

**BEHAVIORALLY-BASED INTERVENTIONS FOR IMPROVING SOCIAL  
INTERACTION SKILLS OF CHILDREN WITH ASD IN INCLUSIVE  
SETTINGS: A SYSTEMATIC REVIEW AND META-ANALYSIS**

A Dissertation

by

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## ABSTRACT

Students with autism spectrum disorders present deficits in social interaction skills that may prevent their successful inclusion in general education placements. Considering the increasing number of children with autism spectrum disorders (ASD) being educated in inclusive settings and recent requirements on the use of research-based interventions in schools, the purposes of this study were (1) to evaluate the quality of single-case research and determine whether behaviorally-based interventions to improve social interaction skills of children with ASD in inclusive settings can be considered evidence-based practices and (2) to conduct a meta-analysis investigating whether specific factors such as participants' age, behavioral components used in the intervention, target social interaction skills, intervention implementer, and peer training moderate effectiveness of the interventions.

Specific criteria for quality of single-case research were used to classify studies according to their certainty of evidence. Tau-U, a non-parametric index of effect size in single-case research, was used to measure the intervention's magnitude of change on target outcomes. Differences between levels of the moderators were analyzed using statistical significance test ( $p = .05$ ) through the use of 83.4% confidence intervals. Results indicate that the use of behaviorally-based interventions to improve social interaction skills of students with ASD in inclusive settings can be considered evidence-based practices. In addition, the interventions produced overall high effect size,

indicating their effectiveness based on studies meeting minimum standards of methodological quality. More specifically, the interventions are demonstrated to be effective for preschool and elementary school children between the ages of 2 and 10 years. Studies targeting social interaction initiations or responses in isolation were more effective than studies focusing on both skills. While interventions using planned reinforcement were shown to be more effective, no differential effects were found regarding the use of planned modeling. No differences were found regarding intervention implementer. Finally, the use of peer training did not appear to increase effectiveness of the behaviorally-based social skill interventions. The results and their implications for practice and future research are discussed.

## **DEDICATION**

To my beloved husband, Edinaldo Camargo, without whom it would NOT be possible.

To my parents, who always helped me to reach my dreams.

To my sister, Francine, and her family and my aunt Cleusa, my constant supporters.

To the Brazilian people, especially the Brazilian children with autism.

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# CHAPTER I

## INTRODUCTION

In the United States, federal legislation clearly requires providing children with disabilities the right of receiving free appropriate public education (FAPE) in the least restrictive environment (LRE; Yell, 2006). While the definition of inclusion is not universal (Fuchs & Fuchs, 1998; Humphrey, 2008; Polat, 2011), the Individuals with Disabilities Education Act (IDEA) mandates the education of children with disabilities in the general education for the maximum extent possible (Koegel, Matos-Freden, Lang & Koegel, 2012; Yell & Shriener, 1996). Thus, an increased trend in including children with disabilities in the general education system has been observed in the last decades (Harrower & Dunlap, 2001; Kamens, Loprete, & Slostad, 2003; Leach, 2010).

Students with autism spectrum disorders (ASD) are being increasingly educated in inclusive classrooms (Hart & Whalon, 2011; Koegel et al., 2012; Owen-DeSchryver, Carr, Cale & Blakeley-Smith, 2008). Besides the fact that federal laws require local education agencies to consider the least restrictive environment for students with disabilities, inclusive placements for children with ASD are increasing every year due to an astonishing increase in the prevalence of ASD in the last decades (Leach, Witzel, & Flood, 2009; Wing, Potter, Goldstein, Naglieri, & Ozonoff, 2009). Latest data on prevalence of ASD in the United States estimates that the number of cases may now be as high as 1 in 88 children; a 23% increase over the last five years (Centers for Disease Control and Prevention, 2012). Thus, with the increased inclusion of students with ASD,

general education teachers are faced with the challenge of meeting the educational needs of these children (Leach et al., 2009).

Inclusion of children with ASD may be challenging because of the nature of autism (Simpson, de Boer-Ott, & Smith-Myles, 2003). ASD is a pervasive and lifelong condition that is characterized by deficits in social interaction skills, communication difficulties and engagement in repetitive and stereotyped behaviors (American Psychiatric Association, 2000). ASD can affect children from any race and culture and the expression of symptoms may vary from mild to severe across these three core areas (Bertoglio & Hendren, 2009). Because of variation on the severity of symptoms, ASD represents an umbrella term including varying characteristics of children with autism, Asperger's syndrome, and pervasive developmental disorder - not otherwise specified (American Psychiatric Association, 2000; Leach et al., 2009; von der Embse, Brown, & Fortain, 2011). Despite individual differences, children with ASD consistently present impairments in social and communication skills that may hinder their successful education in inclusive settings.

Lack of ability to engage in reciprocal social interaction is considered the most detrimental feature of ASD (Boyd, Conroy, Asmus, McKenney, & Mancil, 2008; Kanner, 1943; Matson & Wilkins, 2007; White, Keonin, & Scahill, 2007). Impairments in social interactions skills are manifested in a variety of areas such as initiating and responding to social interactions with peers and adults, sustaining eye contact, sharing objects and activities, and responding to other's feelings (Baker, 2001; Janzen, 2003). These social interaction skills deficits can lead to subsequent failure to develop

meaningful social relationships with others (Baker, 2001; Boyd et al., 2008). As meaningful social relationships with others are prerequisites necessary for social, emotional and cognitive development, limited ability to socially interact with family members, peers, and other adults can lead to further detrimental outcomes that compromise achievement of normal developmental milestones and future independent living (Krasny, Williams, Provencal, & Ozonoff, 2003). Difficulties engaging with others can result in harmful long-term outcomes, as they are associated with poor academic performance, peer rejection, social isolation, social anxiety, and even increased risk of earlier death (Bellini, 2006; Berkman, 1995; Tantam, 2000).

Opportunities to interact with same-age peers without disabilities in inclusive settings is often seen as the ideal context to reduce the risks associated with impairments in social skills of students with ASD as they can benefit from less isolation, more stimulating environment, and behavioral models from typical peers (Anderson, Moore, Godfrey, & Fletcher-Flinn, 2004; Rotheram-Fuller, Kasari, Chamberlain, & Lock, 2010; Karagiannis, Stainback, & Stainback, 1996; Mesibov & Shea, 1996). However, social deficits represent a major challenge for successful inclusion of students with ASD in general education, since they limit their ability to learn through social interactions, observation, and imitation (Charlop-Christy & Kelso, 2003; Greenway, 2000). Thus, placement of children with ASD in inclusive settings is unlikely to result in successful interaction and learning if they are not provided with interventions that attenuate their social impairments and facilitate interactions with peers (Gutierrez, Hale, Gossens-Archuleta, & Sobrino-Sanchez, 2007; Harrower & Dunlap, 2001; Rao, Beidel, &

Murray, 2008). Thus, identification of interventions that are effective in inclusive settings is paramount.

Among a proliferation of treatment options for students with ASD (Rogers, 1998; Vismara & Rogers, 2010), applied behavior analysis (ABA) has been shown to be the most efficacious treatment to support a variety of social, communication, and behavioral skills in children with ASD (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Landa, 2007). ABA is an applied science devoted to investigating the variables that affect human behavior and changing behaviors by modifying their antecedents and consequences (Sugai, Lewis-Palmer, & Hagan-Burke, 2000). For these purposes, ABA uses experimental and systematic methods of observation and measurement of behaviors (Mayer, Sulzer-Azaroff, & Wallace, 2012). By measuring observable behaviors, ABA takes a data-driven approach in the assessment and interventions of behaviors that are important for the individuals and society (Baer, Wolf, & Risley, 1968). Currently, ABA has been widely recognized as an effective treatment for individuals with ASD and has been recommended by a number of federal and state agencies including the Surgeon General of the United States (Rosenwasser & Axelrod, 2001). Thus, the use of ABA to treat and foster quality of life of individuals with ASD has dramatically increased in clinical and educational settings and has featured as the most used intervention for this public (Hundert, 2009).

ABA has been highly supported by research as an intervention approach for children with ASD for several decades (Gillis & Butler, 2007; Koegel, Koegel, Harrower, & Carter, 1999; Lovaas, 1987; Vaughn et al., 2003; Virués-Ortega, 2010).

Several studies have found significant gains in social skills of children with ASD receiving behavioral interventions (Gillis & Butler, 2007; Reichow & Volkmar, 2010; Ringdahl, Kopelman & Falcomata, 2009; Vaughn et al., 2003; Virués-Ortega, 2010; Vismara & Rogers, 2010). Further, in a review involving sixty-six studies implementing a variety of social skills interventions for children with ASD, including video modeling, visual scripts, and social stories, Reichow & Volkmar (2010) found that methods and techniques of ABA such as prompts, reinforcement, and modeling were the most common intervention components utilized. These behavioral components are associated with larger social skill intervention effects (Gillis & Butler, 2007; Vaughn et al., 2003; Virués-Ortega, 2010). However, most of the studies demonstrating efficacy of behaviorally-based interventions for social interaction skills of children with ASD are conducted in homes, clinical settings or segregated special education classrooms (Leach, 2010) and do not provide information regarding whether or not these interventions are equally effective in the unique context of inclusive settings.

Because most research involving behaviorally-based interventions for children with ASD employ single-case research designs (Wang, Cui, & Parrila, 2011, Reichow, Volkmar, & Cichetti, 2008), several single-case research studies have been found in the literature suggesting effectiveness of interventions utilizing behavioral principles and techniques to teach a variety of social skills to children with ASD in the general education classroom. For instance, studies have investigated strategies for initiating and responding to peers (e.g., Crozier & Tincani, 2007; Loftin, Odom, & Lantz, 2008), joining in activities and maintaining conversation (e.g., Sansosti & Powel-Smith, 2008),



context-related comments (e.g., Ganz & Flores, 2008), and reciprocal social interaction (Kohler, Greteman, Raschke & Highnam, 2007). However, the methodological quality of these single-case studies has not been examined, preventing conclusions that behaviorally-based interventions to teach social skills for children with ASD in inclusive settings can be considered evidence-based practices to support their inclusion.

Federal education legislation (Individuals with Disabilities Education Improvement Act [IDEA] of 2004; No Child Left Behind Act of 2001 [NCLB]) has placed considerable attention on the quality of scientific information (Odom et al., 2005). Application of quality indicators enhance credibility of scientific information by identifying methodologically appropriate studies that enable recommendation for effective interventions 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 an intervention can be considered an evidence-based practice (Gersten et al., 2005; Horner et al., 2005). As a result of this emphasis in quality research, IDEA and NCLB require teachers to use educational practices in schools that are considered evidence-based practices to ensure that students receive the highest quality instruction possible.

Despite the laws mandating that teachers and schools utilize evidence-based practices, teachers are provided with little information regarding what strategies are considered evidence-based practices for the specific context of inclusive settings (Lerman, Vorndran, Addison, & Kuhn, 2004). Although some reviews are found in the literature summarizing interventions that are considered evidence-based practices for

children with ASD (e.g., Koegel et al., 2012; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010; Simpson, 2005), such reviews are primarily based on studies conducted in segregated contexts of clinics and special education classrooms that may not generalize to less structured environments of general education classrooms. As a result of the lack of specific information regarding what is considered evidence-based practices for inclusive settings, teachers may adopt interventions that are not effective or research based for this context (Boardman, Arguelles, Vaughn, Hughes, & Klinger, 2005; Stahmer & Aarons, 2009).

The rising prevalence and diagnosis rates of ASD and the increasing number of these children being educated in general education classrooms highlight the need to assess the evidence-base in order to inform teachers regarding best practices to promote social skills and facilitate inclusion of students with ASD. While behaviorally-based interventions are effective for improving social interaction skills of children with ASD in other contexts, they have not yet been determined to be evidence-based practices for the context of general education. Therefore, the purpose of the first article of this dissertation (Chapter II) was to evaluate the quality of single-case design studies using behaviorally-based interventions to improve social interaction skills for children with ASD in inclusive settings and determine whether such interventions can be considered evidence-based practices.

Although determination for evidence-base practice can provide valuable information that can assist teachers and practitioners when choosing strategies to improve social skills and support inclusion of children with ASD, it does not provide

information regarding the effectiveness of these interventions and specific conditions that may increase their effectiveness in inclusive settings (Odom et al., 2005). As no meta-analysis to date have reviewed and aggregated individual studies to address these aspects, teachers are often faced with the challenging task of meeting individual needs of students with ASD in the absence of clear guidelines regarding procedural and contextual aspects that can lead to better outcomes for children with ASD (Simpson et al., 2003). Therefore, answers needed in the area of inclusion also involve determination of differential effects of interventions on children and contexts having different characteristics (Gena, 2006; Kavale, 2000; Lindsay, 2007; Mesibov & Shea, 1996). It is necessary to provide teachers with information regarding the effectiveness of behaviorally-based social skills interventions according to potential moderators such as participant characteristics, intervention variables, and implementation procedures (Odom et al., 2005).

To fill this gap in the literature, the second article of this dissertation (Chapter III), utilized meta-analytic techniques that allow aggregation of effects across studies (Kavale, 2001) to determine differential outcomes that are related to participant age. Additionally, differential effects that occur based on behavioral components used in the intervention and types of social interaction skills targeted in the intervention are analyzed. Finally, the study analyzes specific implementation procedures such as intervention implementer and additional peer training as potential moderators for the magnitude of change that occurs with the implementation of behaviorally-based

interventions to improve social interaction skills of students with ASD included in general education.

**CHAPTER II**

**BEHAVIORALLY-BASED INTERVENTIONS TO IMPROVE SOCIAL  
INTERACTION SKILLS OF CHILDREN WITH ASD IN INCLUSIVE  
SETTINGS: QUALITY OF RESEARCH AND DETERMINATION FOR  
EVIDENCE-BASED PRACTICE**

An increasing number of students with disabilities are being educated in general education settings (Koegel, Matos-Freden, Lang & Koegel, 2012; Owen-DeSchryver, Carr, Cale & Blakeley-Smith, 2008). In 2008, 95% of students with disabilities (ages 3-21), including those with autism spectrum disorders (ASD), were already receiving educational services in general education classrooms (U.S. Department of Education, 2011). With federal mandates (Individuals with Disabilities Education Improvement Act, 2004 and No Child Left Behind, 2001) requiring that children with disabilities receive a free and appropriate public education in the least restrictive environment (Yell, 2006; Yell & Shriner, 1996), the number of students with ASD included in general education classrooms tend to increase every year (Leach, 2010).

Advocates of inclusion suggest that placement of children with ASD in general education can promote academic and social benefits due to reduced isolation and stigma, increased teacher's expectations, access to a more stimulating environment, and behavioral models from typical peers (Anderson, Moore, Godfrey, & Fletcher-Flinn, 2004; Karagiannis, Stainback, & Stainback, 1996; Mesibov & Shea, 1996; Rotheram-Fuller, Kasari, Chanberlaim, & Lock, 2010). However, such benefits may be reduced for

children with ASD as a result of their core social deficits and difficulty learning through social interactions (Bellini, Peters, Benner, & Hopf, 2007; Charlop-Christy & Kelso, 2003; Greenway, 2000).

Individuals with ASD have difficulties initiating and responding to social interactions with peers and adults, difficulties sustaining eye contact, sharing objects and activities, and responding to other's feelings (Baker, 2001; Baron-Cohen, 2004; Boyd, Conroy, Asmus, McKenney, & Mancil, 2008; Hart & Whalon, 2008; Janzen, 2003; Klin et al., 2007). Difficulty comprehending and responding to non-verbal communication as well as deficits in social problem solving are also central problems for individuals with ASD (Baker, 2001; Boyd et al., 2008). Such deficits in social functioning interfere with social, emotional and cognitive development, thereby impeding the establishment of meaningful relationships. Lack of meaningful relationships can lead to detrimental outcomes such as poor academic performance, peer rejection, social isolation, and social anxiety (Bellini, 2006; Bellini et al., 2007; Tantam 2000; Welsh, Parke, Widaman, & O'Neil, 2001). Additionally, lack of social skills may lead to problem behaviors that compromise the long term success of children with ASD in inclusive settings and may result in their placement in more segregated environments (Howlin, Goode, Hutton, & Rutter, 2004; Romanczyk, White & Gillis, 2005). To ensure that children with ASD remain in inclusive settings and satisfactorily benefit from their education in general education, it is necessary to provide these children with interventions that attenuate their social impairments and facilitate interactions with peers (Gutierrez, Hale, Gossens-Archuleta, & Sobrino-Sanchez, 2007; Harrower & Dunlap, 2001).

Several interventions for improving social skills of individuals with ASD have been investigated (Bellini et al., 2007; Gillis & Butler, 2007; Matson, Matson, & Rivet, 2007; Reichow & Volkmar, 2010; Scattone, 2007; White, Keonin, & Scahill, 2007). Examples of such interventions include video modeling (e.g., Apple, Billingsley, Schwartz, & Carr, 2005; Simpson, Langone, & Ayres, 2004), priming (e.g., Zanolli, Daggett, & Adams, 1996), self-management (e.g., Morrison, Kamps, Garcia, & Parker, 2001), written scripts (e.g., Krantz & McClannahan, 1993; Krantz & McClannahan, 1998), social stories (e.g., Thiemann & Goldstein, 2001), and pivotal response training (e.g., Pierce & Schreibman, 1995). Despite the variety of social skills interventions found in the literature, previous studies reviewing these interventions for children with ASD have indicated that methods and techniques of Applied Behavior Analysis (ABA) are frequently incorporated as intervention components (Gillis & Butler, 2007; Matson et al., 2007; Reichow & Volkmar, 2010; Vaughn et al., 2003; Virués-Ortega, 2010). Further, interventions using behavioral components have been demonstrated to be among the most effective social skills interventions for children with ASD (Gillis & Butler, 2007; Matson et al., 2007; Vaughn et al., 2003; Virués-Ortega, 2010).

ABA is a research-based intervention approach that involves systematic application of methods derived from behavioral principles to improve socially significant behavior in a meaningful and positive way (Baer, Wolf, & Risley, 1968). As a scientific approach, ABA is defined as a method to evaluate, explain, and change human behaviors. ABA investigates the variables that affect human behavior, being able to change the behaviors by modifying their antecedents and consequences (Sugai,

Lewis-Palmer, & Hagan-Burke, 2000). General features of ABA interventions typically involve identification of the target behavior, followed by systematic methods of selecting goals, writing objectives, and explicitly designing interventions involving behavioral strategies shown to be effective. Additionally, ABA is characterized by collecting baseline and intervention data to analyze the individual's progress and make instructional decisions to promote skill acquisitions (Baer, Wolf, & Risley, 1968, 1987; Hundert, 2009). This highly structured intervention approach is shown to be effective to children with ASD who typically respond to routine and directness (Schoen, 2003). Thus, ABA has been widely used and recommended to treat and foster quality of life of individuals with ASD (Hundert, 2009; Rosenwasser & Axelrod, 2001).

The principles and techniques of ABA have been effectively used for treating a variety of social, communication and behavioral deficits in children with ASD for several decades (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Landa, 2007; Lovaas, 1987). A recent meta-analysis (Virués-Ortega, 2010) investigating effectiveness of behaviorally-based interventions reported that such interventions resulted in medium to large effect sizes in social functioning of young participants with autism. It is important to note, however, that the studies included in this meta-analysis were primarily conducted in settings other than inclusive classrooms, not specifically informing the effectiveness of the interventions for the unique environment of inclusive settings.

Although behaviorally-based interventions have been shown to be effective in improving social skills, this type of intervention is infrequently conducted in inclusive settings (Gresham, Sugai, & Horner, 2001). Typically, behaviorally-based interventions



are conducted in homes, clinical settings, or special education classrooms. However, to provide more effective behaviorally-based social skills interventions for children with ASD, it is necessary to implement such interventions in the natural context in which students will actually use the skills learned (Bellini et al., 2007, Gresham et al., 2001). Therefore, to improve social skills of children with ASD in inclusive settings is necessary to provide them with systematic behavioral instruction in general education settings.

One reason behaviorally-based interventions should be implemented in inclusive settings to improve social interaction skills of children with ASD is because they commonly have difficulties generalizing learned skills (Bellini et al., 2007). Generalization is a central problem in individuals with ASD in which they may not transfer the skills learned in teaching situations to nonteaching situations involving different materials, places, or people (Heflin & Alaimo, 2007; Plaisted, 2001). A child with ASD who receives behaviorally-based intervention in a clinical setting, for example, may not transfer learned social interactions skills to an inclusive classroom, which involves different social contexts and people (Leach, 2010).

Another reason to implement behaviorally-based interventions in inclusive settings is that mere exposure to typically developing children is not the mechanism by which children with ASD gain meaningful social experiences and benefit from inclusion (Gutierrez et al., 2007; Hunt & Goetz, 1997; Kohler, Strain, & Shearer, 1996). The core social impairments of children with ASD hinder their ability to incidentally learn social skills via contact with typically developing peers in the inclusive setting when there is no

systematic social skill instruction in place (Harrower & Dunlap, 2001). Therefore, to attenuate social deficits of children with ASD and promote their social interaction with peers in general education, behaviorally-based interventions should be conducted in the inclusive settings in which students need to perform the learned social skill (Gresham et al., 2001; Bellini et al., 2007; Leach, 2010; Lovaas, 1987).

