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Review

Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis

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HIGHLIGHTS

- Meta-analysis of Group social skills interventions (GSSIs) for youth with ASD.
- GSSIs have a medium overall effect size, but there is potential publication bias.
- Parents and observers reported small effects, teachers reported null effects.
- Self-report effects were attributable to improved social knowledge, not behavior.

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ABSTRACT

Group-based social skills interventions (GSSIs) are widely used for treating social competence among youth with autism spectrum disorder (ASD), but their efficacy is unclear. Previous meta-analysis of the literature on well-designed trials of GSSIs is limited in size and scope, collapsing across highly heterogeneous sources (parents; youths; teachers; observers; behavioral tasks). The current meta-analysis of randomized control trials (RCTs) was conducted to ascertain overall effectiveness of GSSIs and differences by reporting sources. Nineteen RCTs met inclusion criteria. Results show that overall positive aggregate effects were medium ($g = 0.51$, $p < 0.001$). Effects were large for self-report ($g = 0.92$, $p < 0.001$), medium for task-based measures ($g = 0.58$, $p < 0.001$), small for parent- and observer-report ($g = 0.47$ and 0.40, respectively, $p < 0.001$), and nonsignificant for teacher-report ($p = 0.11$). Moderation analyses of self-report revealed the effect was wholly attributable to youth reporting that they learned about skilled social behaviors (social knowledge; $g = 1.15$, $p < 0.01$), but not that they enacted them (social performance; $g = 0.28$, $p = 0.31$). Social skills interventions presently appear modestly effective for youth with ASD, but may not generalize to school settings or self-reported social behavior.

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1. Introduction

Impairment in social functioning is the defining feature of autism spectrum disorder (ASD). Youth with ASD are at increased risk for social isolation and peer victimization (Hobson, 2014; Mendelson, Gates, & Lerner, 2016). Moreover, social impairments in youth with ASD do not tend to improve merely with development, but rather may become more pronounced during adolescence when the social demands exceed the social skills (Picci & Scherf, 2015), underscoring the need for appropriate interventions to promote social competence in this population.

Group-based social skills interventions (henceforth referred to as GSSIs) are the most widely used approach to address social impairment and foster social skills development in school-age and teenage youth with ASD (McMahon, Lerner & Britton, 2013). As such, it is vital to know the degree to which, and according to what metrics, GSSIs yield benefits. However, despite their widespread use, very little rigorous, well-designed research has been conducted to examine their efficacy (Kasari, Shire, Factor, & McCracken, 2014). Indeed, while there have been more than a dozen systematic reviews of GSSIs conducted in recent years (e.g., Barry et al., 2003; Blacher, Kraemer, & Schalow, 2003; Elder, Caterino, Chao, Shacknai, & De Simone, 2006; Flynn & Healy, 2012; Kaat & Lecavalier, 2014; Kasari & Patterson, 2012; Koenig, De Los Reyes, Cicchetti, Scahill, & Klin, 2009; McMahon, Lerner et al., 2013; Miller, Vernon, Wu, & Russo, 2014; Otero, Schatz, Merrill, & Bellini, 2015; Rao, Beidel, & Murray, 2008; Reichow & Volkmar, 2010; Schreiber, 2011; Spence, 2003; White, Keonig, & Scahill, 2007), there has only been one meta-analysis to evaluate efficacy of GSSIs (Reichow, Steiner, & Volkmar, 2012). This sole meta-analysis – which focused on well-designed randomized controlled trials (RCTs) with a wait-list control, of which only five were evident at the time – provided initial support for the efficacy of GSSIs for improving social competence for ASD youth. Due to the very small number of included trials, though, little beyond a headline effect size ($g = 0.47$) could be determined. However, in the years since, the number of published RCTs of GSSIs has tripled, making evaluation of overall efficacy of GSSIs timely and vital, and facilitating the possibility of a more robust, comprehensive, and precise estimation of their efficacy. Additionally, as evidence of efficacy accumulates, and sufficient studies are available, it is important to identify moderating factors that may influence the strength of intervention effects. Further, extensive literature demonstrates that complex skills expressed in youth are rarely unitary in nature, and so meaningful information can be obtained by disaggregating these constructs into constituent assessments obtained via multiple informants and other sources (De Los Reyes et al., 2015). This information may reveal informative circumstantial variations in expression of skills, especially for highly contextually-dependent domains such as social skills in youth with ASD (De Los Reyes, 2011; Lerner, Calhoun, Mikami & De Los Reyes, 2012; Murray, Ruble, Willis, & Molloy, 2009). Hence, the current meta-analysis sought to ascertain overall efficacy of GSSIs and whether the intervention effects differ by reporting sources.

