Peer-Mediated Instruction and Interventions to Increase Social Skills of Children with ASD without Intellectual Impairments in Inclusive Preschool and Elementary School Settings: A Meta-Analysis

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Abstract

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Using meta-analysis, this study evaluated the rigor and quality of single-case design studies using peer-mediated instruction and interventions (PMII) to improve the social skills of participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. The study employed descriptive analysis, visual analysis, and Single-Case Analysis and Review Framework (SCARF) to evaluate the rigor and quality of 52 single-case design studies from 20 sources. Results indicated that the majority of the single-case designs demonstrated evidence of high rigor and quality with strong positive effects of PMII for participants with ASD (n = 33). Seventy-seven percent of single-case design studies demonstrated a functional relation (i.e., scores of 3 or 4) between PMII and improved social skill outcomes for participants with ASD. Results of multilevel meta-analysis model across 40 cases

showed that the overall effect of PMII on increase in social skills for participants with ASD was significant (LRRi = 1.41; SE= 0.15, $p < 0.001$). Results indicated a moderating effect of type of intervention implementer on the association between PMII and social skills for participants with ASD without intellectual impairments, $F(2, 37) = 5.33$, $p < 0.05$. Findings from this meta-analysis address the methodological rigor of single-case research using PMII to increase social skills of participants with ASD and the magnitude of intervention effects of PMII on social interaction skills of participants with ASD.

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Peer-Mediated Instruction and Interventions to Increase Social Skills of Children with ASD without Intellectual Impairments in Inclusive Preschool and Elementary School Settings: A Meta-Analysis

Chapter 1: Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder with an estimated prevalence rate of 16.8 per 1,000 (1 in 59) children eight years of age (Baio et al., 2018) and 13.4 per 1,000 children four years of age (Christensen et al., 2016). Based on the Diagnostic Statistical Manual of Mental Disorders 5th Edition (DSM-5), ASD is used as a single umbrella term for categorical subgroups of autistic disorder, childhood disintegrative disorder, pervasive developmental disorder not otherwise specified, and Asperger's syndrome (American Psychiatric Association [APA], 2013). Individuals previously diagnosed with Asperger's syndrome are diagnosed with ASD without intellectual impairments, based on the DSM-5 (Masi et al., 2017). ASD is characterized by impairments in social communication and social interaction, and restricted and repetitive behaviors (APA, 2013). Impairments in social communication and interaction are core characteristics of ASD and are collectively characterized as social skill difficulties (Kamps et al., 2015; Wolstencroft et al., 2018).

Within the educational context, an increasing number of children with ASD without intellectual impairments are educated in mainstream general education classrooms with their typically developing peers (Garrotte et al., 2017; Koegel et al., 2012; Sutton et al., 2019). Specifically, from 2001 to 2012, the percent of children with ASD who spent more than 40% of their school day in general education settings increased from 39.6% to 57.6% (Carter et al., 2017; United States Department of Education, 2014). Although there is an increase in inclusion of children with ASD without intellectual impairments in general education classrooms, children

with ASD often do not have the necessary peer-related social skills required to interact with their typically developing peers, which exposes children with ASD to complex social risks and social challenges in inclusive preschool and elementary school settings, in particular (Locke et al., 2017). For example, children with ASD between the ages of 6 to 17 have significantly fewer and lower-quality friendships and are rated lower on social networks as compared to their typically developing peers (Petrina et al., 2014). Additionally, peer-related social skill difficulties contribute to children with ASD experiencing elevated rates of bullying and victimization in inclusive preschool and elementary school settings (Roberts & Simpson, 2016; Sansosti & Sansosti, 2012; Sreckovic et al., 2014). Overall, social risks experienced by children with ASD severely impact their full participation in inclusive preschool and elementary school settings (Winchell et al., 2018).

Peer-Related Social Skill Difficulties of Children with ASD

The DSM-5 presents three primary areas of peer-related social skill difficulties among children with ASD: 1) difficulties in social emotional reciprocity (i.e., back-and-forth conversation), 2) difficulties in nonverbal communication (i.e., integrating nonverbal and verbal communication), and 3) difficulties in developing, maintaining, and understanding relationships (i.e., play, interest in peers). In addition, children with ASD show social skill impairments in perspective taking (Brundson & Harpe, 2013), social reasoning (Shulman et al., 2012), and social motivation (Chevallier et al., 2012).

In preschool and kindergarten school settings, children with ASD demonstrate difficulties initiating and responding to interpersonal interactions with peers and adults, sustaining eye contact, imaginative play, and sharing objects and interests (Waugh & Peskin, 2015). Children with ASD may have difficulties with turn taking in conversation, speech prosody, conversation

topics outside their restricted interests, and in understanding and expressing emotions (Waugh & Peskin, 2015; White et al., 2007). Moreover, children with ASD often demonstrate errors in decoding and interpreting verbal and nonverbal social cues (Webb et al., 2004). For example, children with ASD may have difficulty responding to a peer's comment, making inferences, and understanding differences between literal and figurative meanings (Dennis et al., 2001; Mendelson et al., 2016). As a result, children with ASD show deficits in their social knowledge of irony, faux pas, jokes, lies, and metaphors (Newsom & Hovanitz, 2006). Other challenges facing children with ASD include difficulties with the social skills of perspective taking and sharing affect, which are strongly related to social reciprocity and development of friendships (Gutstein & Whitney, 2002; Mendelson et al., 2016).

Peer-related social skill difficulties become more evident when children with ASD without intellectual impairments face social demands of inclusive preschool and kindergarten school settings (Locke et al., 2017). Several studies in inclusive preschool and elementary school settings highlight that children with ASD without intellectual impairments are more isolated on the playground (Corbett et al., 2014), are less likely to have reciprocal friendships (Bauminger et al., 2010), are rejected by their peers (Locke et al., 2013), and have poor quality friendships (Calder et al., 2012). While inclusive school settings provide opportunities for children with ASD to model and learn social skills from their typically developing peers (Rotheram-Fuller et al., 2010), impairments in observation and imitation limit their ability to learn social skills in inclusive school settings (Camargo et al., 2016). Therefore, consistent social interactions as a component of school-based social skill interventions are essential for children with ASD to learn social skills in inclusive school settings (Strain et al., 2011).

School-Based Social Skill Interventions for Children with ASD

Research indicates that physical proximity to typically developing peers is not enough for children with ASD to learn social skills (Strain et al., 2011). In fact, typically developing peers do not often choose children with ASD as their playmates during free play, choosing instead their peers who do not have identified disabilities (Locke et al., 2013). Therefore, while there are readily available typically developing peers to model age-appropriate social interaction skills, school-based social skill interventions are necessary to foster social skills among children with ASD in inclusive school settings (Camargo et al., 2016; Garotte et al., 2017). Additionally, school settings are fertile ground for implementing social skill interventions with children with ASD as schools provide opportunities for interaction with peers in a naturalistic setting and access to trained professionals such as teachers and psychologists (Bellini et al., 2007).

Several school-based social skill interventions for children with ASD have improved overall social skills of children with ASD in inclusive school settings (Bellini et al., 2007; Camargo et al., 2016; Garotte et al., 2017; Ledford et al., 2018; Odom et al., 2010; Reichow & Volkmar, 2010; Sutton et al., 2019; Whalon et al., 2015). School-based social skill interventions using Applied Behavioral Analysis (ABA) techniques are most commonly used and have demonstrated efficacy in increasing social skills among children with ASD without intellectual impairments (Camargo et al., 2016; Koegel et al., 2012). Elements of ABA techniques such as prompting, reinforcement, modeling, and self-monitoring have been used to increase peer interactions of children with ASD (Garfinkle & Schwartz, 2002; Jung et al., 2008; Loftin et al., 2008).

In addition, ABA has been used often to augment other behavioral intervention components (e.g., peer training, modeling/video modeling, visual supports, pivotal-response training, and naturalistic interventions; Reichow & Volkmar, 2010). For example, peer training

has been implemented to provide pivotal response treatment, visual supports, and prompting for children with ASD, thereby increasing social initiations and social responses of children with ASD toward their peers (Garfinkle & Schwartz, 2002; Kuhn et al., 2008; Nelson et al., 2007). Visual supports such as social stories, social scripts, and visual activity schedules have been used in tandem with ABA techniques to enhance social understanding and to structure social interactions of preschool-age and school-aged children with ASD (Crozier & Tincani, 2007; Ganz & Flores, 2008; Sansosti & Powell-Smith, 2008).

Although the effectiveness of behavioral intervention strategies in increasing social skills of children with ASD is well documented, most systematic reviews of social skill interventions have focused on children with ASD ages 2 to 5 (Odom et al., 2003; Reichow et al., 2008). However, as children with ASD mature and age out of eligibility for early behavioral interventions, many continue to need intervention support and services across the life span (Huntgate et al., 2019). Furthermore, treatment components for younger children with ASD are not as efficacious as for school-age children with ASD and there is a need to examine specific intervention components that effectively promote social skills for preschool and elementary school-age children with ASD (Huntgate et al., 2019). Additionally, the Individuals with Disabilities Education Act (IDEA, 2004) and the Every Student Succeeds Act (ESSA, 2015) require that schools implement evidence-based practices in the least restrictive environment to ensure effective interventions for children with ASD (Koegel et al., 2012). This requirement has increased the need to examine evidence-based social skill interventions for children with ASD in inclusive school settings.

Moreover, while most school-based social skill interventions for children with ASD are adult-mediated, the implementation of behavioral instructional strategies to promote social skills

by adults has limitations in inclusive school settings (Camargo et al., 2016). For example, adult-mediated interventions in isolation have limited efficacy as they focus solely on increasing social initiations as compared to targeting complex social communication skills (McConnell, 2002). Major limitations of adult-mediated interventions are they may increase dependence of children with ASD on adults, reduce social behaviors of children with ASD once adult support is faded, and they lack ecological validity of social skills (Hugh & Campbell, 2019; Weiss & Harris, 2001).

Peer-Mediated Instruction and Interventions (PMII) to Promote Social Skills of Children with ASD

One approach that addresses the barriers of adult-mediated social skill interventions with children with ASD is peer-mediated instruction and interventions (PMII). PMII are evidence-based strategies that consist of incorporating typically developing peers in school-based social skill interventions by teaching "typically developing peers ways to interact with and help learners with ASD acquire new social skills by increasing social opportunities within natural environments" (Wong et al., 2014, p. 76). As compared to adult-mediated social skill interventions, PMII offer unique advantages of learning social skills for children with ASD in inclusive school settings. Some advantages of PMII are: 1) since peers are the primary intervention agents, presence of several peers in schools results in more access to intervention agents (Chan et al., 2009; Rodriguez-Medina et al., 2016); 2) availability of peers as intervention agents reduces demands on teachers as sole intervention providers (Chan et al., 2009; Rodriguez-Medina et al., 2016; Watkins et al., 2015); 3) as PMII are based on the concept of social reciprocity between children with ASD and their typically developing peers, PMII foster interactions between children with ASD and their peers in inclusive school settings, thereby

increasing the number of social partners for children with ASD (Chan et al., 2009; Locke et al., 2012); 4) PMII help children with ASD to practice their social skills with multiple peer partners in naturalistic settings, thereby increasing generalization of the learned social behaviors (Chan et al., 2009; Hume & Campbell, 2019; Watkins et al., 2015; Wong et al., 2015); and 5) PMII can be incorporated in the daily school schedule, making PMII feasible and acceptable for school personnel to implement (Carter et al., 2017; Kasari et al., 2012).

Additionally, for children with ASD, PMII fit into a multi-tiered systems of support (MTSS) framework present in many schools (i.e., universal, targeted, and intensive interventions; Hammond et al., 2013). For example, peer education, a type of PMII, can be implemented within the universal tier of MTSS to improve knowledge and awareness about social skill difficulties of children with ASD (Hume & Campbell, 2019). Other PMII, such as peer networks can be implemented as targeted interventions in tier 2 of MTSS, and peer mentoring can be used as intensive intervention in tier 3 of MTSS (Hume & Campbell, 2019).

Moreover, in several systematic reviews and studies of school-based social skill interventions for children with ASD in inclusive preschool and elementary school settings, PMII have demonstrated more efficacy than adult-mediated social skill interventions (Camargo et al., 2016; Kasari et al., 2012; Whalon et al., 2015; Wong et al., 2015) and qualify as an evidence-based practice (National Autism Center [NAC], 2015; National Professional Development Center [NPDC] on Autism Spectrum Disorders, 2014; Odom et al., 2010; Reichow & Volkmar, 2010). For example, two comprehensive reviews of group and single-case design studies published from 1957 to 2007 focused on identifying empirically-based interventions for preschool and elementary children with ASD indicated that PMII were effective for targeting social communication among children with ASD (Huntgate et al., 2019; NAC, 2015; NPDC,

2014). In another systematic review, contextual variables and treatment components of social skill interventions for children with ASD across school, home, and clinical settings were examined (Ledford et al., 2018). Results indicated that social skill instruction was most effective in the presence of a specified number of peers as compared to one-on-one instruction (Ledford et al., 2018). Additionally, more improvement in social skills for children with ASD was noted when peers were social partners as compared to when teachers or parents were social partners (Ledford et al., 2018). A comparison of PMII and adult-mediated social skill intervention were examined with elementary school children with ASD using a randomized control design (Kasari et al., 2012). Results showed that the length of time alone during recess was significantly reduced for children with ASD who were in the PMII group as compared to the control group (Kasari et al., 2012). Also, results indicated that the effects of PMII were maintained at three months follow-up without additional support (Kasari et al., 2012).

Overall, due to the benefits of PMII, research has shifted away from using adults as sole intervention agents for children with ASD (Hume & Campbell, 2019; Moyle & Schumacher, 2011; Odom, 2019). Systematic reviews and studies of school-based social skill interventions for children with ASD highlight that PMII demonstrate more efficacy than adult-mediated interventions in increasing social skills of children with ASD in inclusive school settings (Camargo et al., 2016; Kasari et al., 2012; Whalon et al., 2015; Wong et al., 2015). However, to date, there is limited research on the effects of PMII in supporting the social skill development of children with ASD without intellectual impairments in inclusive preschool and kindergarten settings (Hansen et al., 2018; Hundert et al., 2014).

Given the advantages of PMII in inclusive school settings and the peer-related social demands faced by children with ASD in general education settings, it is crucial to develop PMII

strategies that promote social skills of children with ASD. Therefore, this study examined (a) extant PMII research with preschool and kindergarten children with ASD without intellectual impairments in inclusive school settings, and (b) the rigor and quality of single-case research using PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings.

Research Questions

This study aimed to add to the literature base in the use of PMII for supporting social skills of children with ASD without intellectual impairments in inclusive preschool and elementary classrooms. Research indicates that PMII meet the criteria for evidence-based practices (NAC, 2015; NPDC, 2014; Zagona & Mastergeorge, 2018), and have shown efficacy in improving social behaviors of children with ASD (see reviews of Chang & Locke, 2016; Watkins et al., 2015). However, reviews in the use of PMII to support the social skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings is limited. This study examined the extent to which PMII are useful in increasing social skills of preschool and elementary children with ASD without intellectual impairments. Therefore, the following research questions were addressed:

R1. To what extent does the evidence on the use of PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings meet the criteria for methodological rigor of quality standards of single-case research?

R2. To what extent are the overall and differential effects of PMII moderated by educational placement, intervention implementer, participant grade level, and behavioral

components of PMII in preschool and elementary children with ASD without intellectual impairment?

Chapter 2: Literature Review

Although an increasing number of children with ASD without intellectual impairments are educated in inclusive classrooms with their typically developing peers, children with ASD often struggle with the peer-related social skills necessary for the environment (Garotte et al., 2017; Koegel et al., 2012; Sutton et al., 2019). Peer-related social skill difficulties expose children with ASD to complex social risks and social challenges, impacting their full participation in inclusive preschool and elementary school settings (Locke et al., 2017; Winchell et al., 2018). Given this, school-based social skill interventions have shown efficacy in increasing targeted social skills of children with ASD (e.g., social initiations, social responses, social interactions) in inclusive school settings (Whalon et al., 2015). Among school-based social skill interventions, PMII and adult-mediated social skill interventions are recommended strategies for practitioners in inclusive school settings (Whalon et al., 2015). However, due to the unique advantages of PMII as compared to adult-mediated interventions in promoting social skills of children with ASD in inclusive school settings, current research has shifted away from focusing on adults as intervention agents for children with ASD (Hume & Campbell, 2019; Moyle & Schumacher, 2011; Odom, 2019).

The purpose of this chapter is four-fold. First, theories of peer-related social skill difficulties of children with ASD without intellectual impairments in preschool and elementary school settings are presented. Second, the social risks for children with ASD in inclusive school settings (e.g., lack of friendships and bullying) are discussed. Third, school-based social skill interventions implemented for children with ASD in inclusive school settings are reviewed. Fourth, research supporting peer-mediated social skill interventions for children with ASD without intellectual impairments is summarized.

Theories of Peer-Related Social Skill Difficulties in Children with ASD

Four theoretical frameworks explain the etiology of peer-related social skill difficulties in children with ASD without intellectual impairments in inclusive preschool and elementary school settings: 1) social cognitive theory (Bandura, 1989, Baron-Cohen et al.,1985; Birtwell et al., 2016), 2) social information processing theory (Mendelson et al., 2016), 3) executive function theory (Kimhi et al., 2014), and 4) social motivation theory (Chevallier et al., 2012). These four theoretical frameworks highlight that: 1) children with ASD without intellectual impairments experience peer-related social skill difficulties, and 2) specific peer-related social skill difficulties and challenges in social motivation impact the peer relationships of children with ASD without intellectual impairments (Mendelson et al., 2016).

Social Cognitive Theory

Social cognitive theory explains how an individual's behaviors, cognitions, and environmental experiences interact to influence social behavior (Bandura, 1989). A basic premise of social cognitive theory is that individuals learn by observing the actions of others and the results of those actions (Bandura, 1989). Social cognitive theory has been used in the context of ASD to explain how atypical social cognitive development impacts the ability of children with ASD to observe and explain the behavior of others (Birtwell et al., 2016; Senju, 2013). Specifically, the cognitive mechanisms of emotion recognition, face processing, and perspective taking play an important role in peer-related social skill difficulties in children with ASD (Mendelson et al., 2016; Senju, 2013).

Emotion recognition and face processing. Children with ASD, as compared to their typically developing peers, struggle with emotion recognition (i.e., inability to accurately identify others' facial expressions, vocal intonations, body postures, and nonverbal

communication in relation to emotional states; Harms et al., 2010; Lozier et al., 2014). A meta-analysis of 43 studies highlighted that children with ASD show impairments in identifying multiple emotional facial expressions, specifically, fear, anger and surprise, and the magnitude of emotion recognition deficits increase with age (Lozier et al., 2014). Children with ASD tend to avoid eye-to-eye gaze, and only focus on the lower part of the face (e.g., mouth) versus the upper part of the face (e.g., eyes) when drawing conclusions about emotions (Gross, 2004; Kuusikko et al., 2009). Challenges in maintaining eye-to-eye gaze can cause difficulty in emotion recognition as children with ASD look to the mouth for emotional cues rather than the eyes (Kuusikko et al., 2009). Difficulties in emotion recognition are important to consider given that typically developing children with greater emotion recognition skills are more likely to be rated higher on measures of social status and social competence by their peers and teachers (Mendelson et al., 2016).

Additionally, children with ASD tend to have difficulty reading facial expressions, matching facial expressions to verbal communication, and comprehending emotion-laden words (Rice et al., 2015). Children with ASD use various facial features to categorize and identify their peers as compared to the holistic approach used by typically developing peers (Dawson et al., 2005). For example, children with ASD tend to recognize isolated facial features and show better memory for the lower half of the face than the upper half, as compared to their typically developing peers (Dawson et al., 2005).

Perspective taking and theory of mind. Difficulty with perspective taking (i.e., ability to perceive, comprehend, and share the cognitive and emotional experiences of another person) and delays in theory of mind (ToM; Baron-Cohen et al., 1985) result in social and communication impairments of children with ASD and play a significant role in peer-related

difficulties (Baron-Cohen, 2009; Happé, 2015). ToM is defined as the cognitive ability to assign mental states (e.g., intentions) to oneself and others, comprehend that others' thoughts and perceptions are independent of one's own, and make inferences about how others perceive social situations (Premack & Woodruff, 1978). Baron-Cohen et al. (1985) were among the first researchers to hypothesize that delays in ToM result in peer-related social skill difficulties in children with ASD. ToM skills of typically developing children consolidate by age 5; in contrast, children with ASD develop the ability to recognize the intentions of other people by 7 years of age and continue to show impairments in their capacity to understand the beliefs and emotions of others until later in life (Mazza et al., 2017). Moreover, deficiencies in ToM and perspective taking skills tend to impact quality of friendships, levels of popularity, prosocial skills, affective sharing, and reciprocity in preschool and elementary children with ASD (Mendelson et al., 2016; Zakai-Mashiach & Dromi, 2017).

Challenges in perspective taking and ToM alter the social learning environments of children with ASD in preschool and elementary school settings and have been shown to be associated with the following difficulties: 1) social pragmatic abilities (i.e., social reciprocity and responsivity), 2) social play with peers, and 3) joint attention (i.e., perceptual or mental ability to formulate a common frame of reference in order to share experiences and emotions; Happé, 2015; Kimhi, 2014; Mazza et al., 2017; Mendelson et al., 2016; Mundy et al., 2017).

