independent social responses of typically developing preschool children towards their peers with ASD. Finally, Chapter 4 evaluated the effects of a multi-component PMI on the social communication behaviors of preschool children with ASD and their peers, using a multiple-probe design across dyads. The intervention led to an increase in verbal social communication exchanges and social engagement between children with ASD and typically developing children with minimal adult mediation during play sessions. Children with ASD also increased social initiations directed to typical peers that maintained three-weeks post intervention. In addition, two of three dyads generalized social communication exchanges to toys in the inclusive preschool classroom.

Generalized Social Communication Repertoires

The positive social communication outcomes observed in social communication intervention studies are limited by a lack of assessment and programming of generalization across people, environments, and contexts. This lack of assessment and programming was clearly evident in Chapter 2, as only half of the studies programmed generalization effects of VBI for social communication in young children with ASD. However, the omnibus generalization effect size was medium to large for stimulus and response generalization of social communication. VBIs therefore show great promise for promoting generalization as they can incorporate viewing of : (a) several contexts modeling multiple response options for promoting response generalization (Dueñas, et al., 2019; MacManus et al., 2015; Maione & Mirenda, 2006;

Plavnick, & Dueñas, 2018); (b) various people modeling social behaviors (e.g., peers, teachers, and parents); (c) modeling of common stimuli and naturally occurring contingencies in the child's environments (e.g., observing a model receive social praise for performing a behavior). (d) portable electronic devices to optimize implementation across settings (e.g., home, community, classrooms).

Based on the results of the VBI review in Chapter 2, video modeling for children with ASD made sense as an essential part of a multi-component intervention. The results of the review also influenced the decision to use video modeling to teach typically developing peers to respond to children with ASD in Chapter 3. Given the potential benefits of VBI in promoting both stimulus and response generalization, Chapter 4 investigated a multi-component intervention that combined multiple exemplar video modeling with PMI on generalized social repertoires of children with ASD. Stimulus generalization outcomes were positive for social communication exchanges and social engagement of two dyads and social initiations of two children with ASD.

Response Generalization

Results of Chapter 2 revealed that few VBI studies assessed response generalization and these tended to have weaker effects. Although the VBI literature points to multiple-exemplar videos as a promising strategy for promoting response generalization, results of Chapter 4 were substantially different from those observed in previous studies (Dueñas, et al., 2019; MacDonald, Sacramone, Mansfield, Wiltz, & Ahearn, 2009; Maione & Mirenda, 2006). In Chapter 4 we employed multiple exemplar video modeling to promote novel social initiations of preschool children with ASD during play with their peers. However, effects of the intervention were minimal for response generalization across participants. Unlike other investigators who have found positive results when using multiple exemplar videos to promote novel responses, the current study showed little to no effect of multiple exemplar videos on novel responding. There are several possible reasons for this deviation from prior research including: (a) the number of video exemplar presentations were lower than previous studies and children saw and imitated each video exemplar twice; (b) typically developing children were taught to respond to children with ASD, which may have led to reinforcement of scripted responses at higher rates; and (c) one child with ASD in this study displayed high rates of unscripted verbalization at baseline.

In Chapter 4 we created two video exemplars for each play set. Therefore, children were exposed to six video models. Children saw each video approximately twice. This differs from Dueñas et al. (2019), MacManus et al. (2015) and Maione and Mirenda (2006) where only three video models were created that each modeled 8-15 verbalizations. It is possible that there is an ideal number of video exposures for children to demonstrate mastery of modeled scripts before unscripted verbalizations begin to emerge. MacManus and colleagues specifically evaluated video modeling in combination with matrix training. Results of their investigation yielded positive outcomes for a specific type of generalization known as recombinative generalization. The procedures in their study differed from the current study in two main ways. First, the researchers waited to assess recombinative generalization until participants had demonstrated mastery of video models. The unscripted verbalization in this study were measured over time during intervention and only once during maintenance. Second, MacManus and colleagues did not show video models during probes when recombinative generalization was measured. It is possible that in the absence of video models, children begin to recombine verbalizations learned from video. In the present study, participants had the highest frequency of unscripted verbalization at the end of the study during maintenance probes when videos were not shown.

Future studies may conduct response generalization probes that involve the withdrawal of video models to assess the effect on unscripted verbalizations.

Previous studies that have used multiple exemplar video modeling to promote response generalization have not specifically taught peers to respond to children with ASD (Dueñas et al., 2009; Maione & Mirenda, 2006). Children with ASD in the present investigation may have received high rates of social reinforcement, that is, peer responses to their initiations at the beginning of the study when the majority of verbalizations were scripted. This may have tipped the scale for the kind of verbalizations that received reinforcement, in favor of scripted verbalizations and therefore increased those types of verbalizations. Future studies may provide more opportunities for peer responding once children begin to deviate from scripts to reinforce the unscripted verbalizations of children with ASD.

One of the participants in the present study displayed higher rates of unscripted verbalizations at baseline than other participants. Olin produced seven unscripted verbalization during baseline, compared to 1-2 unscripted verbalizations by the other participants. Although he increased to 12 during intervention, it is possible that for this participant imitation of video models reduced the overall opportunity to engage in unscripted verbalizations. Future studies may assess verbalizations prior to intervention to determine whether video modeling is optimal or whether peer training alone is sufficient.