1.1. Current evidence for GSSIs in ASD

The sole small previous meta-analysis of GSSIs for youth with ASD found a medium effect, primarily according to parent report (Reichow et al., 2012). This effect was comparable to the mean ES found for behavioral interventions impacting social skills for individuals with ADHD ($g = 0.47$; Daley et al., 2014) and social skills treatment for individuals with schizophrenia ($g = 0.52$; Kurtz & Mueser, 2008), but somewhat larger than that found in social skills treatment for youth with learning disabilities ($g = 0.21$; Forness & Kavale, 1996). Despite these promising results, the study contained only four studies, reflecting the limited state of the literature at the time. As a result, it was unable to consider any potential predictors of variation in effects or test for publication bias, and failed to consider variation in the reports of social competence change across different informants.

1.2. Variations in assessment of intervention efficacy

Although individual studies have yielded some support for the efficacy of GSSIs (e.g., Koning, Magill-Evans, Volden, & Dick, 2013; Lopata et al., 2010), results have not been consistent. One evident source of this variation is the outcome of interest – that is, the source of information on social functioning (e.g., Koning et al., 2013; Laugeson, Frankel, Mogil, & Dillon, 2009). Such a finding is not uncommon. Indeed, extensive literature has consistently shown that ratings of child symptomatology vary between various reporting sources (De Los Reyes et al., 2015). These differences reflect the complex nature of "social skills" and may reveal important and meaningful information about contextual variations in the expression of skills and in the perceived impact of the intervention (Koenig et al., 2009; Lerner, Calhoun et al., 2012). Understanding the shape and nature of changes in GSSIs according to different informants not only offers practical information about what outcomes can be affected, but also provides deeper insight into the nature of the intervention itself and its mechanisms of action (Lerner, White & McPartland, 2012).

Hence, it is important to consider differences in assessment measures used to evaluate the efficacy of a GSSI, as the efficacy is dependent on the quality of assessments (McMahon, Lerner et al., 2013). In fact, GSSIs commonly utilize various sources to assess efficacy. Parent-report questionnaires, in which parents rate broad metrics of frequency or quality of social behavior across windows of time ranging from several days to several months (e.g., Constantino & Gruber, 2007; Gresham & Elliott, 1990; Reynolds & Kamphaus, 2004), are one of the most regularly utilized assessment methods, owing in part to easy and quick administration. Teacher-report questionnaires, in which teachers rate broad metrics of frequency or quality of social behavior as they appear in the classroom (e.g., Gresham & Elliott, 1990; Pekarik, Prinz, Liebert, Weintraub, & Neale, 1976), are frequently used to gather information about child's functioning in school settings. Participants themselves also frequently rate their social competence, via questionnaires, where participants rate broad metrics of frequency or quality of their own social behaviors as they perceive them to be occurring (e.g., Gresham & Elliott, 1990; Reynolds & Kamphaus, 2004) and indicate their own social knowledge, whereby participants indicate what they believe is the right thing to do (regardless of whether they believe they themselves do it) in various social situations (e.g., Laugeson & Frankel, 2006; Lopata, Thomeer, Volker, Nida, & Lee, 2008). Participants also complete task-based assessments that are often aimed at measuring specific skills related to social competence, such as social cognition, emotion recognition, and social response planning (e.g., Nowicki, 2004; Sofronoff, Eloff, Sheffield, & Attwood, 2011). Observer-report measures in which (typically blinded) independent, trained observers evaluate and rate the frequency or quality of social behaviors of the participants in either naturalistic (such as playgrounds) or structured (such as lab-based interactions) settings (e.g., Koning et al., 2013; Lerner & Mikami, 2012), are also used, though not as commonly as parent or teacher ratings (McMahon, Vismara & Solomon, 2013). Some observer-report measures are uniquely designed by the intervention staff to assess participant's behavior (Kamps et al., 2015; Rodgers et al., 2015), whereas others are standardized across settings (e.g., Bauminger, 2002). Therefore, examining change in ratings of social competence as a result of these interventions by different sources is useful to gain a clear understanding of GSSI outcomes.