The downstream effects of challenges in ToM and perspective taking among children with ASD tend to impact their daily peer interactions in preschool and elementary school settings (Happé, 2015; Huang et al., 2017). In relation to difficulties in social pragmatic abilities, children with ASD have a propensity to demonstrate the following when interacting with peers: 1) disorganization of conversation discourse, 2) difficulty in identifying topics of mutual interest

and changing topics in a dynamic manner based on verbal and nonverbal cues, 3) conversations that often include personal preoccupations, 4) engaging in excessive questioning and the use of pedantic or stereotyped language, 5) difficulties in figurative language processing and overly literal interpretations of jokes, sarcasm and metaphors, 6) unusual intonation and nonverbal social gestures such as inappropriate facial expressions, poor eye contact and gaze, 7) difficulties incorporating social and contextual cues to make decisions to inform social behavior, and 8) poor social problem-solving skills and difficulty in recognizing and repairing disagreements with peers (Bauminger-Zviely et al., 2013; Huang et al., 2017; Mendeslon et al., 2016; Stefanatos & Baron, 2011).

Additionally, during social play with peers, children with ASD are likely to demonstrate challenges in sharing control, spontaneously initiating play, imitating peers' play, and in pretending and engaging in symbolic play (Godin et al., 2017; Lam & Yueng, 2012). Social play of children with ASD tends to be limited in scope and diversity, often characterized by repetitive manipulations, and lacking in pleasure and spontaneity (Godin et al., 2017). Children with ASD struggle in initiating joint attention (e.g., holding an object of interest for peer to view) and responding to joint attention (e.g., alternating gaze from an object of interest to a peer and back to the object; Gulsrud et al., 2014; Mundy et al., 2017). For children with ASD, delays in joint attention have been shown to negatively impact their abilities in the areas of sharing interest and attention with peers, using referential language, and cooperating with peers (Gulsrud et al., 2014; Mundy et al., 2017). Joint attention is a core difficulty of children with ASD and it is a significant predictor of peer engagement and prosocial behaviors during preschool and elementary (Chang et al., 2016). Thus, atypical social cognitive development has been associated with specific peer-related social skill difficulties among children with ASD such as emotion

recognition, perspective taking, social pragmatic abilities, social play, and joint attention (Mendelson et al., 2016).

Social Information Processing Theory

Social information processing theory focuses on the ability of individuals to accurately process social information (i.e., ability to understand the intents, thoughts, and feelings of others, and to select appropriate social responses; Crick & Dodge, 1994). Social information processing theory proposes that in response to a social cue, the following mechanisms are activated in individuals: 1) encoding social cues, 2) interpretation of social cues, 3) clarification of social goals, 4) social response construction, 5) social response decision, and 6) enactment of the social response (Crick & Dodge, 1994). Slow and atypical processing of these mechanisms underlies peer-related social skill difficulties among preschool and elementary children with ASD, including: 1) difficulty in participating in play (e.g., physical play with peers), 2) lack of engagement in affective sharing (e.g., shared laughter with peers), and 3) inefficient social reasoning (e.g., attributing hostile intent to peers; Birtwell et al., 2016; Mendelson et al., 2016; Plaisted, 2015; Ziv et al., 2014).

Due to slower rates of social information processing, children with ASD tend to be reliant on explicit and concrete feedback when interacting with peers and they are less likely to seek play with peers, as compared to their typically developing peers (Mendelson et al., 2016). In relation to affective sharing, a slower rate of processing speed among children with ASD results in the appearance of being less responsive to social overtures of peers, having difficulty in coordinated play, and overall lower rates of reciprocity (Mendelson et al., 2016). For children with ASD, difficulty engaging in affective sharing results in having fewer high-quality friendships and experiencing friendships as less rewarding (Mendelson et al., 2016).

Based on social information processing theory, children with ASD have a propensity to show inefficient automatic social reasoning as compared to their peers, thereby demonstrating inflexibility in complex social scenarios (e.g., disagreement with peers) and showing difficulties achieving social synchrony in peer interactions (e.g., less flexible conversation with peers; Bauminger et al., 2008; Mendelson et al., 2016). According to social information processing theory, children with ASD struggle to integrate smaller components of social information into a more cohesive, contextually appropriate, meaningful whole (Plaisted, 2015). Specifically, in ambiguous social situations, children with ASD struggle to understand intent of peers, frequently interpret actions of peers as hostile, and select aggressive responses and evaluate such responses as beneficial (Ziv et al., 2014). Moreover, a slow processing speed of emotional stimuli among children with ASD has been linked to fewer reciprocal friendships and difficulty engaging in rich and varied friendships, specifically with larger friend groups (Mendelson et al., 2016). Additionally, the social information processing theory suggests that children with ASD struggle to comprehend perspective states of peers due to their inability to catch social cues in real time (Mendelson et al., 2016).

Executive Function Theory

Executive functioning is the ability of individuals to effectively engage in attention, emotion regulation, initiation, inhibition, goal setting, planning and organization, flexibility, working memory, and self-regulation (Goldstein & Naglieri, 2014). Executive functioning has been used in the context of ASD to explain the specific peer-related social skill difficulties of children with ASD (Birtwell et al., 2016). Among children with ASD, innate difficulties in higher order cognitive skills of executive functioning impact complex social problem solving and goal-oriented social behaviors in preschool and elementary school settings (Corbett et al., 2009;

Pellicano, 2010). Children with ASD show difficulties in the executive functioning skills of inhibitory control, planning, working memory, cognitive flexibility, and generativity (Mostert-Kerckhoffs et al., 2015). Challenges with executive functioning for children with ASD are associated with difficulties in cognitive and behavioral flexibility, social orienting, attention shifting, and the ability to follow a variety of verbal and nonverbal cues during peer interactions (Kimhi et al., 2014). Difficulties in executive functioning also delay the development of ToM skills in children with ASD, thereby impacting the overall social cognitive skills of children with ASD (Kimhi et al., 2014; Pellicano, 2010).

Social Motivation Theory

A theory gaining attention for children with ASD and peer-related social skill difficulties is social motivation theory (Chevallier et al., 2012). Based on social motivation theory, peer-related social skill difficulties among children with ASD are a result of a lack of motivation for social interactions and a failure to find social interactions intrinsically rewarding (Chevallier et al., 2012; Dawson et al., 2005; Mendelson et al., 2016). The early onset impairments in social attention among children with ASD set in motion developmental processes that limit social learning opportunities, and the continued difficulties in social attention further disrupt social skill and social cognitive development (Chevallier et al., 2012; Dawson et al., 2012). Deficiencies in oxytocin and challenges in the association between social stimuli and emotional awareness contribute to decreased social motivation in children with ASD (Birtwell et al., 2016; Stavropoulos & Carver, 2013). Thus, according to social motivation theory, the lack of an internal social reward system in children with ASD results in a lack of motivation to initiate and engage in social interactions, which impairs the social cognitive development of children with ASD (Chevallier et al., 2012).

Tenets of social motivation theory highlight that children with ASD are less motivated to form friendships with peers and are also less able to fully experience the affective advantages of friendship (Chevallier et al., 2012; Mendelson et al., 2016). Difficulties in social motivation among children with ASD have been associated with the larger social-behavioral profile of ASD and impairments in specific peer-related social skills such as joint attention, face recognition, social orienting, social maintaining, emotion perception, imitation, and affective sharing (Chevallier et al., 2012; Dawson et al., 2005).

Summary of Peer-Related Social Skill Difficulties in Children with ASD

Social cognitive theory, social information processing theory, executive function theory, and social motivation theory have been used to understand the etiology of peer-related social skill difficulties of children with ASD (Birtwell et al., 2016). For example, social cognitive challenges of perspective taking are associated with difficulties in social pragmatic abilities, social play, and joint attention in children with ASD (Happé, 2015; Mazza et al., 2017; Mendelson et al., 2016). Additionally, deficiencies in social motivation contribute to difficulties in social interactions and establishing friendships among children with ASD (Chevallier et al., 2012; Mendelson et al., 2016).

Social Risks for Children with ASD in Inclusive School Settings

Children with ASD without intellectual impairments are increasingly placed in general education settings with their typically developing peers (Garotte et al., 2017; Snyder et al., 2016). Despite increased opportunities to engage with typically developing peers, children with ASD may experience high social risks in inclusive preschool and elementary school settings due to their peer-related social skill difficulties (Locke et al., 2017; Roberts & Simpson, 2016; Winchell et al., 2018). Two critical areas of social risks and problems in the early school context

that impact full participation of children with ASD without intellectual impairments in inclusive preschool and elementary school settings are: 1) limited, or lack of, friendships with peers (Chang et al., 2016; Petrina et al., 2014), and 2) frequent bullying and victimization (Sreckovic et al., 2014).

Limited or Lack of Friendships with Peers

Friendships impact the overall experience in inclusive preschool and elementary school settings for children with ASD (Calder et al., 2013). Peer-related social skill difficulties are associated with difficulties in friendships (Calder et al., 2013; Chang et al., 2016; Petrina et al., 2014). Children with ASD in preschool and elementary often experience challenges with friendship characteristics and reciprocity of friendships (Petrina et al., 2014).

Friendship characteristics. Children with ASD have fundamentally different friendships as compared to their typically developing peers (Petrina et al., 2014). Children with ASD in inclusive preschool and elementary school settings have fewer friends and meet less frequently outside of school as compared to matched typically developing peers (Chang et al., 2016; Mazurek & Kanne, 2010; Rowley et al., 2012; Zeedyk et al., 2016). In fact, children with ASD tend to have the lowest number of reported friendships of all disability groups (Rowley et al., 2012; Solish et al., 2010). Additionally, children with ASD in inclusive elementary school settings are more often on the periphery of their classroom social networks and have smaller social networks compared to their typically developing peers (Kasari et al., 2011; Locke et al., 2013). As compared to their typically developing peers, children with ASD tend to demonstrate lack of stability in friendships, low duration of friendships, and are more likely to have friends with ASD or other disabilities (Bauminger-Zviely & Agam-Ben-Artzi, 2014; Rowley et al., 2012). For example, durability of friendships in preschool children with ASD was reported by

teachers as an average of 9 months as compared to an average of over 12 months for typically developing peers (Bauminger-Zviely & Agam-Ben-Artzi, 2014). Due to the underlying peer-related social skill difficulties, children with ASD demonstrate limited ability to identify and define components of friendships, specifically affect and emotion (Calder et al., 2013). Additionally, children with ASD fail to apply knowledge about friendship qualities in shaping their own traits as a friend (Calder et al., 2013; Petrina et al., 2014). Several comparative studies indicate that children with ASD report lower levels of companionship, security, closeness and help, compared to matched typically developing peers (Calder et al., 2013; Kasari et al., 2011; Petrina et al., 2014). Moreover, children with ASD report a higher level of conflict-betrayal (e.g., telling a secret and talking behind a friend's back) as compared to their typically developing peers (Bottema-Beutel et al., 2018). Due to low quality of friendships among children with ASD, they often do not receive the same benefits of friendships as their peers without ASD (Petrina et al., 2014).

Reciprocity of friendships. Reciprocity is a key component of friendships that offers bonding and support (Petrina et al., 2014). Children with ASD in inclusive preschool and elementary school settings demonstrate significantly fewer reciprocal friendships (Chamberlain et al., 2007; Rotheram-Fuller et al., 2010). Additionally, children with ASD demonstrate misperceptions of their social involvement, as they nominate children as friends who do not consider them as within their social group (Chamberlain et al., 2007; Kasari et al., 2011; Rotheram-Fuller et al., 2010). For example, 18% of nominated friends reciprocated the friendship of elementary-age children with ASD, compared to 64% of typically developing peers from the same class (Kasari et al., 2011).

Frequent Bullying and Victimization

Bullying and victimization experiences of children with ASD have been associated with deterioration of social communication and increase in stereotypical behaviors, aggression, distractibility, sleep disorders, agitation, hyperactivity, self-injury, and loss of self-care skills (Mehtar & Mukaddes, 2011). Systematic reviews by Humphrey and Hebron (2015) and Sreckovic et al (2014) on bullying and victimization experiences among children with ASD in inclusive preschool and elementary school settings have highlighted the following areas: 1) ASD bullying and victimization conceptual framework, 2) prevalence rates, and 3) risk factors

ASD bullying and victimization conceptual framework. To understand the nature of school-based bullying of children with ASD, interaction between the social characteristics of children with ASD without intellectual impairments and their peers has been examined (Humphrey & Hebron, 2015; Klin et al., 2000). Based on this work, the nature of ASD elevates the risk of bullying and victimization experiences among children with ASD without intellectual impairments in inclusive preschool and elementary school settings (Humphrey & Hebron, 2015; Humphrey & Symes, 2011; Richard et al., 2012; Swearer et al., 2010). Children with ASD experience increased risk of bullying in inclusive preschool and elementary school settings because: 1) children with ASD are unable to recognize and respond to bullying behavior, 2) ASD can be a hidden disability and typically developing peers can fail to empathize and understand behavioral differences of children with ASD and responses to the behavioral differences by the school staff, and 3) broad school factors and supports may reduce peer interactions for children with ASD (e.g., provision of adult support in general education classroom for children with ASD can inadvertently reduce peer interactions; Humphrey & Hebron, 2015; Symes & Humphrey, 2012). Additionally, the following characteristics of ASD also increase the risk of victimization experiences among children with ASD without intellectual impairments: 1) low social status in

classrooms (e.g., few number of friendships, smaller social networks, low friendship quality, and low friendship reciprocity), and 2) perception by peers as different and deviating from peer group norms (Humphrey & Hebron, 2015; Humphrey & Symes, 2010; Zeedyk et al., 2016).

The reciprocal effects peer interaction model (REPIM; Humphrey & Symes, 2011) was developed to provide a framework for understanding how social status and peer perception culminate to produce elevated exposure to bullying and negative social outcomes (e.g., isolation and loneliness) among children with ASD (Humphrey & Symes, 2013). The model proposes a dual route mechanism that leads to negative social outcomes for children with ASD; children with ASD demonstrate peer-related social skill difficulties and typically developing peers show a general lack of awareness and understanding of ASD. A combination of the above factors results in the following: 1) reduced quality and frequency of peer interactions among children with ASD, 2) poor peer relationships and higher vulnerability to social rejection among children with ASD, 3) reduced social motivation because of negative social outcomes and further reduced opportunities for peer-related social skill development among children with ASD, and 4) for the peer group, the reduced social contact with children with ASD further limits development of awareness and understanding about ASD (Humphrey & Hebron, 2015; Humphrey & Symes, 2013).

Prevalence rates. Several studies using child, teacher, and parent reports indicate high prevalence rates of bullying and victimization experiences among children with ASD without intellectual impairments in inclusive preschool and elementary school settings (Blake et al., 2012; Chen & Schwartz, 2012; Humphrey & Hebron, 2015; Kowalski & Fedina, 2011; Little, 2002; Twyman et al., 2010; Zablotsky et al., 2013). Additionally, children with ASD in inclusive preschool and elementary school settings are victims of a range of bullying experiences (e.g.,

traditional bullying, cyber bullying, and ostracism; Kowalski & Fedina, 2011; Sreckovich et al., 2014).

Risk factors. Research indicates a link between individual and contextual factors and an increased risk of peer victimization among children with ASD in inclusive preschool and elementary school settings (Humphrey & Hebron, 2015; Sreckovich et al., 2014). Individual factors linked to the likelihood of victimization among children with ASD are: 1) severity of peer-related social skill difficulties, 2) high levels of repetitive and restrictive behaviors, 3) social vulnerability (e.g., being gullible), 4) problem behaviors (e.g., lower executive functioning predicts peer victimization), 5) internalizing mental health problems (e.g., depression and anxiety are linked to peer victimization), 6) disability status (e.g., children with ASD and co-morbid attention deficit hyperactive disorder are bullied three to four times more often than typically developing peers and children with other disabilities), 7) academic achievement (e.g., higher academic achieving children with ASD are more likely to be bullied), and 8) age (e.g., younger children with ASD are more likely to experience physical bullying and older children with ASD are more likely to experience emotional bullying and ostracism; Little, 2002; Sofronoff & Stone, 2011; Sreckovic et al., 2014; Zablotsky et al., 2013).

Additionally, the following contextual factors have been shown to increase the likelihood of peer victimization among children with ASD: 1) educational setting (e.g., children with ASD in general education classrooms are more likely to be victimized than children educated in segregated classrooms), 2) school/public transport (e.g., limited adult supervision on public transport and public schools increases the risk of peer victimization among children with ASD), 3) social support and friendships (e.g., peer support serves as a protective factor against bullying), and 4) parental mental health (e.g., higher levels of parental engagement in the school

serves as a protective factor against bullying; Hebron & Humphrey, 2014; Humphrey & Symes, 2013; Sreckovic et al., 2014; Zablotsky et al., 2013).

Summary of Social Risks for Children with ASD in Inclusive School Settings

Despite the increase in inclusive school settings for children with ASD, children with ASD without intellectual impairments face social risks of limited friendships with peers and frequent bullying and victimization, which impact their full participation in preschool and elementary school (Petrina et al., 2014; Sansosti & Sansosti, 2012; Sreckovic et al., 2014). Children with ASD have a limited number of friendships, lower-quality friendships, fewer reciprocal friendships, and difficulty identifying friendships (Calder et al., 2013; Kasari et al., 2011; Petrina et al., 2014). In addition, individual factors such as peer-related social skill difficulties among children with ASD and contextual factors (e.g., limited peer social support) contribute to high rates of bullying and victimization for children with ASD in inclusive preschool and elementary school settings (Humphrey & Hebron, 2015; Sreckovic et al., 2014). Given the social risks and peer-related social skill difficulties of children with ASD, future research should explore school-based social skill interventions that best support social inclusion of children with ASD in inclusive preschool and elementary school settings (Crossland & Dunlap, 2012; Strain et al., 2011).

School-Based Social Skill Interventions

An increasing number of children with ASD without intellectual impairments are educated in inclusive general education classrooms with their typically developing peers (Garotte et al., 2017; Koegel et al., 2012; Sutton et al., 2019). Because physical proximity to typically developing peers is generally not enough for children with ASD to learn social skills, school-based social skill interventions are necessary to foster social skills among children with ASD

(Camargo et al., 2016; Garotte et al., 2017). Several reviews examining the impact of school-based social skill interventions for children with ASD found that school-based social skill interventions improved overall social skills of children with ASD in inclusive school settings (Bellini et al., 2007; Camargo et al., 2016; Garotte et al., 2017; Ledford et al., 2018; Odom et al., 2010; Reichow & Volkmar, 2010; Sutton et al., 2019; Whalon et al., 2015).

Behavioral Principles

Studies on school-based social skill interventions for children with ASD highlight the frequent use of ABA as part of intervention techniques and intervention models (Huntgate et al., 2019; Odom et al., 2010). School-based social skill interventions using ABA techniques have demonstrated efficacy in increasing social skills among children with ASD without intellectual impairments (Camargo et al., 2016; Koegel et al., 2012). Researchers compared and converged their results with studies reviewed by National Autism Center (NAC; 2014) and National Professional Development Center (NDPC; 2015) to identify nine behavioral intervention components with demonstrated empirical support for use with children with ASD in school settings (Huntgate et al., 2019). These nine behavioral components include: *self-management* (i.e., teaching children with ASD to monitor their own social behaviors), *peer-mediated interventions* (i.e., teaching peers to initiate and sustain social interactions with children with ASD), *modeling and video modeling* (i.e., teaching children with ASD to imitate a target social behavior), *social narratives* (i.e., teaching children with ASD perspective-taking skills using written stories describing events), *scripting* (i.e., teaching children with ASD social pragmatics using verbal or written scripts), *visual supports* (i.e., teaching children with ASD to monitor social skills independently using visual supports), *technology-based intervention* (i.e., teaching children with ASD social communication using computers and technology devices), *pivotal-*

response training (i.e., targeting pivotal behaviors such as social communication, self-initiate, to improve social skills of children with ASD), and *naturalistic interventions* (i.e., teaching children with ASD functional social skills by providing motivating environment and natural reinforcers).

School-based social skill interventions for children with ASD can be categorized based on McConnell's (2002) framework: 1) *ecological interventions* (i.e., environmental or social modifications such as inclusion or social integration that promote social interactions between children with ASD and their peers), 2) *collateral skills interventions* (i.e., interventions that target related skills such as play, social participation to increase social skills of children with ASD), 3) *child-specific interventions/adult-mediated interventions* (i.e., direct instruction of social behaviors that consist of social stories, reinforcement procedures, social skills training, adult-mediated prompts, and self-monitoring to promote social skills of children with ASD), 4) *peer-mediated interventions* (i.e., training of typically developing peers to initiate and respond to social bids of children with ASD), and 5) *comprehensive interventions* (i.e., combination of two or more of the above mentioned interventions).

Most researchers have evaluated the efficacy of school-based social skill interventions using two approaches, quality examination and meta-analysis (Wang et al., 2013). Studies using quality examination evaluate school-based social skill interventions on quality indicators, such as validity of outcome, information for replication, control for confounding variables, and cause-and-effect relationship between dependent and independent variables (Wang et al., 2013). Meta-analyses focus on using statistical methods such as effect sizes to examine overall intervention outcomes and the extent to which different intervention variables account for change in effect sizes in many independent studies (Glass, 1976; Wang et al., 2013).

Previous studies have used meta-analysis to examine school-based social skill interventions for children with ASD in inclusive settings (e.g., Bellini et al., 2007; White et al., 2007). For example, Camargo et al. (2016) conducted a meta-analysis on 19 studies using single-case research and concluded that overall high effect sizes were demonstrated, specifically for children with ASD between the ages of 2 to 10 years. Results of the meta-analysis indicated no differential intervention effects according to participants' age, and the high magnitude of intervention effect was similar for children with ASD in the preschool group and the elementary group. Analysis showed that interventions were more effective when social initiations and responses were targeted separately than simultaneously. In relation to behavioral components, Camargo et al. (2016) highlighted that planned reinforcement as part of the intervention protocol moderated intervention effects and increased acquisition of social skills of children with ASD in inclusive school settings. Additionally, analysis showed that social skill interventions using prompt and reinforcement procedures without the component of modeling were just as effective when modeling was included (Camargo et al., 2016). Overall, behavioral social skill interventions implemented in inclusive preschool and elementary settings showed improvements in social skills for children with ASD (Camargo et al., 2016).