Researchers have investigated the effectiveness of various behaviorally-based social skill interventions to teach a variety of social skills that facilitate inclusion of children with ASD in general education classroom. These studies have reported improvements in social interaction skills such as initiating and responding to peers (e.g., Crozier & Tincani, 2007; Loftin, Odom, & Lantz, 2008), joining in activities and maintaining conversation (e.g., Sansosti & Powel-Smith, 2008), making context-related comments (e.g., Ganz & Flores, 2008), and engaging in reciprocal interaction (e.g., Kohler, Greteman, Raschke & Highnam, 2007). Such positive outcomes of behaviorally-based interventions in inclusive settings combined with the effectiveness of these interventions in other contexts and the need of intervention implementation in the natural setting of general education classroom seems to justify the application of these interventions to improve social interaction skills and support inclusion of children with ASD. However, the quality of studies on the use of behaviorally-based interventions to improve social skills of children with ASD in inclusive settings has not yet been evaluated by the rigorous quality standards for methodologically sound research.

Evaluation of the quality of research has been increasingly used in the field of special education for several reasons (Reichow, Volkmar, & Cicchetti, 2008). First,

application of research quality standards using explicit indicators informs the field about limitations of design and methodological aspects that need to be addressed by future studies, stressing the continued need to conduct quality research (Jitendra, Burgess, & Gajria, 2011). Second, application of quality indicators enhance credibility of scientific information by identifying methodologically appropriate studies that enable recommendation of effective interventions to be used in real world settings (Kratochwill et al., 2010; Reichow et al., 2008). Finally, evaluation and identification of quality research allows for a determination regarding whether or not an intervention can be considered an evidence-based practice (Gersten et al., 2005; Horner et al., 2005).

Evidence-based practices are said to exist when there is quality scientific-based research capable of using empirical evidence to inform practice and guide decisions regarding the best interventions available in the field (Reichow et al., 2008). Besides guiding the field toward effective interventions, evaluating quality of research to determine whether an intervention is an evidence-based practice is increasingly of great importance (Jitendra et al., 2011). Recent federal requirements regarding the implementation of evidence-based practices (Individuals with Disabilities Education Improvement Act [IDEA] of 2004; No Child Left Behind Act of 2001) have placed considerable attention on the quality of scientific information that is acceptable as evidence-based in special education (Odom et al., 2005). Teachers are required to use educational practices in schools that are based on evidence obtained via quality research. Thus, it is necessary to inform teachers and practitioners in education field whether behaviorally-based interventions conducted in inclusive settings are evidence-based

practices that can be used to support education of children with ASD in general education.

While guidelines for analyzing the quality of research are commonly used for group-comparison designs, most research involving behaviorally-based interventions for children with ASD employ single-case research designs (Reichow et al., 2008; Wang, Cui, & Parrila, 2011). Recent publications providing quality indicators for evaluating single-case research designs (Horner et al., 2005; Katrochwill et al. 2010; Reichow et al., 2008) allow systematic evaluation of these studies' quality. Despite an increasing number of studies analyzing quality of single-case research in the field of special education (e.g., Chard, Ketterlin-Geller, Baker, Doabler, & Apichatabutra, 2009; Jitendra et al., 2011; Matson et al., 2007), studies addressing whether behaviorally-based interventions are considered evidence-based practices to improve social interaction skills of children with ASD in inclusive settings are still needed.

The current literature base regarding use of behaviorally-based interventions in inclusive settings has some limitations. First, the literature reviews and meta-analyses indicating that ABA-based interventions are effective evidence-based practices have primarily included studies conducted in self-contained settings such as clinics and special education classrooms (Gillis & Butler, 2007; Matson et al., 2007; Vaughn et al., 2003; Virués-Ortega, 2010). These literature reviews and meta-analyses fail to inform whether or not the use of behavioral procedures to improve social skills of children with ASD in inclusive settings can be considered an effective evidence-based practice. Second, several small-scale studies have suggested effectiveness of interventions using

behavioral components to teach a variety of social skills to children with autism in inclusive settings. Nevertheless, these studies have not been systematically evaluated using research quality standards, equally preventing conclusions that behaviorally-based interventions to teach social interaction skills for children with ASD in inclusive settings can be considered an effective evidence-based practice. Considering the increased number of children with ASD being educated in general education, requirements for the use of evidence-based practices and the potential effectiveness of the use of behaviorally-based interventions in inclusive settings, it is necessary to fill this gap in the literature and investigate the quality of existing evidence in order to identify best practices that promote social skills and facilitate inclusion of students with ASD in general education.

The purpose of this study is to evaluate the quality of single-case design studies using behaviorally-based interventions to improve social interaction skills for children with ASD in inclusive settings and determine whether such interventions can be considered evidence-based practices. The study is designed to answer the following research questions: (a) does the evidence base on the use of behavioral intervention for teaching social skills to children with ASD in inclusive settings meet the criteria for methodological rigor of quality standards of single-case research; and (b) based on the quality analysis, can behaviorally-based interventions be considered evidence-based practices for improving social skills of children with ASD in inclusive settings?

## Method

### Identification of Studies

**Search procedures.** Studies were identified through systematic searches of peer-reviewed journals in four electronic databases through EBSCO publishing: Academic Search Complete, Education Resources Information Center (ERIC), Psychological and Behavioral Sciences, and Medline. In addition, searches were conducted in the PsycInfo database through the Cambridge Scientific Abstracts (CSA) database. Publication year was not restricted. On all databases, the following Boolean string searches were conducted: social skills, aut\* and inclus\*; social behavior, aut\* and inclus\*; ABA or Applied Behavior Analysis, aut\* and inclus\*; behavioral intervention, aut\* and inclus\*; social skills, aut\* and mainstream\*; social skills training, aut\* and inclus\*; social skills training, aut\* and mainstream\*; social skills intervention, aut\* and mainstream\*; and social skills intervention, aut\* and inclus\*. Additional ancestry searches through the reference lists of studies meeting inclusion criteria was also conducted in order to find other possibly relevant studies that may have been missed by the electronic search. These searches yielded a total of 196 articles, published between 1980 and January 2012.

**Inclusion and exclusion criteria.** To be included in this comprehensive review, each article was evaluated using several criteria. First, the article had to describe the use of a behaviorally-based intervention to teach social interaction skills for at least one participant with ASD, including autism, Asperger's Syndrome or PDD-NOS (Pervasive Developmental Disorder- Not Otherwise Specified). Behaviorally-based interventions to teach social skills were defined as social skill interventions utilizing components of

ABA as teaching strategies (Baer et al., 1968; Leach, 2010; Reichow & Volkmar, 2010), including, for example, different prompting paradigms, reinforcement schedules, imitation, and modeling (Reichow & Volkmar, 2010; Strain & Schwartz, 2001). Interventions in which behavioral strategies were not delivered to participants with ASD (e.g. typical peer training only) were excluded (e.g., McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992).

Second, articles had to include at least one target social interaction skill as a dependent variable. Social interaction skills were defined as those social skills that enable some type of social exchange and social reciprocity with others (i.e., back and forth verbal or nonverbal interaction). Examples of social interaction skills included turn taking, sharing, initiating conversations and activities, maintaining social interaction, making comments, responding to other's social initiation and conversations, complimenting, and joint attention (Clark & Smith, 1999; Gillis & Butler, 2007).

Third, each article had to be an English publication in a peer-reviewed journal utilizing a single-case research design. Fourth, included studies had to provide raw data in some format identifying scores with time sequence (line graph). Fifth, the studies had to be conducted in an inclusive setting. Studies conducted in inclusive settings were defined as those whose intervention and/or data collection took place in general education schools (more specifically classroom or other school area) in which participants with ASD were able to interact with typically developing peers and teachers. Studies that collected data in inclusive settings for maintenance and generalization purposes only, that is, those for which data were primarily collected in secluded settings

or contexts, but that had a small number of data points within inclusive contexts were not included in this review. Additionally, studies in which the intervention and data collection were solely conducted in a pull out rooms or classrooms that were not part of the students' routine were not included. Because inclusion refers to placement of special education students in general education (Rogers, 1993), studies involving reverse inclusion in which typical peers were brought into the special education classroom for interacting with students with ASD were also excluded of this review (e.g., McGrath, Bosch, Sullivan, & Fuqua, 2003). No explicit information that the intervention was conducted in an inclusive setting also resulted in exclusion of the study (e.g., Goldstein, Kaczmarek, Pennington, & Shafer, 1992; Pierce & Schreibman, 1995). Of the original 196 identified articles, 30 met the criteria for inclusion in this review.

***Inter-rater agreement for inclusion criteria.*** A second independent evaluator reviewed 40% of included articles. 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 by 100. A third evaluator reviewed articles for which the first two evaluators disagreed and/or one evaluator was undecided. The decision made by at least two of the evaluators was the final decision with 100% agreement. Appendix A presents the inclusion criteria and reliability form utilized by independent evaluators.

**Data extraction.** Each included study was summarized in terms of participant characteristics; methodological and procedural details, such as design, reliability, and



treatment fidelity; description of variables; intervention procedures; results; and evaluation of social validity, maintenance and generalization of skills. Based on the data presented by the authors, results were classified as positive (target behaviors increased for all participants), negative (no effects on target behaviors following intervention), or mixed (some participants improved and others did not or some target behaviors improved and others did not). This classification was determined based on visual analysis of the graphs according to differences in level, trend and variability between baseline and intervention phases (Horner et al., 2005). In addition, visual analysis was supported by the reporting narrative of the results in each study (Rispoli, Franco, van der Meer, Lang, & Camargo, 2010).

A second independent evaluator inspected the first rater's summaries in 30% of the studies using a checklist similar to that previously used by Rispoli et al. (2010). The checklist included 13 questions regarding various details coded for each study (e.g., "Is this an accurate summary of procedures" and "Is this an accurate summary of results?"; see Appendix B). Items of the summary considered inaccurate were modified. This approach was intended to ensure accuracy of the summaries that were then used to assist with quality of research evaluation and to create the summary table on page 32.

### **Quality of Research Evaluation**

The quality of research was evaluated based on criteria for determining certainty of evidence previously used by Rispoli et al. (2010) and Millar, Light and Schlosser (2006). Certainty of evidence was evaluated by analyzing study outcomes considering the research design and other methodological details. To provide more precise criteria

for strong methodological rigor when evaluating certainty of evidence, the criteria were adapted based on the evaluative method for determining evidence-based practices in autism described by Reichow et al. (2008) and the *Single-Case Design Technical Documentation* from What Works Clearinghouse (Kratochwill et al., 2010). While all sources include similar quality indicators, Kratochwill et al. (2010) and Reichow et al. (2008) present additional and more explicit criteria for evaluating methodologically sound single-case research. Based on such criteria, the rubric previously used by Rispoli et al. (2010) was expanded enabling identification of studies that met quality indicators, studies that met quality indicators with reservations (i.e., studies met minimum standards with minor flaws in design and procedures) and studies that did not meet minimum standards.

The final expanded rubric used in this review included nine single-case quality indicators focusing on design and methodological aspects related with establishment of conclusion validity and study replicability. The nine quality indicators were grouped in five categories including: (a) experimental control; (b) reliability; (c) treatment fidelity; (d) operational definition of dependent and independent variables; and (e) description of procedures.

In an effort to provide an overview of the quality of evidence across reviewed studies, certainty of evidence was rated as either “inconclusive”, “promising” or “conclusive” (Rispoli et al., 2010; Schlosser & Sigafoos, 2006). To be considered conclusive, studies must have met all quality indicators. Certainty of evidence was considered promising when all or some quality indicators were met with reservations,

indicating minor flaws in design and procedures. Finally, because only studies demonstrating minimum standards of experimental control, reliability, fidelity of implementation measures and description of variables and intervention procedures can provide strong evidence and be potentially considered as quality research (Horner et al., 2005; Kratochwill et al., 2010, Reichow et al., 2008), certainty of evidence was considered inconclusive if any of the criteria pertaining to these categories were not met.

**Quality rubric.** Quality indicators and specific criteria considering whether a study met, met with reservations or did not meet each criteria used to further classify studies as conclusive, promising or inconclusive are described below and summarized in Table 1. The rubric is available upon request from the author.

***Experimental control.*** Three quality indicators were used to evaluate experimental control in each study. First, studies must have used a single-case research design capable of demonstrating experimental control (e.g., multiple baseline, reversal design, alternating treatment design and changing criterion design) (Rispoli et al., 2010).

Second, the strength of such designs in terms of number of phases and concurrent baseline control were considered to determine certainty of evidence. To meet this criterion, studies must have included a strong experimental design with at least three demonstrations of experimental effect (three phase changes excluding maintenance and generalization phases), at three different points in time. Designs meeting this criterion included ABAB reversal design, multiple baseline with at least three phase changes with concurrent baseline control, alternating treatment design comparing at least three treatments with a baseline condition or alternated comparison of two treatments, and

Table 1  
*Quality indicators and specific criteria for certainty of evidence*

Quality indicators					Certainty of Evidence
1. Experimental control	2. Reliability	3. Treatment Fidelity	4. Operational definition of variables	5. Description of procedures	
<p><b>1.1.</b> Design is capable of demonstrating experimental control (e.g. Multiple baseline-MBD, reversal, alternating treatment design, changing criterion design)</p> <p><b>1.2.</b> Demonstration of strong experimental control – at least 3 phase changes (excluding maintenance and generalization phases) at 3 different points in time with concurrent baseline control for MBD design (met with reservation if a medium strength design was used – 2 phase changes in different points in time with concurrent baseline control for MBD)</p> <p><b>1.3.</b> Consistency of changes in at least one dependent variable (DV) across phase changes (met with reservations if data follow this criteria in the majority of phase changes in at least one DV)</p>	<p><b>2.1.</b> Agreement observation conducted across 20% of sessions (meet with reservation if reliability was systematically conducted in less than 20% of sessions)</p> <p><b>2.2.</b> Mean agreement coefficient exceeding 80% if measured by percentage of agreement or 60% if measured by Cohen’s Kappa or justification or correction procedures were presented for lower reliability (meet with reservations if reliability coefficient was lower than above criteria)</p>	<p><b>3.1.</b> At least 20% of sessions with fidelity assessment at or above 80% or correction procedures were provided for less than 80% implementation accuracy (met with reservations if less than 20% of sessions were assessed at or lower than 80% or authors mentioned continuous assessment)</p>	<p><b>4.1.</b> The dependent variable was operationally defined with replicable precision (meet with reservations if not clearly defined)</p> <p><b>4.2.</b> The independent variable was operationally defined with replicable precision (meet with reservations if not clearly defined)</p>	<p><b>5.1.</b> Intervention procedures was described in sufficient detail to enable replication (meet with reservations if not clearly described)</p>	<p><b>Conclusive:</b> all criteria met</p> <p><b>Promising:</b> all criteria met with reservations or some criteria met and some met with reservation</p> <p><b>Inconclusive:</b> any criteria not met</p>

changing criterion design with at least three different criteria levels beyond baseline (Kratochwill et al., 2010). Studies met this criterion with reservations if a medium strength design was used, including multiple baselines with only two-phase changes in different points in time with concurrent baseline control. Studies did not meet this criterion when they used designs not capable of demonstrating experimental control (e.g., AB or ABCD designs)

Finally, changes in at least one dependent variable must have been consistent across phase changes (Kratochwill et al., 2010, Reichow et al., 2008; Rispoli et al., 2010). That is, to meet this criterion, the data set for each phase within the same condition must have presented similar changes in level and/or trend with the introduction or removal of the independent variable (e.g., target social skill presented changes in level and trend in the same direction in all intervention phases when intervention was introduced, returning to the same baseline levels when intervention was removed). Consistency of data patterns from phases with similar conditions has greater probability to represent a causal relationship (Kratochwill et al., 2010). This determination was based on visual inspection of data within and across phases (Rispoli et al., 2010). A study met this criterion with reservations if all but a small minority of phases shows change in the hypothesized direction upon manipulation of the independent variable. Studies not including an experimental design with the above criteria did not meet minimum standards of experimental control (Horner et al., 2005; Millar et al., 2006; Rispoli et al., 2010).

***Reliability.*** Reliability of dependent variable measures was evaluated across

studies based on two quality indicators. First, studies must have reported reliability, with agreement observations conducted across at least 20% of the sessions (Horner et al., 2005). Second, agreement coefficients should have exceeded 80% if measured by inter-observer agreement (Rispoli et al., 2010) or 60% if measured by Cohen's Kappa (Kratochwill et al., 2010, Reichow et al., 2008). In addition, studies met this criterion if justification and correction procedures were present for lower reliability; i.e., authors mentioned identification of problems leading to low reliability (e.g., imprecise operational definition of variables) and described the strategies used to correct them. Studies met these two criteria with reservations if reliability measures were systematically conducted in less than 20% of sessions and reported coefficient agreement was lower than above criteria with no justification or correction procedures. Studies lacking reliable measures of target outcomes by independent evaluators do not meet these criteria (Kratochwill et al., 2010; Rispoli et al., 2010).

***Treatment fidelity.*** To have met this criterion, studies must have reported assessment of treatment fidelity in at least 20% of sessions with measurement at or greater than 80%. Lower than 80% implementation accuracy was accepted if procedures were provided for correcting inaccurate implementation. Because treatment fidelity is still considered a secondary quality indicator in some recent publications (Reichow et al., 2008) and the practice of reporting it in special education is limited (Smith, Daunic, & Taylor, 2007), studies were considered to have met this criterion with reservations if less than 20% of sessions were assessed at or above 80%; or at minimum, authors mentioned continuous treatment fidelity assessment, i.e., implementation accuracy was

periodically checked although not measured. Studies not reporting treatment fidelity did not meet this criterion.

***Operational definition of variables.*** To have met this criterion, the dependent and independent variables must have been operationally defined in enough detail to enable replication (Reichow et al., 2008; Rispoli et al., 2010). The dependent variable should have presented clear description of the target social skill, so that the occurrence of the behavior could be observed and measured (e.g., “talking to peers was defined as verbal utterances directed to peers. Utterance was considered to be anything from a single word to a group of phrases or sentences such as saying hello, using a peer’s name, asking for food, and asking or answering questions. New utterances were recorded after not speaking for at least 5 s and changed the person to whom he was speaking”, Crozier & Tincani, 2007, p.1806). The independent variable or the intervention being utilized had to be defined clearly and thoroughly enough to allow replication (e.g., defining what is a social story, peer network, visual script, etc.).

Studies met this criterion with reservation if variables were not clearly defined, i.e., the dependent variable was defined, but not with complete operational details and examples that could determine exact occurrence and accurate measurement of the behavior (e.g., sharing is defined as “verbal or physical offer or request of an object from another child”, Shearer, Kohler, Buchan, & McCullough, 1996, p. 210). Likewise, a study met this criterion with reservations if the intervention utilized was mentioned throughout the article, but its definition was not consistently provided or depicted. Finally, studies did not meet this criterion if there was no operational definition of

variables.

***Description of intervention procedures.*** Intervention procedures must have been described in sufficient detail to enable replication (Rispoli et al., 2010). To have met this criterion, a full and complete description of each procedural step taken in the intervention should be provided and clearly identified (e.g., details of social skill training, places and people involved, and behavioral procedures utilized). A study was considered to have met this criterion with reservations if intervention description was not clearly or completely described, i.e., some steps were not described or lacked information to allow accurate replication. A study did not meet this criterion if there is no description of intervention procedures.

***Inter-rater agreement for quality indicators.*** A second evaluator independently reviewed 53% of studies included in this analysis with respect to the nine quality indicators and criteria for certainty of evidence. Sixteen articles were randomly selected for review. A third evaluator reviewed studies for which the first two evaluators disagreed and/or one evaluator was undecided. The decision made by two of the three evaluators was discussed to obtain a final decision for classification of the study's certainty of evidence with 100% agreement. There were 144 items (9 items per study) in which agreement or disagreement could occur regarding studies classification for specific quality indicators and 16 items for final classification of studies' certainty of evidence.

Inter-rater agreement for quality indicators and certainty of evidence was calculated dividing the number of agreements by the number of agreements plus



disagreements between raters and multiplying by 100. Initial average of inter-rater agreement for specific quality indicators across studies was 92% (range =78 -100% across studies) and initial agreement regarding final classification of studies' certainty of evidence was 87%. The elevated number of items for specific quality indicators, whose disagreements could impact the final classification, can explain the lower reliability for final classification of studies' quality. In addition, the lower number of items for final classification caused higher impact of disagreements in the initial reliability score. However, disagreements were resolved until 100% of agreement was obtained for both specific and final classification of studies' quality.

### **Evaluation for Evidence-Based Practice**

Following analysis of quality of research, criteria proposed by Horner et al. (2005) and adopted by What Works Clearinghouse (Kratochwill et al., 2010) were used to determine whether the use of behaviorally-based interventions to teach social interaction skills for children with ASD in inclusive settings could be considered evidence-based practices. Guidelines for documenting evidence-based practice through single-case research designs include: (a) a minimum of five single-subject studies published in peer-reviewed journals that demonstrate experimental control and meet the minimal methodological criteria (in this study determined by criteria for conclusive and promising certainty of evidence); (b) studies must have been conducted by at least three different researchers, (c) across at least three geographic locations; and (d) the five or more studies meeting minimum criteria for quality research must have included a minimum of 20 participants across studies.

**Inter-rater agreement for evidence-based practice.** A second evaluator independently checked whether studies included in this review met the criteria for documenting evidence-based practice. There were four aspects in which agreement or disagreement could occur (number of quality studies published, number of different researchers, geographic locations and total number of participants included across studies). Inter-rater agreement was determined by dividing the number of agreements by the number of agreements plus disagreements between raters and multiplied by 100. Agreement regarding whether or not studies met each criterion for evidence-based practice was 100%.