1.3. Plausible moderators of treatment effects

The mixed results of individual studies may also be due to differences in participant or intervention-related characteristics – that is, plausible moderators (Kazdin, 2007; Lerner & White, 2015; Lerner, White et al., 2012). Indeed, GSSIs vary widely according to a broad range of characteristics, from participant age to length of treatment to the cognitive profile of the participants (McMahon, Lerner et al., 2013). This heterogeneity invites the likelihood that such factors may contribute to differences in intervention efficacy. Therefore, we consider factors that may moderate the effects of GSSIs, which can help to better identify efficacious methods of GSSI as well as for whom, and under what conditions, these interventions are best suited (Kazdin & Nock, 2003).

1.3.1. Participant characteristics

The target age range of GSSIs can vary widely (e.g., Ichikawa et al., 2013; Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015). Several studies have shown different effects of GSSI by age, though these findings are inconsistent. For example, some have indicated relatively greater improvements in older participants (e.g., Herbrecht et al., 2009; Mathur, Kavale, Quinn, Forness, & Rutherford, 1998), while others suggest greater benefits for younger children in some approaches (McMahon, Vismara et al., 2013; Wang, Cui, & Parrila, 2011). Considering the inconsistent findings of the effects of GSSIs for each age group, it is currently unclear whether effects should be larger or smaller among older youth, but is vital for guiding service recommendations.

Participants in GSSIs are generally thought to exhibit average to above-average cognitive ability (McMahon, Lerner et al., 2013), however, participants above this level still display a wide range of overall cognitive and verbal ability (Lerner & White, 2015). Research has shown that more cognitively-able participants with a higher IQ and better verbal ability have demonstrated greater improvements in emotion recognition (e.g., Solomon, Goodlin-Jones, & Anders, 2004) and benefit most from participating in a GSSI (Herbrecht et al., 2009). Therefore, participants with higher cognitive and verbal ability may show greater improvements after participating in the GSSI.

In addition, males and females with ASD may have unique social challenges that could potentially moderate treatment outcomes (Dean et al., 2014). However, while many interventions do include at least a few female participants, there has rarely been sufficient sample size in an individual study to empirically examine effects of gender on treatment outcomes. Intriguingly, the one study that examined gender effects of a GSSI showed relatively greater improvements in girls (McMahon, Vismara et al., 2013). Owing to the dearth of evidence of gender on the outcomes of GSSI, it is unclear whether effects are indeed larger in females than males, but current clinical practice urges examination of potential differences.

Individuals with ASD commonly experience other comorbid psychiatric conditions (Simonoff et al., 2008) that may affect treatment outcomes. There is strong reason to believe this may be the case for GSSIs. For example, one study found that those with ADHD comorbidity showed less improvement in social skills, while those with anxiety comorbidity showed greater improvements (Antshel et al., 2011). A more recent study found attenuated effects associated with comorbid anxiety (Pellecchia et al., 2015). Therefore, there is evidence to suggest that participants with (versus without) psychiatric comorbidities (that

is, the preponderance of ASD youth seeking GSSIs) should show less improvement in social competence following GSSIs.

Relatedly, psychopharmacological medication is often prescribed to youth with ASD due to frequent psychiatric comorbidities (Malone, Maislin, Choudhury, Gifford, & Delaney, 2002). The literature investigating the effects of medication on interventions has been inconclusive, with some showing greater improvements in a medicated group (Herbrecht et al., 2009) and others showing greater improvements in an un-medicated group (Frankel, Myatt, & Feinberg, 2007). Given the current evidence, it is unclear whether effects should be larger or smaller among participants who are on psychopharmacological medication, but the high rate of medication use necessitates their investigation.