In another meta-analysis, 22 single-case design studies that targeted social initiations and responses by children with ASD, between the ages of 3 to 12 years in inclusive school settings were examined (Sutton et al., 2019). Results indicated that 20 of the 22 studies demonstrated increase in the number or duration of social initiations and responses to peers by children with ASD (Sutton et al., 2019). Analysis showed that the two studies that did not demonstrate positive outcomes used social stories/narratives as their primary intervention component. Additionally, interventions that utilized social skill training of both children with ASD and their typically

developing peers showed statistically significant increases in frequency and duration of social initiations and responses (Sutton et al., 2019). Of the 22 studies reviewed, 19 used peer-mediated interventions and researchers were the primary implementers in 13 studies (Sutton et al., 2019). Analysis showed that in 14 of the 22 studies, intervention settings were non-academic (e.g., recess; Sutton et al., 2019).

Reichow and Volkmar (2010) used a quality examination approach to examine effectiveness of social skill interventions for children with ASD in 66 studies using group designs and single-case designs. Specifically, 52 of the 66 studies (31 preschool and 21 elementary school) were conducted with children with ASD without intellectual impairments in inclusive school settings. Results showed that among preschool children with ASD (2 to 5 years), a combination of behavioral techniques including naturalistic interventions, visual supports, and peer training were most frequently used, and school was the most common treatment setting (Reichow & Volkmar, 2010). Among school age-children with ASD (6 to 12 years) peer training with visual techniques and video modeling were used commonly (Reichow & Volkmar, 2010). Specifically, social skill groups (i.e., group lessons focused on specific social skills) and video modeling for school-age children with ASD met the criteria of Reichow et al. (2008) classification of an evidence-based practice (Reichow & Volkmar, 2010).

Extending the analysis by Reichow and Volkmar (2010), studies of social skill interventions for preschoolers with ASD ages 3 to 5 years, using group and single-case design were examined (Goldstein et al., 2014). Results of the review showed that 22 studies used peer-mediated interventions, 13 used adult-mediated interventions, nine studies used a combination of adult-mediated and peer-mediated interventions, and the remaining 21 studies used comprehensive, self-monitoring, and self-modeling interventions (Goldstein et al., 2014). Based

on their analysis, overall quality of single-subject design studies was in the acceptable range or higher. However, overall quality of group design studies did not demonstrate treatment efficacy due to limitations in research design, lack of detailed description of intervention, and poor social validity measures (Goldstein et al., 2014).

Whalon et al. (2015) evaluated 37 single-case design studies of school-based social skill interventions implemented with 3 to 12-year-old children with ASD without intellectual impairments, targeting the social skills of initiations, responses, interactions, and engagement. In their analysis, results showed that adult-mediated interventions using a combination of instructional strategies such as social scripts, video modeling, self-modeling, prompting, and reinforcement were used most commonly to promote peer-related social competence (20 of 37 studies; Whalon et al., 2015). Teachers most frequently implemented adult-mediated interventions in the general education setting. Based on their review of studies, six studies used peer-mediated interventions, eight studies used comprehensive interventions, and three studies used collateral skill interventions (Whalon et al., 2015). Overall, results showed that adult-mediated interventions, peer-mediated interventions, and comprehensive interventions had moderate to strong intervention impact, suggesting use as evidence-based practices (Whalon et al., 2015).

Summary of School-Based Social Skill Intervention for Children with ASD

School-based social skill interventions in inclusive school settings have demonstrated improvement in social skills for children with ASD without intellectual impairments. Single-case research studies are used most frequently to assess the efficacy of school-based social skill interventions for children with ASD (Huntgate et al., 2019). Targeted social skills in most school-based social skill interventions include social initiations, social responses, and social

interactions (Whalon et al., 2015). Most school-based social skill interventions utilize a combination of behavioral instructional strategies such as social scripts, reinforcements, prompting, modeling, peer-mediated interventions, and adult-mediated interventions (Huntgate et al., 2019). Specifically, school-based social skill interventions using peer-mediated and adult-mediated interventions are classified as evidence-based practices and considered as recommended strategies for practitioners in the school setting (Reichow & Volkmar, 2010).

Peer-Mediated Instruction and Interventions (PMII)

As greater numbers of children with ASD are educated alongside their typically developing peers in school settings (Garotte et al., 2017; Snyder et al., 2016), typically developing peers play an important role of serving as social gatekeepers in the school setting facilitating social acceptance and inclusion of children with ASD (Bottema-Beutel & Li, 2015). Children with ASD face complex social challenges in inclusive school settings and often experience social isolation, fewer reciprocated friendships, and bullying (Campbell & Berger, 2014; Locke et al., 2013). Peer-mediated instruction and interventions (PMII) have a unique characteristic of incorporating typically developing peers in school-based social skill interventions by teaching "typically developing peers ways to interact with and help learners with ASD acquire new social skills by increasing social opportunities within natural environments" (Wong et al., 2014, p. 76). Furthermore, in inclusive school settings, PMII offer the advantage of training typically developing peers to implement social skill strategies with children with ASD, thus reducing demands on teachers as sole intervention providers (Collins et al., 2018). Additionally, PMII are versatile and can be incorporated in daily school activities, increasing their implementation feasibility in inclusive school settings for children with ASD (Watkins et al., 2015).

PMII are based on the principle of social reciprocity and consist of teaching social communication skills to both children with ASD and their typically developing peers, thus providing opportunities for natural feedback from peers, social reinforcement from peers, practice of social skills in socially relevant contexts, and promoting generalization of social skills (Kamps et al., 2014; Odom, 2019). Current forms of PMII originated from studies where typically developing peers were used as models of socially appropriate behaviors (Cooke et al., 1977) to provide prompts and reinforcements to increase social interactions with children with disabilities (Strain et al., 1977; Strain et al., 2011). These pioneering studies established that peers can be used as intervention agents to promote social skills of children with ASD in inclusive school settings.

Approaches to PMII

Odom (2019) identified three approaches of PMII that foster positive social outcomes for children with ASD in inclusive preschool and elementary school settings: 1) peer education, 2) ecological approach, and 3) direct PMII.

Peer education. This indirect approach of PMII involves promoting peer education and awareness about ASD, which in turn increases positive attitudes and social acceptance of children with ASD in the school setting (Frederickson et al., 2010). It has been noted that 40% to 50% of schools conduct peer education interventions (Frederickson et al., 2010). Previous studies have shown that peer education interventions about ASD help to improve peer knowledge, understanding, and attitudes toward ASD (Mavropoulou & Sideridis, 2014; Staniland & Byrne, 2013). For example, in a study by Campbell et al., (2019) a peer education program about ASD, Kit for Kids, was implemented in three elementary schools. Results showed that typically developing peers demonstrated gains in knowledge about ASD and positive

attitudes toward a hypothetical peer with ASD (Campbell et al., 2019). Overall, peer education interventions are a promising approach to improve attitudes toward children with ASD, thus increasing peer social relationships for children with ASD.

Ecological approach. Ecological approaches to PMII focus on identifying features, activities, and settings within an inclusive school setting that help to promote peer interactions and implementation of direct PMII for children with ASD (Odom, 2019). Studies have indicated that preschool-age children with ASD are more likely to engage with typically developing peers in settings with books or food, large groups of peers, during gross motor activities, small group activities, preferential activities, pretend play, large motor activities, and when an adult is not present (Boyd et al., 2008; Hume et al., 2019; Reszka et al., 2012). Additionally, comprehensive treatments such as the Learning Experiences and Alternative Program for Preschoolers and Their Parents (LEAP; Strain & Bovey, 2011) model and Project DATA (Developmentally Appropriate Treatment for Autism; Schwartz et al., 2013) are examples of ecological approaches to PMII where inclusive preschool environments are designed specifically to provide opportunities for children with ASD to interact with their typically developing peers, which increase social behaviors and decrease problem behaviors and symptoms of ASD.

Direct PMII. While typically developing peers serve as intervention agents in PMII, direct training of PMII approaches by an adult is crucial for the efficacy of PMII (Katz & Girolametto, 2013). Direct PMII approaches consist of explicitly training typically developing peers to prompt and reinforce specific behaviors from children with ASD, and to socially initiate interactions with children with ASD (Odom, 2019). A direct PMII approach, direct training of social skills is provided to both typically developing peers and children with ASD (Hume & Campbell, 2019). Prompting and reinforcing interventions have shown to increase frequency of

turn-taking conversations, social initiations, social responses, and duration of extended conversations among children with ASD (Harper et al., 2008; Katz & Girolametto, 2013). Additionally, peer initiation interventions have demonstrated efficacy in increasing acquisition of social communication skills, number of context related comments, socially appropriate phrases, and social interactions for children with ASD (Banda et al., 2010; Ganz & Flores, 2008; Odom, 2019).

Categories of PMII

PMII are often categorized. For the purpose of this review, five common PMII as identified by Hume and Campbell (2019) are discussed. Two of the categories of PMII, Peer Education and Direct PMII were discussed above. Other categories of PMII are: 1) Peer Tutoring/Supports, 2) Peer Modeling, and 3) Peer Networks (Hume & Campbell, 2019). Peer tutoring is defined as a strategy where children with ASD and their typically developing peers help each other to learn social skills by teaching social skills and providing frequent feedback to each other (e.g., Lunch Bunch et al., 2009). While peer tutoring has been implemented most often in academic settings, it has demonstrated direct and collateral benefits on social skills such as classroom appropriate social behaviors, social initiations, and social responses (Bowman-Perrott et al., 2014). Peer modeling involves training typically developing peers to model appropriate social behaviors in the presence of children with ASD and has been shown to improve social interactions among children with ASD in school settings in the classroom, cafeteria, and playground (Jung et al., 2008; Ledford & Wolery, 2013; Owens-DeSchryver et al., 2008). Peer networks (e.g., Remaking Recess) include a small group of typically developing peers selected to provide social engagement opportunities for children with ASD, facilitated by an adult (Gardner et al., 2014; Kamps et al., 2014; Shih et al., 2019). For example, Kamps et al.

(2014) studied peer network intervention using a randomized control group study, which included participants with ASD from kindergarten through the end of first-grade in a peer network group and in a control group (Kamps et al., 2014). Results indicated that children with ASD in the comprehensive peer network group showed increased number of social initiations during non-treatment and generalization phases as compared to the control group (Kamps et al., 2014). Also, findings showed that the total number of communicative acts were affected by the length of time children with ASD were in the peer network group (Kamps et al., 2014). Overall, peer network interventions have demonstrated effectiveness in promoting friendships and social relationships for children with ASD (Odom, 2019).

Systematic Review and Meta-Analyses of PMII

Comprehensive evaluations of school-based social skill interventions with children with ASD in inclusive school settings identify PMII as scientifically rigorous and as meeting the criteria of an evidence-based practice (Ganz et al., 2012; Kasari et al., 2012; Katz & Girolametto, 2013; NAC, 2015; NPDC, 2014; Zagona & Mastergeorge, 2018). Additionally, systematic reviews and meta-analyses have confirmed the efficacy of PMII for children with ASD in inclusive preschool and elementary school settings (Chan et al., 2009; Chang & Locke, 2016; Gunning et al., 2019; Watkins et al., 2015; Whalon et al., 2015; Zagona & Mastergeorge, 2018). For example, in a systematic review of 32 studies with preschool-age children with ASD, PMII were effective in improving peer social interactions and most studies achieved research ratings of strong or adequate based on the criteria by Reichow et al. (2008; Gunning et al., 2019). Additionally, results highlighted that peer-training procedures such as prompting, instructions, modeling, roleplay, and corrective feedback were used most commonly across studies of PMII (Whalon et al., 2015). Overall, findings indicated that preschool-age typically developing peers

learned new social skills and supported learning of social skills for children with ASD (Reichow et al., 2008). In another systematic review of 14 studies using PMII, peer initiations were the most common PMII strategy across preschool and elementary school settings (Watkins et al., 2015). Additionally, all studies utilized an additional intervention procedure such as pivotal response training (Harper et al., 2008) and scripted phrases (Ganz & Flores, 2008) in addition to PMII (Watkins et al., 2015). This is consistent with other studies that have combined PMII with pivotal response training (PRT; Boudreau et al., 2015) and other intervention components such as video-modeling and social narratives (Odom, 2019). Moreover, the review indicated that generalization and maintenance results of the PMII were associated positively with peers' characteristics of average language and social skills, regular attendance, and prior interest in interacting with children with ASD (Watkins et al., 2015).

Future Research in PMII Supporting Peer-Related Social Skills of Children with ASD

PMII are evidence-based practices to increase social skills for children with ASD (NAC, 2015; NPDC, 2014). Research in PMII supporting peer-related social skills of children with ASD is needed in preschool settings (Zagona et al., 2018). To date, only four studies in PMII have been conducted with children with ASD under age 5 (Ganz & Flores, 2008; Katz & Girolametto, 2013; Kern & Alridge, 2006; Trembath et al., 2009). In addition, results of the studies suggest that the incorporation of several components (e.g., prompts, social stories, script training) and direct PMII strategies may further support social skill outcomes for children with ASD in preschool settings (Odom, 2019; Watkins et al., 2015). By combining strategies within the PMII structure, researchers may further assist typically developing peers in the delivery of specific social skills.

In addition, there is a need for studies using PMII to include generalization and maintenance measures, given that social skill interventions are most effective when an individual can generalize new learning to other individuals, settings, and activities (Zagona et al., 2018). Previous reviews have highlighted that limited PMII have focused on social validity measures (Watkins et al., 2015; Zagona et al., 2018). Social validity data can help inform the positive developmental outcomes of PMII as well as the perspectives and experiences of the teacher participants in the study.

Summary of Peer-Mediated Instruction and Interventions

PMII provide opportunities for incorporating typically developing peers in school-based social skill interventions for children with ASD in inclusive school settings. Thereby, PMII increase generalization of social skills for children with ASD and are feasible for teachers to implement in the school setting (Watkins et al., 2015). Typically developing peers who participate in PMII evaluate their experience as a peer mediator positively (Carter et al., 2011), sustain their influence in their broader social network (Locke et al., 2012), and report positive attitudes toward children with ASD (Odom, 2019). Given the frequent lack of social motivation among children with ASD, PMII can be used as a tool to reinforce social interactions at an early age in order to develop and maintain peer relationships across elementary school and higher grades (Odom, 2019).

Statement of Purpose

Children with ASD experience overall social benefits of inclusive preschool and elementary school settings (e.g., decrease in autism symptomology, improvement in coping strategies for transition and changes in routine, and reductions in challenging behaviors; Goodall, 2012; Humphrey & Symes, 2013; Sansosti & Sansosti, 2012; Smith, 2012). Additionally,

opportunities to interact daily with typically developing peers in inclusive school settings support social skill development of children with ASD and provide an ideal ground for implementation of social skill interventions for children with ASD (Ferraioli & Harris, 2011; Roberts & Simpson, 2016; Smith, 2012).

PMII are effective in increasing social skills in inclusive preschool and kindergarten classrooms for children with ASD (Watkins et al., 2015; Zagona et al., 2018). PMII involve training typically developing peers and creating opportunities for children with ASD to engage socially with their peers across a variety of contexts and activities, which is crucial in inclusive classroom settings (Zagona et al., 2018). PMII applied to inclusive preschool and kindergarten classrooms may be particularly effective in supporting social initiations, social responses, and overall social interactions of children with ASD through peer modeling, visual supports, and prompting (Garfinkle & Schwartz, 2002; Kuhn et al., 2008; Nelson et al., 2007).

Although PMII have been identified as an evidence-based practice, continued investigation of the current applications of PMII are warranted to continue to advance the practice, to examine the design and methodology of recent studies using PMII, to identify the quality of the analytic approaches implemented in studies using PMII, and to understand the implications for future research and practice (Camargo et al., 2016; Zagona et al., 2018; Zhang & Wheeler, 2011). Furthermore, given that the Individuals with Disabilities Education Act (IDEA, 2004) and the Every Child Succeeds Act (ESSA, 2015), require schools to implement evidence-based practices in the least restrictive environment to ensure effective interventions for children with ASD, a targeted review of studies using PMII to teach social skills to children with ASD in inclusive school settings would help educators to implement scientifically-proven practices with high fidelity (Koegel et al., 2012; Watkins et al., 2015). Additionally, as a variety of strategies

are incorporated in PMII, a better appraisal of those strategies and of the context in which the interventions are applied is necessary to maximize the benefits for the students involved (Watkins et al., 2015; Zhang & Wheeler, 2011).

Quality Examination and Meta-Analyses of Peer-Mediated Instruction and Interventions

Most studies in the area of PMII for children with ASD have used single-case research design due to its flexibility in inclusive school settings and its ability to establish causal relations between intervention and target social behaviors (Huntgate et al., 2019; Reichow & Volkmar, 2010). Previous reviews have evaluated the efficacy of PMII for children with ASD using two approaches, quality examination and meta-analysis of single-subject studies (Wang et al., 2013). Studies using quality examination evaluate PMII on quality indicators, such as validity of outcome, information for replication, control for confounding variables, and cause-and-effect relationship between dependent and independent variables (Wang et al., 2013). Application of quality indicators help to enhance credibility of scientific information by identifying methodologically appropriate studies that enable recommendation for effective PMII to be used in real world settings (Kratochwill et al., 2010; Reichow et al., 2008). Furthermore, evaluation and identification of quality research allows for determinations regarding whether or not strategies incorporated in PMII can be considered evidence-based practices (Camargo et al., 2016; Horner et al., 2005).

Meta-analyses focus on using statistical methods such as effect sizes to examine overall intervention outcomes and the extent to which different intervention variables within PMII account for change in effect sizes in many independent studies (Glass, 1976; Wang et al., 2013). Meta-analyses for single-subject studies using PMII have the following advantages: 1) the aggregation of findings from a large number of single-subject studies using PMII provide a

sizeable sample to strengthen conclusions about the practical implications of PMII to practitioners; 2) as information on the intervention outcomes of PMII are taken from graphs and an unbiased synthesis of the empirical data is produced, an accurate estimation of the impact of PMII is generated; 3) the compilation of findings from studies implementing PMII identifies factors of PMII contributing to the effectiveness, so that PMII can be tailored more specifically to the unique characteristics of the situation and participants with ASD; and 4) the coding method highlights the important variables in studies using PMII and identifies gaps in the existing research literature (Zhang & Wheeler, 2011).

While there have been a number of reviews of school-based social skills interventions for children with ASD in inclusive school settings using quality examination and meta-analyses (see Bellini et al., 2007; Camargo et al., 2016; Garotte et al., 2017; Ledford et al., 2016; Reichow & Volkmar, 2010; Sutton et al., 2019; Whalon et al., 2015; White et al., 2007), two reviews have examined quality indicators of studies using PMII for children with ASD in inclusive preschool and elementary school settings (Gunning at el., 2019; Watkins et al., 2015). Understanding quality indicators of studies using PMII for children with ASD without intellectual impairments in inclusive preschool and elementary school settings is important because it helps to determine the incorporated strategies as evidence-base practices. To date two meta-analyses have examined the efficacy of PMII in increasing social skills for children with ASD (see Wang et al., 2011; Zhang & Wheeler, 2011). Wang et al. (2011) included studies of both PMII and video modeling published from 1994 to 2008, and participants' mean age was 6 years. Zhang and Wheeler (2011) focused on studies using PMII published from 1974 to 2006 that included participants with ASD across all levels of severity in home, clinic and school settings, and participants' age was under 8 years. Therefore, a comprehensive review of studies through 2020 using quality

examination and meta-analysis to evaluate the efficacy of PMII for children with ASD without intellectual impairments in inclusive preschool and elementary school settings is needed.

Additionally, reviews of PMII have demonstrated higher success when implemented with younger children as compared to adolescents, and have highlighted that specific intervention characteristics related to efficacy warrant further research to identify the participant and intervention factors that support positive outcomes in PMII (Wang et al., 2011; Zhang & Wheeler 2011). Furthermore, despite the potential advantages of PMII for preschool and elementary children with ASD without intellectual impairments, a number of questions warrant a synthesis of published PMII research for this population. For example, concerns over treatment integrity have been raised as a potential limitation associated with PMII (Chan et al., 2009). Additionally, researchers have posited that higher levels of support, training, and resources may be required in PMII with preschool-age participants (Watkins et al., 2015). Given the importance of generalization and maintenance of intervention outcomes, particularly for individuals with ASD, as well as the suggested efficacy of PMII to support these outcomes, an analysis of such findings with preschool and elementary children with ASD without intellectual impairments is needed (Camargo et al., 2016; Wang et al., 2013; Watkins et al., 2015).

Thus, the purpose of this meta-analysis was to examine the extent to which the use of PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings meet the criteria for methodological rigor of quality standards of single-case research. The second objective of this study was to examine the overall and differential effects of PMII moderated by educational placement, intervention implementer, participant age/grade level, and behavioral components of PMII. Through examination of the rigor and quality of single-case design studies, PMII are determined as

evidence-based practices, which provides valuable information to teachers and practitioners in choosing PMII strategies to improve social skills of children with ASD. However, examination of the rigor and quality are not sufficient, as they do not provide information regarding the effectiveness of specific conditions that may increase efficacy of PMII in inclusive school settings (Camargo et al., 2016; Zhang & Wheeler, 2011). As only two meta-analyses published to date in peer-reviewed journals have reviewed and aggregated individual studies using PMII to address specific aspects of PMII, teachers and practitioners are often faced with the challenging task of meeting the individual needs of children with ASD in the absence of clear guidelines regarding procedural and contextual aspects that can lead to better outcomes for children with ASD (Camargo et al., 2016; Zhang & Wheeler, 2011). Therefore, to tailor PMII more specifically to the unique characteristics of children with ASD it is necessary to determine differential effects of PMII and provide teachers and practitioners with information regarding the effectiveness of PMII according to potential moderators such as participant characteristics, intervention variables, and implementation procedures (Camargo et al., 2016; Zhang & Wheeler, 2011). To fill these gaps in the literature, this study utilized meta-analytic techniques that allowed aggregation of effects across studies to determine differential outcomes related to participant educational placement setting and intervention implementer. Additionally, differential effects that occurred based on participant age/grade level were analyzed. Finally, the analysis consisted of the behavioral components used in PMII as a potential moderator for the magnitude of change that occurred with the implementation of PMII to improve social interaction skills of children with ASD in inclusive preschool and elementary school settings.