## **Results**

### **Overall Study Characteristics**

A description of each of the 19 included peer-reviewed studies meeting minimal standards of quality in single-case research is presented below and summarized in Table 2. Studies are summarized according to participants' characteristics, type of social skill intervention and behavioral components utilized. Target social interaction skills, as well as the experimental design, intervention procedures, maintenance, generalization and overall results are also noted. Results on the quality indicator analysis and final classification of the 30 included studies according to certainty of evidence follow. Based on the results it was determined whether behaviorally-based interventions to teach social interaction skills for children with ASD in inclusive settings met criteria to be considered evidence-based practices.

Table 2  
*Summary of conclusive and promising articles*

Citation	Participants <sup>1</sup>	Design	Outcome variables	Intervention and behavioral components	Intervention Procedures	Results	M <sup>2</sup>	G <sup>3</sup>
<b><i>Conclusive</i></b>								
Crozier & Tincani (2007)	1 male, 3 yrs, autism	Multicomponent reversal	Conversations with peers, both initiation and response	Social Story; prompt	A story was read prior to data collection in circle time. Three comprehension questions were asked. During data collection the child was verbally prompted to talk with peers in a VI <sup>4</sup> schedule	Positive	Yes	N/A
Ganz & Flores (2008)	3 males, 4 yrs, HFA <sup>5</sup> , autism and PDD-NOS <sup>7</sup>	Changing Criterion	Context-related comments initiation and responses	Visual scripts; prompting and modeling	Participants were trained to use a script phrase for different play themes. Typically developing peers were trained to follow instructions to interact with peers using a peer instruction script card. Least to most prompt was used to prompt participants to use the script	Mixed	N/A <sup>6</sup>	Yes
Gena (2006)	2 males, 2 females, 4 yrs, autism	MBD <sup>8</sup> across partic.	Social interaction initiation and response	Not specified; prompt and reinforcement	Participants were physically and verbally prompted by a shadow teacher to initiate and respond to typical peers' initiations. Social reinforcement contingent to independent initiations and responses was provided	Positive	N/A	Yes
Kern & Aldridge (2006)	4 males, 3-4 yrs, autism	MBD across partic.	Both social interaction initiation and response	Musical therapy; prompt and reinforcement	Teacher initiated play in the Musical Hut with participants and at least one peer, modeling the content of the song (e.g., naming peers, waiting for turns). Peer was trained to follow the same teacher's procedures. Prompts were faded	Positive	N/A	Yes
Nelson et al. (2007)	4 males, 3-4 yrs, autism	MBD across partic. and setting	Play initiation	Visual script; prompt and reinforcement	Peers were instructed and prompted to use keys to play cards ("I want to play") to initiate play interaction with participants. Through incidental teaching, participants were prompted and reinforced by investigator in the use of keys to initiate play interaction with peers	Positive	Yes	N/A
Thiemann & Goldstein (2004)	5 males, 6-9 yrs, autism and AS <sup>9</sup>	MBD across partic.	Social interaction initiation and both initiation and response	Peer training and visual script; prompt and reinforcement	Peers were trained to respond to participants. Both participants and peers were instructed in the use of written-text script to promote social interaction. Researcher prompted and reinforced participants with happy faces for a prize contingent to response	Mixed	Yes	N/A
<b><i>Promising</i></b>								
Chan & O'Reilly (2008)	1 male, 5 yrs, autism	MBD across behaviors	Play initiation	Social Story; prompt and reinforcement	A story was read prior to the start of school day. Three comprehension questions were asked. Contingent to wrong or no answer, the participant was prompted to reread the story and provide correct answer. Verbal prompt and praises were delivered during role-play activity preceding data collection	Positive	Yes	N/A

Table 2 (Cont.)

Citation	Participants	Design	Outcome variables	Intervention and behavioral components	Intervention procedures	Results	M	G
Garfinkle & Schwartz (2002)	3 males, 3-5 yrs, autism	MBD across partic.	Peer imitation (response) and social interaction initiation	Peer imitation; prompt and reinforcement	Participants were taught to imitate peers' appropriate play using least to most prompt hierarchy and contingent verbal praise. Data was collected during free-play activities and prompts were faded	Mixed	No	Yes
Hughes et al. (2011)	1 male, 2 females, 16-21 yrs, autism	MBD across partic. and settings	Frequency and duration of interaction initiation and response and both	Communication books; modeling, prompting, repeated practice, and corrective feedback	Participants were taught to use communication books to interact with peers through modeling, prompting, repeated practice and corrective feedback. Peers were trained to respond to participants, prompt conversation and provide support during intervention	Positive	Yes	Yes
Jung et al. (2008)	2 males, 1 female, 5-6 yrs, autism and PDD-NOS	MBD across partic.	Social interaction initiation and both initiation and response	Low and high-p requests sequence; prompt, reinforcement, and modeling	During low-p requests participants were asked to initiate with peers who were trained to respond. During high p, requests to play were delivered to peers for providing modeling to participants. Then high p requests were made to participants alternating with a low p request in a 3:1 sequence. Reinforcement was provided upon response	Positive	Yes	Yes
Kamps et al. (1997)	3 males, 6-8 yrs, autism	Multiple probe across settings	Duration of both social interaction initiation and response	Peer network including scripts and social stories; prompt and reinforcement	Intervention was tailored to each setting and followed five basic steps: participant and peer training prior to data collection, prompt and reinforcement of target students, use of scripts for task completion; reinforcement system for peer interaction (e.g., tokens, star charts); and teacher feedback to students at the end of activities	Positive	Yes	N/A
Kohler et al. (2001)	4 males, 4 yrs, autism and PDD-NOS	MBD across partic.	Both social interaction initiation and response	Naturalistic teaching; prompt	Teachers were trained in naturalistic teaching strategies to prompt peers and target students to direct social overtures to peers or adult. Teachers received technical assistance during implementation of naturalistic strategies	Positive	Yes	N/A
Laushey & Heflin (2000)	2 males, 5 yrs, severe autism and HFA	Reversal	Both social interaction initiation and response	Buddy skills; reinforcement	Participants were paired with a daily buddy. Training was provided to peers to teach them to stay with, play with, and talk with the buddy. Buddy pairs names were entered into a drawing contingent to social response during the first intervention phase	Positive	Yes	N/A
Loftin et al. (2008)	3 males, 9-10 yrs, autism	MBD across partic.	Social interaction initiation and response	Multi-component social skills; modeling, prompt, and reinforcement	Participants were instructed in social initiations through role-play and task analyses using modeling, repeated trials, prompts, and reinforcement. Participants were taught to self-monitor social behavior and were positively reinforced contingent to response	Positive	Yes	N/A

Table 2 (cont.)

Citation	Participants	Design	Outcome variables	Intervention and behavioral components	Intervention Procedures	Results	M	G
McGee & Daly (2007)	3 males, 4-5 yrs, autism	MBD across partic	Both initiation and response to specific social situations	Incidental teaching; modeling, prompt and reinforcement	Participants were taught to use target social phrases ("All right" and "you know what") to respond to interruptions during play. Prompts, modeling and reinforcement contingent to response were used and faded across five teaching phases and acquisition probes	Positive	Yes	Yes
Sainato et al. (1992)	3 males, 3-4 yrs, autism	MBD across partic.	Social interaction initiation and both initiation and response	Peer self evaluation in peer training; prompts	Peers were previously trained to include, share and respond to participants' initiations and monitor their behaviors through modeling and role-play. Peers were reinforced for self-monitoring and teacher prompted both peers and participants to interact	Negative	N/A	Yes
Sansosti & Powell-Smith (2008)	2 males, 6-9 yrs, autism and AS	MBD across partic.	Social interaction initiation	Social story and video modeling; modeling and prompts	Participants watched the video modeled social story previously to the target activity. Teacher prompted participants to use the skills taught and peers to respond to participants. Frequency of social stories, video models and teacher's prompts was faded over time.	Positive	Yes	Yes
Shabani et al. (2002)	2 males, 6-7 yrs, autism	Reversal	Social interaction initiation and response	Not specified; modeling, prompt, and reinforcement	Participants were trained to make verbal initiation toward an adult when a tactile prompt was activated. Three phrases ("Look at this," "I have [object label]," and "Do you want to play?") were prompted, modeled and reinforced by an adult after tactile prompt. Prompts and reinforcement were faded over time	Positive	Yes	N/A
Zanolli et al. (1996)	2 males, 4 yrs, autism	MBD across activities	Social interaction initiation	Priming; modeling, prompt and reinforcement	Peers were trained to respond to participants and to give brief access to tangible reinforcement. Priming sessions were conducted with participants immediately before activities. Teacher prompted participants to initiate and peers reinforced with access to tangibles	Mixed	No	Yes

<sup>1</sup> Only participants meeting the study's criteria, <sup>2</sup> M- Maintenance, <sup>3</sup> G- Generalization, <sup>4</sup> VI – Variable Interval schedule, <sup>5</sup> HFA - High Functioning Autism, <sup>6</sup> N/A – not applicable to the study (not measured), <sup>7</sup> PDD-NOS – Pervasive Developmental Disorders – Not Otherwise Specified, <sup>8</sup> MBD– Multiple baseline design, <sup>9</sup> AS – Asperger Syndrome

**Participant characteristics.** A total of 55 participants with ASD were included across the included studies. Ninety-one percent (n=50) of participants were male and 9% (n=5) were female. The average age was 5 years (range= 3 – 21 years). Sixty-three percent (n=35) of participants were preschoolers, while 31% (n=17) were in elementary school age. Only 2% (n=1) of the total participants were secondary and 4% (n=2) were post-secondary school age. The majority of participants (85%, n=47) were diagnosed with autism (including high functioning, moderate, and severe autism), while 9% (n=5) were diagnosed with pervasive developmental disorder not otherwise specified (PDD-NOS) and 6% (n=3) were diagnosed with Asperger syndrome.

**Design.** The majority of studies (79%, n=15) used a multiple baseline design to investigate intervention effects, with one being a multiple probe across settings (Kamps, Potucek, & Lopes, 1997). Three studies used reversal design, with one study using multicomponent reversal design (Crozier & Tincani, 2007; Laushey & Heflin, 2000; Shabani et al., 2002), and one used changing criterion design (Ganz & Flores, 2008).

**Outcome variables.** A variety of social behaviors were targeted for intervention. Some studies (Crozier & Tincani, 2007; Thieman & Golstein; Hughes et al., 2011; Jung, Sainato, & Davis, 2008; Kamps et al., 1997; Kohler, Anthony, Steighner, & Hoyson, 2001; Laushey & Heflin, 2000; Sainato, Goldstein, & Strain, 1992) defined the target social skills as both social interaction initiation and response (e.g., initiating and responding to requests, comments, play, etc.). Other studies investigated effects of behaviorally-based social skills interventions on either social interaction initiation or response with some including specific social behaviors such as conversations, context-

related comments, play, and peer imitation. From a total of 32 outcome variables investigated across studies, the majority (50%, n=16) focused on initiation. Examples of target skills in this category included play interaction initiation (Chan & O'Reilly, 2008; Nelson, McDonell, Johnston, Crompton & Nelson, 2007), conversations or context-related comments with peers (Crozier & Tincani, 2007; Ganz & Flores, 2008), and complimenting or requesting information (Thieman & Goldstein, 2004). Nineteen percent of outcome variables investigated across studies (n=6) focused on responding to other's social initiations, as for example, responding to other's comments (Ganz & Flores, 2008), responding to peers' interaction initiation (Loftin et al., 2008), and imitating peers (Garfinkle & Schwartz, 2002). Thirty-one percent of target outcomes investigated (n=10) were defined as focusing in both social interaction initiation and response (e.g., Crozier & Tincani, 2007; Hughes et al., 2011; Thiemann & Golstein, 2004).

**Interventions and behavioral components.** A variety of social skill interventions that incorporated features of ABA were used to facilitate participants' social interaction in inclusive settings. The most common social skills interventions used across studies involved peer-mediated interventions such as peer training, peer imitation, peer network, and buddy skills package (Garfinkle & Schwartz, 2002; Kamps et al., 1997; Laushey & Heflin, 2007; Sainato et al., 1992; Thiemann & Golstein, 2004). Social stories (Chan & O' Reilly, 2008, Crozier & Tincani, 2007; Kamps et al., 1997; Sansosti & Powell-Smith, 2008), and visual scripts (n=4; Ganz & Flores, 2008; Kamps et al., 1997; Nelson et al., 2007; Thiemann & Goldstein, 2004) were frequently used also.

Other examples of types of social skills interventions used across studies included naturalistic/incidental teaching (Kohler et al., 2001; MacGee & Daly, 2007), music therapy (Kern & Aldridge, 2006), priming (Zanolli, Dagget, & Adams, 1996), communication books (Hughes et al., 2011), low and high probability requests sequence (i.e., behavioral momentum; Jung et al., 2008), and video modeling (Sansosti & Powell-Smith, 2008). One study used a multi-component social skills intervention (Loftin et al., 2008) and two did not specify the social skill intervention used (Gena, 2006; Shabani et al., 2002). Despite the different intervention types implemented by the studies in this review, all used behavioral intervention components to teach social skills. Regarding the types of behavioral components utilized, peer or adult modeling, different prompt hierarchies and types (e.g., most to least or least to most hierarchy and verbal, visual, written or tactile prompt) and/or a variety of positive reinforcement (e.g., edibles, tangibles, and/or praise) were consistently used across studies. Only one study (Hughes et al., 2011) also implemented repeated practice and corrective feedback as behavioral intervention procedure.

**Intervention results.** Regarding intervention outcomes, 14 studies (74%) reported positive results (all participants' social interaction skills improved) and 4 studies (21%) reported mixed results (some participants or target skills improved and some did not). Only one study (5%) presented negative results, i.e., no effect was observed after introduction of intervention (Sainato et al., 1992).

**Maintenance and generalization.** Maintenance and generalization of social interaction skills taught was not investigated in all quality studies. Fifteen studies (79%)



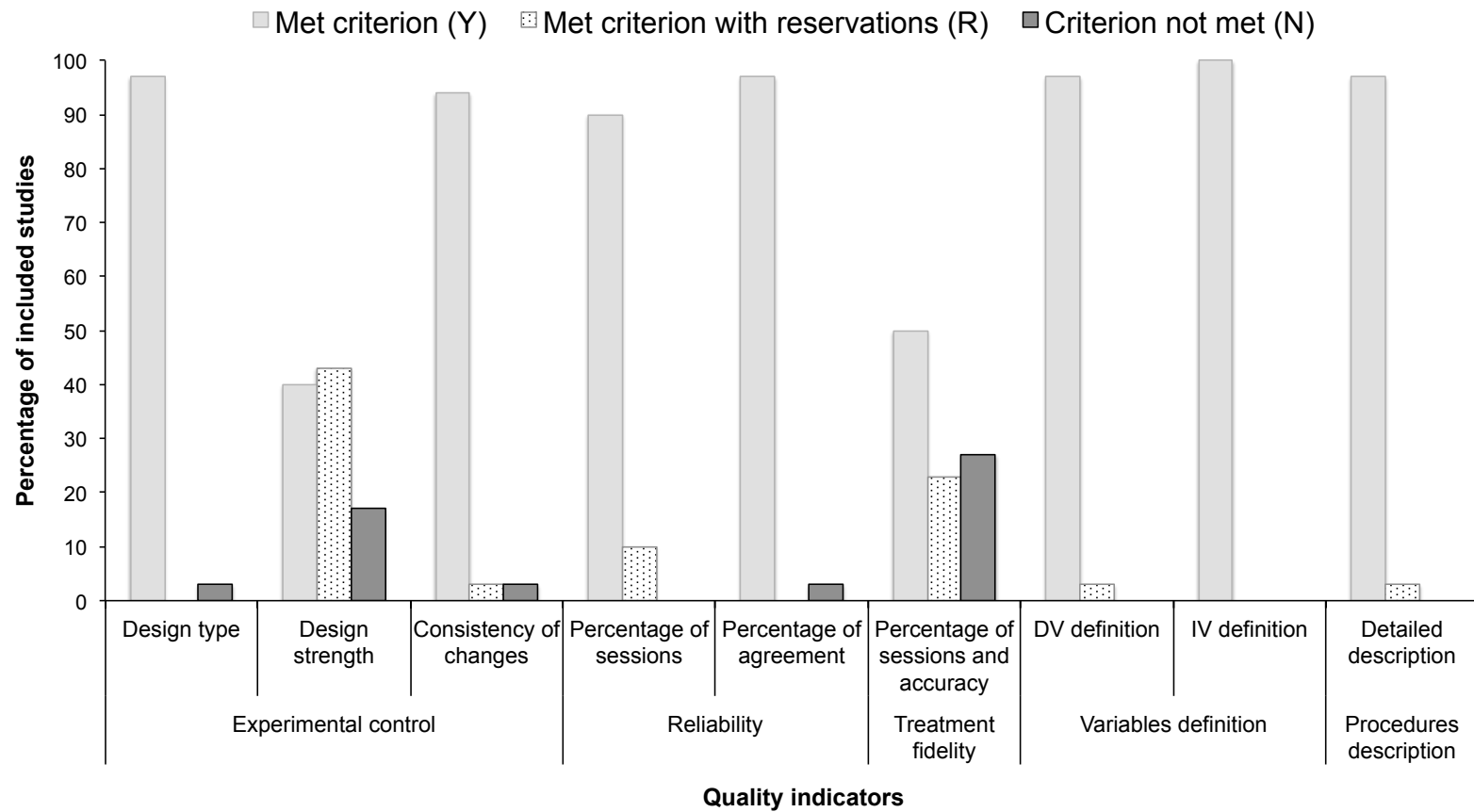


Figure 1. Summary of articles meeting each quality indicator.

reported investigation of maintenance of skills. From those, 13 studies demonstrated that participants were able to maintain at least one of the target skills. Generalization was evaluated in only 9 studies (47%) and all of them demonstrated participants' generalization of skills across peers, school personnel or settings.

### **Quality of Studies**

Results of the quality indicator analysis are presented below for each of the 30 studies and summarized in Figure 1.

**Experimental control.** Three quality indicators were evaluated to indicate whether the study used experimental control: type of design, strength of design and consistency of change across phases. Regarding the type of design, only one study utilized a single-case design (ABAC) for which experimental control was compromised due to possible sequence effects and lack of replication of intervention phases (Sawyer, Luiselli, Ricciardi, & Gower, 2005). The majority of studies (97%, n=29) fully met this indicator by using designs such as multiple baselines, reversal or changing criterion design.

Design strength was evaluated according to the number of phase changes with concurrent baseline control. The majority of studies (n=25, 83%) either met this criterion or met it with reservations. Those meeting the criterion with reservation (n=13; 43%, Chan & O'Reilly, 2008; Garfinkle & Schwartz, 2002; Garrison-Harrel, Kamps, & Kravitz, 1997; Hughes et al., 2011; Jung et al., 2008; Kamps et al., 1992; Kamps et al., 1997; Kohler et al., 2007; Loftin et al., 2008; Mcgee & Daly, 2007; Sainato et al., 1992; Sansosti & Powell-Smith, 2008; Zanolli et al., 1996) presented a medium strength design

with two phase changes in different points in time with concurrent baseline control (excluding maintenance and generalization phases). Those fully meeting the criterion (n=12; 40%, Crozier & Tincani, 2007; Ganz & Flores, 2008; Gena, 2006; Kern & Aldridge, 2006; Kohler et al., 1995; Morrison, Kamps, Garcia, & Parker, 2001; Nelson et al., 2007; Thiemann & Goldstein, 2004; Kohler et al., 2001; Laushey & Heflin, 2000; Shabani et al., 2002; Shearer et al., 1996) demonstrated a strong experimental control with at least 3 phase changes at 3 different points in time with concurrent baseline control. Five studies (17%; Apple et al., 2005; Banda, Hart, & Liu-Gitz, 2010; Harper, Symon, & Frea, 2008; Pierce & Schreibman, 1995; Sawyer et al., 2005) did not meet this criterion for not presenting a design strength considered medium or strong, such as a multiple baseline design with two phase changes and only one with concurrent baseline control (Banda et al., 2010).

Finally, the consistency of changes across phases was also evaluated in each study. The majority of studies (n=28, 94%) demonstrated consistency in level and/or trend changes in at least one dependent variable with introduction or removal of the intervention. Only one study (Sainato et al., 1992) met this criterion with reservations for having a minority of phases with different data patterns. Also one study (Shearer et al., 1996) did not meet this criterion for not demonstrating consistency on trend or level across phase changes in at least one dependent variable.

**Reliability.** Reliability was evaluated considering the percentage of sessions in which reliability measures were conducted and the percentage of agreement reported in the study. The majority of studies (n=27, 90%) met the minimum criterion, conducting

reliability checks for at least 20% of sessions. Only three studies (10%; Garrison-Harrel et al., 1997; Kohler et al., 2007; Sawyer et al., 2005) met this criterion with reservations, conducting agreement observation for less than 20% of sessions. Each of these studies reported an IOA at or above the standard of 80% reliability; only one study (Kohler et al., 1995) did not meet this criterion.