1.3.2. Intervention characteristics

GSSIs for youth with ASD show a wide range of variation in their content, type, structure, and therapeutic targets. For example, the length of interventions often varies dramatically, ranging from a few weeks to spanning two academic years (e.g., Kamps et al., 2015; Lopata et al., 2010). Moreover, while the majority of GSSIs are conducted for 1- to 2-h weekly sessions, there are more intensive interventions, often during the summer, that meet for 5–6 h/weekday for several weeks (McMahon, Lerner et al., 2013). There has been a recent effort to evaluate how duration/intensity of an intervention may be associated with intervention efficacy (i.e., "dose-response relationship"; Turner-Brown, Perry, Dichter, Bodfish, & Penn, 2008), however results of this investigation are mixed. While in one study intervention length was not correlated with social improvement (Tyminski & Moore, 2008), another study found greater increase in peer interactions among those who attended more intervention sessions (McMahon, Vismara et al., 2013). Considering the inconsistent findings, it is currently unclear whether effects should be larger in longer or more intense interventions, but guidance is needed for service providers to optimize dosage (and minimize costs) to individuals and families.

In some cases, non-ASD youths of similar age participate in GSSIs as peer tutors or peer models (Kamps et al., 2015; Wang et al., 2011). This strategy involves the use of socially competent students to model, interact, and occasionally use intervention strategies to promote social skill development in individuals with ASD (DiSalvo & Oswald, 2002; Rogers, 2000). Although a meta-analysis of single-subject research studies showed evidence that peer-mediated intervention may be an effective strategy for social skill deficits (Wang et al., 2011), the impact of such peers as an adjuvant in the context of a group intervention has not explicitly evaluated, and it is unclear whether it is an effective treatment component (Kaat & Lecavalier, 2014).

1.3.3. Intervention content

GSSI strategies often vary in terms of the specific content they focus on. That is, some focus (at least in part) on didactically presenting information about correct behaviors in social contexts (i.e., social knowledge training), while others aim more squarely on providing a context in which successful peer interactions may occur and reinforcing them when they happen *without* prescriptive teaching of rules (i.e., social performance; Gresham, 1997; Lerner & Mikami, 2012; Lerner & White, 2015; White et al., 2007). As such, the specific content targeted in these GSSIs may be assessed using measures that aim to collect information on either gains made in the participants' self-reported social knowledge or social performance (i.e., enacted social behavior), which may conclude different information about the changes in skills of the participant as a result of the intervention. Though there is reason to believe that social knowledge and social performance may be independent constructs (Lerner & Mikami, 2012; Lerner & White, 2015; Lerner, White et al., 2012), many studies assess social knowledge and social performance together via self-report. Hence, it is important to consider whether there may be a difference between self-reported gains in social knowledge (i.e., knowing what to do in a social situation) and self-reported gains in social performance (i.e., applying the social skills and displaying appropriate social behaviors) when evaluating efficacy of GSSIs.

1.4. Measurement of intervention effect

A crucial question when examining complex, group-based interventions such as GSSIs is whether group effect comparisons are valid and accurate. Most meta-analytic studies of RCTs examine treatment effects by using post-test scores to obtain standardized mean difference (SMD) between experimental and control conditions, based on the assumption that randomization will produce two equivalent groups (Durlak, 2009). However, especially for a complex construct like social competence that is both treated and measured in the context of other people (Koenig et al., 2009), intervention effects may be confounded by many unmeasured constructs (Rosenbaum & Rubin, 1983), which may lead to biased intervention effects. Meta-analyses of such interventions that examine treatment effects by comparing endpoint may be susceptible to such confounding (Preece, 1983). As such, it is especially crucial to not take for granted that the two groups are equivalent and consider whether the pattern of change itself over the course of intervention is different across the two groups.

1.5. The present systematic review and meta-analysis

Examining whether, how much, and according to whom GSSIs may be efficacious is essential for guiding delivery and improvement of this core clinical service for ASD youth. Thus, the present study first sought to meta-analytically examine the efficacy of GSSIs as assessed using well-designed RCTs according to the contemporary literature. Second, we aimed to consider whether these effects differed according to all known sources of information in the literature (parent report, teacher report, self report, observer report, measured behavior on a relevant task), as well as according to intervention characteristics, content, and change measurement.

2. Methods

2.1. Identification and selection of studies

The databases of PsycINFO, PubMed and Web of Science were searched using the following Boolean String: (*ASD OR autism spectrum disorder OR Asperger OR autism OR pervasive developmental disorder*) *AND* (*social skills OR peer interaction OR social competence OR social functioning OR friendship OR social interaction OR social play*) *AND* (*treatment OR intervention*) *NOT* (*early intervention OR toddler OR early intensive behavior intervention*) *NOT* (*pharmacological OR medical*).