Chapter 3: Method

Inclusion and Exclusion Criteria

Articles were included in this meta-analysis if they met the following criteria: 1) target participants had a medical diagnosis of autism spectrum disorder (ASD) or asperger's syndrome or autistic disorder or pervasive developmental disorder not otherwise specified (PDD-NOS) or target participants met eligibility criteria for special education services in their school district under the category of autism, 2) all children with ASD had cognitive functioning in the average to above average range based on authors' descriptions of cognitive functioning (e.g., authors reported participants with ASD had cognitive functioning in the average to above average range) or participants with ASD were reported to have standard scores of above 70 on standardized intelligence tests (Laushey & Heflin, 2009). Inclusion criteria on cognitive functioning were based on prior literature that showed children with ASD without intellectual impairments or high functioning autism are generally set apart from children with autism based on intelligent quotient (IQ) scores (M = 100, SD = 15; Laushey & Heflin, 2009). Previous research has shown that children with ASD with IQ scores above 70 are described as having ASD without intellectual impairments or high functioning autism (Carpenter et al., 2009), 3) all children with ASD were in a general education setting for at least 60% or more of the school day, 4) all children with ASD were enrolled in inclusive preschool and elementary school settings, 5) PMII were used to improve the social interaction skills of children diagnosed with ASD, 6) PMII took place in inclusive preschool and elementary school settings in which children with ASD shared learning contexts and activities with typically developing peers (i.e., studies that took place in a self-contained special education class were excluded), and 7) typically developing peers served as the intervention agents and PMII included an active peer support or training component.

Furthermore, at least one dependent variable in the study included a direct measure of social interaction involving an initiation and/or response between a participant with ASD and at least one peer without ASD. An *initiation* consisted of verbal or nonverbal behaviors produced by a participant and directed toward a peer for the purpose of 1) beginning or maintaining a conversation, 2) beginning a joint activity, or 3) conversing during an ongoing joint activity (adapted from Watkins et al., 2019). A *response* included verbal or nonverbal behaviors produced by a participant for the purpose of 1) answering an initiation made by a peer, 2) maintaining a joint activity with a peer, or 3) demonstrating understanding of an initiation made by a peer (Watkins et al., 2019). Finally, the study used a single-case design with at least three opportunities to demonstrate an effect such that a functional relation could be identified (i.e., three potential demonstrations). Studies that did not utilize a single-case research design (e.g., group comparison design) were excluded. A study was not included in the meta-analysis if it met any of the exclusion criteria as outlined in Appendix A.

Identification of Studies

The current study involved a systematic analysis of studies that focused on the use of PMII to increase social interaction skills of preschool and elementary children with ASD without intellectual impairments in inclusive environments. To identify studies for this meta-analysis, a search was conducted in May, 2020 by the author using the following databases: EBSCOhost, Education Resources Information Center (ERIC), PsycARTICLES, PsycINFO, ProQuest Dissertations and Theses, and Web of Science. A combination of terms was used in the database searches: 1) “autism*” or “Asperger” or “high-functioning autism,” 2) ‘‘peer mediat*” or ‘‘peer training’’ or ‘‘peer model*” or ‘‘peer group’’ or “peer socialization” or ‘‘peer support” or “peer network” or “peer tutor*” or “”buddy system,” 3) ‘‘social skills’’ or “social skills training” or

"social behavior" or "social development" or "social interaction" or "communication skills" or "play" or "friendship" or "friends" or "peer relations," and 4) "elementary" or "elementary school students" or "elementary education" or "preschool" or "kindergarten" or "early childhood." The total number of combined keyword sets was 1,620 (3*9*10*6). The search included published peer-reviewed studies and gray literature written in English accessed through library searches so that all relevant evidence was used to interpret findings and draw conclusions (Ledford & Pustejovsky, n.d.). The search for published and unpublished studies was extended through 2020. In order to identify any relevant studies missed by electronic search, ancestry searches through the reference lists of studies meeting inclusion criteria were conducted. The search process resulted in 2,541 sources.

To identify sources that may not have been indexed in the original searches due to recent publication, two searches of sources published in 2019 or 2020 were conducted. First, given the nature of the meta-analysis and journals included in previous quality examination and meta-analyses of PMII by Gunning et al. (2019), Watkins et al. (2015) and Zhang and Wheeler (2011), six journals (i.e., *Journal of Autism and Developmental Disorders, Journal of Applied Behavior Analysis, Journal of Early Intervention, Focus on Autism and Other Developmental Disabilities, Journal of School Psychology, and Topics in Early Childhood Special Education)* relevant to early childhood, autism, or school-based social skill interventions were hand-searched for the years 2019 or 2020, including articles published online and not yet assigned to an issue. Second, a search using Google Scholar for sources published "since 2019" was conducted. The second search yielded 25 additional articles. The identification of sources using electronic databases and hand-searching of journals resulted in 1,447 sources that were duplicates. After duplicates were removed, 1,119 abstracts and titles were screened against the inclusion and exclusion criteria.

The screening resulted in the identification of 266 articles for inclusion. The full text of each article was then screened against the inclusion criteria, which resulted in the identification of 26 articles. Of these articles, 4 were excluded because they used non-concurrent multiple baseline designs and 2 were excluded because the studies failed to show at least three demonstrations of intervention effect, which is recommended by What Works Clearinghouse (WWC) to infer a functional relation between PMII and the acquisition of social skills (Kratochwill et al., 2013). In total, 20 studies were included in this meta-analysis. The method of the search process in this meta-analysis was aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; The PRISMA Group, 2009). Appendix B depicts the PRISMA flowchart for the search process.

Inter-Rater Agreement for Inclusion Criteria

A research assistant screened 40% of the included articles against the inclusion criteria (Camargo et al., 2016). Each article was randomly selected and analyzed to determine if all criteria were met for inclusion. Inter-rater agreement was calculated by dividing the number of agreements regarding inclusion of an article by the number of agreements plus disagreements between raters and multiplying it by 100. The inter-rater agreement was 100%. Appendix C presents the inclusion criteria and reliability form, which was used by the research assistant.

Descriptive Coding

Descriptive data for each study included in the meta-analysis were coded in the following domains: 1) general information, 2) participant characteristics, 3) inclusion criteria for participants, 4) type of inclusive setting and adult facilitators, 5) dependent variables, 6) peer-mediated intervention training, intervention procedures, and measurement, and 7) social validity. These domains were selected based on past research (Ledford & Pustejovsky, n.d.). General

information included publication year, status (i.e., peer-reviewed or not), and design type. Type of inclusive setting included training context and measurement context (e.g., classroom, playground). Information about adult facilitators (e.g., teacher, researcher), characteristics of participants with ASD and their typically developing peers (e.g., total number, gender, age, race/ethnicity, and the criteria by which typically developing peers were chosen to implement the intervention) were included. Each dependent variable in the study was coded; information included total number of dependent variables per study, behavior category (e.g., social initiations, social responses), and recording system (e.g., interval, count). For peer-mediated intervention training, codes were subdivided into three different types of PMII including prompting and reinforcing, peer initiation, and peer modeling (Odom & Strain, 1984). Prompting and reinforcing referred to interventions in which peers were taught explicitly to prompt and/or reinforce a specific response or behavior from participants. Peer initiation referred to interventions in which peers were taught specifically to initiate interaction with participants. Additionally, training participants (e.g., peers only, buddy groups, whole class) and dosage of PMII (e.g., number and duration of training sessions) was coded. For intervention procedures, any other intervention strategies used in addition to PMII were also coded (e.g., social stories, pivotal response training). Social validity measures within each study were coded if present (e.g., whether data were reported regarding acceptability of participants or stakeholders, normative comparisons).

Rigor Coding

The Single-Case Analysis and Review Framework (SCARF; Ledford et al., 2016) was used to evaluate the rigor and quality of the single-case design studies included in this meta-analysis. Designs were evaluated if at least three demonstrations of basic effect were present.

Each single-case design within an article was evaluated separately (e.g., an article with three participants in a multiple-baseline design across participants design was evaluated as one design; an article with three participants in three A-B-A-B designs was evaluated as three separate designs). Single-case designs were scored on a scale of 0 - 4 (defined below) by responding to several yes/no questions across 10 categories. The 10 categories in SCARF are divided into rigor (e.g., data sufficiency, reliability, and fidelity) and quality/breadth of measurement (e.g., social validity, ecological validity, participant descriptions, condition descriptions, dependent variables, maintenance, and generalization; Ledford et al., 2016). For example, a score of 0 was recorded for reliability if reliability data were not provided. A score of 1 was recorded if reliability data were not provided for at least 20% of sessions in both baseline and intervention conditions. A score of 2 was recorded if reliability was reported for 20% or more sessions in each condition. A score of 3 was recorded if at least 80% inter-rater agreement was reported and a score of 2 was met. A score of 4 was recorded if requirements for a score of 3 were met and data collectors were blind to study condition. Based on SCARF, scores above 2 are adequate (Ledford et al., 2016). In addition to calculating total rigor and quality scores, outcomes were assessed separately for primary, generalized, and maintained effects on a 0 - 4 scale. Results for primary outcomes were presented on a scatterplot with average design quality and rigor on the x-axis and the outcomes score on the y-axis. Results for generalized and maintained outcomes were presented in a table format. See Appendix D for detailed description of the SCARF coding procedure.

Inter-Rater Agreement for Descriptive and Rigor Coding

The author coded descriptive data and developed a summary for each study. A research assistant inspected the author's summaries in 30% of the studies using a checklist similar to one used by Rispoli et al. (2010). The checklist included 10 questions regarding the various details

coded for each study: 1) general information, 2) participant characteristics, 3) inclusion criteria for participants, 4) type of inclusive setting and adult facilitators, 5) dependent variables, 6) peer-mediated intervention training, intervention procedures and measurement, and 7) social validity. Inter-rater agreement was calculated by dividing the number of agreements regarding accuracy of the summaries by the number of agreements plus disagreements between raters and multiplying by 100. The inter-rater agreement on descriptive coding was 100%. Appendix E presents the descriptive coding reliability checklist. For rigor coding, the author scored each study using a scale of 0 - 4 across the 10 categories in SCARF. A research assistant scored 30% of the studies. Inter-rater agreement was calculated by dividing the number of agreements on the scores across 10 categories in SCARF by the number of agreements plus disagreements between raters and multiplying by 100. Inter-rater agreement of 100% agreement was obtained between the researcher and the research assistant. Appendix F presents the rigor coding reliability checklist.

Visual Analysis

Visual analysis was conducted for all social skill behaviors across studies. A systematic visual comparison of data was conducted within and across conditions to evaluate evidence and magnitude of PMII effects for social behaviors among children with ASD (Gast & Ledford, 2018; Kratochwill et al., 2013). Data points of the social behaviors within and between conditions were analyzed visually using six key features: 1) level (i.e., mean behavior recorded during the condition), 2) trend (i.e., slope or the systematic increase or decrease in behaviors over time), 3) variability (i.e., fluctuation of behaviors around the mean or slope during a condition), 4) immediacy of effect (i.e., level of change between the last three data points in one condition and the first three data points in the adjacent condition), 5) proportion of overlapping

data points in adjacent phases, and 6) consistency of behaviors across intervention and non-intervention conditions (Kratochwill et al., 2013). Presence of functional relations between PMII and social behaviors for children with ASD were evaluated on a 0 - 4 scale, consistent with the SCARF procedure. A score of 0 indicated no behavior change; scores of 1 - 2 indicated inconsistent behavior change with one or more non-effects, and scores of 3 - 4 indicated consistent behavior change with no non-effects (Ledford et al., 2016). Generally, scores of 3 and 4 are consistent with determinations that functional relations exist (Ledford et al., 2016).

Effect Sizes and Meta-Analysis

For the purposes of effect size calculation, one dependent variable for each participant in each study was selected. Based on previous meta-analyses on PMII to improve social skills for children with ASD, most studies measured social interaction skills (Zhang & Wheeler, 2011). Therefore, for the current meta-analysis, dependent variables categorized as broad social interaction (e.g., initiation and response between a participant with ASD and at least one peer without ASD) were used to estimate the effect of PMII for children with ASD in inclusive preschool and elementary school settings. For studies that measured more than one dependent variable, the outcome that was categorized most reasonably as broad social interaction was selected for calculating effect size.

Log Response Ratio (LRR)

While there has been significant discussion and disagreement regarding the best statistical procedures for effect size interpretation in single-case research (Pustejovsky, 2018), one effect size index useful for describing the magnitude of functional relations on behavioral measures is the log response ratio (LRR; Pustejovsky, 2019). In single-case designs, LRR quantifies functional relations in terms of the natural logarithm of the proportionate change

between phases in the level of the outcome (Pustejovsky, 2019). As compared to other non-parametric effect size measures (e.g., Tau-U; Kratochwill et al., 2013; Non-overlap of All Pairs analysis; Parker et al., 2011), LRR has several advantages for meta-analysis of single-case design studies with behavioral outcome measures (Pustejovsky, 2019). Some advantages are: 1) LRR is connected directly to the metric of percentage change, which is a familiar interpretable conceptualization of effect size across behavioral researchers used to quantify intervention impacts; 2) magnitude of LRR depends only on the mean levels of the outcome in each phase; therefore, LRR is relatively insensitive to how the outcome variable was measured, such as different recording systems (e.g., continuous recording, momentary time sampling) or different observation lengths; and 3) LRR effect sizes based on different dimensional characteristics of a behavior can be compared directly. For example, a collection of single-case design studies might include studies that use event recording to measure frequency of social behaviors and other studies that use momentary time sampling to measure estimate of social behavior. LRR effect sizes can be used to compare intervention effects on behavioral frequency to intervention effects on percentage duration or in combining results across both behavioral dimensions (Pustejovsky, 2019). There are two distinct ways that the LRR can be applied to proportion outcomes for meta-analysis of single-case design studies, depending on whether the behaviors are expected to increase during intervention conditions (LRR-i) or whether behaviors are expected to decrease during intervention conditions (LRR-d). Since social interaction skills were expected to improve during intervention conditions in the present meta-analysis, LRR-i was used to measure the effect size estimates.

Data Extraction

Prior to calculation of effect sizes, the graphs from each study in the review were digitized with GetData software (Retrieved from http://getdata-graph-digitizer.com/download.php), which translated the data points into readable raw values. The raw data obtained from the x and y axes of the line graphs were saved in an Excel document for further analysis. Similar software programs for data extraction have been used in previous research allowing for an accurate analysis of effects sizes (Camargo et al., 2016; Parker et al., 2007; Vannest et al., 2011). Obtained raw values were corrected under the following conditions: 1) if the value was not possible given the range of values (e.g., -0.1 or 100.1 on a percentage scale), the obtained value was corrected to the nearest possible value (e.g., 0 or 100), and 2) if there were 21 or fewer possible values, obtained values were rounded to the nearest possible value (Ledford & Pustejovsky, n.d). For example, if there were 20 intervals per session, with possible values of 0, 5 or 10, a value of 4.9 was corrected to 5.

Phase Contrasts and Effect Sizes

To calculate LRR effect size estimates between baseline and intervention phases, SingleCaseES package (Pustejovsky & Swan, 2018) was used. In studies with a multiple baseline or probe design, LRR estimate from a single A-B comparison was calculated for each participant with ASD. For studies utilizing more than one intervention phase (e.g., ABC), average effect was calculated between A x B and A x C. Average effects were estimated by calculating separate LRR values for each A-B comparison and then taking the arithmetic mean; standard errors for the average effects were calculated.

Meta-Analysis

LRR effect sizes were synthesized using multi-level random effects meta-analysis model (Pustejovsky, 2018). Multi-level meta-analysis models include overall average effect size and the

variance components, which quantify the degree to which effect sizes are heterogenous across participants and across studies (Pustejovsky, 2018). To aid interpretation of the meta-analysis results, overall average LRR effect size was translated to the metric of percentage change and both LRR metric and percentage change results were reported. For the LRR metric, the estimated average effect, the corresponding standard error, and a 95% confidence interval for the average effect were reported. Heterogeneity estimates of between-study and within-study variances were reported. All calculations were conducted in R statistical environment (R Core Team, 2018), using the metafor package for meta-analysis (Pustejovsky, 2019; Viechtbauer, 2010).

Moderator Variables and Meta-Regression

Moderator variables typically impact the effects that independent variables have on the dependent variable (Holmbeck, 1997). Thus, effect size analysis of potential moderators can identify specific contextual factors in which interventions are effective or ineffective, detecting for whom and under what conditions an intervention yields meaningful acquisition of the target social skill (Bellini et al., 2007). Once studies were summarized and overall average effect sizes were calculated, potential moderators were coded for each study including: 1) educational placement setting (e.g., general education and general education in combination with special education), 2) intervention implementer (e.g., researcher, teacher, and researcher in combination with school staff), 3) participant age/grade level (e.g., lower elementary, 6-9 years and upper elementary, 10-12 years), and 4) behavioral components utilized in PMII (e.g., peer supports and scripting). Judgments about coding and moderator categories were made on the basis of information provided in the published articles.

Inter-Rater Agreement for Moderator Coding

A research assistant independently coded 33% of the studies randomly selected for each of the identified moderators. Inter-rater agreement was calculated by using the exact agreement approach (agreements/ [agreements + disagreements] * 100) on codes on the moderator coding sheet. Inter-rater agreement of 100% agreement was obtained between the author and the research assistant. Appendix G presents the moderator coding sheet.

Meta-Regression

In addition to calculating the overall average effect size and variance components, a meta-regression model was implemented to examine whether variables such as participant educational setting (e.g., general education, general education and special education), intervention implementer (e.g., researcher, teacher, and researcher and school staff), participant age/grade level (e.g., lower elementary, 6 - 9 years and upper elementary, 10 - 12 years), and behavioral components utilized in PMII (e.g., peer supports, scripting) moderated the magnitude of intervention effects across studies. An omnibus test was performed to determine whether a moderating effect of one or more variables included in the meta-regression model was statistically significant. Results of the omnibus test, the estimated effect sizes, the corresponding standard error, and a 95% confidence interval for the average effect were reported. All calculations were conducted in R statistical environment (R Core Team, 2018), using the metafor package for meta-regression (Pustejovsky, 2019; Viechtbauer, 2010).

Data Analysis

RQ 1. To what extent does the evidence on the use of PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings meet the criteria for methodological rigor of quality standards of single-case research?

Descriptive analysis of each of the included studies using PMII for children with ASD was summarized. Studies were summarized in the following domains: 1) general information, 2) participant characteristics, 3) inclusion criteria for participants, 4) type of inclusive setting and adult facilitators, 5) dependent variables, 6) peer-mediated intervention training, intervention procedures and measurement, and 7) social validity. Rigor and quality analysis using the SCARF was conducted on each single-case design within an article separately. Overall, 52 single-case designs across 20 articles were evaluated using the SCARF. The average rigor and quality scores across single-case designs was presented in scatterplots with average design rigor and quality on the x-axis and the outcomes score (i.e., primary) on the y-axis. Studies that obtained scores/data points farther along the x-axis, were interpreted as having higher rigor and quality. Additionally, studies that obtained scores/data points farther along the y-axis, were interpreted as having stronger positive effects of the PMII. All data across studies were plotted on the scatterplot and the SCARF guidelines for detecting the presence of a functional relation was followed. Ratings on the SCARF are presented in Table 1. Based on the results, it was determined whether PMII to teach social skills for children with ASD without intellectual impairments in inclusive preschool and elementary school settings met the criteria for methodological rigor and evidence-base practices.

RQ 2. To what extent are the overall and differential effects of PMII moderated by educational placement, intervention implementer, participant grade level, and behavioral components of intervention?

A multilevel meta-analysis model was used to yield an overall average magnitude of intervention effects and the degree of heterogeneity of results across studies (Cheung, 2014). LRR effect sizes from single-case designs describe results at the level of the individual case

rather than at the level of the study (Pustejovsky, 2018). Studies that include multiple cases can thus contribute to multiple effect size estimates. Since effect size estimates for individual cases are nested within studies, a multilevel meta-analysis model was used to synthesize effect size estimates from single case designs (Cheung, 2014; Pustejovsky, 2018). A multilevel meta-analysis model was used to examine differences in effect sizes between studies (i.e., between-study heterogeneity) and differences in effect sizes within studies (i.e., within-study heterogeneity). Additionally, to control for Type I error rates, the Knapp and Hartung (2003) adjustment was applied and test results and confidence intervals were based on the *t*-distribution (Assink & Wibbelink, 2016). To determine the significance of the heterogeneity in effect sizes, two separate log-likelihood-ratio tests were performed. The estimated overall average LRR effect size and its confidence interval was translated into metric change using Pustejovsky's formula (2018). Data analysis was conducted in R statistical environment (R Core Team, 2018), using the metafor package (Pustejovsky, 2019; Viechtbauer, 2010). Complete raw data and computer code for replicating all calculations are provided in Appendix H.

To examine whether participant and intervention components moderated the magnitude of effects, a meta-regression model with an omnibus test was performed. The null hypothesis in the omnibus test stated that all regression coefficients (i.e., betas) were equal to zero, and the alternative hypothesis stated that at least one of the regression coefficients was not equal to zero. Results of the omnibus test are reported in Table 7. Additionally, LRR effect sizes, standard errors, and confidence intervals for levels of participants' educational placement, intervention implementer, age/grade level, and PMII behavioral components were calculated. Effect sizes of moderator variables were used to assess a statistically significant difference between the levels of moderator variables on PMII. Data analysis was conducted in R statistical environment (R Core

Team, 2018), using the metafor package (Pustejovsky, 2019; Viechtbauer, 2010). Complete raw data and computer code for replicating all calculations are provided in Appendix I.