**Treatment fidelity.** This indicator was evaluated based on the percentage of sessions in which studies reported treatment fidelity data and the reported accuracy in the implementation of intervention procedures. Fifty percent of studies (n=15; Apple et al., 2005; Banda et al., 2010; Chan & O'Reilly, 2008; Crozier & Tincani, 2007; Ganz & Flores, 2008; Gena, 2006; Harper et al., 2008; Hughes et al., 2011; Jung et al., 2008; Kern & Aldridge, 2006; Loftin et al., 2008; Nelson et al., 2007; Sansosti & Powell-Smith, 2008; Thiemann & Goldstein, 2004; Zanolli et al., 2006) met this criterion, conducting treatment fidelity assessment across at least 20% of sessions with at least 80% of accuracy. Twenty-three percent of studies (n=7; Garfinkle & Schwartz, 2002; Kamps et al., 1997; Kohler et al., 2001; Laushey & Heflin, 2000; Mcgee & Daly, 2007; Sainato et al., 1992; Shabani et al., 2002) met this criterion with reservations, i.e., fidelity assessment was conducted in less than 20% of sessions with at least 80% of accuracy or authors noted that they conducted continuous treatment fidelity assessment. However, 27% of studies (n=8) did not meet this criterion due to an absence of documentation of assessment of accuracy of intervention implementation (Garrison-Harrel et al., 1997; Kamps et al., 1992; Kohler et al., 1995; Kohler et al., 2007; Morrison et al., 2001; Pierce & Schreibman, 1995; Sawyer et al., 2005; Shearer et al., 1996).

**Operational definition of variables.** Studies were evaluated regarding to the operational precision with which the dependent and independent variable were defined to allow their direct observation and replication. The majority (n=29, 97%) of studies met this criterion, clearly defining the dependent variable. Only one study (Shearer et al., 1996) met this criterion with reservation as several dependent variables were investigated in the study with definitions that seemed not clearly exclusive. That is, different target skills seemed to have similar operational definitions, which may compromise replication of the study (e.g. engagement with peer, engagement with adult and engagement with peer and adult). All studies clearly defined the independent variable by providing thorough explanation of the type of intervention provided to improve social interaction skills of children with ASD in inclusive settings.

**Description of procedures.** Studies were finally evaluated to whether the intervention procedures were described in sufficient detail to allow replication. Intervention procedures were described in sufficient detail to enable study's replication in 97% (n=29) of studies. Only one study (Kamps et al., 1992) met this criterion with reservation, as it was not clear whether behavioral components such as prompt, modeling and reinforcement were utilized in the social skills training conducted with participants and their peers prior to the data collection, when reinforcement was delivered. The study reported who implemented the training, but how training was implemented and the steps involved were not specified.

### **Certainty of Evidence**

Using the quality indicator analysis results, final classification of studies according to their certainty of evidence was conducted. Classification of certainty of evidence as either “inconclusive”, “promising” or “conclusive” (Rispoli et al., 2010; Schlosser & Sigafoos, 2006) provides an overview of the quality of evidence across reviewed studies. Of the 30 studies included in this review, 63% (n=19) met the minimum requirements for quality research and were classified as either conclusive (n=6) or promising (n= 13). The remaining 37% (n=11) of the studies did not meet minimal standards and were classified as inconclusive evidence. Reasons articles were classified as inconclusive included lack of design with experimental control, lack of a strong or medium strength design, failure to demonstrate consistency of changes across phases, failure to obtain a minimum of 80% agreement in reliability checks or, the most common reason, absence of treatment fidelity measures. Table 3 summarizes findings for specific quality indicators for each of the studies considered conclusive or promising. Table 4, presents findings for specific quality indicators for studies that were considered inconclusive.

### **Determination for Evidence-Based Practice**

Overall, behavioral intervention components to improve social interaction skills of children with ASD in inclusive settings meet the requirements for determination of evidence-based practice proposed by Horner et al. (2005) and Kratochwill et al. (2010). There were 19 studies (see Table 2 with conclusive and promising studies) meeting minimum standards for rigorous research quality (Kratochwill et al., 2010; Reichow et

al., 2008; Rispoli et al., 2010). This number of studies exceeds the minimum requirements of 5 studies proposed by Horner et al. (2005) and Kratochwill et al. (2010) to document evidence-based practice.

Although the majority of studies do not mention the location in which the study was conducted, mostly due to ethical concerns, seven studies have given information indicating the geographic location in which the study was conducted (Ganz & Flores, 2008; Gena, 2006; Hughes et al., 2011; Jung et al., 2008; Kohler et al., 2001; Sansosti & Powell-Smith, 2008; Thieman & Goldstein, 2004). Of those, six different locations were identified (Greece, Southeastern US, Florida, Texas, Midwestern US and Pennsylvania) exceeding the minimum requirements of at least three different geographic locations (Horner et al., 2005; Kratochwill et al., 2010).

In addition, the 19 studies meeting minimum quality standards were conducted by 16 different groups of researchers, also exceeding the minimum requirements of at least three different researchers (Horner et al., 2005; Kratochwill et al., 2010). Finally, these 19 studies included a total of 55 participants with ASD. It represents more than double of the minimum requirement of 20 participants (Horner et al., 2005; Kratochwill et al., 2010). Therefore, behaviorally-based interventions qualify as evidence-based practices to improve social interaction skills of children with ASD in inclusive settings.

Table 3  
*Conclusive and promising studies and their classification for meeting specific quality indicators*

Study	Quality indicators								
	1. Experimental control			2. Reliability		3. Treatment Fidelity	4. Variables Definition		5. Procedures Description
	Type of Design	Strength of Design	Consistency of change	% of sessions	% of agreement	% of sessions and accuracy	DV <sup>a</sup> definition	IV <sup>b</sup> definition	Detailed description
<b>Conclusive</b>									
Crozier & Tincani (2007)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ganz & Flores (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gena (2006)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kern & Aldridge (2006)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nelson et al. (2007)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Thiemann & Goldstein (2004)	Y	Y	Y	Y	Y	Y	Y	Y	Y
<b>Promising</b>									
Chan & O'Reilly (2008)	Y	R	Y	Y	Y	Y	Y	Y	Y
Garfinkle & Schwartz (2002)	Y	R	Y	Y	Y	R	Y	Y	Y
Hughes et al. (2011)	Y	R	Y	Y	Y	Y	Y	Y	Y
Jung et al. (2008)	Y	R	Y	Y	Y	Y	Y	Y	Y
Kamps et al. (1997)	Y	R	Y	Y	Y	R	Y	Y	Y
Kohler et al. (2001)	Y	Y	Y	Y	Y	R	Y	Y	Y
Laushey & Heflin (2000)	Y	Y	Y	Y	Y	R	Y	Y	Y
Loftin et al. (2008)	Y	R	Y	Y	Y	Y	Y	Y	Y
Mcgee & Daly (2007)	Y	R	Y	Y	Y	R	Y	Y	Y
Sainato et al. (1992)	Y	R	R	Y	Y	R	Y	Y	Y
Sansosti & Powell-Smith (2008)	Y	R	Y	Y	Y	Y	Y	Y	Y
Shabani et al. (2002)	Y	Y	Y	Y	Y	R	Y	Y	Y
Zanolli et al. (1996)	Y	R	Y	Y	Y	Y	Y	Y	Y
Percentage of Y <sup>c</sup>	100	47	95	100	100	63	100	100	100
Percentage of R <sup>d</sup>	0	53	5	0	0	37	0	0	0

<sup>a</sup>DV – dependent variable, <sup>b</sup>IV – Independent Variable, <sup>c</sup>Y- Met criterion, <sup>d</sup>R- Met criterion with reservations



Table 4  
*Inconclusive studies and their classification for meeting specific quality indicators*

Study	<i>Quality indicators</i>								
	1. Experimental control			2. Reliability		3. Treatment Fidelity	4. Variables Definition		5. Procedures Description
	Type of Design	Strength of design	Consistency of changes	% of sessions	% of agreement	% of sessions and accuracy	DV <sup>a</sup> definition	IV <sup>b</sup> definition	Detailed description
Apple et al. (2005)	Y	N	Y	Y	Y	Y	Y	Y	Y
Banda et al. (2010)	Y	N	Y	Y	Y	Y	Y	Y	Y
Garrison-Harrel et al. (1997)	Y	R	Y	R	Y	N	Y	Y	Y
Harper et al. (2008)	Y	N	Y	Y	Y	Y	Y	Y	Y
Kamps et al. (1992)	Y	R	Y	Y	Y	N	Y	Y	R
Kohler et al. (1995)	Y	Y	Y	Y	N	N	Y	Y	Y
Kohler et al. (2007)	Y	R	Y	R	Y	N	Y	Y	Y
Morrison et al. (2001)	Y	Y	Y	Y	Y	N	Y	Y	Y
Pierce & Schreibman (1995)	Y	N	Y	Y	Y	N	Y	Y	Y
Sawyer et al. (2005)	N	N	Y	R	Y	N	Y	Y	Y
Shearer et al. (1996)	Y	Y	N	Y	Y	N	R	Y	Y
Percentage of M <sup>c</sup>	91	27	91	73	91	27	91	100	91
Percentage of R <sup>d</sup>	0	27	0	27	0	0	9	0	9
Percentage of N <sup>e</sup>	9	46	9	0	9	73	0	0	0

<sup>a</sup>DV – dependent variable, <sup>b</sup>IV – Independent Variable, <sup>c</sup>Y-Met criterion, <sup>d</sup>R-Met criterion with reservations, <sup>e</sup>N-Criterion not met

## **Discussion**

Although several single-case studies have suggested that behaviorally-based interventions may be effective to teach a variety of social interaction skills to children with ASD in inclusive settings (e.g., Banda et al., 2010; Crozier & Tincani, 2007; Nelson et al., 2007), prior to this analysis, no studies had provided a global investigation regarding whether implementation of these interventions could be considered evidence-based practices. Results of this review address this gap in the literature by evaluating the quality of single-case design studies using behaviorally-based interventions to teach social interaction skills to children with ASD in inclusive settings. The results suggested that behaviorally-based interventions for improving social skills of children with ASD in inclusive settings qualify as evidence-based practices. This finding adds to the emerging body of literature on application of quality indicators in single-case research to identify evidence-based practices for children with ASD (Mayton, Wheeler, Menendez, & Zhang, 2010; Reichow et al., 2008; Reichow & Volkmar, 2010) and highlight implications for practice and areas for future research.

The first research question sought to investigate whether the evidence base on the use of behaviorally-based interventions for teaching social interaction skills to children with ASD in inclusive settings met the minimum criteria for methodological rigor of quality standards for single-case research. The research quality of 30 published single-case design studies were evaluated based on nine quality indicators to determine certainty of evidence. The majority of studies met each of the quality indicators, except those related with design strength and treatment fidelity. Although less frequent, other

quality indicators generally not met are related with no experimental type of design, no consistency of change across phases, and low percent of agreement between raters for reliability measures. These overall results on quality inform the field of single-case research about identified issues related to quality indicators that should be addressed by future research to advance the empirical support regarding behaviorally-based interventions for children with ASD in inclusive settings (Jitendra et al., 2011). Future single-case research conducted in inclusive settings should rely on strong experimental designs that are more likely to demonstrate experimental control, such as including a concurrent baseline control for at least three phase changes. Equally important to ensure conclusion validity, future single-case researchers should evaluate and report treatment fidelity, making the changes needed to ensure fidelity of implementation throughout the study. Similarly, studies should address problems leading to reliability measures below the minimally acceptable standards.

The application of the quality indicators adopted in this review resulted in the identification of 19 studies meeting minimum standards for quality of single-case research. Of those, certainty of evidence was considered conclusive for 6 studies, while for 13 studies, certainty of evidence was considered promising. A total of 11 studies were classified as inconclusive certainty of evidence for not meeting one or more of the quality standards.

The majority of studies meeting minimum standards of methodologically sound single-case research presented positive participant outcomes, suggesting improvements in social interaction skills of children with ASD in inclusive settings when receiving

behaviorally-based interventions. Although one could argue for a cautious interpretation of these positive outcomes due to the fact that the majority of studies were considered promising (i.e., presenting minor flaws in design and/or procedures), it is necessary to consider that the movement toward identifying quality guidelines in single-case research is relatively new. These guidelines have emerged within the last seven years (Horner et al., 2005; Jitendra et al., 2011; Kratochwill et al., 2010; Reichow et al., 2008; Rispoli et al., 2010), and the majority of promising studies were conducted prior to their development. Thus, the year of publication may have contributed to the fact that several promising studies met criteria with reservations. Further, it is necessary to consider that while some single-case scholars agree upon the standards used in this review, they have not been universally adopted (Tankersley, Cook, & Cook, 2008).

One of the main reasons why most promising studies met criteria with reservations, for example, was due to fewer number of phase changes with concurrent baseline control. Although it is desirable and recognized that additional phase repetitions increases the power of the design to obtain more valid causal inferences (Kratochwill et al., 2010), studies using a medium strength design where concurrent baseline controls are present for only two phase changes are often considered capable of providing sufficient internal validity (Horner et al., 2005, Kratochwill & Levin, 2010; Kratochwill et al., 2010). In addition, there is no empirical basis for the recommendation of three phase changes with concurrent baseline control in at least three points in time (Kratochwill & Levin, 2010) and the number of repetitions can vary depending on the intervention outcomes, cost and logistical factors (Kratochwill et al., 2010).

Another main reason to which promising studies met criteria with reservations is related to treatment fidelity measures. However, it is important to consider this is a recent methodological consideration that is often not required for publication in peer-reviewed journals (Horner et al., 2005). Additionally, while treatment fidelity measures are essential to judge whether the results are the product of the reported intervention, some researchers consider treatment fidelity as a key quality indicator (e.g., Chard et al., 2009; Horner et al., 2005; Jitendra et al., 2011;), whereas others weight it as a secondary quality indicator (e.g., Reichow et al., 2008). Therefore, it was considered that studies meeting treatment fidelity criterion with reservations were at least tracking whether ineffectiveness of intervention would be due to an ineffectual strategy or poor implementation of procedures (Gresham et al., 2001). However, it is recommended that future research carefully address the quality indicators related with design strength and treatment fidelity in which most of the promising studies met with reservations. It can improve overall quality of future studies, helping to determine with more confidence the effectiveness of behaviorally-based interventions for teaching social skills to children with ASD in inclusive settings.

The primary reasons for studies being considered inconclusive are also related to the number of phase changes with concurrent baseline control and lack of treatment fidelity measures. These results are consistent with other studies employing quality indicators for single-case research indicating lack of treatment fidelity as one of the primary reasons for studies failing to meet minimum quality standards for single-case research (Bellini & Akullian, 2007; Chard et al., 2009). Because lack of treatment

fidelity compromises internal validity (Cook, Tankersley, & Landrum, 2009; Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000), results obtained from inconclusive studies should be interpreted with caution. Therefore, it is recommended that conclusions regarding behaviorally-based interventions to improve social interaction skills of children with ASD in inclusive settings should be interpreted in light of the conclusive and promising studies meeting minimum standards of quality single-case research.

Based on the results of quality analysis, the second research question focused on determining whether behaviorally-based interventions could be considered evidence-based practices to improve social skills of children with ASD in inclusive settings. To make this determination, criteria proposed by Horner et al. (2005) and Kratochwill et al. (2010) were considered. The 19 studies meeting minimally acceptable methodological criteria with the majority documenting positive participant outcomes met the requirement of a minimum of five quality studies for an intervention be labeled “evidence-based practice”. Furthermore, 16 different groups of researchers in at least six different geographic locations conducted the 19 quality studies, exceeding the minimum requirement of three different researchers from three regions of the country (Horner et al., 2005; Kratochwill et al., 2010). Finally, quality studies collectively provided social skills interventions using behavioral components to a total of 55 students with ASD included in general education. Thus, studies met the final criteria for determination of evidence-based practice requiring a minimum of 20 participants across studies (Horner et al., 2005; Kratochwill et al., 2010). This analysis suggests that behaviorally-based

social skills interventions can be considered evidence-based practices to improve social interaction skills of children with ASD in inclusive settings (Horner et al., 2005).

### **Implications for Practice**

In the context of an increasing number of children with ASD being included in general education, this review has several implications for practice. First the results hold great promise as it expands the evidence base on effective use of behavioral interventions to improve social interactions skills of children with ASD from clinics, home and special education classrooms to inclusive settings. Second, although the use of evidence-based practices is required in schools (Individuals with Disabilities Education Improvement Act [IDEA] of 2004; No Child Left Behind Act of 2001), studies providing teachers with specific information regarding to which interventions are considered evidence-based practices to be implemented in the unique context of inclusive settings are not found (Lerman, Vorndran, Addison, & Kuhn, 2004). As a result, many teachers may not have enough information and still opt for adopting interventions that are not considered either effective or research based (Boardman, Arguelles, Vaughn, Hughes, & Kligner, 2005; Stahmer & Aarons, 2009). Thus, this article can assist educators and enable informed decision regarding behavioral interventions as evidence-based practices for improving social interaction skills of children with ASD in inclusive settings.

Furthermore, the 19 studies meeting minimum quality standards involved a majority of preschool and elementary school age children. This result indicates that the positive outcomes in these studies are mainly related with these age groups of children

with ASD. Consistent with previous evidence that early behavioral interventions are effective for improving several impaired skill areas in children with ASD (Ben-Itzhak & Zachor, 2007; Eldevik et al., 2009; Lovaas, 1987; Virués-Ortega, 2010), this result suggests that behaviorally-based interventions are well suited for young children included in general education and could be used to improve their social development in natural environments as early as possible. Early behavioral support for social skills of children with ASD in inclusive settings can promote quicker adaptation and social adjustment with typically developing peers, enhancing the quality of their relationships that can mitigate future challenges in the adulthood and future independent living (Koegel, Kuriakose, Singh, & Koegel, 2012).

Although the majority of quality studies have addressed social interaction initiation as target skills, the fact that some studies have also addressed responding to social interactions is equally important. Some studies suggest that if students with ASD are able to initiate social interactions with peers they are able to maintain social interaction (Koegel et al., 2012). However, it is reasonable to suggest that they may need specific instructions to respond to peers and maintain interactions, particularly considering they have difficulties generalizing to untargeted skills (Plaisted, 2001). Thus, the indication that behaviorally-based interventions may be also effective to teach children with ASD not only to initiate, but also to respond to peers, enable teachers to expand social skill instruction in inclusive settings that may lead to more meaningful and long-lasting interactions.



With respect to the behavioral components used, teachers and practitioners may want to consider planning the use of modeling, prompts, and reinforcement or at least two of these behavioral components to teach social interaction skills for children with ASD in inclusive settings. The combination of two or all of these behavioral components was often used in the quality studies reviewed and appears to be more frequently linked with positive outcomes (i.e., all participants improved after intervention) across all target social interaction skills (social interaction initiation, social interaction responses or both). For example, Jung et al. (2008) and Loftin et al. (2008) used prompt, modeling and reinforcement as behavioral components and all participants presented improvements in their social interaction skills. Gena (2006) used prompt and reinforcement and Sansosti and Powell-Smith (2008) used modeling and prompts and their interventions also led to positive outcomes. Implementation of each of these behavioral components alone was less common across studies with one of them using only prompts (Sainato et al., 2002) leading to negative results (i.e., no intervention effects). This negative outcome suggests that planning the use of a combination of two or more of these behavioral components may be an important strategy to lead to more effective interventions to teach social skills to children with ASD in inclusive settings.

Finally, central for successful teaching of social interaction skills for children with ASD in inclusive settings is the students' ability to maintain and generalize the skills learned across people and settings (Bellini et al., 2007). The majority of the 14 quality studies that investigated maintenance and all of the 10 studies that investigated generalization of skills showed that the majority or all participants were able to maintain

the skills taught after intervention procedures were ceased as well as demonstrate the learned social interaction skills across different peers, school personnel, or settings. These findings support the assertions of Gresham et al. (2001), Bellini et al. (2007) and Lovaas (1987) indicating that social skills interventions conducted in the setting where the student will use the skill produce higher maintenance and generalization effects. Considering that generalization and maintenance of skills are significant difficulties in children with ASD, it is highly recommended that educators plan for implementation of intervention procedures in multiple school settings (e.g., classroom, playground and cafeteria) when teaching social interaction skills for these children in the general education environment.

### **Limitations and Implications for Research**

The results from this review extend the literature investigating quality of interventions using single-case research designs and identify behaviorally-based interventions as evidence-based practices that can be used to teach social interaction skills for children with ASD in inclusive settings. However, several limitations should be considered as implications for future research.

First, it is important to note that conclusions made in this review are solely based on the information reported by authors in their published articles. It is necessary to consider that authors may not have reported all of the procedures used in the intervention. For example, even if prompts or reinforcement were not included in the intervention protocol, implementers may have inadvertently provided verbal prompt or reinforcement to participants and the effects of those erroneous prompts or

reinforcement may not have been taken into account. Additionally, omissions in reporting important information may occur due to page limitations required by many high quality journals that compromise authors' ability of reporting every detail of the study (Tankersley et al., 2008). Thus, it is assumed that intervention outcomes are related to the use of the behavioral procedures identified in the articles, but it may compromise the confidence of conclusions.

Second, this literature review is limited in scope as the majority of quality studies involved young students with ASD (preschool or elementary age group). Therefore, it is not possible to assume with confidence that the same conclusions would be obtained for older students with ASD. Future studies should focus on investigating social skills interventions using behavioral components for teaching social interaction skills for older students with ASD included in general education.

Additionally, this study suggests that behavioral components may be an essential aspect of successful social skills interventions. However, this review does not investigate differential effects between social skills interventions utilizing and not utilizing behavioral procedures. Although previous studies have reasoned that social skill interventions such as peer training and video modeling were more effective with introduction of behavioral procedures (Banda et al., 2010; Mason, Ganz, Parker, Burke, & Camargo, 2012), further research is needed to support the conclusion that behaviorally-based social skill interventions are more effective in inclusive settings than those that do not use behavioral components in the intervention.