2.2. Study selection and literature search

The systematic literature search was conducted in two stages. In an initial search, the entire literature was examined, up to July 2014. A subsequent search was then conducted to ensure the current literature was covered; thus, an identical second search was conducted covering the literature from July 2014 to January 2016.

2.2.1. First stage of literature search

Fig. 1 gives a detailed layout for the identification and selection of studies process. This search yielded 2620 results. The following inclusion criteria were used to refine the results, such that eligible studies were: a) empirical, b) peer reviewed or dissertations, c) evaluated an intervention claiming to be used by providers to address core social deficits, d) included school-aged children and adolescents aged 5–21, e) included participants with a diagnosis of autism, including PDD-NOS and Asperger's syndrome, f) written in English, g) did not include medical or pharmacological interventions, and h) did not include early intervention. In this first pass, 298 abstracts with duplicates removed were

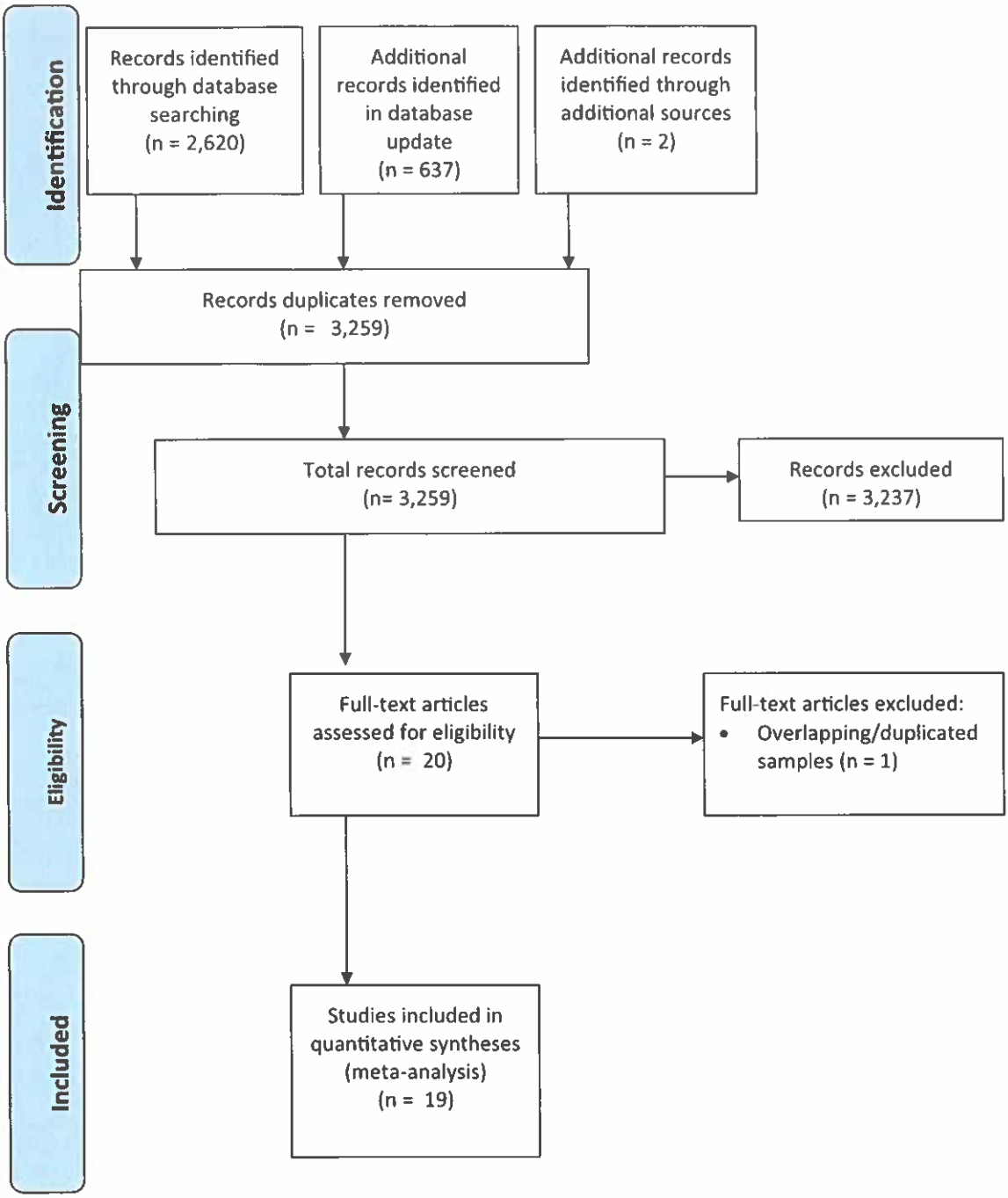

Fig. 1. PRISMA flowchart representing the identification and selection of studies.