Chapter 4: Results

Rigor and quality analysis using the SCARF framework was conducted on 52 single-case designs across 20 included articles. Visual analysis was conducted for social skill behaviors in 52 single-case designs from 20 sources. Additionally, the SCARF rating scale of 0 - 4 was used to evaluate the presence of functional relations between PMII and social skill behaviors for participants with ASD.

LRR effect size estimates between baseline and intervention phases were calculated for studies that measured broad social interaction as a dependent variable (n = 14). One study did not demonstrate large LRR effect size estimate and was not included in the meta-analysis based on the exclusion criteria in a previous study (Ledford & Pustejovsky, n.d.). Forty cases across 13 studies demonstrated large LRR effect size estimates and were synthesized using a multi-level random effects meta-analysis model. Overall, average LRR effect size estimates, standard errors, percentage change results, and confidence intervals for 40 cases across 13 studies are presented below. In addition, results from the meta-regression model that included separate intercepts for each combination of the moderators were calculated.

Descriptive Analysis

Across 20 sources, 18 were published peer-reviewed articles and two were dissertation studies (i.e., duplicates of dissertation studies were excluded in the dataset). Publication year of sources included in this meta-analysis ranged from 1992 to 2019. Of the 20 sources, 15 used multiple-baseline designs. Multiple-baseline design across participants was used most frequently (n = 10) and two sources used multiple-baseline design across behaviors. In addition, multiple-probe design across participants was used (n = 2), with one source using a multiple-probe design across settings. Other designs, such as withdrawal of intervention (n = 4, i.e., ABAB) and

changing criterion design (*n* =1), were also utilized in the sources. Researchers in 12 of the 20 sources measured social skills in both participants with ASD and typically developing peer participants; seven sources included measurement of social skills in only the participants with ASD and one source included measurement of social skills in participants with ASD and adult facilitators.

Participants

Across 20 sources, 38% of participants were children with ASD and 62% were typically developing peer participants. Of the 20 sources, 20% of studies included peers in the whole classroom as typically developing peer participants and one study did not report the number of typically developing peer participants. When reported individually, the average age was 91 months for participants with ASD (range = 48 – 150 months; reported in 19 of 20 sources) and 78 months for typically developing peer participants (range = 48 – 121 months; reported in 9 of 20 sources). When gender was reported, most participants with ASD (*n* = 49; 89%) and typically developing peer participants (*n* = 40; 53%) were reported to be male. Race was unreported for 55% of participants with ASD and 78% of typically developing peer participants. When reported individually, 17 participants with ASD and 7 typically developing peer participants were identified as White, 6 participants with ASD and 4 typically developing peer participants were identified as Black, one participant with ASD was identified as Hispanic and one typically developing peer participant was identified as multiracial. In addition to the diagnosis of ASD, 7 participants with ASD had a diagnosis of speech language impairment and one participant was identified with a vision impairment. Full scale IQ scores were reported for 36% of participants with ASD and the average IQ was 96 (range = 70-114). Of participants with ASD, 38% were

integrated fully in the general education setting and did not receive any special education services.

Inclusion Criteria

Inclusion criteria for participants with ASD were reported in 9 of 20 sources. All the 9 sources included the following inclusion criteria for participants with ASD: ASD diagnosis, minimum language, social and play skills, age/grade levels, and consent. Additional inclusion criteria for participants with ASD listed in two of the nine sources included, having educational placement in the inclusive classroom for more than 50% of the school day and not receiving any current social skill interventions. Inclusion criteria for typically developing peer participants was reported in 13 of the 20 sources and varied widely across studies. When reported, the most common criteria were adequate social skills (n = 11), cognitive skills (n = 7), similar interests or likely to interact with participants with ASD (n = 6), adequate communication skills (n = 6), compliance (n = 6), good attendance (n = 6) and same class or age as participant with ASD (n = 4). In addition, no history of playing with the participant with ASD (n = 1) or the opportunity to boost self-concept by being a peer model (n = 1) were reported.

Setting and Adult Facilitators

The 20 studies were conducted in settings in which participants with ASD were included with typically developing peer participants. Eighteen studies utilized a single setting and two studies utilized a combination of settings (i.e., general education classroom and playground). Of the 18 sources that utilized a single setting, PMII were typically implemented in inclusive general education classrooms (n = 15), in a schoolyard or playground (n = 2), or in a cafeteria (n = 1). Fifteen studies took place in elementary school settings and five studies took place in preschool settings. PMII were facilitated by researchers alone in 11 studies and by general

education teachers alone in four studies. In five studies, PMII were facilitated by a combination of researchers, general education teachers, special education teachers, paraprofessionals, and speech language pathologists.

Dependent Variables

Sources included measurement of 1 to 7 different social skill dependent variables, for a total of 54 different social skill variables across studies, in 52 different experimental designs. Twelve of the 20 studies reported at least one social skill outcome for both participants with ASD and typically developing peer participants. The majority of the behaviors were demonstrated by participants with ASD (n = 35), while others (n = 19) were demonstrated by typically developing peer participants or by both participants and non-participants (e.g., children in classrooms who were not assigned as "buddies," n = 2). Broad social interaction was the most common variable type (n = 19). Interval was the most common measurement system (n = 21) with count used in 20 designs (see Table 1 for the variable type and measurement system for each variable, by experimental design for participants with ASD).

Training and Measurement Sessions

All studies included two components: 1) training, during which participants were taught social skill strategies, and 2) measurement sessions, during which social skill outcomes were measured. Authors of 15 sources reported training participants with ASD and typically developing peer participants together on social skills. Other authors reported whole-group training provided to all children in the classroom (n = 2), whole-group training plus buddy-group training (i.e., triads or pairs of typically developing peer participants plus participants with ASD; n = 2), and training only for typically developing peer participants, with no training for

participants with ASD (*n* = 1). Three studies reported separate training provided to school personnel on implementing social skill lessons with participants.

During training, a variety of peer-mediated intervention strategies were used by adult facilitators. Peer initiation in combination with prompting and reinforcing procedures were the most commonly applied PMII, utilized in 13 sources. Initiations plus prompting and reinforcing procedures consisted of preschool aged, typically developing peer participants engaging with participants with ASD in joint play activities and elementary aged, typically developing peers initiating interaction during games and activities during recess, while receiving prompts and reinforcers from adult facilitators (Ganz & Flores, 2008; Katz & Girolametto, 2013; Mason et al., 2013; Owen-DeSchryver et al., 2008). Typically developing peer participants were also taught to naturally reinforce social interactions with participants with ASD by responding to participants' initiations in conversation and play (Loftin et al., 2008). Peer modeling was a peer-mediated intervention strategy used in combination with peer initiation, prompting, and reinforcing procedures in 10 studies. Other studies utilized peer-mediated intervention strategies such as peer supports plus prompting and reinforcing procedures (*n* = 4) and peer networks in combination with peer initiation, prompting, and reinforcing procedures (*n* = 2). The majority of studies utilized an additional behavioral component such as scripting (*n* = 4), naturalistic interventions (*n* = 3), visual supports (*n* = 2), and social narratives (*n* = 1) in conjunction with PMII. Utilization of pivotal response training, self-management, and technology-based interventions in conjunction with PMII and the above behavioral components were reported in 10 studies.

In reporting sources, the mean and median total number of training sessions with child participants was 5 (range = 1 – 12) and school personnel was 1.5 (range = 1 – 2). When reported by authors, the duration per session ranged from 10 to 45 min. When both number and duration

of sessions were reported, the mean training time was 122 min (range = 28 – 270 min; when a range was reported by a source, the midpoint was used to calculate the average; when only a maximum was reported, the source was excluded from calculation). There was an average of 9 measurement sessions per intervention (average range across sources = 5 – 16), for a total duration of 120 minutes.

Social Validity

Most (*n* = 12) sources included at least one measure of social validity. Three sources reported data regarding the acceptability of PMII by non-implementing stakeholders. Data were reported regarding the acceptability of PMII by adult facilitators (*n* = 3) and by child participants (*n* = 1). One source reported data regarding the acceptability of PMII by both, non-implementing stakeholders and adult facilitators. Data were reported regarding the acceptability of PMII by non-implementing stakeholders, adult facilitators, and child participants in one source. Two sources used normative comparison data to compare social skills of participants with ASD with typically developing peers. In one source, secondary raters were used to assess social skill outcomes of participants with ASD via video. All social validity data were positive and PMII were reported as resulting in favorable outcomes.

Rigor and Quality Analysis

The average overall rigor and quality score across 52 single-case designs from 20 studies was 2.4 (possible range 0 – 4; actual range 1.7 – 3.2) and the average primary outcome score was 3 (possible range 0 – 4; actual range 1 – 4); see Table 2 for rigor and quality analysis data and Figure 1 for a visual depiction of rigor and quality analysis and primary outcomes. The majority of single-case designs demonstrated evidence of high rigor and quality with strong positive effects of PMII for participants with ASD in inclusive preschool and elementary school settings

(*n* = 33). Few single-case designs demonstrated high rigor and quality evidence of minimal effects (*n* = 3). Sixteen single-case designs contributed to rigor and quality scores equal to or lower than 2.0 due to the following reasons: 1) more data points were needed in baseline and intervention conditions due to within-condition variability, 2) the authors did not report collection of fidelity data and when reported, fidelity data were only collected during intervention conditions, and 3) social validity data via questionnaires, interviews, or surveys were not collected. Of the 16 single-case designs, six designs demonstrated low rigor and quality evidence of positive effects, and 10 designs demonstrated low rigor and quality evidence of minimal or negative effects of PMII.

Generalization outcomes were reported for 28 single-case designs. The average rigor and quality of generalization measurement was 3.75 and the average generalized outcome score was 3 (possible range 0 – 4; actual range 1 – 4); see Table 3 for detailed results. The majority of single-case designs showed high rigor and quality evidence of positive effects of PMII for participants with ASD (*n* = 20) in generalization settings. Eight single-case designs demonstrated high rigor and quality evidence of minimal effects of PMII in generalization settings. Maintenance outcomes were reported for 20 single-case designs. The average rigor and quality of maintenance measurement was 3 (possible range 0 – 4; actual range 1 – 4); and the average maintained outcome score was 3 (possible range 0 – 4; actual range 1 – 4); see Table 4 for detailed results. Half of the single-case designs demonstrated high rigor and quality evidence of positive effects of PMII for participants with ASD (*n* = 10). Ten single-case designs contributed to low rigor and quality scores of lower than 2 as maintenance data were collected immediately following completion of PMII or authors failed to report a clear time frame of maintenance data collection.

Visual Analysis

Visual analysis was conducted for 52 single-case designs (from 20 sources). Overall, 40 of the 52 single-case designs (77%) demonstrated a functional relation (scores of 3 or 4) between PMII and improved social skill outcomes for participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. Lack of functional relation was due primarily to inconsistent effects (e.g., one non-responder in a multiple-baseline across participants design). As seen in Figure 1, 33 designs had high rigor and quality scores and positive outcomes, while 3 designs had high rigor and quality scores and inconsistent or equivocal outcomes.

Effect Size Estimates

LRR effect size estimates for participants with ASD ranged from -0.59 to 3.54 (see Table 5). The lowest estimate of participant with ASD social behavior change came from the study by Coogle et al. (2019); the participant with ASD demonstrated a decrease in social skills during PMII. The low effect size estimate may be attributed to limited peer training and use of a measure that was not sensitive enough to examine social skill outcomes for participants with ASD (Coogle et al., 2019). The largest effect size estimate of participants with ASD social behavior change came from the study by Kisac (2016). Participants with ASD received PMII with multiple components, such as verbal prompting, time delay, error correction, peer prompter procedure, and tangible reinforcers (Kisac, 2016). Detailed results are listed in Table 5.

Meta-Analysis

For the purpose of meta-analysis, LRR effect size estimates between baseline and intervention phases were synthesized for studies that demonstrated large LRR effect size estimate and measured broad social interaction as a dependent variable. Therefore, 40 cases

across 13 studies demonstrated large LRR effect size estimates and were synthesized using a multi-level random effects meta-analysis model. Across all 40 cases from 13 studies, the average effect for participants with ASD was LRRi = 1.41; SE = 0.15 (95% CI = 1.11, 1.70; see Table 6), which corresponds to an increase in social behaviors of 310% (95% CI = [203%, 447%]). Results showed that the overall effect of PMII on increase in social skills for participants with ASD was significant ($t(39) = 9.61$, $p < .001$; see Table 6). Notably, there was a substantial degree of heterogeneity in effects between studies ($\tau^{\wedge 2} = 0.21$, $p < .01$; see Table 6) and within studies ($\omega^{\wedge 2} = 0.08$, $p < .01$; see Table 6) that may be expected based on sampling variance alone. Detailed results from the multivariate meta-analysis model are reported in Table 6.

Meta-Regression

Given significant between-study and within-study variances, moderators (i.e., educational placement setting of participants with ASD, participants' age/grade level, intervention implementer, and components of PMII) were examined to see if they explained variation in the magnitude of intervention effects. A meta-regression model that included separate intercepts for each combination of moderators was fitted. Results indicated a moderating effect of type of intervention implementer on the association between PMII and social skills for participants with ASD without intellectual impairments, $F(2, 37) = 5.33$, $p < 0.05$ (see Table 7). For studies where PMII were implemented by teachers, mean effects for participants with ASD were significantly larger (average effect = 2.32, SE = 0.31, $p = < 0.001$; see Table 7) than for studies where PMII were implemented by researchers or researchers in combination with school staff. Results showed that overall association between PMII and social skills for participants with ASD was not moderated by educational placement, age/grade level, and behavioral components of PMII. Detailed results of the meta-regression model are listed in Table 7.

Chapter 5: Discussion

Although several single-case design studies have suggested that PMII are effective to teach a variety of social interaction skills to children with ASD in inclusive preschool and kindergarten classrooms (Garfinkle & Schwartz, 2002; Kuhn et al., 2008; Nelson et al., 2007) prior to this meta-analysis no studies had conducted meta-analysis and quality examination of single-case design studies using PMII for children with ASD without intellectual impairments in inclusive preschool and elementary school settings. While quality examination of single-case design studies using PMII help to identify PMII that can be considered evidence-based practices, meta-analysis of single-case design studies help to examine overall intervention outcomes and the extent to which moderator variables account for change in effect sizes (Horner et al., 2005; Wang et al., 2013). Given the advantages of PMII for children with ASD in inclusive preschool and elementary school settings, it is crucial to identify PMII that are determined as evidence-based practices and can be implemented by teachers and practitioners to promote social skills of children with ASD without intellectual impairments.

To address this gap in literature, the purpose of this meta-analysis was to conduct a comprehensive review of single-case design studies using quality examination and meta-analysis to evaluate the efficacy of PMII for children with ASD without intellectual impairments in inclusive preschool and elementary school settings. Therefore, the first research question examined the extent to which the use of PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings met the criteria for methodological rigor of quality standards of single-case research. The second research question sought to investigate the overall and differential effects of PMII moderated by educational placement, intervention implementer, participant age/grade level, and behavioral

components of PMII in preschool and elementary children with ASD without intellectual impairments.

The results of this meta-analysis showed that across 52 single-case designs using PMII, 40 single case designs demonstrated a functional relation (scores of 3 or 4) between PMII and improved social skill outcomes for participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. In particular, 33 of the 40 single-case designs demonstrated evidence of high rigor and quality with positive effects for participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. In addition, results of this meta-analysis demonstrated that the overall effect of PMII on increase in social skills for participants with ASD was statistically significant. In particular, findings indicated that there was a moderating effect of type of intervention implementer on the association between PMII and social skills for participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. This study adds to the literature by providing quality examination and meta-analysis of studies through 2020 to evaluate the efficacy of PMII in increasing social skills for children with ASD without intellectual impairments in inclusive preschool and elementary school settings. Although previous studies have examined the efficacy of PMII in improving social skills for children with ASD, prior reviews have either focused solely on quality indicators of studies using PMII for children with ASD (Gunning at el., 2019; Watkins et al., 2015) or have conducted meta-analysis that included participants with ASD across all levels of severity in home, clinic and school settings, where participants' age was under 8 years (Zhang & Wheeler, 2011). Findings from this study address the call for identifying quality research and evidence-based strategies incorporated in PMII that can be implemented to improve social skills for children with ASD without intellectual

impairments in inclusive preschool and elementary school settings (Kratochwill et al., 2010; Reichow et al., 2008). Finally, findings from this meta-analysis have implications for teachers and practitioners in identifying the intervention factors that support positive outcomes in PMII for children with ASD without intellectual impairments in inclusive preschool and elementary school settings. This chapter presents interpretations of this meta-analysis in the following order: 1) research question 1, and 2) research question 2. This chapter then presents discussion of the limitations of the study and concludes with implications for educators and future research.

Research Question 1

The first research question sought to examine the extent to which the use of PMII for teaching social skills to preschool and elementary children with ASD without intellectual impairments in inclusive school settings met the criteria for methodological rigor of quality standards of single-case research. Findings of the rigor and quality analysis using the Single-Case Analysis and Review Framework (SCARF; Ledford et al., 2016) suggested that 33 (63%) single-case designs included in this meta-analysis demonstrated evidence of high rigor and quality with positive effects for participants with ASD in inclusive preschool and elementary school settings. Additionally, results of visual analysis using the SCARF suggested that 40 (77%) single-case design studies demonstrated a functional relation between PMII and social skill outcomes for children with ASD without intellectual impairments.

The methodological rigor of studies in this meta-analysis was assessed using the following categories on the SCARF: 1) data sufficiency, 2) reliability, and 3) fidelity (Ledford et al., 2016). Presence of functional relations between PMII and social behaviors for children with ASD were evaluated on a 0 - 4 scale, consistent with the SCARF procedure (Ledford et al., 2016). It was noted that 29 (56%) single-case designs across 12 studies demonstrated high

sufficiency of data and strong functional relation in the following ways: 1) measured social skills on at least five data points in each baseline and intervention phases, 2) included three or more attempts to demonstrate an intervention effect each at a different point in time, and 3) graphically demonstrated no overlap of data points with adjacent phases (Delano & Snell, 2006; Ganz & Flores, 2008; Hu et al., 2018; Kamps et al., 1992; Katz & Girolametto, 2013; Kisac, 2016; Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; Radley et al., 2017; Schoen, 2010). Thereby, the phases within each of the above single-case design studies qualified as an attempt to demonstrate an intervention effect (Kratochwill et al., 2013). Sufficiency of data is pertinent in establishing standards of single-case designs as a larger number of data points within each phase increases methodological rigor, and provides more information and confidence with respect to the pattern of responding (WWC, https://ies.ed.gov/ncee/wwc/Docs/ReferenceResources/wwc_scd.pdf). Based on WWC guidelines, the majority of the single-case designs in this meta-analysis met standards for single-case designs (Kratochwill, 2013). Thereby, findings indicated high methodological rigor for single case designs using PMII with children with ASD without intellectual impairments in inclusive preschool and elementary school settings.

In single-case research, the dependent variable is measured by more than one assessor to meet standards for reliability (e.g., interobserver agreement [IOA]; Horner et al., 2005; Kazdin, 2019). All the 20 single-case design studies in this meta-analysis reported that dependent variable reliability data was measured. It is to be noted that the most commonly used techniques of IOA in single-case design research are percentage agreement and Cohen’s Kappa coefficient (Hartmann, et al., 2004). Based on the criteria of WWC, to meet single-case design standards, an intervention study using single-case research design must obtain IOA for each subject on each

dependent variable, collect IOA on at least 20% (preferably 25%-33%) of the data points within each phase (e.g., baseline and intervention), have IOA values that range from 0.80 to 0.90 (on average) for percentage agreement, and have IOA values of at least 0.60 when measured by Cohen's Kappa (Artman-Meeker et al., 2012; Kratochwill et al., 2013). While 18 studies collected IOA for each subject on each dependent variable and on at least 20% of the data points within each phase, only four studies reported IOA higher than 80% or higher than 0.60 Kappa (Katz & Girolametto, 2013; Mason et al., 2014; McFadden et al., 2014; Radley et al., 2017). Moreover, three studies reported using observers who were blind to study conditions (Coogle, 2019; Hu et al., 2018; McKenney et al., 2016). Additionally, none of the studies graphed IOA data, thereby limiting reliability of data collection and assessment of threats to internal validity (Artman-Meeker et al., 2012).

Moreover, measures of procedural fidelity were robust, appearing in 15 of the 20 single-case design studies (Coogle, 2019; Delano & Snell, 2006; Ganz & Flores 2008; Hu et al., 2018; Kamps et al., 1999; Katz & Girolametto, 2013; Kisac, 2016; Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; McKenney et al., 2016; Petursdottir et al., 2007; Radley et al., 2017; Schoen, 2010). However, these results should be interpreted judiciously as fidelity measures were not always assessed across all phases and only two studies reported collection of fidelity across baseline and intervention phases (Hu et al., 2018; Loftin et al. 2008). Two studies measured the competence of the teacher or facilitator implementing a component of the intervention and did not measure fidelity of the peer-implemented strategies (Ganz & Flores, 2008; Loftin et al., 2008). In addition, Katz and Girolametto (2013) included measures of assurance that typically developing peers were correctly following procedures during the peer training period, yet fidelity measures were not reported throughout the

intervention phase. With peers acting as intervention agents, fidelity data would seem especially pertinent to PMII research in order to discern the precision with which the intervention was delivered (Watkins et al., 2015). Specifically, researchers recommend that procedural fidelity data should be collected across phases (e.g., baseline and intervention) and consist of at least one third of sessions in each condition (Ledford & Gast, 2014; Wolery et al., 2011). Future studies should include direct measures of fidelity across the entire intervention in order to more confidently demonstrate that the positive findings are attributable to the intervention.