Similarly, this study is limited in the sense that feasibility of using modeling, prompts, and reinforcement to improve social interaction outcomes of children with ASD in the context of inclusive settings was not addressed. Studies generally did not focus on social validity of interventions in terms of acceptability and future adoption of the intervention by teachers based on convenience and ease of implementation. It is important that future studies include this information to enable conclusions regarding applicability of behaviorally-based interventions to improve social skills of children with ASD in the already demanding routine of inclusive settings (Odom & McEvoy, 1990). This information is particularly needed as it is also observed that researchers rather than classroom teachers who will be likely using such interventions in a daily basis, implemented many of the interventions included in this review.

Considering the increasing attention given for evaluating quality of educational research and the fact that several articles included in this review were inconclusive for presenting major limitations across the nine quality indicators, it is necessary that future studies on this topic address these limitations, more notably related with experimental control and treatment fidelity assessment. Both aspects can improve conclusion validity and replicability of studies. Also, reporting treatment fidelity with detailed procedural protocols can address some of the above-mentioned issues regarding omission of information.

Finally, while this study provides summaries of how behavioral components have been combined and implemented in inclusive settings, it does not inform which of these types or combinations are more effective. Because behaviorally-based interventions to

teach social interaction skills for children with ASD in inclusive settings are evidence-based practices, critical questions for future research are generated. Beyond conclusions that these interventions are evidence-based practice, it is necessary to determine overall and context-specific effectiveness of such interventions through meta-analytic techniques that allow aggregation of effects across studies (Gena, 2006; Kavale, 2000; Odom et al., 2005; Scruggs & Mastropieri, 1998). It is important, for example, to determine in which conditions such procedures have been most effective according to students' age group, intervention implementer, additional need of peer training and targeted social interaction skill. Such information would broaden the utility of the behavioral interventions as it can guide general education policies towards strategies that promote social interaction skills and successful inclusion of students with ASD.

**CHAPTER III**

**BEHAVIORALLY-BASED INTERVENTIONS FOR TEACHING SOCIAL  
INTERACTION SKILLS TO CHILDREN WITH ASD IN INCLUSIVE  
SETTINGS: A META-ANALYSIS**

Impairment in social interaction skills is a core and defining characteristic of persons with autism spectrum disorders (ASD, American Psychiatric Association, 2000; Matson & Wilkins, 2007; White, Keoning, & Scahill, 2007). Difficulties initiating, responding, and sustaining social interactions, comprehending non-verbal communication, making eye contact as well as deficits in social problem solving are critical limitations for individuals with ASD and may lead to other detrimental outcomes (Baker, 2001; Boyd, Conroy, Asmus, McKenney, & Mancil, 2008; Bellini, Peters, Benner, & Hopf, 2007; Flynn & Healy, 2012). Social skill deficits may impede the establishment of meaningful relationships that are the precursors for social, cognitive, and language development (Bellini; 2006; Tantam, 2000). In addition, lack of social skills has been associated with peer rejection, problem behaviors, and social anxiety (Bellini, 2006; Bellini et al., 2007; Tantam 2000; Welsh, Parke, Widaman, & O'Neil, 2001). These resulting outcomes can compromise the quality of life of individuals with ASD, leading to increased isolation and consequent risk of earlier death due to conditions associated with lack of social relationships such as depression and obesity (Berkman, 1995; Matson, Matson, & Rivet, 2007; White et al., 2007).

Inclusive educational practices for children with ASD is often seen as an

opportunity to increase socialization with typical peers and, as a consequence, minimize these detrimental outcomes resultant of lack of social skills (Anderson, Moore, Godfrey, & Fletcher-Flinn, 2004; Karagiannis, Stainback, & Stainback, 1996; Mesibov & Shea, 1996; Rotheram-Fuller, Kasari, Chanberlaim, & Lock, 2010). However, lack of necessary social interaction skills to develop meaningful relationships with typically developing peers becomes a major barrier for inclusion and permanence of children with ASD in general education, since they eliminate opportunities to learn through social interactions (Bellini et al., 2007; Charlop-Christy & Kelso, 2003; Greenway, 2000; Wang, Cui & Parrila, 2011). Therefore, social interaction skill deficits of children with ASD need to be targeted in inclusive education.

Besides representing a barrier for inclusion of children with ASD in general education (Wang et al., 2011), social interaction deficits should be addressed in inclusive settings for two additional reasons. First, simply providing opportunities for socialization with typical peers does not ensure improved social interaction skills and academic success for children with ASD (Gutierrez, Gossens-Archuleta, & Sobrino-Sanchez, 2007; Scattone, 2007). While typically developing children and children with disabilities other than autism are able to socially and academically benefit by simply observing other children (Bandura, 1977), children with ASD often are unable to attend to and learn by observing peer models. This difficulty may be due to an inherent lack of interest in others' behaviors and activities that, in some cases, is due to lack of skills to know how to interact with others (Leach, 2010). Therefore, improved social interactions do not naturally occur as a consequence of physical proximity to typical peers (Gutierrez et al.,

2007; Scattone, 2007). It is necessary to provide these children with interventions that help them to overcome social difficulties and benefit from social opportunities with typical peers in inclusive settings.

In addition, it is necessary to address social deficits of students with ASD in the inclusive settings because federal legislation requires providing children with disabilities the right of receiving free appropriate public education (FAPE) in the least restrictive environment (LRE; Yell, 2006). The Individuals with Disabilities Education Act (IDEA) mandates that school districts educate children with disabilities in the general classroom for the maximum extent possible (Koegel, Matos-Freden, Lang & Koegel, 2012; Yell & Shriner, 1996). Thus, there is an increasing trend in including children with disabilities in the general education (Harrower & Dunlap, 2001; Kamens, Loprete, & Slostad, 2003; Leach, 2010). Consequently, inclusion must be supported and must address the social deficits of these students to ensure successful and appropriate education that leads to positive outcomes for students with ASD (Leach, Witzel & Flood, 2009).

Providing supports for the successful inclusion for children with ASD may lead to important developmental gains. When students receive support to reduce the impact of their social deficits in inclusive settings, they can directly benefit from unique opportunities to socially interact and learn with peers (Dihel, Ford & Frederico, 2005). By addressing their social interaction deficits, students with ASD can participate more actively in school activities, which may help to improve problem behaviors, communication and academic skills that ensure their successful inclusion and placement in general education classroom (Leach, 2010; Leach et al., 2009). Furthermore,



continued successful education along with typically developing peers provides access to social situations that will prepare students with ASD to better function in an inclusive society as adults (Leach, 2010; Karagiannis et al., 1996). Therefore, systematic intervention approaches in the general education setting can promote successful inclusion, rather than their mere presence in this environment.

Several social skills interventions to address social deficits of children with ASD are found in the literature. Examples of these interventions include video modeling, priming, self-management, written scripts, social stories, and pivotal response training (Matson et al., 2007; Reichow & Volkmar, 2010; Scattone, 2007; White et al., 2007). Despite the variety of existing interventions, meta-analyses and literature reviews (Gillis & Butler, 2007; Matson et al., 2007; Reichow & Volkmar, 2010; Vaughn et al., 2003; Virués-Ortega, 2010) have indicated that most of these interventions utilize behavioral principles and techniques of applied behavior analysis (ABA) such as modeling, prompts, and reinforcement.

ABA is a systematic data-driven intervention approach that uses experimental and systematic methods of observation and measurement of behaviors (Mayer, Sulzer-Azaroff, & Wallace, 2012). As an applied science ABA is dedicated to assess and intervene on problem behaviors that are important for the individuals and the society (Baer, Wolf, & Risley, 1968) by modifying behaviors' antecedents and consequences (Sugai, Lewis-Palmer, & Hagan-Burke, 2000). Thus, ABA has demonstrated to be effective for treating a variety of limitations caused by ASD, including social deficits (Baer, Wolf & Rasley, 1968; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005;

Landa, 2007). Some reviews and meta-analysis have reported that large effects were obtained in studies using behavioral components to improve social interaction skills of students with ASD (Gillis & Butler, 2007; Vaughn et al., 2003; Virués-Ortega, 2010). In a recent meta-analysis involving 26 studies, for example, Virués-Ortega (2009) investigated effectiveness of applied analytic interventions for young children with autism in clinical and special education settings. He found that ABA interventions led from medium to large positive effects in social functioning of children with ASD in these settings.

Additionally, a number of single-case research design studies have indicated that behaviorally-based social skills interventions are effective for improving social interaction skills of children with ASD in inclusive settings (e.g., Crozier & Tincani, 2007; Ganz & Flores, 2008; Kohler, Greteman, Raschke & Highnam, 2007; Loftin, Odom, & Lantz, 2008; Sansosti & Powel-Smith, 2008). A recent review of methodological quality of 30 studies employing single-case research designs have indicated that there is a sufficient number of quality studies to consider behaviorally - based interventions evidence-based practices to improve social skills of children with ASD in inclusive settings (Camargo, in preparation). There is empirical evidence to support the use of behaviorally-based interventions as means of improving social skills of students with ASD in a variety of contexts, including general education. However, important aspects regarding their effectiveness in inclusive environments still need to be addressed. Although current studies provide valuable information that can assist teachers and practitioners who are required to choose evidence-based practices to facilitate social

interaction of children with ASD in general education (Individuals with Disabilities Education Improvement Act [IDEA] of 2004; No Child Left Behind Act of 2001), additional information is still needed. No studies to date have analyzed how effective these interventions are and specific conditions that may increase their effectiveness in inclusive settings related with participant characteristics, intervention variables, and implementation procedures (Odom et al., 2005).

Considering that behaviorally-based interventions are evidence-based practices to support inclusion of children with ASD (Camargo, in preparation), investigating overall effectiveness of this intervention and aspects that lead to better outcomes in inclusive settings is needed for two main reasons. First, answers currently needed in the area of inclusion involve determination of differential effects of interventions on children and contexts having different characteristics (Gena, 2006; Kavale, 2000; Lindsay, 2007; Mesibov & Shea, 1996). The literature have perseverated in the debate of inclusion concerning the rights of all children with disabilities to access general education, while it should be reframed for what strategies, accommodations, adaptations and practices should be in place to ensure that inclusion can be carried out successfully for children with different levels of intellectual, social, and communication skills (Kavale, 2000; Zigmond & Baker, 1995). The most important research questions regarding inclusion of children with ASD in general education settings pertain to how educators can provide appropriate education for students with disabilities and ensure their permanence and success in general education (Kavale, 2000; Lindsay, 2007; Mesibov & Shea, 1996, Peterson & Hittie, 2010; Zigmond & Baker, 1995). Although

behaviorally-based interventions seems to be an effective means to provide appropriate support for children with ASD included in general education (Leach, 2010), there is little research support for teachers to know how to implement these interventions effectively taking in account students, interventions and context differences.

Another reason why it is important to investigate effectiveness of behavioral intervention components and specific conditions in which they are most effective in inclusive settings is that children with ASD often have difficulties generalizing skills learned in teaching environments to environments in which those skills were not targeted (Bellini et al., 2007; Heflin & Alaimo, 2007). Although improvements in social skills are observed when interventions are conducted in clinical, home or special education settings, children with ASD do not easily transfer such skills to inclusive settings, which frequently involve different people and social situations (Rao, Beidel & Murray, 2008). Thus, because interventions should be conducted in the inclusive setting to improve students' social interaction skills in this specific setting, it is necessary to know which aspects of interventions conducted in general education can lead to more effective behaviorally - based interventions for students with ASD. For example, is necessary to know whether participants' age, type of target social skills, behavioral components used, intervention implementer and additional need for peer training lead to differential outcomes. Such information can guide practitioners in the direction of interventions that will be more likely to produce the desired social outcomes.

Considering that schools and teachers should be prepared for supporting inclusion of students with disabilities independent of age, investigation of differential

effects based on student's age can provide information regarding whether or not behaviorally-based interventions can be an effective tool to improve social skills and support inclusion of all students with ASD regardless of age. A previous meta-analysis of school-based social skills interventions did not find statistically significant differences across preschool, elementary, and secondary age groups of students with ASD (Bellini et al., 2007). However, studies included in the Bellini et al. meta-analysis involved several school contexts other than inclusive settings such as resource and therapy rooms. Moreover, it is unclear whether the school-based interventions included were behaviorally-based, since this information is not provided in the meta-analysis. Thus, differential outcomes as function of participant's age need to be further investigated for behaviorally-based interventions that are specifically conducted in inclusive settings.

In addition to participant's age, some intervention variables can also account for differences in effects such as the behavioral components utilized (Scruggs & Mastropieri, 1998). Since studies have identified that prompts, modeling, and/or reinforcement (alone or combined) are the most frequently used behavioral components in social skills interventions (Camargo, in preparation; Gillis & Butler, 2007; Reichow & Volkmar, 2010; Vaughn et al., 2003) it is important to know which ones should be included in the treatment protocol to provide the most beneficial results for students with ASD. This is particularly important when considering that each of these behavioral components, when planned as part of intervention procedures, involve different strategies and might require different resources such as teacher's time and additional personnel when teaching social skills. Modeling, for example, may require a significant

amount of time commitment as multiple exemplars and repetition of instruction is often needed (Beidermann & Freedman, 2007; McLeskey & Waldron, 2011; Mason, Ganz, Parker, Burke, & Camargo, 2012). Prompts may require additional child's supervision and personnel training to timely prompt the child and avoid prompt dependency (Hume, Plavnick, & Odom, 2012; Odom & McEvoy, 1990). Similarly, reinforcement that is planned as part of intervention procedure such as delivery of praises, preferred edibles, items or activities requires teacher's time and/or additional personnel for conducting preference assessments, planning and implementing the schedule of reinforcement (Leach, 2010; Roane, Vollmer, Ringdahl, & Marcus, 1998). Implementation of all these procedures may be challenging and not feasible for general education teachers in the inclusive settings, since they are required to manage a classroom with several students in a less structured environment than clinics and special education classrooms (Odom & McEvoy, 1990). Considering that, it is important to provide teachers and practitioners with research-based interventions that are both effective and feasible for inclusive classrooms.

Although a number of publications demonstrating effective behaviorally - based interventions for teaching social skills for children with ASD in inclusive settings exists, few address their applicability in the context of general education (Camargo, in preparation). A study investigating teacher's perceptions regarding adoption of research-based interventions found that teachers tend to choose interventions based on ease of implementation and amount of time required from classroom schedule (Boardman, Arguelles, Vaughn, Hughes, & Kligner, 2005). Therefore, it is important to investigate,

for example, whether interventions utilizing planned reinforcement that is part of the intervention protocol combined with prompts and/or modeling are more effective than those not utilizing planned reinforcement. It would indicate whether reinforcement consistently delivered by teachers in the inclusive settings is an essential component of intervention strategy to improve social skills of children with ASD or the opportunities to interact with peers in social situations through other behavioral intervention strategies would be reinforcing itself. Similarly, it would be important to evaluate whether interventions using modeling, which is proven to be effective in other environments (Charlop-Christy, Le, & Freeman, 2000; Mason et al., 2012) and is the most time consuming behavioral component, would lead to better outcomes in students' social skills than those not using it in inclusive settings. These analyses can bridge the gap between research and inclusive practice, providing parameters for teacher and practitioners to adopt more suitable research-based practices and allocate needed resources towards more effective strategies.

Similarly to behavioral components, the social interaction skill targeted in the intervention may lead to differential outcomes. Since individuals with ASD have deficits in social interaction, behaviorally-based social skills interventions have been used to teach a variety of social interaction skills for children with ASD, including, for example, social interaction initiation or responses to others' requests, conversations, comments, or play interaction (Bellini et al., 2007; Gillis & Butler, 2007; Reichow & Volkmar, 2010). Additionally, some studies define both general types of social interaction skills (initiation and response) as the targeted skill (Camargo et al., in preparation). To date, no

studies have conducted analyses of differential effects of behaviorally - based interventions according to these target social skills in inclusive settings and neither investigated whether targeting these social interaction skills in isolation or not impact the obtained results. Therefore, evaluation for which of these types of targeted social interaction skills in isolation or combined behaviorally-based interventions have been more effective in inclusive settings is necessary for guiding future adoption of interventions that can be potentially more effective for the target skill being taught.

Other important factors that may moderate the impact of the intervention on the outcome in inclusive settings are variables related with who implemented the intervention and additional implementation of peer trainings. A variety of intervention implementers are found in the literature including teacher or peer-mediated interventions (Reichow & Volkmar, 2010). Moreover, it is common for researchers to carry out the implementation of intervention conducted in inclusive settings (e.g., Crozier & Tincani, 2007; Ganz & Flores, 2008; Nelson, McDonell, Johnston, Crompton & Nelson, 2007). However, researchers are not typical interventionists that will be conducting social skills interventions in the daily inclusive school environment and may be more cognizant of issues involving treatment fidelity. This highlights the importance of evaluating whether interventions in which teachers or peers delivered behavioral components to target students would produce different effects than those delivered by researchers. Additionally, an analysis of intervention effectiveness by whether typically developing peers were trained to respond to participants with autism or not can identify the need of



additional resources and students' training to generate effective social skills interventions for children with ASD in inclusive settings.

In order to derive this practical information regarding conditions under which the intervention will provide the most beneficial results in real-world settings, it is necessary to employ systematic procedures that are able to provide a quantitative synthesis of individual studies (Scruggs & Mastropieri, 1998). Meta-analytic techniques that allow aggregation of effects across studies provides means to determine specific conditions in which behaviorally - based interventions have been most effective to teach social skills of children with ASD in inclusive settings (Kavale, 1984, 2001).

Meta-analysis is a recognized method of research synthesis for assessing the magnitude of intervention effects based on the combination of a set of independent studies (Kavale, 2001). This statistical method for summarizing and combining studies' individual effects involve the calculation of effect sizes (Kavale, 2001; Kratochwill et al., 2010). Effect sizes are typically used with group research designs (Kratochwill & Levin, 2010; Kratochwill et al., 2010). Because most research in ABA and ASD employ single-case research designs that do not meet parametric statistical assumptions, these studies have not been often analyzed through meta-analytic methods (Parker, Vannest & Brown, 2009; Vannest, Davis, Davis, Mason, & Burke, 2010). However, advancements in the field of single-case research have offered and progressively improved effect sizes measures that are suitable to the nonparametric features of this research design, for which significance levels and confidence intervals can be calculated (Maggin, O'Keeffe, & Johnson, 2011; Parker et al., 2009; Parker, Vannest, & Davis, 2011; Ganz et al.,

2012). As a result, calculation of effect sizes in single-case research can provide an objective index of intervention success. Therefore, quantitative analysis to determine specific conditions in which behaviorally-based interventions have been most effective through meta-analytic techniques can guide general education policies and practices towards interventions that can promote social skills and successful inclusion of students with ASD in general education settings (Odom et al. 1995).

Considering the advancements in meta-analytic techniques for single-case research and lack of aggregation studies in the area of social skills, ASD, and inclusion, the purpose of this study is to conduct a meta-analysis of the single-case studies previously identified by Camargo (in preparation) as quality studies for determining behaviorally-based interventions as evidence-based practices to improve social interaction skills of students with ASD in inclusive settings. Specific goals of this meta-analysis are to examine the aggregated outcomes of these quality studies to identify overall and differential effects of the intervention as moderated by participant's age, target social skills, behavioral components used, intervention implementer and peer training. Research questions include: (a) for which age groups of students with ASD are behaviorally-based interventions for improving social interaction skills in inclusive settings most effective; (b) are behaviorally-based interventions for social interaction skills in inclusive settings differentially more effective according to the type of target social interaction skills; (c), do the behavioral components utilized moderate intervention outcomes; (d) does intervention implementer moderate intervention outcomes; and (e)

does additional peer training moderate the magnitude of change in social interaction skills of children with ASD in inclusive settings?

## **Method**

### **Study Identification**

**Search Method.** Studies were identified through systematic searches in the following five electronic databases through EBSCO and Cambridge Scientific Abstracts (CSA) publishing: Academic Search Complete, Education Resources Information Center (ERIC), Psychological and Behavioral Sciences, Psyc Info, and Medline. The search was restricted to peer-reviewed studies and included the following Boolean search terms: social skills, aut\* and inclus\*; social behavior, aut\* and inclus\*; ABA or Applied Behavior Analysis, aut\* and inclus\*; behavioral intervention, aut\* and inclus\*; social skills, aut\* and mainstream\*; social skills training, aut\* and inclus\*; social skills training, aut\* and mainstream\*; social skills intervention, aut\* and mainstream\*; and social skills intervention, aut\* and inclus\*. Use of these search terms and additional ancestry searches through the reference lists of studies identified yielded 196 studies.

**Inclusion criteria.** Each potential study was analyzed using the following inclusion criteria: (1) the independent variable was a behaviorally-based intervention, which consisted of a social skills intervention utilizing behavioral components (e.g., prompting paradigms, reinforcement schedules, imitation, and modeling (Reichow & Volkmar, 2010; Strain & Schwartz, 2001); (2) the study was an English publication; (3) the article was published in a peer-reviewed journal; (4) the dependent variable(s) included at least one target social interaction skill (i.e., turn taking, sharing, initiating

conversations and activities, maintaining social interaction, making comments, responding to other's social initiation and conversations, complimenting, and joint attention); (5) at least one of the participants had diagnosis of an ASD; (6) the study utilized a single-case research design; (7) raw data was provided in some format (i.e., line graph or table) identifying scores with time sequence; and (8) the study was conducted in a inclusive setting (more specifically, classroom or other school area in the general education system).