Stimulus Generalization

The meta-analysis of VBIs in Chapter 2 also revealed that generalization effects were higher for stimulus generalization, that is, the likelihood that a response will transfer to different people, settings, or contexts. The results of the study in Chapter 4 coincide with the finding that stimulus generalization may be easier to achieve than response generalization. However, stimulus generalization was not obtained for one dyad and one child with ASD. We chose materials that were available in the classroom for stimulus generalization probes, as this may impact the likelihood that social communication exchanges would generalize to that environment post intervention. That is, if social communication behaviors generalize to other toys then it is important to ensure that those toys are in the children's natural environment. The issue with selecting stimuli already available in the classroom for generalization probes, however, is that we do not know whether children enjoyed playing with these materials. In addition, the toys had a larger degree of difference than stimuli used for intervention, all of which may have impacted stimulus generalization outcomes for one participant. Future studies may either select toys for intervention that are already in the classroom or conduct generalization probes with stimuli that more closely resemble intervention toys.

Multi-component Social Communication Interventions

An emerging body of literature has begun to combine peer mediated interventions and child specific intervention strategies to meet the complex social needs of young children with ASD and promote generalization. Combining direct social instruction delivered to children with ASD while also training peers to be responsive social partners is hypothesized to lead to more robust outcomes (McConnell, 2002; Whalon, Conroy, Martinez, & Werch, 2015). When combining interventions, it has been argued, that the packaging of procedures makes it difficult to determine which components of the intervention are responsible for positive outcomes (Whalon et al., 2015). When designing multi-component interventions careful attention must be placed on the individual components that lead to change in behavior to minimize potentially effortful and unnecessary components. In addition, eventual implementation of components by practitioners requires not only a demonstration of efficacy of components but the supports needed at different levels for successful implementation in natural environments (Locke et al., 2016). This involves determining who will implement each component, how often the components need to be implemented, and how much support and coaching will be needed for implementation (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Odom, Boyd, Hall, & Hume, 2010).

The present dissertation contributes to the multi-component PMI research by demonstrating positive social communication outcomes for preschool age children during extended play interactions. In addition, the multi-component PMI evaluated intervention components that may minimize ongoing adult facilitation, and explored generalization effects (Gunning, Breathnach, Holloway, McTiernan, & Malone, 2018; Whalon et al., 2015).

Peer training strategies. Reviews of peer training strategies used within the PMI intervention literature note researchers use several strategies to promote peer adherence to intervention. The majority of studies include (a) instructions, (b) modeling, (c) roleplay, (d) prompting, (e) corrective feedback, (f) visual supports, and (g) reinforcement systems, which demonstrated positive results (Gunning et al., 2018). Furthermore, the majority of studies include in-vivo training for peers with the children with ASD as well as initial training sessions. However, a limitation of these strategies is that they require ongoing adult mediation (e.g., promoting and reinforcement) during those interactions. Chapters 3 and 4 of the present dissertation evaluated the use of self-management to promote typical peer responsiveness to children with ASD. This strategy successfully increased independent social communication exchanges that occurred away from the play sessions of children with ASD and typical peers. Typically developing children aged 3 to 4 learned to be responsive social communication partners of children with ASD without prompting and reinforcement during play interactions.

This may positively impact the long-term effectiveness of PMI, as children become less dependent on adults to prompt and monitor those interactions. Additional research is needed to understand the conditions that need to be in place to promote peer interaction in natural settings.

Child specific interventions. Children with ASD struggle to acquire social communication repertoires, especially those that involve social initiations within play contexts (Thiemann-Bourque, McGuff, & Goldstein, 2017). This has been hypothesized to be due to characteristics of an autism diagnosis that involve difficulties attending to relevant social cues in the environment, as well as a tendency to perform behaviors in the same manner as were taught during treatment arrangements. Child specific intervention therefore must consider strategies that can incorporate generalization programming strategies to encourage responding across settings, people, and contexts. Chapters 2 and 4 of this dissertation explore the effects of video modeling interventions on stimulus and response generalization of acquired social communication repertoires. Video modeling is a promising intervention for promoting stimulus generalization, but response generalization outcomes are mixed. Additional research is needed to understand the specific multiple exemplar video modeling procedures that need to be in place to promote response generalization, for example, assessing mastery of scripts from video models, assessing unscripted verbalization when video models are withdrawn, and determining the adequate number of videos that children may need.

The current dissertation provides support for the combination of strategies that address the needs of children with ASD and prepare typical peers to be responsive social partners. Results of Chapter 3 indicated that teaching children with ASD to initiate social interactions was not enough to effect change in the responsiveness of typical peers. However, we did observe an increase in the frequency of initiations of children with ASD once typical peers became more responsive. In Chapter 4, teaching children with ASD to initiate and teaching typically developing children to respond resulted in a one-directional interaction between dyads, rather than a reciprocal one. These findings have important implications for the design and measurement of future multi-component PMI studies. When designing multi-component PMIs, though it may be clear that intervening with both children is necessary, what to teach each child merits further investigation. We concluded in chapter 4 that children with ASD and typical peers in our study may have required intervention that taught both initiations and responses. To capture improvements in both reciprocal initiations and responses of both children, future research may need to look more closely at social communication exchanges, particularly, the direction of interactions (i.e., who responds and who initiates).

Several reviews of social communication interventions and broader social skills intervention research have highlighted promising outcomes for individuals with ASD, but have continued to note limitations with regards to long-term effects (Bellini, Peters, Benner, & Hopf, 2007; Cappadocia & Weiss, 2011; Goldstein, Lackey, & Schneider, 2014; McConnell, 2002; Rao, Beidel, & Murray, 2008; Reichow &Volkmar 2010; White et al., 2007). The increasing concern over achieving long-term positive social outcomes has led to the design of social communication interventions that address the complex social needs of children with ASD by combining intervention strategies that align with generalization programming strategies that may lead to both stimulus and response generalization and longer treatment effects (Whalon et al., 2015). The multi-component intervention approach shows promise, as children with ASD are provided with direct intervention that may be sustained over time and across contexts by preparing typical peers to be responsive. However, additional research is needed that specifically evaluates the effects of multi-component interventions over time and across contexts.

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