Additionally, quality/breadth of measurement in single-case designs was evaluated using the following categories on the SCARF: 1) social validity, 2) participant descriptions, 3) condition descriptions, 4) dependent variables, 5) maintenance, and 6) generalization (Ledford et al., 2016). Social validity is another measure of particular importance to PMII and in single-case research consists of three factors: 1) goals of the intervention, 2) procedures used to implement an intervention, and 3) outcomes of an intervention (Snodgrass et al., 2018). If those involved in the intervention (i.e., teachers, peers, and participants) report positive experiences and outcomes, the likelihood that interventions continue to be implemented might increase (Kazdin, 2011; Snodgrass et al., 2018). Social validity was reported in the following studies, with the feedback generally reflecting high rates of satisfaction with the PMII from practitioners, participants, and peers (e.g., Delano & Snell, 2006; Dugan et al., 1995; Hu et al., 2018; Katz & Girolametto, 2013; Kisac, 2016; Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; Petursdottir et al., 2007; Radley et al., 2017; Schoen, 2010). In addition, normative data that compared participant levels of social interaction to that of typically developing peers (Delano & Snell, 2006; Schoen, 2010) and observations from lay observers on participant levels of social behavior (Katz & Girolametto, 2013) suggested that PMII increased social interaction for

children with ASD to levels that were comparable to that of the typically developing peers. These positive findings suggest that PMII were generally perceived to be an acceptable intervention for use in inclusive preschool and elementary school settings and is beneficial and acceptable to both children with ASD and typically developing peers and is supported by teachers in the classroom. Previous studies have shown that high social validity of PMII can be attributed to the structure of PMII, which allow PMII to be incorporated in the daily school schedule and activities, making PMII feasible and acceptable for school personnel to implement (Carter et al., 2017; Kasari et al., 2012). Additionally, availability of peers as intervention agents reduces demands on teachers as sole intervention providers, which further increases acceptability of PMII for school personnel (Chan et al., 2009; Rodriguez-Medina et al., 2016; Watkins et al., 2015).

To aid in replicability of single-case research, detailed descriptions of participants (e.g., demographics, inclusionary criteria), intervention procedures (e.g., prompts, reinforcements), materials used for intervention (e.g., curriculum, toys, tokens, scripts), dependent variables (e.g., social initiations, social responses), and the setting where the study was conducted (e.g., classroom, cafeteria) were provided across studies in this meta-analysis that obtained high methodological rigor (Horner & Spaulding, 2010; Wolery et al., 2011). In addition, beyond using at least one of the main peer implemented strategies (i.e., prompting and reinforcing, peer initiation, peer modeling, or peer network), studies incorporated a variety of additional strategies ranging from direct instruction of social skills, pivotal response training, visual supports, self-monitoring, social scripts, visual supports, time delay procedures, and stay, play, and talk strategies to increase social interaction in children with ASD (Delano & Snell, 2006; Ganz & Flores, 2008; Hu et al., 2018; Kamps et al., 1992; Katz & Girolametto, 2013; Kisac, 2016;

Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; Radley et al., 2017; Schoen, 2010). It is important to consider the intervention characteristics when choosing which PMII are most appropriate for certain social skill difficulties, whether it be a skill deficit (i.e., lack of ability) or performance deficit (i.e., lack of interest or social motivation). For example, PMII that include direct instruction of social interaction (Katz & Girolametto, 2013; Mason et al., 2013) along with a peer prompting and reinforcing strategy (Loftin et al. 2008) may be more appropriate for a child with ASD demonstrating a social skill deficit. In comparison, for a child with ASD demonstrating a social performance deficit, a different approach may be needed, and PMII that promote use of the desired social behavior by, for example, using a peer support strategy and incorporating whole classroom (Kamps et al., 1994; Kamps et al., 1999) or using highly preferred interests (Hu et al., 2018) or increasing the number of peer initiations directed toward a participant (Owen-DeSchryver et al. 2008) would be appropriate (Watkins et al., 2015).

In addition, findings of this meta-analysis showed that a majority of the single-case designs demonstrated high rigor and quality evidence of generalization of PMII, which further supports the use of this intervention method for children with ASD. It is important to note that only 7 of the 20 studies included measurement of generalization. Of the 28 single-case designs (across seven studies) reporting generalization, 20 single-case designs (across six studies) demonstrated high rigor and quality evidence of generalization and found positive generalization effects (Delano & Snell, 2006; Ganz & Flores, 2008; Katz & Girolametto 2013; Kisac, 2016; Laushey & Heflin, 2009; McFadden et al., 2014). Of the 20 single-case designs (across 12 studies) reporting maintenance, 10 single-case designs (across five studies) demonstrated high rigor and quality evidence of maintenance with positive maintenance effects (Kamps et al., 1992;

Katz & Girolametto, 2013; Kisac, 2016; Laushey et al., 2009; Radley et al., 2017). The generalization and maintenance of skills are important indicators of the overall effectiveness of an intervention (Horner et al., 2005; Kratochwill & Levin, 2010; Watkins et al., 2015). In their meta-analysis of school-based social skills interventions, Bellini et al. (2007) asserted that the success of a social skills intervention should be based upon the extent to which the skills generalize across a variety of settings and with multiple persons.

It is interesting to note that studies which reported high methodological rigor and positive generalization and maintenance results used peer interventionists based upon similar selection criteria as children with ASD (Katz & Girolametto, 2013; Kisac, 2016; Laushey & Heflin, 2009). These findings may be attributed to previous research that has shown that peers with typical language and social skills, prior interest in interacting with children with ASD, regular attendance, and high levels of compliance are more likely to successfully implement the intervention and increase the likelihood that skills generalize and maintain post-intervention than peers who do not meet these criteria (Watkins et al., 2015). Of further interest are the strategies incorporated as part of PMII that were associated with successful generalization and maintenance of skills. Findings indicated that training of typically developing peers with children with ASD on social skills and using initiation, prompting and reinforcing strategies, either used alone or together, resulted in successful generalization and maintenance results (Katz & Girolametto, 2013; Kisac, 2016; Laushey & Heflin, 2009). Possible explanation of successful generalization and maintenance results in the above studies is that peer training of social skills in the presence of children with ASD helps to improve peers' positive attitudes toward children with ASD and sustain influence on peers' broader social network (Carter et al., 2011; Locke et al., 2012; Odom, 2019).

Additionally, the findings in this meta-analysis pertaining to the high methodological rigor and quality are consistent with the previous quality examination studies by Gunning et al. (2019) and Watkins et al. (2015), which used the methodological rigor criteria by Reichow et al. (2008). Specifically, findings showed that single-case design studies in this meta-analysis that obtained high rigor, quality, and functional relation scores (i.e., above 2) were rated as adequate to strong in previous quality examination studies (Ganz & Flores, 2008; Katz & Girolametto, 2013; Loftin et al., 2008; Mason et al., 2013; Owen-DeSchryver, 2008). Similarly, the single-case design study that obtained low rigor, quality, and functional relation score in this meta-analysis was rated as weak in prior quality examination studies (Petursdottir et al., 2007). Thereby, findings indicated that majority of the studies in this meta-analysis demonstrated high methodological rigor, quality, and functional relation scores. Therefore, this study provided a preliminary validation of an innovative tool (i.e., SCARF) as the high methodological rigor of the single-case design studies as measured on the SCARF was comparable to the rigor evaluations from other published reports by Reichow et al. (2008).

Research Question 2

The second research question sought to examine the extent of overall and differential effects of PMII moderated by educational placement, intervention implementer, participant age/grade level, and behavioral components of PMII. Findings of the LRR effect size estimates between baseline and intervention phases for all studies that measured broad social interaction as a dependent variable indicated that 40 cases across 13 single-case design studies showed positive effect sizes, indicating improved social skill outcomes of PMII for children with ASD without intellectual impairments in inclusive elementary school settings (Delano & Snell, 2006; Dugan et al., 1995; Kamps et al., 1992; Kamps et al., 1994; Kamps et al., 1999; Kisac, 2016; Kohler et al.,

2007; Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; Radley et al., 2017; Schoen et al., 2010). Specifically, the cases that demonstrated largest magnitude of social skill behavior change were either fully integrated in the general education setting with their typically developing peers or were placed in the general education setting for more than 78% of the school day (Kisac, 2016; Kohler et al., 2007). There are at least three possible explanations of why PMII resulted in large magnitude of social skill outcomes for children with ASD who were integrated in the general education setting for more than 78% of the school day. First, since inclusive preschool and elementary school settings for children with ASD are related to decrease in autism symptomology and reductions in challenging behaviors, inclusive school settings served as a protective factor for participants with ASD, providing participants opportunities to learn social skills from peers and teachers (Goodall, 2012; Humphrey & Symes, 2013; Sansosti & Sansosti, 2012; Smith, 2012). Second, since inclusive school settings promote peer acceptance of ASD and positive attitudes toward children with ASD, participants with ASD in the above studies were socially included by their peers, thereby improving their social skill outcomes (Campbell et al., 2019; Humphrey & Symes, 2013; Mavropoulou & Sideridis, 2014). Third, since inclusive school settings provide opportunities for children with ASD to interact daily with their typically developing peers, PMII may be feasibly and effectively implemented for participants with ASD who spend more than 78% of the school day in general education setting (Ferraioli & Harris, 2011; Roberts & Simpson, 2016; Smith, 2012). Therefore, findings indicated that participants with ASD in the above studies may have benefitted socially from being placed in the inclusive school settings for majority of their school day.

Additionally, the majority of the single-case design studies using PMII that demonstrated positive outcomes implemented multiple components of PMII (e.g., verbal prompting, time delay, error correction, video modeling, peer prompter procedure, and tangible reinforcers) and included more than one peer interventionist (Delano et al., 2006; Dugan et al., 1995; Kamps et al., 1992; Kamps et al., 1994; Kamps et al., 1999; Kisac, 2016; Kohler et al., 2007; Laushey et al., 2009; Loftin et al., 2008; Mason et al., 2014; McFadden et al., 2014; Radley et al., 2017; Schoen et al., 2010). In contrast, the single-case design study that demonstrated negative social skill outcome primarily implemented least to most prompting hierarchy and included only one peer buddy as part of the PMII (Coogle, 2019). These findings are in line with previous research that shows a variety of peer-mediated intervention strategies and multiple peer buddies are related to increase in social behaviors for children with ASD (Watkins et al., 2015; Whalon et al., 2015).

In relation to the multilevel meta-analysis, results suggested that the overall effect of PMII on increase in social skills for children with ASD was significant and corresponded to an increase in social behaviors of 310%. Overall results indicated that PMII are highly effective to improve social interaction skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings. These findings are consistent with previous meta-analyses of PMII with children with ASD (Wang et al., 2011; Zhang & Wheeler, 2011) and prior meta-analyses of school-based social skill interventions that demonstrated strong intervention impact of PMII for children with ASD (Sutton et al., 2019; Whalon et al., 2015). Possible explanations of effectiveness of PMII in improving social skills for children with ASD in inclusive preschool and elementary school settings range from increased access to typically developing peers as intervention agents and PMII facilitating social reciprocity between children

with ASD and typically developing peers, thereby increasing social partners for children with ASD (Chan et al., 2009; Locke et al., 2012; Rodriguez-Medina et al., 2016). Additionally, since PMII can be incorporated in daily school schedules, PMII help children with ASD to practice their social skills with multiple peer partners in naturalistic settings, thereby increasing generalization of the learned social behaviors (Chan et al., 2009; Hume & Campbell, 2019; Watkins et al., 2015; Wong et al., 2015).

Although the estimated average effects were positive, results of the meta-analysis indicated variation in the effectiveness of PMII between and within studies. Results of the meta-regression model suggested that the variation in the magnitude of intervention effects was moderated by type of intervention implementer. Findings showed that studies where PMII were implemented by teachers (Dugan et al., 1995; Kohler et al., 2007), positive social skill outcomes were significantly larger than when PMII were implemented by researchers (Delano & Snell., 2006; Kamps et al., 1999; Kisac, 2016; Loftin et al., 2008; Radley et al., 2017; Schoen et al., 2010) and researchers in combination with school staff (Kamps et al., 1992; Kamps et al., 1994; Laushey et al., 2009; Mason et al., 2014; McFadden et al., 2014). It was noted that in one study teachers implemented PMII in the whole classroom as part of cooperative learning groups (Dugan et al., 1995) and in the other study teachers implemented PMII and provided positive reinforcements to peer buddies in response to their social bids toward children with ASD (Kohler et al., 2007). It may be reasoned that once teachers are trained and coached by researchers, they are able to implement PMII accurately and effectively for children with ASD in inclusive preschool and elementary school settings (Camargo et al., 2016; Gunning et al., 2019; Watkins et al., 2015; Whalon et al., 2015). Specifically, in inclusive preschool and elementary school settings teachers are able to implement class-wide behavior and social skill strategies for children

with ASD and their typically developing peers, which may help to increase peer awareness of ASD and social skill development of children with ASD (Roberts & Simpson, 2016; Sansosti & Sansosti, 2012; Smith, 2012). These results are favorable to implementation of PMII in inclusive preschool and elementary school settings, since teachers who are responsible to the daily instruction of children with ASD can effectively implement the intervention, thereby increasing fidelity and acceptability of PMII.

Limitations

Publication bias is a potential confound in most meta-analyses and suggest systematic differences between the selected and excluded studies (Borenstein et al., 2009). An extensive literature search using multiple single-case design research methods and sources was conducted to limit the effects of publication bias. However, the narrow inclusion criteria that involved children with ASD without intellectual impairments in inclusive preschool and elementary school settings likely created a situation in which the existence of publication bias cannot be totally dismissed. Unfortunately, there are no methods of calculating or estimating the effect of publication bias given the constraints and methods of this meta-analysis (i.e., there are no methods of estimating publication bias for single subject research; Borenstein et al., 2009). Thus, it is acknowledged that there may be the possibility of study selection bias and the readers are alerted to its possibility.

Caution must be taken when interpreting the results of the evaluation with respect to methodological rigor and quality of studies using PMII to increase social skills for children with ASD. The exclusion criteria of typically developing peers playing a limited role in the implementation of PMII (e.g., video modeling of peers without any active peer to participant with ASD) greatly narrowed the scope of the meta-analysis. Many PMII where typically

developing peers are recipients of social initiations without any training have been studied for many years, which would not be reflected in the current meta-analysis. The results of the methodological rigor and quality of studies using PMII should be used as a starting point for further evaluation of PMII for children with ASD close to meeting evidence-based practice criteria. It is likely that future meta-analyses of PMII with a more focused scope involving broader inclusion criteria is likely to produce additional studies using PMII that can be considered evidence based.

This meta-analysis has some limitations that lead to implications for future research. The primary limitation is the small number of studies containing features related with all levels of moderators of interest, preventing further conclusions that would provide more precise information on the effectiveness of PMII to increase social interaction skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings. Another important limitation of this meta-analysis is that judgments regarding intervention features and procedures that were further aggregated in moderator levels are based only on the information provided by the authors of the articles. Considering that space limitations in scientific journals may result in omission of many details of the research, results must be viewed with caution (Camargo et al., 2016).

Conclusion on effectiveness of PMII to improve social skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings should be further supported, since moderating effects of the type of peer-mediated intervention used was not determined due to the wide range of peer-mediated intervention strategies utilized across included studies. As not enough studies have been conducted to break down the analysis by peer-mediated intervention type, more studies should be conducted using peer education, peer

tutoring/supports, peer modeling, and peer networks within inclusive school settings to enable additional meta-analysis regarding the potential moderating effects of these PMII (Watkins et al., 2015; Zhang & Wheeler, 2011). Future research should also include the type of social skill deficits and also detailed information regarding participants' level of functioning; that is, the severity of the symptoms and associated comorbid conditions. It would make possible to investigate how effects of PMII would be moderated by different characteristics of individuals with ASD along the autism spectrum.

Implications for Practice and Future Research

The increasing number of children with ASD in general education and the requirements for implementation of evidence-based practices in schools demands quantitative analysis to identify studies using PMII that are most effective to attenuate social impairments that prevent successful inclusion of children with ASD (Bellini et al., 2007; Koegel et al., 2012). This meta-analysis provides information regarding effectiveness of PMII to improve social skills of students with ASD that emphasizes the practical significance of these interventions and guides practitioners toward effective evidence-based practices in inclusive preschool and elementary school settings.

The high methodological rigor and quality and overall effect size suggests that PMII can be used as an effective intervention to improve social interaction of children with ASD without intellectual impairments in inclusive preschool and elementary school settings. Overall results on rigor and quality inform the field of single-case design research using PMII about identified issues related to quality indicators that should be addressed by future research to advance empirical support regarding PMII for children with ASD in inclusive school settings (Gunning et al., 2019; Watkins et al., 2015). An examination of the results of the methodological rigor and

quality for the included single-case design studies revealed four areas consistently underperforming expectations. First, participant characteristics need to be more descriptive, and when possible, should use the results of standard diagnostic measures to characterize the participants with ASD (Watkins et al., 2015). Second, procedural fidelity needs to be measured more frequently. Given the frequent drop of fidelity when implementing treatments in natural settings, not knowing the precision with which PMII must be implemented to be effective make recommending PMII to school practitioners difficult (Camargo et al., 2016; Ledford & Gast, 2014). Third, few single-case design studies evaluated for this meta-analysis used blind raters. Using blind raters reduces the likelihood of observer bias and should be employed, whenever possible (Ledford & Gast, 2014; Wolery et al., 2011). Finally, many studies did not meet the inclusionary criteria for this meta-analysis because single case designs did not show at least three opportunities to demonstrate an intervention effect (Kratochwill et al., 2013). For the overall rigor and quality of studies using PMII with children with ASD, these four methodological aspects need to receive greater attention in future research.

Results regarding moderating effects of intervention implementer also generate some implications for practice. The fact that statistically significant differences were found between researcher, researcher in combination with school staff, and teacher as implementer suggest that in inclusive school settings, teachers may be more effective in implementing PMII with children with ASD. However, ongoing teacher training is necessary to ensure continuity and accuracy of PMII when researchers are no longer present in the school environment (Chang & Locke, 2016; Zagona & Mastergeorge, 2018) Specifically, previous research has highlighted the importance of teachers' use of intervention practices and supports for teachers' use of intervention practices to yield positive social outcomes in early childhood (Artman-Meeker et al., 2015). Effectiveness of

PMII for children with ASD in inclusive school settings will also depend on how prepared teachers are to implement PMII (Koegel et al., 2012). Therefore, teacher training is essential to bridge the gap between research and practice.

With respect to other moderating effects investigated in this meta-analysis, the results provide several implications for practice. First, results regarding moderating effect of educational placement setting of participants with ASD suggest that PMII with children with ASD in fully integrated general education setting may lead equally to positive social effects than when children with ASD are integrated in the general education setting for at least 60% or more of their school day. Thus, PMII can be implemented with children with ASD across educational placements. Second, analysis of moderators showed that PMII are effective for lower elementary and upper elementary children with ASD without intellectual impairments (ages 6 – 12 years). It is well established that early interventions incorporating strategies of PMII increase the adaptability and social adjustment of children with ASD in school settings (Hume et al., 2019; Schwartz et al., 2013). Therefore, implementation of PMII to improve social skills starting in preschool and kindergarten increase the chance of children with ASD being accepted socially and progressively more successful in general education. Additionally, analysis of differential effects according to the use of behavioral components utilized in PMII (e.g., peer supports, scripting) leads to the conclusion that peer supports and scripting may lead equally to positive social effects for children with ASD. Thus, teachers and practitioners can implement PMII using a simpler and less time-consuming approach that can produce similar impacts on target social skills. These results provide teachers with more feasible and effective strategies of PMII to improve social skills of children with ASD in inclusive settings that may compensate for greater effects that could possibly occur with more time consuming and expensive interventions.

Conclusion

The effectiveness of PMII to enhance social interaction skills of children with ASD in settings such as clinics, homes, and special education classrooms is well documented in the literature (Gunning et al., 2019; Watkins et al., 2015; Whalon et al., 2015; Zhang & Wheeler, 2011). However, the current research base lacks information regarding whether studies using PMII demonstrate methodological rigor and quality and can be considered evidence-based practices to improve social skill outcomes of children with ASD without intellectual impairments. Additionally, effectiveness of PMII, particularly considering implementation and contextual factors that lead to better outcomes in social interaction skills of children with ASD in the unique context of inclusive settings, has not been investigated comprehensively. This study sought to address these gaps and to provide teachers and practitioners with information that can support them in the challenge of meeting educational needs of children with ASD included in general education.

In summary, the results from the first research question suggested that studies using PMII for improving social skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings qualify as evidence-based practices. The application of the quality indicators based on the Single-Case Analysis and Review Framework (SCARF; Ledford et al., 2016) resulted in the identification of 33 single-case designs demonstrating high rigor, quality, and functional relation scores. Forty single-case designs demonstrated a functional relation (scores of 3 or 4) between PMII and improved social skill outcomes for participants with ASD without intellectual impairments in inclusive preschool and elementary school settings. Of the 52 single-case designs, 19 single-case designs did not meet minimum requirements of methodologically sound single-case research mainly due to lack of a strong experimental design

and no evaluation of fidelity and social validity of intervention implementation. Considering that the majority of the studies met the criteria for methodological rigor and quality, the use of PMII in inclusive preschool and elementary school settings could be considered evidence-based practices to improve social interaction skills of children with ASD without intellectual impairments.

As PMII to improve social interaction skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings were found to be evidence-based practices, the second research question of this study investigated the overall magnitude of impact of PMII on the social interaction skills of children with ASD based on studies meeting methodological rigor and measuring broad social interaction skills. Furthermore, the moderating effects of educational placement setting of participants with ASD, participants' age/grade level, intervention implementer, and components of PMII were investigated. Results indicated that, overall, PMII can lead to positive effects and improvements on social interaction skills of preschool and elementary age children with ASD included in general education. Meta-regression results showed that PMII were equally effective across educational placements, participants' age/grade level, and components of PMII (i.e., peer supports and scripting). Results indicated that PMII were more effective in increasing social interaction skills for children with ASD without intellectual impairments when they were implemented by teachers in inclusive preschool and elementary school settings.