***Inter-rater reliability.*** A second independent evaluator reviewed 63% of identified studies to verify if all studies meeting the criteria were included. A third evaluator reviewed studies for which the first two evaluators disagreed and/or one evaluator was undecided. Agreements between two of the evaluators was the final decision. Inter-rater agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements between raters and multiplied by 100. This process resulted in the inclusion of the same 30 studies meeting the criteria with 100% final agreement between evaluators, from which 19 were previously considered as meeting minimum quality standards of single-case research (Camargo, in preparation). With no new studies identified, 19 studies meeting quality criteria for evidence-based practice in single-case research were included in this meta-analysis.

### **Extraction of Descriptive Information**

Each of the 19 included studies was systematically reviewed to summarize relevant features of the study. Summaries included participants' characteristics, methodological and procedural details, treatment fidelity, description of dependent and

independent variables, intervention procedures, and results. Evaluation of social validity, maintenance and generalization of skills were also noted. The summaries were used to identify potential moderators and create the summary table on page 81.

### **Potential Moderators Coding**

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 and /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, potential moderators were coded for each study including: (a) participants' age, (b) target social skills, (c) behavioral components utilized, (d) intervention implementer, and (e) implementation of peer training. It is important to note that judgments about coding and moderator categories were made on the basis of information provided in the published articles and that possible omitted information were not considered.

**Participants' age.** Coding of this moderator resulted in two levels: preschool (2-5 years), and elementary (6-10 years) age group. Only one study involved participants from secondary (11-17 years) and post-secondary (18 years and older) age group. As a result these categories were unable to be included as levels of age moderator.

**Behavioral components.** Coding of behavioral components was twofold. First, behavioral components were coded and grouped according to the use of planned reinforcement, i.e., reinforcement that was part of intervention protocol and was

delivered to the participants with ASD by the interventionist. This involved two levels: *use of planned reinforcement* and *no use of planned reinforcement*. No use of planned reinforcement refers to interventions in which no reinforcement was provided by the interventionist as part of the intervention procedures. One or more types of behavioral components other than reinforcement may have been used in each category (i.e., prompt and modeling).

Second, studies were coded and grouped according to the use of modeling, i.e., demonstration of the target skill by a video, peer or adult. Modeling was coded in two levels: *use of planned modeling* and *no use of planned modeling*. Planned modeling refers to the use of modeling as part of the intervention protocol, while no use of planned modeling refers to intervention that did not include modeling as behavioral component in the intervention procedures. Because a few studies did not use prompts, use or no use of prompts could not be a moderator of the behavioral component. Although some may consider modeling as a type of prompting, both are distinctly defined in this study. Modeling refers to demonstration of the target social skill by others or videos, showing what the participant is expected to do in the natural social situation prior to child's response. Prompts in turn, are considered to be strategies that instead of demonstrating the skill for student's independent performance tell the student what to do or physically guide the student to appropriately perform the skill in response to certain social situations, increasing the probability that specific discriminative social stimulus will occasion the desired social response (Green, 2001; Leach, 2010; Vaughan et al., 2003).

**Target social skills.** Target social skills refer to the outcome variable investigated in each study. Coding of this variable consisted of three levels of analysis according to their ultimate social goal: *initiating social interaction*, *responding to other's social initiations*, or *both initiating and responding* during social interactions. Kern and Aldridge (2006), for example, targeted positive interaction, which was defined as participant's initiation of positive interaction with peers and participant's positive response to the interaction initiated by a peer.

**Intervention implementer.** The intervention implementer refers to the person who directly implemented the behavioral components with participants with ASD and included two levels: *researcher as implementer* and *teacher as implementer*. There were only a few studies in which typically developing peers participated as direct interventionists, not allowing inclusion of this level.

**Peer training.** Peer training refers to studies' additional procedure of training typical peers to respond to participants with ASD's initiation. Thus, it included two levels: *peer training* and *no peer training*.

**Inter-rater reliability for moderator coding.** To ensure accurate coding of the studies by moderators, a second rater independently coded 33% of the studies randomly selected for each of the identified moderators. Inter-rater agreement was determined by the calculation of percent agreement ( $\text{agreements} / [\text{agreements} + \text{disagreements}] \times 100$ ). Initial inter-rater agreement was 85% across all moderators. A third evaluator reviewed studies for which the first two evaluators disagreed and/or one evaluator was undecided.

The decision made by at least two of the evaluators was the final decision with 100% agreement between raters.

### **Effect Size and Replication Analysis**

Although there has been significant discussion and disagreement regarding the best statistical procedures to allow effect size interpretation in single-case research, the most recent non-parametric effect size measure to utilize for single-case analysis is Tau-U (Parker, Vannest, Davis, & Sauber, 2011). While other measures of effect sizes like Non-overlap of All Pairs analysis (NAP, Parker & Vannest, 2009) are considered more robust inspection of data overlap between phases over the traditionally used Percent of Non-Overlapping Data (PND, Scruggs, Mastropieri, & Casto, 1987), the use of non-overlap measures alone does not control for positive trend in baseline (Parker et al., 2011). Tau-U can address this limitation by providing a complete measure involving both level and trend.

For studies in which controlling for undesirable positive phase A trend is necessary (i.e., Tau trend = .10 and above), Tau-U becomes a suitable measure of effect size in that it is flexible and provides the option of subtracting Phase A trend from the nonoverlap formula. Tau-U summary index can be interpreted as “the percent of non-overlap between phases” or “percent of data showing improvement between phases” (Parker et al., 2011, p. 291). A Tau-U score of .68, for instance, indicates that 68% of data do not overlap between baseline and intervention phases or 68% of data show improvement between phases.



Additionally, Tau-U has been demonstrated to perform reasonably well with auto correlated data (serial dependency in time series data) and monotonic trends (any trend profile), common occurrences in single-case research. Tau-U values range from 0 to 1. Given that Tau-U scores are equivalent to NAP ( $\text{Tau-U} = 2 * \text{NAP} - 1$ ), effect sizes can be interpreted according to the following range of scores: weak or small effects: 0 – .65; medium to high effects: .66 – .92; and large or strong effects: .93 – 1.0 (Parker & Vannest, 2009).

Considering that Tau-U can be considered an appropriate non-parametric index of effect size in single-case research, Tau-U was the effect size measure conducted in this meta-analysis. Additional information on Tau-U effect size can be found on Parker et al. (2011)'s article. Online Tau-U software developed by Vannest, Parker & Gonan (2011) was utilized for calculating effect sizes.

**Data extraction.** Prior to calculation of effect sizes, the graphs from each study in the review were digitized utilizing GetData software, which translated the data points into readable raw values. The raw data obtained from the x and y access of the line graphs were saved in an excel document for further analysis. Similar software programs for data extraction have been utilized in previous research (Parker, Hagan-Burke, & Vannest, 2007; Vannest, Harrison, Temple-Harvey, Ramsey, & Parker, 2011), allowing an accurate analysis of effects sizes.

**Phase contrasts and omnibus effect sizes.** Effect sizes were calculated in order to obtain individual measures of the magnitude of change occurring between at least one contrast (phase A x phase B). For designs with more than one phase change (e.g.,

reversal and multiple baseline designs), each phase change was contrasted (i.e.  $A_1 \times B_1$  and  $A_2 \times B_2$ ) and then aggregated in a single effect for the design as appropriate. Studies utilizing more than one intervention phase (e.g., ABC), had phase contrast analysis conducted between  $A \times B$  and  $A \times C$ . Maintenance and generalization were not included in phase contrasts. Aggregation of effect sizes was conducted using meta-analytic methods in the WinPEPI free software package (Abramson & Gahlinger, 2011). Tau-U values and their standard errors were entered into WinPEPI and were combined using a fixed-effect model. To obtain an omnibus effect size with confidence intervals, the software automatically weights the results for each series by the inverse of its variance (Parker et al., 2011).

**Statistical significance.** Differences between levels of the moderators were analyzed using statistical significance test through the use of 83.4% confidence intervals (CI). Confidence intervals inform the degree of precision of an estimated score and are particularly useful for interpreting differences among small N studies (Thompson, 2002; 2007). A Tau-U of 0.81 with 83.4% confidence interval between 0.78 and 0.85, for example, indicates that we are 83.4% certain that the true Tau U effect size is somewhere between 0.78 and 0.85. Statistically significant differences ( $p = .05$ ) occur when the 83.4% confidence intervals of at least two given measures do not overlap at the upper and lower limits (Payton, Miller, & Raun, 2000; Payton, Greenstone, & Schenker, 2003).

This test of nonoverlap is equivalent to the student T-test of statistical significance at 95% confidence interval ( $p=.05$ ) (Payton et al., 2000). Thus, confidence

intervals for omnibus effect sizes of each moderator level were computed at the 83.4% level, allowing the visual analysis of statistical significant differences between multiple effect sizes through the use of a forest plot (Mason et al., 2012; Payton et al., 2000).

## **Results**

### **Descriptive Summary**

Table 5 provides a descriptive summary of the 19 studies included in this meta-analysis according to the identified moderators of interest.

**Participants' characteristics and age group.** Of the 55 participants involved across the studies, 85% (n=47) were diagnosed with autism (including severe, moderate and high functioning autism). The remaining participants were diagnosed with pervasive developmental disorder not otherwise specified (PDD-NOS, 9%, n=5) and Asperger syndrome (6%, n=3). The majority of students (91%, n=50) were male and only 9% (n=5) were female. The participants' age average was 5 years (range= 3 – 21 years). Regarding age group, the majority of students (63%, n=35) were in the preschool age category (2-5 years), while 31% (n=17) were children in the elementary age group (6-10 years). Only two participants (4%) were in the post-secondary age category and one (2%) in the secondary age category, thus, it was not possible to include secondary and post-secondary participants in the analyses investigating differential effects based on age.

**Outcome variables.** Several social interaction skills were investigated across the 19 studies, including play initiation, conversation initiation, response to other's requests, or response to other's comments and interactions. The majority of these target social skills

Table 5

*Summary of studies included in the meta-analysis*

Study	Participants <sup>1</sup>	Age group	Outcome variables	Intervention and behavioral components	Intervention Implementer	Peer Training
Chan & O'Reilly (2008)	1 male, autism	Preschool	Play initiation	Social Story; prompt and reinforcement	Teacher	No
Crozier & Tincani (2007)	1 male, autism	Preschool	Conversations with peers, both initiation and response	Social Story; prompt	Researcher	No
Ganz & Flores (2008)	3 males, HFA <sup>2</sup> , autism and PDD-NOS <sup>3</sup>	Preschool	Context-related comments initiation and responses	Visual scripts; prompting and modeling	Researcher	Yes
Gena (2006)	2 males, 2 females, autism	Preschool	Social interaction initiation and response	Not specified; prompt and reinforcement	Teacher	No
Garfinkle & Schwartz (2002)	3 males, autism	Preschool	Peer imitation (response) and social interaction initiation	Peer imitation; prompt and reinforcement	Teacher	Yes
Hughes et al. (2011)	1 male, 2 females, 16-21 yrs, autism	Secondary and post secondary	Frequency and duration of interaction initiation and response and both	Communication books; modeling, prompting, repeated practice and corrective feedback	Researcher and peer	Yes
Jung et al. (2008)	2 males, 1 female, autism and PDD-NOS	Preschool and Elementary	Social interaction initiation and both initiation and response	Low and high-p requests sequence; prompt, reinforcement and modeling	Researcher	Yes
Kamps et al. (1997)	3 males, autism	Preschool and Elementary	Duration of both social interaction initiation and response	Peer network including scripts and social stories; prompt and reinforcement	Teacher and peer	Yes
Kern & Aldridge (2006)	4 males, autism	Preschool	Both social interaction initiation and response	Musical therapy; prompt and reinforcement	Peer	Yes/No
Kohler et al. (2001)	4 males, autism and PDD-NOS	Preschool	Both social interaction initiation and response	Naturalistic teaching; prompt	Teacher	No
Laushey & Heflin (2000)	2 males, severe autism and HFA	Preschool	Both social interaction initiation and response	Buddy skills; reinforcement	Teacher	Yes
Loftin et al. (2008)	3 males, autism	Elementary	Social interaction initiation and response	Multi-component social skills; modeling, prompt and reinforcement	Researcher	Yes
McGee & Daly (2007)	3 males, autism	Preschool	Response to specific social situations	Incidental teaching; modeling, prompt and reinforcement	Teacher	No
Nelson et al. (2007)	4 males, autism	Preschool	Play initiation	Visual script; prompt and reinforcement	Researcher	Yes

Table 5 (cont.)

Study	Participants	Age group	Outcome variables	Intervention and behavioral components	Intervention Implementer	Peer Training
Sainato et al. (1992)	3 males, autism	Preschool	Social interaction initiation and both initiation and response	Peer self evaluation in peer training; prompts	Teacher	Yes
Sansosti & Powell-Smith (2008)	2 males, autism and AS	Elementary	Social interaction initiation	Social story and video modeling; modeling and prompts	Teacher	No
Shabani et al. (2002)	2 males, autism	Elementary	Social interaction initiation and response	Not specified; modeling, prompt, and reinforcement	Adult	No
Thiemann & Goldstein (2004)	5 males, autism and AS	Elementary	Social interaction initiation and both initiation and response	Peer training and visual script; prompt and reinforcement	Researcher	Yes
Zanolli et al. (1996)	2 males, autism	Preschool	Social interaction initiation	Priming; modeling, prompt, and reinforcement	Teacher and peer	Yes

<sup>1</sup>Only participants meeting the study's criteria, <sup>2</sup>HFA - High Functioning Autism, <sup>3</sup>PDD-NOS – Pervasive Developmental Disorders – Not Otherwise Specified

focused on interaction initiation (50%, n=16), including play initiation (Chan & O'Reilly, 2008; Nelson et al., 2007), gaining peer's attention (Harper et al., 2008) and initiating conversations or context-related comments with peers (Crozier & Tincani, 2007; Ganz & Flores, 2008). Response to other's social interaction was targeted in 19% (n=6) of studies, including for example, responding to other's comments (Ganz & Flores, 2008), responding to peers' interaction initiation (Loftin et al., 2008) and responding to specific social situations such as being interrupted by others (McGee & Daly, 2007). Outcome definitions in which both social interaction initiation and response were targeted occurred in 31% (n=10) of studies (e.g., Thiemann & Goldstein, 2004; Morrison, Kamps, Garcia, & Parker, 2001).

**Intervention and behavioral components.** Behaviorally-based interventions used across studies involved different types of social skills interventions, mostly including peer mediated interventions (Garfinkle & Schwartz, 2002; Kamps, Potucek & Lopez, 1997; Laushey & Heflin, 2007; Sainato, Goldstein, & Strain, 1992; Thieman & Golstein, 2004), social stories (Chan & O' Reilly, 2008, Crozier & Tincani, 2007; Kamps et al., 1997; Sansosti & Powell-Smith, 2008), and visual scripts (Ganz & Flores, 2008; Kamps et al., 1997; Nelson et al., 2007; Thiemann & Goldstein, 2004). Despite the variety of social skills interventions utilized, all studies consistently used peer or adult modeling, different prompt hierarchies and types (e.g., most to least or least to most hierarchy and verbal, visual, written or tactile prompt) and/or a variety of positive reinforcement (e.g., edibles, tangibles, and/or praise) as behavioral components. The use of all or at least two of these behavioral components was often combined across the

studies (e.g., Chan & O'Reilly, 2008; Garfinkle & Schwartz, 2002; Gena, 2006; Jung et al., 2008; Loftin et al., 2008; McGee & Daly, 2007).

**Intervention implementer.** Teachers were the primary implementers of behavioral components with students with ASD in most of the studies (n=9, 47%). Researcher was the second most common implementer of the behavioral components across studies (n=6, 32%). Peers were the implementers in only one study (5%). Both teacher and peers prompted, modeled or reinforced participants with autism in two studies (10%), followed by researcher and peer (n=1, 5%), and a non-specified adult (n=1, 5%).

**Peer training.** Of the 19 studies, 12 (63%) trained typical peers to respond to interaction initiations and social overtures from participants with ASD. Forty-two percent (n=8) of the studies did not implement training with typically developing peers in the inclusive settings. Of note, one of the studies (Kern & Aldridge, 2006) was computed in both levels of peer and no peer training as both situations occurred in different phases of the study.

### **Effect Size and Replication Analyses**

**Overall effect size.** Results yielded to an overall Tau-U effect size of .88 (CI [.85, .91]). The range of effect sizes across studies varied between 0.58 and 1.0 and is visually depicted in Figure 2.

The obtained overall omnibus effect size indicates high magnitude of change on the social interaction skills of students with ASD as a result of behaviorally - based interventions in inclusive settings, with 88% of data showing improvement between phases. The narrow confidence interval indicates a precise estimation of intervention

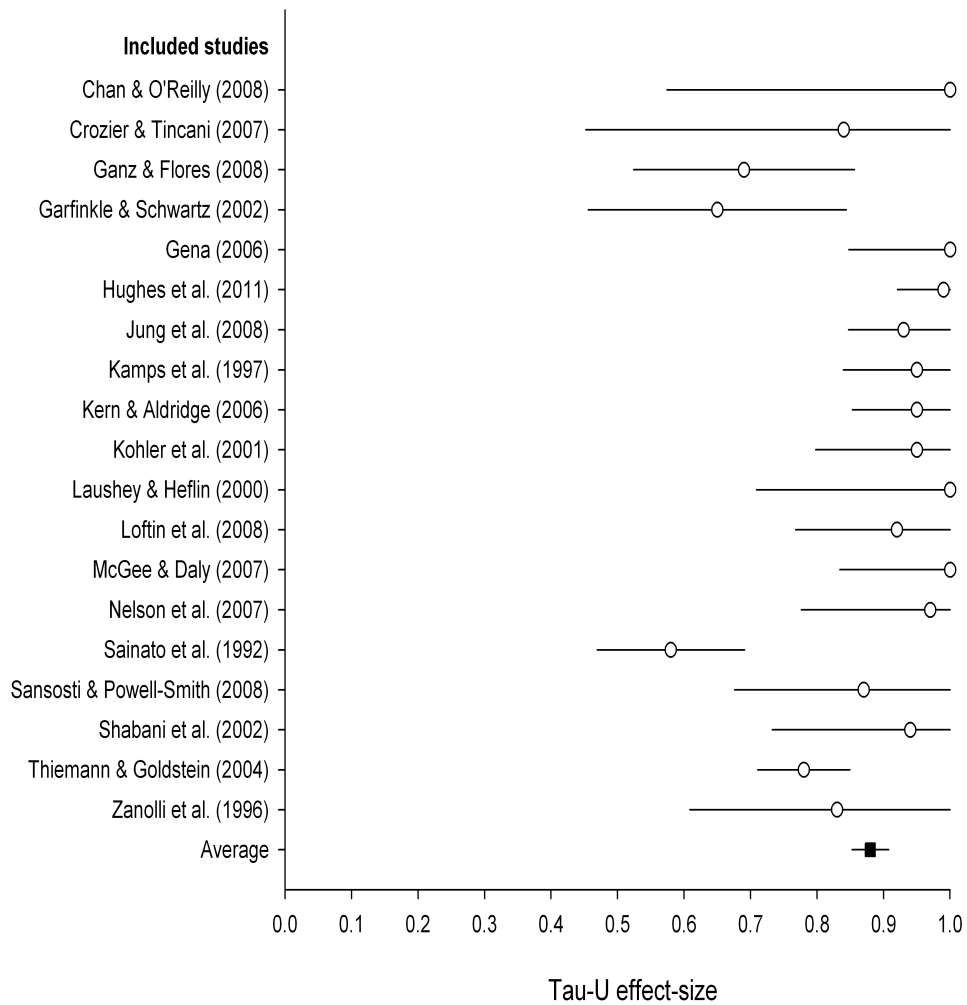


Figure 2. Tau-U and 83.4% CI overall and by study.



Table 6  
*Number of studies, participants and contrasts for each moderator and respective levels*

Moderators and levels	Studies	Participants	Contrasts
<b><i>Overall</i></b>	19	55	172
<b><i>Participants' age</i></b>			
Preschool	13	35	75
Elementary	6	17	70
<i>Total</i>	19	52	145
<b><i>Target social skills</i></b>			
Initiation	13	36	61
Response	7	21	38
Both	9	28	53
<i>Total</i>	29	85	152
<b><i>Behavioral components</i></b>			
Reinforcement	13	39	64
No reinforcement	7	18	53
<i>Total</i>	20	57	117
Modeling	5	13	46
No modeling	7	24	60
<i>Total</i>	13	37	106
<b><i>Intervention Implementer</i></b>			
Researcher	6	19	89
Teacher	9	26	40
<i>Total</i>	15	45	129
<b><i>Peer Training</i></b>			
Peer training	12	37	140
No peer training	8	18	32
<i>Total</i>	20	55	172

effect with 83.4% confidence that the true effect size is between 0.85 and 0.91.

However, the relative wide range of effects across studies suggests that variations related with participants, intervention, and implementation features may yield differential effects. Thus, these moderator variables were further analyzed. Table 6 displays the number of studies, participants and contrasts involved in the computation of the intervention overall effect size and as well as in the computation of disaggregated effects according to each moderator and their respective levels involved in this meta-analysis. The totals exceed the total number of conclusive studies and participants because some of the studies included phases and/or participants in multiple moderator levels (e.g., Jung et al., 2008; Loftin et al., 2008; Shabani et al., 2002).