The findings from both research questions have several implications for practice, particularly for teachers involved with education of children with ASD in inclusive preschool and elementary school settings. First, it is clear that PMII can be used to improve social interaction skills of children in inclusive settings as effective evidence-based practices.

Therefore, these studies can assist educators and enable informed decision when choosing evidence-based practices for improving social interaction skills of children with ASD in inclusive school settings. Providing supports for social interaction skills of children with ASD may impact the quality of their experience with typically developing peers and the continuity of their placement in inclusive school settings (Odom, 2019). Additionally, the finding that PMII were effective in inclusive settings for both preschool and elementary children with ASD indicates that early use of these interventions in schools has the potential to lead to important developmental gains that may impact their future as productive members of society (Schwartz et al., 2013; Strain & Bovey, 2011). Furthermore, findings indicate that teachers as implementers of PMII have a larger impact on the effectiveness of PMII for children with ASD in inclusive preschool and elementary school settings. This result is consistent with other studies showing that teachers can implement PMII with a high degree of efficacy (Gunning et al., 2019; Watkins et al., 2015; Zhang & Wheeler, 2011). Therefore, teacher training of PMII is necessary and recommended to ensure continuity and accuracy of implementation, since teachers are in charge of supporting inclusion of children with ASD on a daily basis.

In sum, this meta-analysis added to the literature of PMII by identifying studies using PMII to improve social interaction skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings that met the criteria for methodological rigor of quality standards of single-case research. Findings indicated that majority of the studies met the criteria for methodological rigor and quality and the use of PMII in inclusive preschool and elementary school settings could be considered evidence-based practices to improve social interaction skills of children with ASD without intellectual impairments. Additionally, this meta-analysis added to the literature of PMII by providing information about the overall and

differential effects of PMII on the social interaction skills of children with ASD without intellectual impairments in inclusive preschool and elementary school settings. Findings showed that PMII led to positive effects on social interaction skills of preschool and elementary age children with ASD included in general education. Furthermore, PMII were more effective in increasing social interaction skills for children with ASD without intellectual impairments when they were implemented by teachers in inclusive preschool and elementary school settings. Overall, this study helped to identify procedural and contextual aspects of PMII that can lead to better outcomes for children with ASD and aid teachers and practitioners to tailor PMII more specifically to the unique characteristics of children with ASD.

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Tables and Figures

Table 1

Study, Measurement Characteristics, and Visual Analysis Outcomes for Participants with ASD, by Design.

First author	Design	Behavior Type	Measurement	Visual Analysis (SCARF score)	# of Effect Sizes
Coogle	MP across contexts	Broad SI	Count	No FR (2)	1
Delano	MP across participants	Specific SI (social engagement)	Duration	FR (4)	--
Delano	MP across participants	Broad SI	Count	FR (4)	3
Dugan	ABAB	Ann Broad SI	Duration	FR (4)	1
Dugan	ABAB	Matt Broad SI	Duration	FR (4)	1
Ganz	Changing Criterion	Dario Scripted phrases	Interval	FR (4)	--
Ganz	Changing Criterion	Dario Unscripted phrases	Interval	No FR (2)	--
Ganz	Changing Criterion	Dario Context-related comments	Interval	FR (4)	--
Ganz	Changing Criterion	Dario Responses	Interval	No FR (2)	--
Ganz	Changing Criterion	Dario Speech	Interval	No FR (2)	--
Ganz	Changing Criterion	Max Scripted phrases	Interval	FR (4)	--
Ganz	Changing Criterion	Max Unscripted phrases	Interval	FR (4)	--
Ganz	Changing Criterion	Max Context-related comments	Interval	FR (4)	--
Ganz	Changing Criterion	Max Responses	Interval	FR (4)	--
Ganz	Changing Criterion	Max Speech	Interval	FR (4)	--
Ganz	Changing Criterion	Eddie Scripted phrases	Interval	FR (4)	--
Ganz	Changing Criterion	Eddie Unscripted phrases	Interval	No FR (2)	--
Ganz	Changing Criterion	Eddie Context-related comments	Interval	FR (4)	--
Ganz	Changing Criterion	Eddie Responses	Interval	No FR (2)	--
Ganz	Changing Criterion	Eddie Speech	Interval	No FR (2)	--
Hu	ABAB	Yangang Specific SI (initiations)	Count	FR (4)	--
Hu	ABAB	Yangang Specific SI (responses)	Count	FR (4)	--

Hu	ABAB	XinXin Specific SI (initiations)	Count	FR (3)	--
First author	Design	Behavior Type	Measurement	Visual Analysis (SCARF score)	# of Effect Sizes
Hu	ABAB	XinXin Specific SI (responses)	Count	FR (4)	--
Hu	ABAB	Youyou Specific SI (initiations)	Count	FR (4)	--
Hu	ABAB	Youyou Specific SI (responses)	Count	FR (4)	--
Kamps (1992)	MB across participants	Broad SI	Count	FR (4)	3
Kamps (1994)	MB across participants	Broad SI	Duration	FR (4)	3
Kamps (1999)	ABAB	Broad SI	Duration	FR (4)	1
Katz	MB across participants	Specific SI (initiations)	Percent	FR (4)	--
Katz	MB across participants	Specific SI (responses)	Percent	FR (4)	--
Kisac	MB across behaviors	Jack Broad SI	Count	FR (4)	1
Kisac	MB across behaviors	Darrell Broad SI	Count	FR (4)	1
Kohler	MB across participants	Broad SI	Interval	FR (3)	3
Laushey	MB across behaviors	Max Broad SI	Percent	FR (4)	1
Laushey	MB across behaviors	Sam Broad SI	Percent	FR (4)	1
Laushey	MB across behaviors	Cole Broad SI	Percent	FR (4)	1
Laushey	MB across behaviors	Kip Broad SI	Percent	FR (4)	1
Loftin	MB across participants	Specific SI (initiations)	Interval	FR (4)	--
Loftin	MB across participants	Broad SI	Interval	FR (4)	3
Mason	MB across participants	Broad SI	Count	FR (4)	3
McFadden	MB across participants	Specific SI (initiations)	Interval	FR (3)	--
McFadden	MB across participants	Broad SI	Interval	FR (4)	4
McKenney	MB across participants	Specific SI (initiations)	Count	No FR (2)	--
McKenney	MB across participants	Specific SI (responses)	Count	No FR (2)	--
Owen-DeSchryver	MB across participants	Specific SI (initiations)	Count	FR (3)	--
Owen-DeSchryver	MB across participants	Specific SI (responses)	Count	FR (3)	--
Petursdottir	ABAB	Rick Specific SI (initiations)	Count	No FR (2)	--
Petursdottir	ABAB	Joe Specific SI (initiations)	Count	No FR (1)	--

Petursdottir	ABAB	Bob Specific SI (initiations)	Count	No FR (1)	--
First author	Design	Behavior Type	Measurement	Visual Analysis (SCARF score)	# of Effect Sizes
Radley	MB across participants	Broad SI	Interval	FR (4)	5
Schoen	MP across participants	Broad SI	Count	FR (3)	4

Note: SCARF = Single Case Analysis and Review Framework. SI = social interaction. MB = multiple-baseline design. FR = functional relation. # of Effect Sizes = number of effect sizes calculated from this design (see Table 3). -- indicates effect sizes were not calculated.

Table 2

SCARF Scores of Rigor/Quality and Primary Outcomes for Each Eligible Design for Participants with ASD

First Author	Dependent Variable	Rigor/Quality Score	Primary Outcomes Score	Scatterplot Color
Coogle	Broad SI	1.682539683	2	Grey
Delano	Specific SI (social engagement)	2.460317460	4	Black
Delano	Broad SI	2.238095238	4	Black
Dugan	Ann Broad SI	1.952380952	4	Red
Dugan	Matt Broad SI	1.952380952	4	Red
Ganz	Dario Scripted phrases	2.539682540	4	Pink
Ganz	Dario Unscripted phrases	1.873015873	2	Pink
Ganz	Dario Context-related comments	2.539682540	4	Pink
Ganz	Dario Responses	1.873015873	2	Pink
Ganz	Dario Speech	2.539682540	2	Pink
Ganz	Max Scripted phrases	2.539682540	4	Pink
Ganz	Max Unscripted phrases	2.539682540	4	Pink
Ganz	Max Context-related comments	2.539682540	4	Pink
Ganz	Max Responses	2.539682540	4	Pink
Ganz	Max Speech	2.539682540	4	Pink
Ganz	Eddie Scripted phrases	2.539682540	4	Pink
Ganz	Eddie Unscripted phrases	1.873015873	2	Pink
Ganz	Eddie Context-related comments	2.539682540	4	Pink
Ganz	Eddie Responses	1.873015873	2	Pink
Ganz	Eddie Speech	1.873015873	2	Pink
Hu	Yangang Specific SI (initiations)	3.206349206	4	Turquoise
Hu	Yangang Specific SI (responses)	3.206349206	4	Turquoise
Hu	XinXin Specific SI (initiations)	2.761904762	3	Turquoise
Hu	XinXin Specific SI (responses)	2.761904762	4	Turquoise

First Author	Dependent Variable	Rigor/Quality Score	Primary Outcomes Score	Scatterplot Color
Hu	Youyou Specific SI (initiations)	3.206349206	4	Turquoise
Hu	Youyou Specific SI (responses)	3.206349206	4	Turquoise
Kamps (1992)	Broad SI	2.063492063	4	Orange
Kamps (1994)	Broad SI	1.682539682	4	White
Kamps (1999)	Broad SI	1.952380952	4	Light yellow
Katz	Specific SI (initiations)	2.873015873	4	Purple
Katz	Specific SI (responses)	2.873015873	4	Purple
Kisac	Jack Broad SI	2.873015873	4	Light Blue
Kisac	Darrell Broad SI	2.873015873	4	Light Blue
Kohler	Broad SI	1.634920635	3	Green
Laushey	Max Broad SI	2.380952381	4	Green
Laushey	Sam Broad SI	2.380952381	4	Green
Laushey	Cole Broad SI	2.380952381	4	Green
Laushey	Kip Broad SI	2.380952381	4	Green
Loftin	Specific SI (initiations)	2.984126984	4	Salmon Pink
Loftin	Broad SI	2.984126984	4	Salmon Pink
Mason	Broad SI	2.761904762	4	Teal
McFadden	Specific SI (initiations)	2.857142857	3	Brown
McFadden	Broad SI	2.857142857	4	Brown
McKenney	Specific SI (initiations)	2.666666667	2	Maroon
McKenney	Specific SI (responses)	2.000000000	2	Maroon
Owen-DeSchryver	Specific SI (initiations)	1.952380952	3	Lavender
Owen-DeSchryver	Specific SI (responses)	1.952380952	3	Lavender
Petursdottir	Rick Specific SI (initiations)	2.444444444	2	Dark Blue
Petursdottir	Joe Specific SI (initiations)	1.777777778	1	Dark Blue
Petursdottir	Bob Specific SI (initiations)	1.777777778	1	Dark Blue
Radley	Broad SI	2.904761905	4	Yellow
Schoen	Broad SI	2.682539683	3	Dark Green

Note. SI = social interaction.

Table 3

SCARF Scores of Rigor/Quality and Generalized Outcomes for Each Eligible Design for Participants with ASD

First Author	Dependent Variable	Rigor/Quality Score	Generalized Outcomes Score
Delano	Specific SI (social engagement)	3	4
Delano	Broad SI	3	4
Ganz	Dario Scripted phrases	4	4
Ganz	Dario Unscripted phrases	4	2
Ganz	Dario Context-related comments	4	4
Ganz	Dario Responses	4	4
Ganz	Dario Speech	4	2
Ganz	Max Scripted phrases	4	4
Ganz	Max Unscripted phrases	4	2
Ganz	Max Context-related comments	4	2
Ganz	Max Responses	4	3
Ganz	Max Speech	4	4
Ganz	Eddie Scripted phrases	4	4
Ganz	Eddie Unscripted phrases	4	2
Ganz	Eddie Context-related comments	4	4
Ganz	Eddie Responses	4	2
Ganz	Eddie Speech	4	3
Katz	Specific SI (initiations)	3	3
Katz	Specific SI (responses)	3	3
Kisac	Jack Broad SI	4	4
Kisac	Darrell Broad SI	4	4
Laushey	Max Broad SI	4	3
Laushey	Sam Broad SI	4	3

First Author	Dependent Variable	Rigor/Quality Score	Generalized Outcomes Score
Laushey	Cole Broad SI	4	3
Laushey	Kip Broad SI	4	3
McFadden	Specific SI (initiations)	3	2
McFadden	Broad SI	3	3
Schoen	Broad SI	3	1

Note. SI = social interaction.

Table 4

SCARF Scores of Rigor/Quality and Maintained Outcomes for Each Eligible Design for Participants with ASD

First Author	Dependent Variable	Rigor/Quality Score	Maintained Outcomes Score
Coogle	Broad SI	1	2
Delano	Specific SI (social engagement)	1	4
Delano	Broad SI	1	4
Kamps (1992)	Broad SI	4	3
Kamps (1999)	Broad SI	1	3
Katz	Specific SI (initiations)	4	4
Katz	Specific SI (responses)	4	4
Kisac	Jack Broad SI	4	4
Kisac	Darrell Broad SI	4	4
Kohler	Broad SI	1	4
Laushey	Max Broad SI	3	4
Laushey	Sam Broad SI	3	4
Laushey	Cole Broad SI	3	4
Laushey	Kip Broad SI	3	4
Loftin	Specific SI (initiations)	1	4
Loftin	Broad SI	1	4
McKenney	Specific SI (initiations)	1	2
McKenney	Specific SI (responses)	1	2
Radley	Broad SI	4	4
Schoen	Broad SI	1	1

Note. SI = social interaction.

Table 5

LRR Effect Size Estimates

First author	Participant with ASD	
	Effect Size (standard error)	Included Phase Comparison
Coogle	-0.59 (0.35)	3 A - B, 1P
Delano	1.24 (0.15)	1 A - B, 1P
	0.78 (0.22)	1 A - B, 1P
	0.65 (0.16)	1 A - B, 1P
Dugan	2.38 (0.47)	2 A - B, 1P
	2.21 (0.66)	2 A - B, 1P
Kamps (1992)	1.81 (0.57)	1 A - B, 1P
	0.84 (0.26)	1 A - B, 1P
	1.80 (0.49)	1 A - B, 1P
Kamps (1994)	0.96 (0.42)	1 A - B, 1P
	1.05 (0.22)	1 A - B, 1P
	1.69 (0.31)	1 A - B, 1P
Kamps (1999)	1.50 (0.75)	2 A - B, 1P
Kisac	3.54 (0.53)	3 A - B, 1P
	1.43 (0.21)	3 A - B, 1P
Kohler	3.13 (0.46)	1 A - B, 1P
	1.71 (0.35)	1 A - B, 1P
	2.41 (0.24)	1 A - B, 1P
Laushey	0.86 (0.16)	3 A - B, 1P
	0.73 (0.14)	3 A - B, 1P
	0.58 (0.21)	3 A - B, 1P
	0.73 (0.20)	3 A - B, 1P
Loftin	1.05 (0.20)	1 A - B, 1P
	2.62 (0.61)	1 A - B, 1P
	1.24 (0.49)	1 A - B, 1P
Mason	1.44 (0.19)	1 A - B, 1P
	1.81 (0.23)	1 A - B, 1P
	1.88 (0.28)	1 A - B, 1P

First author	Participant with ASD	
	Effect Size (standard error)	Included Phase Comparison
McFadden	2.15 (0.32)	1 A - B, 1P
	1.08 (0.27)	1 A - B, 1P
	0.79 (0.38)	1 A - B, 1P
	1.61 (0.19)	1 A - B, 1P
Radley	1.49 (0.24)	1 A - B, 1P
	1.84 (0.43)	1 A - B, 1P
	0.92 (0.34)	1 A - B, 1P
	1.62 (0.69)	1 A - B, 1P
	0.94 (0.27)	1 A - B, 1P
Schoen	0.97 (0.16)	1 A - B, 1P
	0.49 (0.14)	1 A - B, 1P
	0.64 (0.23)	1 A - B, 1P
	0.84 (0.08)	1 A - B, 1P

Note. A – B = A single baseline versus PMII comparison. 1P = Metric represents data from a single participant.

Table 6

Meta-Analysis Results Based on LRR-i Effect Sizes for Broad Social Interaction

Outcome	Studies	Cases	LRR		Percentage Change		*df*	*t*	$\tau^{\wedge 2}$	$\omega^{\wedge 2}$
			Average Effect (SE)	95% CI	Average Effect	95% CI				
Participants with ASD	13	40	1.41 (0.15)***	(1.11, 1.70)	310	(203, 447)	39	9.61	0.21**	0.08**

Note. SE = standard error, df = degrees of freedom, CI = confidence interval. $\tau^{\wedge 2}$ = estimated between-study variance. $\omega^{\wedge 2}$ = estimated within-study variance. $^{**}p < .01$, $^{***}p < .001$.

Table 7

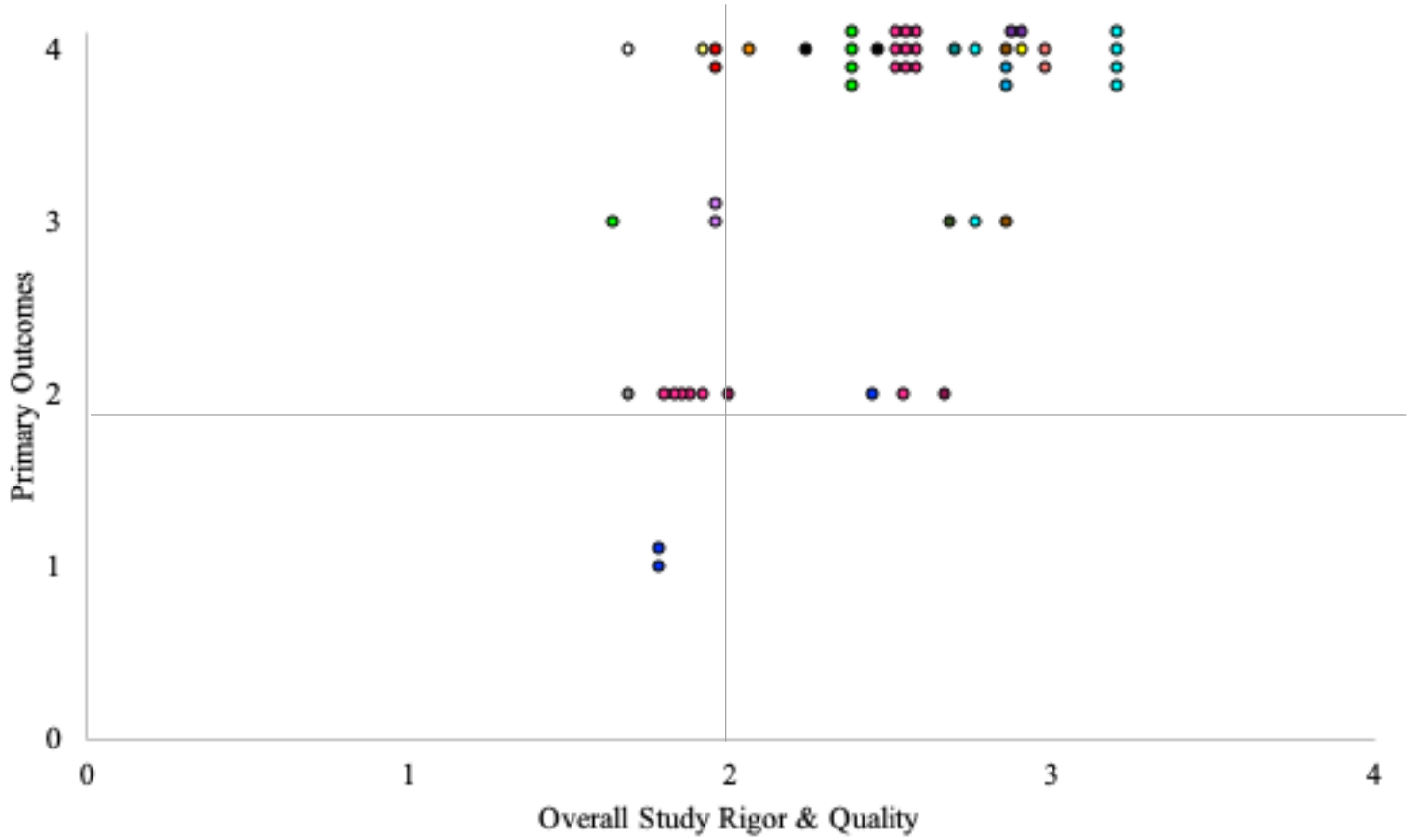
Meta-Regression Results

Moderators	Average Effect (SE)	95% CI	*df*	*F*	*p*
Educational Placement			(1, 38)	0.91	0.35
General Ed. Placement	1.54 (0.20)	(1.14, 1.94)			
General Ed & Special Ed. Placement	1.30 (0.18)	(0.94, 1.66)			
Intervention Implementer			(2, 37)	5.33	0.01*
Researcher Implementer	1.22 (0.17)	(0.88, 1.55)			
Teacher Implementer	2.32 (0.31)**	(1.69, 2.94)			
Researcher & Staff	1.26 (0.17)	(0.91, 1.61)			
Grade Level			(1,38)	1.01	0.32
Lower Elementary	1.39 (0.16)	(1.07, 1.71)			
Upper Elementary	1.53 (0.19)	(1.44, 1.92)			
Components in PMII (Peer Supports)			(1,38)	0.53	0.47
Peer Supports PMII	1.61 (0.31)	(0.97, 2.24)			
No Peer Supports PMII	1.35 (0.17)	(1.01, 1.69)			
Components in PMII (Scripting)			(1,38)	0.00	0.96
Scripting	1.42 (0.31)	(0.79, 2.05)			
No Scripting	1.40 (0.18)	(1.05, 1.76)			

Note. SE = standard error, df = degrees of freedom, CI = confidence interval. $^{*}p < .05$, $^{**}p < .01$.

Figure 1

SCARF Scores of Rigor/Quality and Primary Outcomes for Each Eligible Design for Participants with ASD



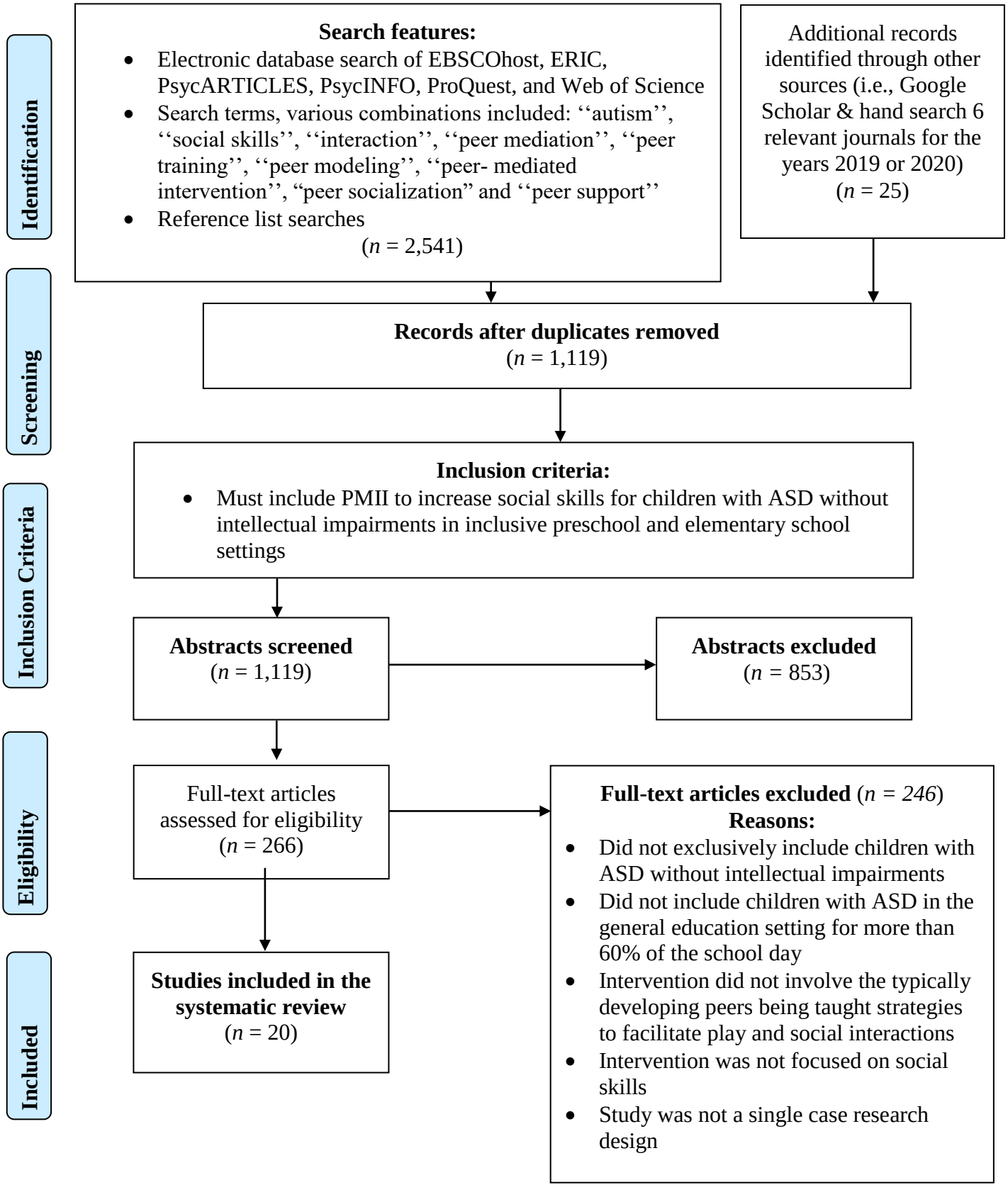
Appendices

Appendix A

Exclusion Criteria for Studies

Number	Exclusion Criterion
1.	Target participants did not have a diagnosis of ASD or Asperger's Syndrome or Autistic Disorder or PDD-NOS or did not qualify for special education service under the category of autism.
2.	Children with ASD had intellectual impairments (e.g., IQ scores < 70 or author reported participants had severe cognitive deficits).
3.	Children with ASD spend less than 50% of the time in the general education setting.
4.	Participating peers were not typically developing.
5.	Typically developing peers played a limited role in the PMII: • Peers were recipients of social initiations without any training • Peers were placed in an orchestrated setting to enhance peer interaction, but no adult direction/training was given • Children with ASD observed peers perform particular behaviors without any interaction between the two (e.g., video modelling of peers without any active peer to participant with ASD interaction)
6.	Study took place at a clinic, or home, or secluded classroom, or therapy room.
7.	Dependent variables did not include measures of social interaction.
8.	Study was not a single case research design and did not show at least three opportunities to demonstrate intervention effect.
9.	Study was a group design.
10.	Study was a commentary, opinion, or a discussion piece.
11.	Study was a meta-analysis or a systematic literature review.

Appendix B
PRISMA Flowchart



Appendix C

Inclusion Criteria Reliability Form

Directions: Please complete each column with ‘yes’ or ‘no’ based on the inclusion/exclusion criteria below. For studies you think that should not be included, please give the reason in the last column.

Study Code	It is a PMII	English Publication	At least one target skill is social interaction skill	Participants are children with ASD without intellectual impairments and their typically developing peers	Intervention conducted in inclusive preschool or elementary school setting	Single-case design	Data provided within line graph or table	Include	If no, why?

Appendix D

SCARF Coding Instructions

Section 1: Rigor
The first three components (and most highly weighted) are regarding the believability and sufficiency of the dependent variables (reliability), procedures (fidelity), and data.

Section 2: Quality and Breadth of Measurement
The next seven components are ratings regarding important components regarding author descriptions necessary for replication (participant, condition, and dependent variables), presence of social and ecological validity indicators, and measurement of maintenance and generalization (response or stimulus generalization).

Section 3: Outcomes
The next three coding components are regarding the primary outcomes, generalization outcomes, and maintenance outcomes.

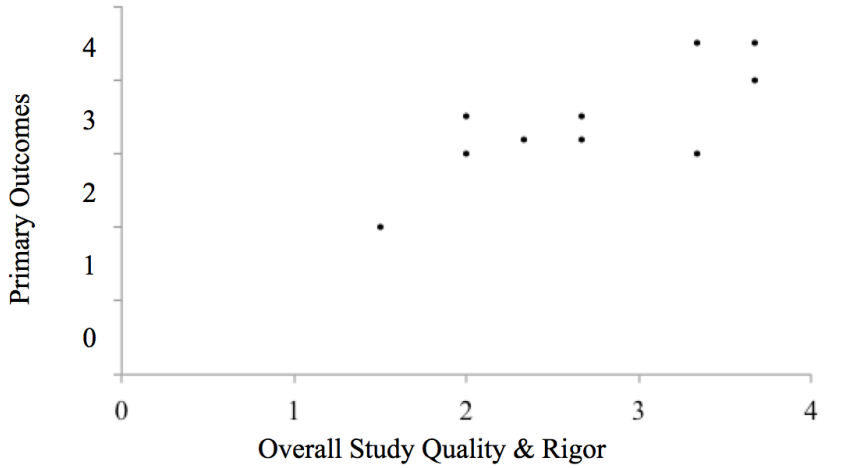
Scores
Scores (automatically populated and shown in graphs) are calculated based on the following formulas:

Graph #1: Primary Outcomes
Overall Quality & Rigor (range: 0-4) = [2 x (average rigor score) + (average quality and breadth of measurement score)]/3
Primary Outcomes (range 0-4) = Score coded by reader, based on visual analysis

Graph #2: Generalized Outcomes
Quality & Rigor of Generalization Measurement (range 0-4) = Higher value of generalization scores coded by reader based on timing and consistency of response and/or stimulus generalization measurement
Generalized Outcomes (range 0-4) = Score coded by reader, based on consistency of generalized effects *and* confidence in effects based on measurement occasions (e.g., 3 coded for consistent positive effects with pre- and post-tests; 4 coded for consistent positive effects in context of single case design).

Graph #3: Maintained Outcomes
Quality & Rigor of Generalization Measurement (range 0-4) = Score coded by reader (M3) based on timing of maintenance measurement and number of measurement occasions
Maintained Outcomes (range 0-4): Score coded by reader, based on consistency of maintained effects *and* confidence in effects based on measurement occasions

Graphed Scores Generated from Hypothetical Coding Results



Source: Ledford, J. R., Lane, J. D., Zimmerman, K. N., Chazin, K. T., & Ayres, K. A. (2016, April). Single case analysis and review framework (SCARF). Retrieved from: http://ebip.vkcsites.org/scarf/

Appendix E

Descriptive Coding Reliability Checklist

Directions: Please read the summary and the article and circle yes or no.

Study Code: _____ Evaluator: _____ ( ) Primary ( ) Secondary

1. Is this accurate information of the publication year, status (peer-reviewed or not), and design type?	Yes	No
2. Is this an accurate summary of the inclusive setting?	Yes	No
3. Is this an accurate summary of the adult facilitators?	Yes	No
4. Is this an accurate summary of the participants with ASD (gender, age, race/ethnicity)?	Yes	No
5. Is this an accurate summary of the typically developing peers (gender, age, race/ethnicity, criteria chosen to implement PMII)?	Yes	No
6. Is this an accurate summary of behavioral procedures of the intervention used?	Yes	No
7. Is this an accurate summary of dependent variables investigated?	Yes	No
8. Is this an accurate summary description of intervention procedures?	Yes	No
9. Is this an accurate summary description of the results?	Yes	No
10. Is this accurate information of social validity assessment?	Yes	No

Adapted from: Camargo, S. P. H., Rispoli, M., Ganz, J., Hong, E. R., Davis, H., & Mason, R. (2016). Behaviorally based interventions for teaching social interaction skills to children with ASD in inclusive settings: A meta-analysis. *Journal of Behavioral Education, 25*(2), 223-248.

Appendix F

SCARF Coding Reliability Checklist

Study Code: _____ Evaluator: _____ ( ) Primary ( ) Secondary

SCARF DOMAIN	SCARF SCORE
Data Sufficiency	
Participant Descriptions	
Social & Ecological Validity	
Condition Descriptions	
Dependent Variable	
Reliability	
Fidelity	
Maintenance	
Generalization	

Appendix G

Moderator Coding Reliability Checklist

Study Code: _____ Evaluator: _____ ( ) Primary ( ) Secondary

MODERATORS	MODERATOR CODE
Educational Placement (e.g. general education and general education in combination with special education)	
Participant Age/Grade Level (e.g., lower elementary, 6-9 years and upper elementary, 10-12 years)	
Behavioral Components Utilized in PMII (e.g., peer supports and scripting)	
Intervention Implementer (e.g., researcher, teacher, and researcher in combination with school staff)	

Appendix H

R Code and Output for Multilevel Meta-analysis

R Code

```
"Metadata1" <- read.csv("Metadata1.csv")
attach(Metadata1)
library(metafor)

overall <- rma.mv(LRR, Variance,
            random = list(~ 1 | EffectSizeID, ~ 1 | StudyID),
            tdist= TRUE, data= Metadata1)
summary(overall, digits=3)

modelnovar2 <- rma.mv(LRR, Variance,
                      random = list(~ 1 | EffectSizeID, ~ 1 | StudyID),
                      sigma2=c (0, NA),
                      tdist= TRUE, data= Metadata1)
anova(overall,modelnovar2)
modelnovar3 <- rma.mv(LRR, Variance,
                      random = list(~ 1 | EffectSizeID, ~ 1 | StudyID),
                      sigma2=c (NA, 0),
                      tdist= TRUE, data= Metadata1)
anova(overall,modelnovar3)

n <- length(Metadata1$Variance)
list.inverse.variances <- 1 / (Metadata1$Variance)
sum.inverse.variances <- sum(list.inverse.variances)
squared.sum.inverse.variances <- (sum.inverse.variances) ^ 2
list.inverse.variances.square <- 1 / (Metadata1$Variance^2)
sum.inverse.variances.square <-
  sum(list.inverse.variances.square)
numerator <- (n-1) * sum.inverse.variances
denominator <- squared.sum.inverse.variances -
sum.inverse.variances.square

estimated.sampling.variance <- numerator/denominator
I2_1 <- (estimated.sampling.variance)/ (overall$sigma2 [1]
      + overall$sigma2[2] + estimated.sampling.variance)
```

```
I2_2 <- (overall$sigma2[1]) / (overall$sigma2[1]
      + overall$sigma2[2] + estimated.sampling.variance)

I2_3 <- (overall$sigma2[2]) / (overall$sigma2[1]
      + overall$sigma2[2] + estimated.sampling.variance)
amountvariancelevel1 <- I2_1 * 100
amountvariancelevel2 <- I2_2 * 100
amountvariancelevel3 <- I2_3 * 100

amountvariancelevel1
amountvariancelevel2
amountvariancelevel3
```

R Output

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -34.649    69.297    75.297    80.288    75.983

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.082  0.286     40     no  EffectSizeID
sigma^2.2  0.213  0.462     13     no       StudyID

Test for Heterogeneity:
Q(df = 39) = 212.140, p-val < .001

Model Results:

estimate     se   tval   pval  ci.lb  ci.ub
   1.406  0.146  9.612  <.001  1.110  1.701  ***

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
         df     AIC     BIC    AICc   logLik    LRT   pval       QE
Full      3 75.2971 80.2877 75.9828 -34.6485                212.1400
Reduced   2 82.6442 85.9713 82.9775 -39.3221 9.3471 0.0022 212.1400
```

```
         df     AIC     BIC    AICc   logLik     LRT   pval       QE
 Full     3 75.2971 80.2877 75.9828 -34.6485                 212.1400
 Reduced  2 84.8052 88.1324 85.1386 -40.4026 11.5082 0.0007 212.1400
```

Appendix I

R Code and Output for Meta-regression

R Code

```
#Moderator Analysis

NotInGeneral <- rma.mv(LRR, Variance, mods = ~ GeneralPlacement, random = list(~ 1 | EffectSizeID, ~
                1 | StudyID), tdist=TRUE, data= Metadata1)
summary(NotInGeneral, digits=3)

GeneralPlacementS <- rma.mv(LRR, Variance, mods = ~ BothPlacement, random = list(~ 1 | EffectSizeID, ~
                   1 | StudyID), tdist=TRUE, data= Metadata1)
summary(GeneralPlacementS, digits=3)

ResearcherImp <- rma.mv(LRR, Variance, mods = ~ TeacherImpID + ResearcherStaffImpID, random = list(~
                 1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(ResearcherImp, digits=3)

TeacherImplementer <- rma.mv(LRR, Variance, mods = ~ ResearcherImpID + ResearcherStaffImpID, random = list(~
                1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(TeacherImplementer, digits=3)

ResearcherandStaffImplementer <- rma.mv(LRR, Variance, mods = ~ ResearcherImpID + TeacherImpID, random = list(~
                1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(ResearcherandStaffImplementer, digits=3)

LowerElementary <- rma.mv(LRR, Variance, mods = ~ UE, random = list(~
                 1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(LowerElementary, digits=3)

UpperElementary <- rma.mv(LRR, Variance, mods = ~ LE, random = list(~
                1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(UpperElementary, digits=3)

NotusedPeerSupport <- rma.mv(LRR, Variance, mods = ~ PeerSupports, random = list(~
                   1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                  summary(NotusedPeerSupport, digits=3)
(Top Level)
```

```
PeerSupport <- rma.mv(LRR, Variance, mods = ~ NoPeerSupport, random = list(~
               1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(PeerSupport, digits=3)

NotusedScripting <-rma.mv(LRR, Variance, mods = ~ Scripting, random = list(~
                  1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(NotusedScripting, digits=3)

Scripting <-rma.mv(LRR, Variance, mods = ~ NoScripting, random = list(~
            1 | EffectSizeID, ~ 1 | StudyID), tdist=TRUE, data= Metadata1)
                 summary(Scripting, digits=3)
```

R Output

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.584    67.168    75.168    81.719    76.380

Variance Components:

            estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.094  0.306     40     no  EffectSizeID
sigma^2.2  0.191  0.437     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 188.328, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.912, p-val = 0.346

Model Results:

                  estimate     se   tval   pval   ci.lb  ci.ub
intrcpt              1.302  0.178  7.327  <.001   0.942  1.662  ***
GeneralPlacement     0.236  0.247  0.955  0.346  -0.264  0.736

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.584    67.168    75.168    81.719    76.380

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.094  0.306     40     no  EffectSizeID
sigma^2.2  0.191  0.437     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 188.328, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.912, p-val = 0.346

Model Results:

               estimate     se    tval   pval   ci.lb  ci.ub
intrcpt           1.538  0.198   7.754  <.001   1.137  1.940  ***
BothPlacement    -0.236  0.247  -0.955  0.346  -0.736  0.264

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -29.214    58.428    68.428    76.482    70.363

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.069  0.263     40     no  EffectSizeID
sigma^2.2  0.105  0.325     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 37) = 143.749, p-val < .001

Test of Moderators (coefficients 2:3):
F(df1 = 2, df2 = 37) = 5.328, p-val = 0.009

Model Results:

                     estimate     se   tval   pval   ci.lb  ci.ub
intrcpt                 1.216  0.166  7.323  <.001   0.880  1.552  ***
TeacherImpID            1.101  0.351  3.141  0.003   0.391  1.811   **
ResearcherStaffImpID    0.046  0.240  0.190  0.850  -0.441  0.532

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -29.214    58.428    68.428    76.482    70.363

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.069  0.263     40     no  EffectSizeID
sigma^2.2  0.105  0.325     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 37) = 143.749, p-val < .001

Test of Moderators (coefficients 2:3):
F(df1 = 2, df2 = 37) = 5.328, p-val = 0.009

Model Results:

                     estimate     se    tval   pval   ci.lb   ci.ub
intrcpt                 2.317  0.309   7.505  <.001   1.692   2.943  ***
ResearcherImpID        -1.101  0.351  -3.141  0.003  -1.811  -0.391   **
ResearcherStaffImpID   -1.056  0.354  -2.981  0.005  -1.773  -0.338   **

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -29.214    58.428    68.428    76.482    70.363

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.069  0.263     40     no  EffectSizeID
sigma^2.2  0.105  0.325     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 37) = 143.749, p-val < .001

Test of Moderators (coefficients 2:3):
F(df1 = 2, df2 = 37) = 5.328, p-val = 0.009

Model Results:

                estimate     se    tval   pval   ci.lb  ci.ub
intrcpt            1.262  0.173   7.276  <.001   0.910  1.613  ***
ResearcherImpID   -0.046  0.240  -0.190  0.850  -0.532  0.441
TeacherImpID       1.056  0.354   2.981  0.005   0.338  1.773   **

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.822    67.644    75.644    82.195    76.856

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.093  0.304     40     no  EffectSizeID
sigma^2.2  0.208  0.456     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 209.003, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 1.007, p-val = 0.322

Model Results:

         estimate     se    tval   pval   ci.lb  ci.ub
intrcpt     1.532  0.192   7.998  <.001   1.144  1.920  ***
LE         -0.185  0.184  -1.004  0.322  -0.557  0.188

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
---
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -34.269    68.537    76.537    83.087    77.749

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.090  0.300     40     no  EffectSizeID
sigma^2.2  0.223  0.472     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 191.233, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.167, p-val = 0.686

Model Results:

         estimate     se   tval   pval   ci.lb  ci.ub
intrcpt     1.390  0.157  8.875  <.001   1.073  1.707  ***
UE          0.077  0.188  0.408  0.686  -0.304  0.458

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.532    67.064    75.064    81.614    76.276

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.080  0.283     40     no  EffectSizeID
sigma^2.2  0.225  0.475     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 196.173, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.526, p-val = 0.473

Model Results:

              estimate     se   tval   pval   ci.lb  ci.ub
intrcpt          1.348  0.170  7.943  <.001   1.005  1.692  ***
PeerSupports     0.259  0.357  0.725  0.473  -0.464  0.981

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.532    67.064    75.064    81.614    76.276

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.080  0.283     40     no  EffectSizeID
sigma^2.2  0.225  0.475     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 196.173, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.526, p-val = 0.473

Model Results:

               estimate     se    tval   pval   ci.lb  ci.ub
intrcpt           1.607  0.314   5.119  <.001   0.971  2.243  ***
NoPeerSupport    -0.259  0.357  -0.725  0.473  -0.981  0.464

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.809    67.618    75.618    82.168    76.830

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.083  0.288     40     no  EffectSizeID
sigma^2.2  0.238  0.488     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 209.086, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.003, p-val = 0.958

Model Results:

           estimate     se   tval   pval   ci.lb  ci.ub
intrcpt       1.404  0.176  7.996  <.001   1.049  1.760  ***
Scripting     0.019  0.358  0.053  0.958  -0.705  0.743

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Multivariate Meta-Analysis Model (k = 40; method: REML)

  logLik  Deviance       AIC       BIC      AICc
 -33.809    67.618    75.618    82.168    76.830

Variance Components:

           estim   sqrt  nlvls  fixed        factor
sigma^2.1  0.083  0.288     40     no  EffectSizeID
sigma^2.2  0.238  0.488     13     no       StudyID

Test for Residual Heterogeneity:
QE(df = 38) = 209.086, p-val < .001

Test of Moderators (coefficient 2):
F(df1 = 1, df2 = 38) = 0.003, p-val = 0.958

Model Results:

             estimate     se    tval   pval   ci.lb  ci.ub
intrcpt         1.423  0.312   4.570  <.001   0.793  2.054  ***
NoScripting    -0.019  0.358  -0.053  0.958  -0.743  0.705

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```