**Participant age.** Analysis of the combined Tau-U measures by the most common age groups of participants included in the studies indicated the same high magnitude of intervention effects (Tau-U = 0.86 (CI [.82, .90])) for both preschool and elementary age group. Exact overlap of 83.4% confidence intervals detected no statistically significant difference ( $p = .05$ ) between preschool and elementary age groups. Forest plot with results for participant age as moderator is presented in Figure 3.

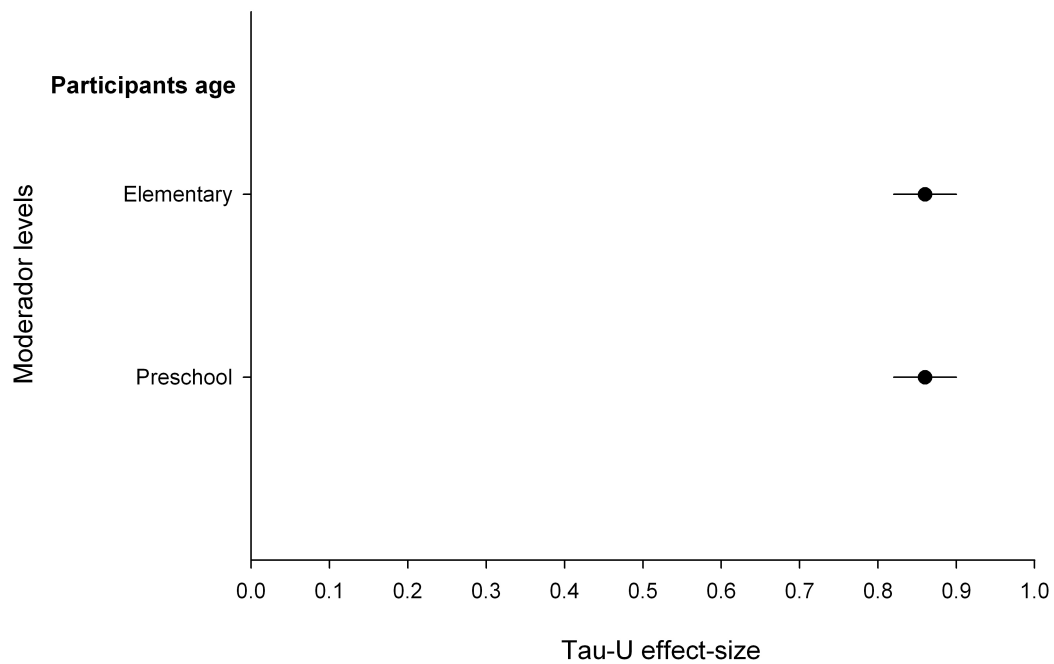


Figure 3. Tau-U and 83.4% CI for participant age.

**Target social skill.** Computation of omnibus effects for levels of target social skills is displayed in Figure 4. Studies focusing on social interaction initiation skills to participants with ASD obtained a high overall effect size of .86 (CI [.82, .90]). A large overall effect size of .94 (CI [.87, 1.0]) was obtained for studies focusing on teaching social interaction response, and medium intervention effect (.76, CI [.72, .80]) was obtained for studies focusing on both social interaction initiation and response.

Overlap of confidence intervals for social interaction initiation and social interaction response indicates no statistically significant difference between these two groups of target outcomes beyond  $p = 0.05$ .

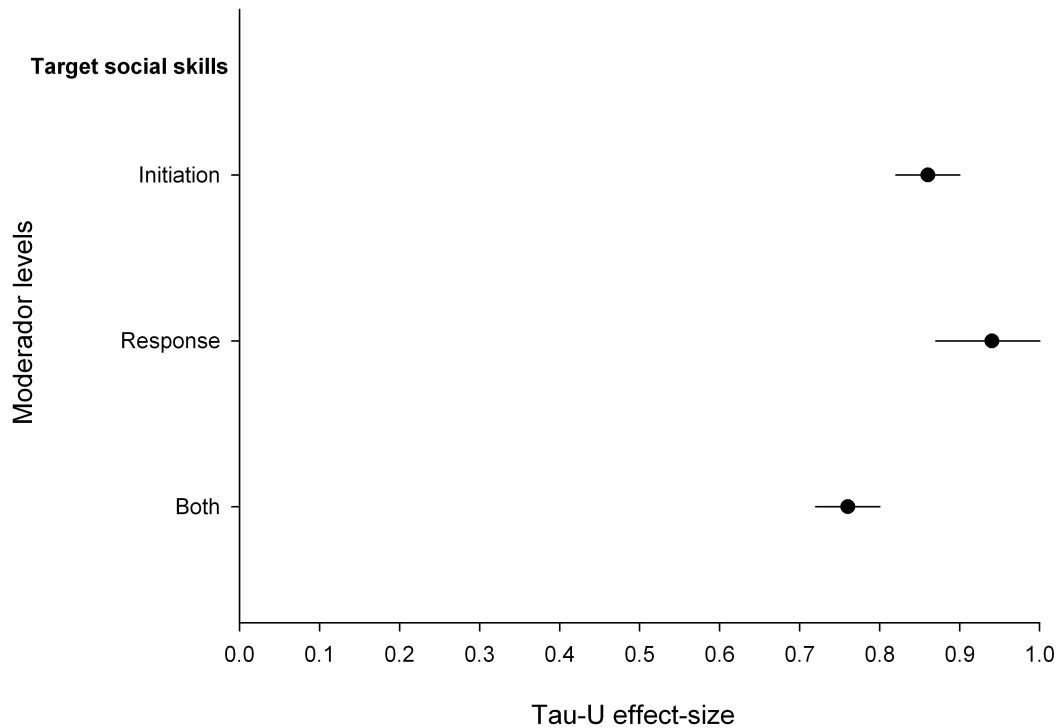


Figure 4. Tau-U and 83.4% CI for target social skills.

However, statistically significant differences ( $p = .05$ ) were noted by non-overlap of confidence intervals for target social skills focusing on both social interaction initiation and response and confidence intervals for the other two groups analyzing these target social skills separately.

**Behavioral components.** The included studies were further analyzed to determine the presence of differential effects based on behavioral components used. The results are illustrated in Figure 5. First, effects of interventions including the use of

planned reinforcement were compared to those that did not use planned reinforcement, that is, reinforcement that was part of the intervention protocol. When interventions included planned reinforcement, a high overall effect size and narrow 83.4% confidence interval was obtained (.89, CI [.86, .92]). On the contrary, a smaller effect with wider confidence interval was obtained when interventions did not use planned reinforcement (.77, CI [.70, .84]). The non-overlap of the confidence intervals for interventions using planned reinforcement when compared to those not using planned reinforcement indicates a statistically significant difference ( $p = .05$ ). That is, interventions using planned reinforcement demonstrated the greatest magnitude of change.

The second comparison of effects according to behavioral components used involved the use or no use of planned modeling, i.e., modeling procedures that were included in the intervention protocol. Because studies included in both levels of this moderator implemented the same behavioral components (i.e., prompt and reinforcement, with modeling combined or not combined), the remaining few studies having different behavioral components were not included in this analysis. Although with smaller number of studies involved, it allowed for a more accurate comparison in which only the presence of modeling was manipulated, enabling the estimation of its moderator effect. Results indicated a high to large effect sizes for both levels. Tau-U effect sizes and respective confidence intervals of .96 (CI [.92, 1.0]) for interventions using modeling and .82 (CI [.86, .90]) for interventions not using modeling were obtained. Non-overlap of confidence intervals demonstrates no statistically significant difference ( $p = .05$ ) regarding the use or no use of modeling.

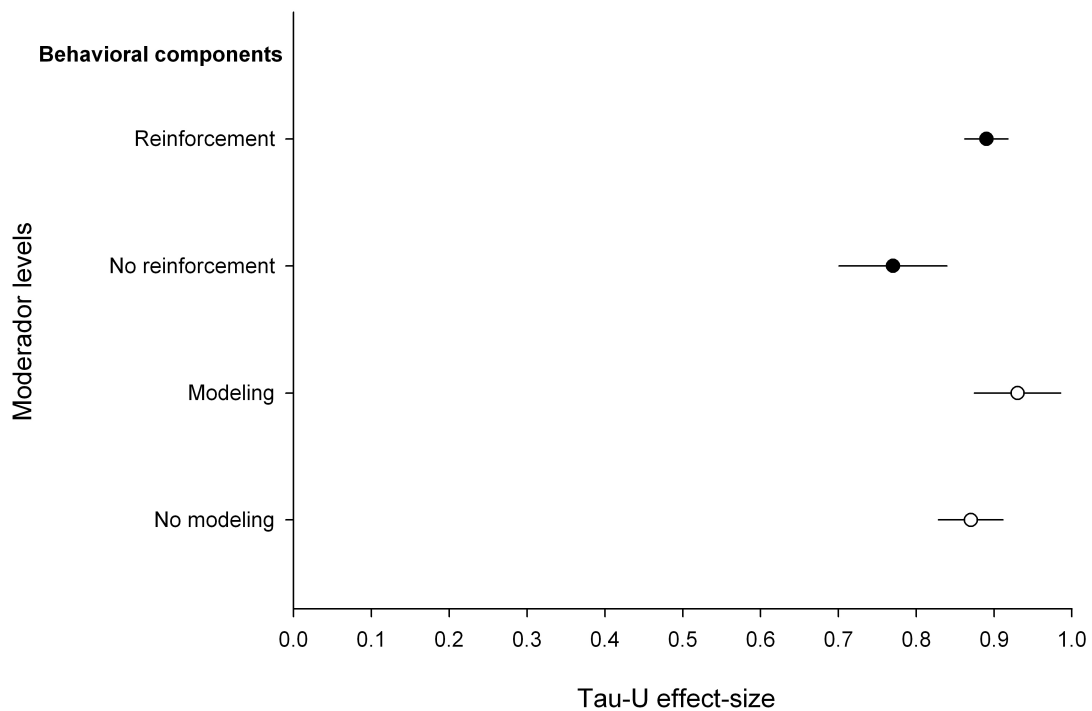


Figure 5. Tau-U and 83.4% CI for behavioral components according to the use and no use of reinforcement (black circles) and modeling (white circles).

**Intervention implementer.** The studies were analyzed to determine whether the person implementing the intervention would impact effects of behaviorally-based interventions for children with ASD in inclusive settings. Figure 6 presents the forest plot with overall effects for each level and respective confidence intervals.

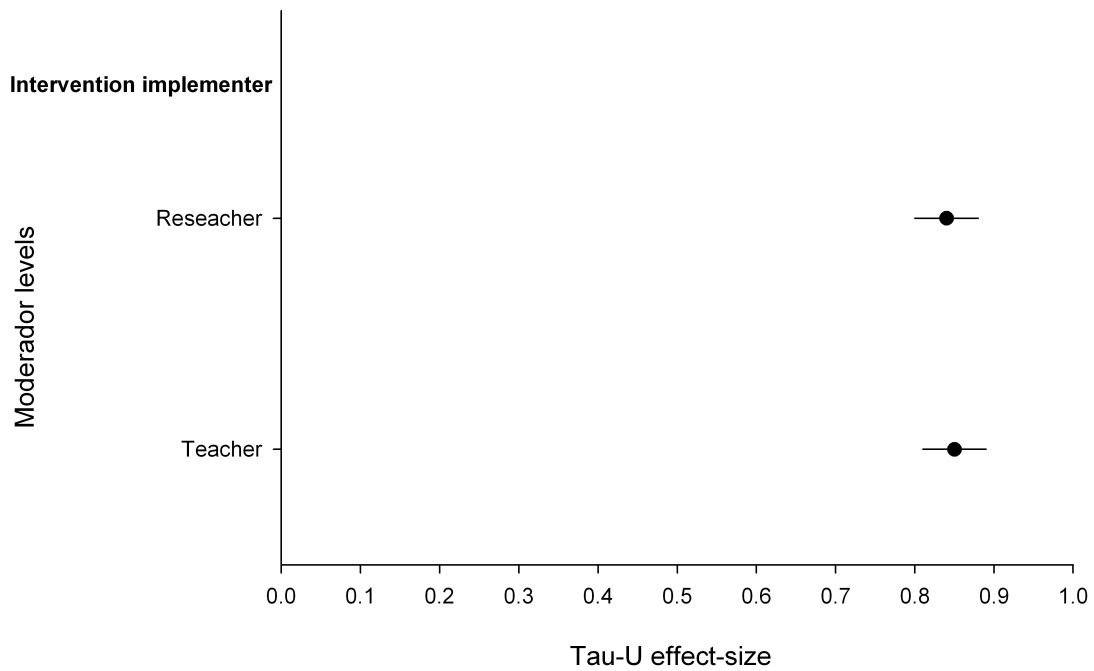


Figure 6. Tau-U and 83.4% CI according to intervention implementer.

Tau-U overall effects was compared between studies having researcher as intervention implementer and studies having teachers as implementer. Combined omnibus effect sizes for teacher category (.85 CI [.79, .91]) was slightly greater than researcher category (.84, CI [.80, .88]). However, both produced high magnitude of change in participants' target social skills. The overlap between confidence intervals shows no statistically significant difference ( $p = .05$ ) in effects between these two categories.

**Peer training.** Comparison of overall effects according to studies using or not using peer training to respond to participants' with ASD is presented in Figure 7. High to large impact on social interaction skills were obtained for both studies using (.87, CI [.84, .90]) and not using (.95, CI [.88, 1.0]) additional peer training as intervention procedure. Although no peer training produced higher effect size than peer training category, overlap between confidence intervals for both groups indicates no statistically significance ( $p = .05$ ) regarding the implementation or no implementation of peer training.

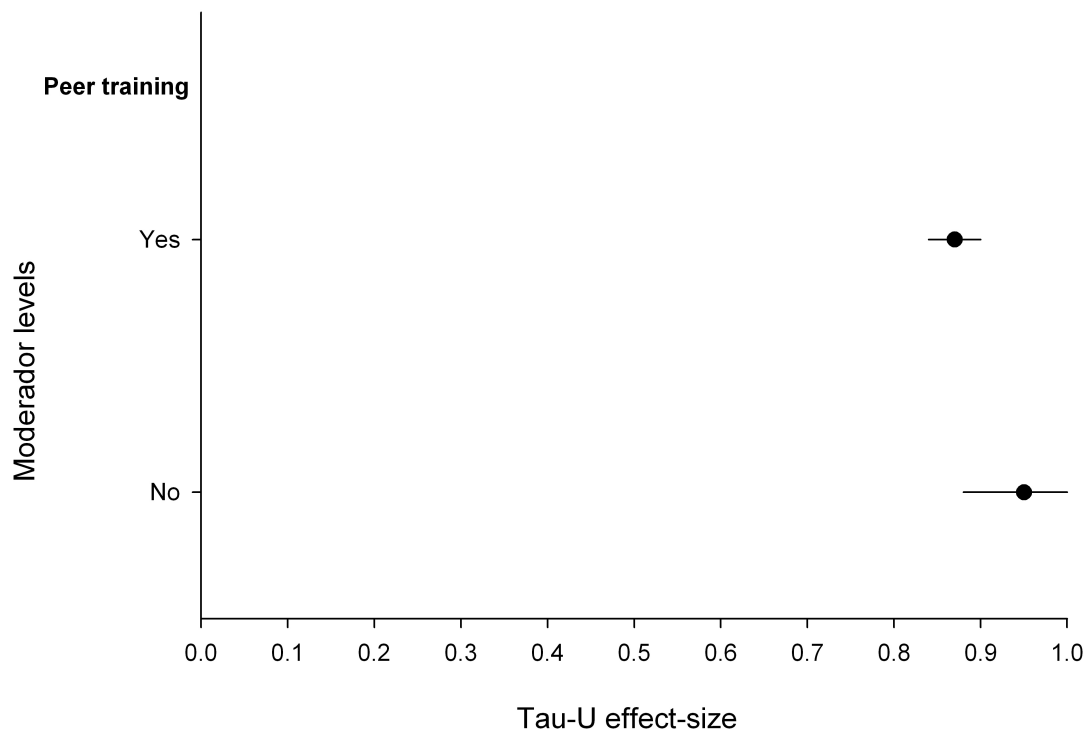


Figure 7. Tau-U and 83.4% CI according to peer training.



## **Discussion**

This meta-analysis investigated intervention effects of 19 single-case studies implementing behaviorally-based interventions to attenuate social deficits of children with ASD included in general classrooms. Overall results indicated that these interventions are highly effective to improve social interaction skills of students with ASD in inclusive settings. High to large intervention effects and improvements on target skills were obtained for nearly all of the included studies. These results lend further evidence indicating effectiveness of behaviorally-based intervention to improve social skills of students with ASD in inclusive settings. Further analysis investigated potential influence of moderators leading to the most effective interventions. Such moderators included participants' age, target social interaction skills, behavioral components used in the intervention and procedural features consisting of intervention implementer and peer training.

The first research question focused on investigating differential intervention effects according to participants' age group. Results showed no difference in the intervention effect according to age. The intervention resulted in the same high magnitude of change with narrow confidence intervals for both students in the preschool age group (2-5years) and students in the elementary age group (6-10 years). No conclusions could be made regarding students in the secondary and post secondary age group as few studies included participants older than 10 years old. Thus, this analysis indicates that behaviorally-based interventions are highly effective for improving social interaction skills of young children with ASD (ages 2 to 10) included in general

education. Despite the smaller sample of participants in the elementary age group with a balanced number of contrasts between levels that could explain the obtained results, findings showing high effects with no statistically significant difference between preschool and elementary age group could be inferred to be a result consistent with the fact that interventions implemented at earlier stages of development tend to lead to positive results for students with ASD (Reichow, 2012). Although effectiveness of behaviorally - based interventions for young children with ASD is well documented (Gillis & Butler, 2007; Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011; Virués-Ortega, 2010), their effectiveness on social interaction skills in inclusive settings had not been previously explored in the research literature. Thus, this result emphasizes effectiveness of early interventions while expanding the empirical evidence and the scope of settings in which young students with ASD can benefit from behaviorally-based interventions.

The second research question focused on the moderating effects of social interaction skills targeted in the intervention. Results indicated that the intervention was more effective when social interaction initiation and response were targeted separately than when the target skill focused on both interaction initiation and response. High and large effect sizes were obtained for initiation and response target skills respectively, while only medium effects were obtained in studies focusing on both target skills at the same time. A possible explanation for lower effect from interventions targeting interaction initiation and response simultaneously may be twofold. First, it may reflect a measurement problem. As studies measure effects of intervention in target social skills

initiation and response separately, it is possible to capture the effects of the intervention on each of them. However, when the target skill measures effectiveness of the intervention in both types of social skills simultaneously, possible ineffectiveness of the intervention for one target skill counterbalances the possible effectiveness for the other, resulting in overall lower effects.

In the same vein, the second possible explanation may be the fact that when studies focus on target social skills that are defined as both initiation and response, the intervention strategy used may not specifically address both types of social skills and the type of skill deficit (acquisition, performance or fluency deficits). The importance of matching intervention strategy with type of social skill being taught and the social skill deficit has been pointed out in the literature (Bellini, 2006; Bellini et al., 2007; Gresham, Sugai, & Horner, 2001, Quinn, Kavale, Mathur, Rutherford, & Forness, 1999). In a meta-analysis of social skills interventions for students with emotional and behavioral disorders, Quinn et al. (1999) suggested that features of the intervention should vary based on the type of social problem being addressed. For example, an intervention strategy that promotes skill acquisition should be employed for students who lack skills to initiate to peers, while strategies to increase skill performance should be employed for students who have skills to respond to others but fail to do so (Bellini et al., 2007). That is, students with ASD may have the verbal ability and knows what to do to interact with others, but chooses not to because of motivational factors.

For students with ASD, strategies addressing specific social interaction initiation or response deficits may be particularly important. Since students with ASD have

difficulties generalizing learned skills, effectiveness of intervention strategies for deficits related with interaction initiation might not generalize to deficits related with responses to others' interaction. Lack of appropriate intervention strategies for targeting each type of social skill deficits may make difficult to produce improvements in all types of initiation and response target social skills, thus resulting in lower intervention effects. On the other hand, studies that focused and measured target social skill initiation and response individually may have tailored intervention strategies to address each of them. This analysis suggests that matches between types of skill deficits and intervention procedures to address these deficits may be moderating the obtained effects. However, future research will be needed to elucidate this question, as studies included in this meta-analysis do not provide the type of participants' skill deficits.

Regarding differential effects according to the behavioral components used, the third research question sought to investigate whether the use of planned reinforcement and planned modeling moderated the magnitude of change in the target social skill. Results indicated that combining the use of planned reinforcement in the intervention protocol moderated intervention effects. Larger effects with narrower confidence intervals were obtained when planned reinforcement was utilized in the intervention. A statistically significant difference was found when compared with interventions not using planned reinforcement. This difference can be explained by the fact that interventions not using planned reinforcement delivered by the interventionist may have not provided consistent reinforcement to students with ASD in their attempts to interact with peers. For example, typically developing peers may have not consistently

responded to students with ASD's social overtures, preventing occurrence of natural reinforcement of their social behaviors. As motivation to interact and respond to interactions is a particular challenge for students with ASD, consistently providing meaningful reinforcement is critical to sustain student's motivation to socially interact with others (Dunlap & Fox, 1999). Thus, this result suggests that planned reinforcement as part of the intervention procedure in inclusive settings may be needed until students acquire the skill, so that planned reinforcement can be faded and transferred to more natural reinforcing consequences later. This result support some studies stating that mere contact of students with ASD with typical peers does not ensure they are benefiting from inclusion (Gutierrez et al., 2007; Scattone, 2007). On the contrary, students with ASD need planned instructional strategies and involvement from teachers until they learn the needed skills that will enable them to effectively relate with peers. However, results on the effectiveness of intervention using reinforcement as compared to those not using it must be viewed with caution and further explored due to confounding effects associated with the use and combination of other behavioral components (i.e., prompts and modeling) that may be contributing to the obtained results.

Concerning moderating effects according to the use of planned modeling, results show that studies using modeling with prompt and reinforcement were both highly effective and not statistically different than those using only prompt and reinforcement. This result may indicate that intervention procedures using prompt and reinforcement without the use of modeling can be just as effective as when modeling is in place. This result may be promising as it indicates that use of prompt and reinforcement can be more

feasible for teachers implement in inclusive settings without extra time and involvement required by modeling. A plausible explanation for the lack of differences in effects of interventions using and not using modeling is that students with ASD may have started attending more to typical peers' social behavior and models as a result of the intervention using prompt and reinforcement. However, there may be other explanations, such as inclusion of a variety of types of overarching interventions used, which may be moderating the obtained effects, making it difficult to completely isolate the effects of modeling alone. Therefore, this result must be viewed with caution, also considering the small number of studies involved in this analysis. In addition, this result does not mean that modeling should not be used. Modeling is known as effective intervention to teach social skills for students with ASD (Bellini & Akullian, 2007; Mason et al., 2012) and its use with prompting and reinforcement tends to lead to higher effects in the inclusive settings, although no differences were found. Further, a study conducted by Charlop-Christy et al. (2000) found that video modeling is more effective than in vivo, or live, modeling. Considering that studies included in this analysis implemented more in vivo than video modeling, combination of video modeling instead could have produced significant differences. As new studies are needed to verify this supposition, it is necessary to consider that video modeling can be more expensive and time-consuming strategy to be implemented in the inclusive settings (Biedermann & Freedman, 2007; Mason et al., 2012; McLeskey & Waldron, 2011) and may not be easily adopted by teachers.

The fourth research question investigated whether variables related with intervention implementer moderated intervention effects. Studies included in this meta-analysis have described different people as the implementers of the behavioral intervention components (e.g., teacher, peer or researcher). The most common intervention implementers were teachers and researchers. Because researchers are not typically the ones available to implement social skills intervention with children with ASD in the daily routine of inclusive classrooms, this study compared differential effects according to these two groups of implementers. It was found no differences between effects from researcher or teacher, indicating that the interventions included in this review can be highly effective independently of the implementer. It may be reasoned that more important than who implements behavioral teaching strategies with children with ASD in the inclusive settings, it is important to properly carry out the intervention. This result is favorable to implementation of behaviorally-based interventions in inclusive settings, since teachers who are responsible to the daily instruction of children with ASD can effectively implement the intervention just as researchers. However, a possible explanation for no differences found between teachers and researchers is that teachers may have been trained and coached by researchers throughout the study to ensure accuracy of intervention implementation. Thus, teacher instruction may have led to similar effects that researchers obtain when they are implementing the intervention. As teachers training is likely to have happened in studies where they were implementers, this inference is consistent with studies emphasizing the importance of teachers training to provide them with needed skills and expertise to effectively implement interventions

for children with ASD in inclusive settings (Koegel et al., 2012; McCulloch & Martin, 2011). Lack of studies using peers as direct implementer of the behavioral components does not allow the conclusion that peers as implementer would or would not be more effective than an adult (teacher or researcher) implementing the intervention in inclusive settings. Future analysis may lead to conclusions supporting studies demonstrating effectiveness of peer-mediated intervention on social interaction skills of children with ASD (Chan et al., 2009).

Finally, the fifth research question sought to determine whether interventions training typically developing peers to respond to participants with autism's interactions would lead to larger effect size. It was hypothesized that peer training would lead to higher effects considering that being trained to respond to students with ASD, peers would provide consistent natural reinforcement that could increase students motivation to interact. However, there was no statistically significant difference between studies that trained peers to respond to participants with ASD and studies that did not train peers. Although the group of studies not implementing peer training produced larger magnitude of change, results indicated that either alternative could produce high to large intervention effects. This result may be explained by the fact that most of studies that did not use peer training (5 out of 8) used planned reinforcement, so although peers may not have been reinforcing participants attempts to interact, the interventionist was. It may suggest that peer training may not be an essential procedure as long as some source of reinforcement (either from interventionist or peer) is provided to students with ASD in the inclusive settings. Thus, if peers are not trained to respond, but the interventionist



reinforces the child, the increased appropriate social interaction skills of children with ASD can naturally evoke peer response, allowing occurrence of natural reinforcement and fading of planned reinforcement with time.

### **Implications for Practice**

The increasing number of children with ASD being included in general education and the requirements for implementation of evidence-based practices in schools demands quantitative analysis to identify interventions and features that are most effective to attenuate social impairments that prevent successful inclusion of children with ASD (Bellini et al., 2007; Gena, 2006; Koegel et al., 2012). This meta-analysis provides information regarding effectiveness of behaviorally-based interventions to improve social skills of students with ASD that emphasizes the practical significance of these interventions and guide practitioners towards effective evidence-based practices in inclusive settings.

The high overall effect size suggests that behaviorally-based interventions can be used as an effective intervention to improve social interaction of children with ASD and support their inclusion in general education. Further, analysis by moderators showed that the interventions are effective for preschool and elementary students (ages 2-10), indicating their role on early intervention. It is well established that early interventions increase the adaptability and social adjustment of children with ASD (Eldevick et al. 2009; Peters-Schaffer et al., 2011). Therefore, implementation of behaviorally-based interventions to improve social skills starting in preschool and elementary school years

can increase the chance of children with ASD being socially acceptable and progressively more successful in general education.

With respect to the other moderating effects investigated in this meta-analysis, the results provide several implications for practice. First, results regarding moderating effects of target social skills suggest that it would be important to teachers focus social skills deficits related with social interaction initiation and response separately, according to the priority for each individual and using strategies that match the type of skill deficit. Focusing on initiation and response individually would enable teachers tailor the intervention according to student's different needs and facilitate generalization to different situations involving initiation or response to social interactions.

Second, analysis of differential effects according to the use of planned reinforcement leads to the conclusion that teachers should include reinforcement for the child with ASD in the intervention protocol. As peers may not necessarily respond and naturally reinforce their classmates with ASD, inclusion of planned reinforcement can promote their motivation to search and respond to social interaction with others. As the ultimate goal is the natural reinforcement through interaction with peers in inclusive setting, teachers should initially plan for reinforcing students with ASD as part of intervention strategy and gradually thin the schedule of reinforcement as their social behavior increase and more meaningful social interactions occur (Hundert, 2009; Leach 2010).

Third, results regarding effects based on use of planned modeling suggest that use of prompt and reinforcement without modeling may equally lead to high effects than

when modeling is used. Thus, teachers can implement a simpler and less time consuming intervention that can produce similar impact on target skills. Despite this conclusion, use of modeling, particularly video modeling, should not be ruled out as an option that can lead to better outcomes. They have been shown to be effective in other contexts (Mason et al., 2012) and further investigations are needed regarding use of video modeling on inclusive settings. However, these results provide teachers with more feasible and effective intervention to improve social skills of children with ASD in inclusive settings that may compensate greater effects that can possibly occur with more time consuming and expensive interventions.

Results regarding moderating effects of intervention implementer also generate some implications for practice. The fact that no statistically significant difference was found between researcher and teacher as implementer suggest that effective interventions that were implemented by researchers can also be effective when implemented by teachers. However, it is necessary ongoing teachers training to ensure continuity and accuracy of implementation when researchers are no longer present in the school environment. Effectiveness of interventions for students with ASD in inclusive settings will also depend on how prepared teachers and school personnel are to implement research-based interventions (Koegel et al., 2012). Therefore, teacher training is essential to bridge the gap between research and practice.

Finally, results indicated that studies implementing and not implementing typical peer training to respond to participants with autism are equally effective. However, data from this analysis also suggest that it is necessary to make sure that some source of

consistent reinforcement can be present to motivate students if no peer training is conducted. Although no implementation of peer training is more convenient for teachers as it saves time and other personnel resources, having peers trained to respond to participants with autism should not be discarded when it is possible for teachers to implement it, since it might lead to more rapid transition to natural forms of reinforcement and increased motivation to interact (Leach, 2010).

### **Limitations and Implications for Research**

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 behaviorally-based interventions to teach social interaction to students with ASD in inclusive settings. Another important limitation of this meta-analysis is that judgments regarding intervention features and procedures that were further aggregate in moderator levels are based only on the information provided by authors in the articles. Considering that space limitations in scientific journals may result in omission of many details of the research (Jitendra, Burgess, & Gajria, 2011; Tankersley, Cook, & Cook, 2008), results must be viewed with caution.

Conclusion on effectiveness of behaviorally-based interventions to improve social skills of students with ASD in inclusive settings should be further supported, since moderating effects of the type of intervention used was not determined due to the wide range of interventions utilized across included studies. As not enough studies have been

conducted to break the analysis down by overarching intervention type, more studies should be conducted using video modeling, social stories, visual scripts, etc., within the inclusive settings to enable additional meta-analysis regarding the potential moderating effects of these interventions. Also, conclusions regarding the use of planned reinforcement should be viewed with caution as the effects may have been confounded by effects from the other behavioral components associated with the use or no use of planned reinforcement. Similar analysis controlling for the manipulation of reinforcement only are needed, so it can advance further evidence regarding this results. 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 intervention effects would be moderated by different characteristics of individuals with ASD along the autism spectrum.

The lack of conclusions regarding older students in this meta-analysis may be related to the tendency of studies to investigate intervention for young children, as the focus is often early intervention for individuals with ASD (Matson & Smith, 2008; Peters-Schaffer et al., 2011). Therefore, more single-case studies are needed with older participants to make conclusions that these intervention would be equally effective for them in secondary and post-secondary schools and even in jobs positions sited in inclusive contexts as adults. However, another possible reason for lack of studies with older participants is that fewer opportunities are provided for individuals with ASD to participate in inclusive environments as they get older (Graetz, 2010), particularly those

individuals with comorbid intellectual disabilities (Eaves & Ho, 2008; Health World Organization, 2001).

Also, more studies using peer as implementer of behavioral intervention components in inclusive settings are needed. The overall goal of peer-mediated intervention is to promote inclusion and lasting interactions between individuals with disabilities and their peers (Chan et al., 2009). Peer-mediated intervention is one of the interventions that impacts social outcomes of individuals with ASD most supported by research (Zhang & Wheeler, 2011). Therefore, future studies should investigate whether peer as intervention implementer may lead to larger improvements in social interaction skills of children with ASD in inclusive settings.

Finally, social validity measures were not investigated in all studies included in this meta-analysis. Future studies implementing social skills interventions using behavioral procedures to improve social skills interventions of children with ASD in inclusive settings should address social validity questions related with demonstration that teachers and school personnel report procedures to be acceptable and feasible within the general education's available resources. It would inform whether the effectiveness of interventions using behavioral components found in this meta-analysis meets not only the needs of students, but general education teachers, making possible to promote successful inclusion of individuals with ASD in inclusive settings.

## CHAPTER IV

### SUMMARY AND CONCLUSIONS

The effectiveness of the use of behaviorally-based interventions 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 (Gillis & Butler, 2007; Reichow & Volkmar, 2010; Ringdahl, Kopelman & Falcomata, 2009; Vaughn et al, 2003; Virués-Ortega, 2010; Vismara & Rogers, 2010). However, the current research base lacks information regarding whether these interventions can be considered evidence-based practices to support inclusion of children with ASD. Additionally, effectiveness of these interventions, 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. This dissertation sought to address these gaps and to provide teachers with information that can support them in the challenge of meeting educational needs of students with ASD included in general education.

In summary, the results from the first article (Chapter II) suggested that behaviorally-based interventions for improving social skills of children with ASD in inclusive settings qualify as evidence-based practices. The application of the quality indicators based on the quality rubric used by Rispoli, Franco, van der Meer, Lang, & Camargo (2010) and expanded according to Reichow, Volkmar, & Cicchetti (2008) and Kratochwill et al. (2010) resulted in the identification of 19 studies meeting minimum

standards for quality of single-case research. Of those, certainty of evidence was considered conclusive for 6 studies, while for 13 studies, certainty of evidence was considered promising. A total of 11 studies were classified as inconclusive certainty of evidence for not meeting one or more of the quality standards. Inconclusive studies 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 of intervention implementation. The remaining conclusive and promising studies met minimum quality standards and were further evaluated according to Horner et al. (2005)'s criteria for determining evidence-based practices. Considering that conclusive and promising studies met or exceed all the requirements, the use of behaviorally-based interventions in inclusive setting could be considered evidence-based practices to improve social interaction skills of children with ASD.

As behaviorally-based interventions to improve social interaction skills of children with ASD in inclusive settings was found to be evidence-based practices, the second article of this dissertation (Chapter III), investigated the overall magnitude of impact of these interventions in the social interaction skills of students with ASD based on the studies meeting minimum quality standards. Furthermore, the moderating effects of participants' age, behavioral components used, and targeted social interaction skills were investigated. Differential effects according to intervention implementer and additional peer training to respond to social overtures of students with ASD were also examined.



Results indicated that, overall, behaviorally-based interventions can lead to high effects and improvements on target social interaction skills of children with ASD included in general education. The narrow confidence intervals indicated high precision regarding the obtained results. Although effectiveness of the intervention for students in the secondary and post-secondary age group could not be determined, disaggregation of effects according to participant age as moderator showed that the intervention is equally effective for young children with ASD, ages 2 to 10. High effect sizes were obtained for both age groups with narrow confidence intervals indicating high precision of results.

Regarding moderating effects of target social interaction skills, results indicated that the intervention was more effective when social interaction initiation and response were targeted separately than when the target skill focused on both interaction initiation and response. High to large effects were obtained respectively for initiation and response target social interaction skills and relative narrow confidence intervals also indicated that results can be interpreted with high level of certainty regarding the obtained effects.

Although no differences in effects were found when prompt and reinforcement were used with or without planned modeling, combining the use of planned reinforcement in the intervention protocol moderated the intervention effects. Larger effects were obtained when planned reinforcement was utilized in the intervention protocol in conjunction with other behavioral components. Narrow confidence intervals also indicated high precision of the obtained results regarding the use of planned modeling and planned reinforcement. No differences were found between effects from researcher or teacher as the intervention implementer, indicating that intervention can be

highly effective independently of the person who is in charge of the intervention.

Finally, the analysis by moderators showed no difference between studies that trained peers to respond to participants with autism and studies that did not train peers, and either alternative could produce high to large intervention effects with high levels of certainty in these estimates due to narrow confidence intervals obtained.

### **Implications for practice**

The findings from both studies have several implications for practice, particularly for teachers involved with education of children with ASD in inclusive settings. First, it is clear that behaviorally-based interventions to improve social interaction skills of these children can be used 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 settings. Providing supports for social interaction skills of children with ASD may impact the quality of their experience with typical peers and the continuity of their placement in inclusive settings. Additionally, findings showing that behaviorally-based interventions were effective in inclusive settings for both preschool and elementary school age group of participants with ASD indicates that early use of these interventions in schools has the potential of leading to important developmental gains that may impact their future as productive members of society.

Furthermore, results suggested that it would be valuable to teachers focus social skills deficits related with social interaction initiation and response separately, according to the priority for each individual. It would enable teachers to tailor the intervention

according to student's different needs and improving effectiveness of the intervention, facilitating more rapid generalization to different situations involving initiation or response to social interactions. Similarly, teachers may want to consider including the use of planned reinforcement as one of the behavioral components of the interventions protocol, as it leads to more effective interventions. The addition of consistent planned reinforcement is recommended at least until children are able to acquire and maintain needed skills, when it can be faded to sole natural reinforcement from interactions with typical peers.

Although the use of planned modeling should not be ruled out as an option that can lead to important outcomes, results suggest that use of prompt and reinforcement may equally lead to high effects than when modeling is also used. It indicates that teachers can implement a simpler and less time consuming intervention that can produce similar high impact on target skills. Likewise, the additional training of typical peers to respond to students' with autism attempts to interact was not shown to be more effective than when peer training is not implemented. Thus, no use of peer training may be a more convenient and feasible option for teachers as long as some source of reinforcement is provided, since peers may not consistently respond and reinforce children with ASD. However, the use of peer training is still recommended when feasible for teachers to implement as it may facilitate transition from planned reinforcement to more natural reinforcement. Finally, findings indicate that the person implementing the intervention (researcher or teacher) will unlikely have an impact on its effectiveness. This result is consistent with other studies showing that teachers can implement behavioral

interventions with high degree of efficacy (Lerman et al., 2004; Noell, Witt, Gilbertson, Ranier, & Freland, 1997). However, teacher training is necessary and recommended to ensure continuity and accuracy of implementation, since teachers are in charge of supporting inclusion of children with ASD in a daily basis.

### **Limitations**

In addition to the abovementioned limitations for each study in their respective chapters, it is important to note that both articles excluded non peer-reviewed studies. This is a limitation because studies such as dissertations and other non-peer reviewed published articles, for example, may provide information that guide further and different conclusions. Also, inclusion of only peer-reviewed articles leads to limitations associated with publication bias towards successful interventions, given that interventions shown to be ineffectual are generally not published. However, inclusion of only peer-reviewed publications was intended as they are considered more credible source of information for going through a rigorous process of revision before being published.

Another additional limitation to be considered is that although behaviorally-based interventions were considered to be effective in inclusive settings, these studies do not inform the intensity of treatment needed to produce the effects found. Lack of this analysis, however, is due to inconsistent information from studies included regarding dosage of the intervention such as length of sessions and time that students with ASD spent in inclusive settings. This information is important because inclusion is not consistently defined in the literature (Fuchs & Fuchs, 1994; Rogers, 1993) and while

some children may be fully included, others may be partially integrated. These differences can also moderate interventions' effect and should be investigated in the near future.

### **Future research**

Besides informing the field of single-case research about identified issues related with quality indicators that should be addressed by future research, this dissertation also highlights new questions to be answered. In order to advance the empirical support regarding behaviorally-based interventions for children with ASD in inclusive settings, new studies should utilize stronger experimental designs and evaluate implementation fidelity. Both aspects can enhance conclusion validity and enable studies replicability. Also, reporting treatment fidelity with detailed procedural protocols can minimize some of the mentioned limitations of this dissertation regarding omission of information that may not be accounted in the analysis of overall and differential effects according to potential moderators.

Furthermore, effectiveness of behaviorally-based interventions to improve social skills of students with ASD in inclusive settings should be further evaluated via single-case research and meta-analysis once more small-n studies are available, since moderating effects of the type of intervention used (e.g., video modeling, social stories, visual scripts, etc.) was not determined due to the wide range of interventions utilized across included studies. Thus, future research will be needed to determine, for example, if differences associated with type of interventions such as use of more visual or naturalistic strategies in inclusive settings have impacted the obtained results. Also, new

research is needed to compare effectiveness of studies using social skill interventions with and without combination of behavioral components. Such analysis could further the evidence on effectiveness and importance of including behavioral components in social skills interventions for students with ASD.

The included studies did not involve a sufficient number of participants with ASD older than 10 years old; thus, future research will be needed to explore effectiveness of behaviorally-based interventions to improve social interaction skills of students in the secondary and post-secondary level. It would be helpful to provide teachers of older students with information regarding evidence-based practices for supporting inclusion of individuals that are included with typical peers only when they are already teenagers or adults. Similarly, few studies included had peers as the intervention implementer. As other studies have demonstrated effectiveness of peer-mediated interventions (Zhang & Wheeler, 2011), new investigations should explore the impact of peer as implementer on intervention outcomes in inclusive settings.

Finally, future studies should also include the type of social skill deficits and also detailed information regarding participants' level of functioning, including standardized assessment scores. It would make possible to investigate how intervention effects would be moderated by different characteristics of individuals with ASD along the autism spectrum. As students with ASD are a heterogeneous group, this information would enable analysis that can lead to interventions with higher probability of being effective for particular groups of students with ASD. Future research answering these still answered questions will further enhance the practical utility of behaviorally-based

interventions in inclusive settings and add information regarding best practices to help teachers in the challenges of educating children with ASD in inclusive settings.

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## APPENDIX A

### INCLUSION CRITERIA RELIABILITY FORM

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

Study Code	1. IV- it is a social skill intervention using behavioral components	2. English publication	3. Peer-reviewed journal	4. At least one target social interaction skill	5. At least one participant with ASD	6. Single-case design	7. Data provided within line graph or table	8. Conducted in inclusive setting	Include?	If no. Why?

## APPENDIX B

### DATA EXTRACTION RELIABILITY CHECK

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

**Study code:** \_\_\_\_\_ **Evaluator:** \_\_\_\_\_ ( ) **Primary** ( ) **Secondary**

1. Is this accurate information of participants' age, diagnosis and level of functioning?	Yes	No
2. Is this an accurate summary of intervention used?	Yes	No
3. Is this an accurate summary of behavioral procedures used?	Yes	No
4. Is this an accurate summary of outcome variables investigated?	Yes	No
5. Is this an accurate summary description of intervention procedures?	Yes	No
6. Is this an accurate summary description of the results?	Yes	No
7. Is this accurate information of the results classification?	Yes	No
8. Is this accurate information of design used?	Yes	No
9. Is this accurate information of maintenance assessment?	Yes	No
10. Is this accurate information of generalization assessment?	Yes	No
11. Is this accurate information of treatment fidelity assessment?	Yes	No
12. Is this accurate information of social validity assessment?	Yes	No
13. Is this accurate information of reliability assessment?	Yes	No