identified. The abstracts were screened again using additional criteria: i) published between January 2010 and July 2014; j) peer-reviewed; k) a randomized controlled trial; l) a social skills group intervention; m) included a treatment as usual, wait-list control, or no-treatment control group, and selected by two independent reviewers; 100% of articles were screened by both reviewers, with excellent reliability, (ICC (2,1) > 0.93; Cicchetti, 1994). All discrepancies were resolved via group consensus. The conclusion of part one yielded 14 studies eligible for full-text review.

2.2.2. Second stage of literature search

In an effort to include the most up-to-date articles, a second stage of searching was conducted up to January 2016. An additional 637 results were searched from PsycINFO, PubMed, and Web of Science using the same criteria listed above, with the exception of date, which was set from August 2014 to January 2016. Out of these 637 articles, 6 additional articles were eligible for full-text review. One study was excluded because it did not fit the definition of a social skills group intervention (Kretzmann, Shih, & Kasari, 2015). After removing this study, five studies remained for full data extraction. Therefore, the conclusion of part two yielded another five studies for full-text review.

Recent review articles as well as their reference sections were searched. We included two additional studies published before January 2010 (Laugeson et al., 2009; Solomon et al., 2004) that were included in the most recent meta-analysis of social skills intervention conducted by Reichow et al. (2012), which thoroughly searched the published literature up until 2010.

2.3. Data extraction

Twenty articles were double-coded by the same two blind raters on various demographic variables, as well as outcome data on social competence (See Appendix F for a full list of articles included in the meta-analysis and notable articles in the search process). The a priori definition was: The measure must assess the level of ability or skill an individual possesses when required to engage in socio-cognitive processes and display social behaviors (Beauchamp & Anderson, 2010), and/or involve the active and skillful coordination of multiple processes and resources available to the child to meet social demands and achieve social goals in a particular type of social interaction (e.g., parent–child, peer relations) and within a specific context (e.g., home, school; Iarocci, Yager, & Elfers, 2007). We also included any measures that were specifically identified in the text of the studies as a social competence measure (see Appendix A for included measures). Agreement among coders was excellent, ICC (1, 2) > 0.90.

After the variable set was completed, all authors were contacted for additional data needed including demographic and outcome variables. After corresponding with authors, it was revealed that two studies (Schohl et al., 2014; Van Hecke et al., 2015) contained overlapping participants (A.V. Van Hecke, personal communication, April 27, 2016). It was decided that the study with the more complete set of data would be included (Schohl et al., 2014). Similarly, one study (Rodgers et al., 2015) contained completely overlapping participants with two other studies (Lopata et al., 2010; Thomeer et al., 2012; J.D. Rodgers, personal communication, June 6, 2016). Therefore, this article was excluded from the overall analysis. However, we included this study in the observer-report analysis, as it was the sole study from this sample that included data from observers. Consequently, data from 19 articles were included in the meta-analyses.

2.4. Meta-analytic procedure

The meta-analytic procedures used in this paper adhered to all applicable Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for Meta-Analysis (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). The current study included six separate meta-analyses. The first meta-analysis included all measures of social competence from each study regardless of informant. This analysis averaged all relevant measures of social competence in each study. In order to examine informant influence on social competence outcome ratings, the other meta-analyses were composed of measures reported exclusively from different sources: parent, teacher, self, observer, and behaviors measured on a relevant task.

2.4.1. Parameterization of terms

Parent-report was defined as social competence data collected using standardized assessments, questionnaires, and/or interviews about frequency and quality of the child's social interactions with others from the perspective of a parent or caregiver of the child or teenager with ASD. Teacher-report was defined as social competence data collected using standardized assessments, questionnaires, and/or interviews from the participant's teacher that assess frequency and quality of the child's social interactions with others in school settings. Self-report was defined as social competence data collected from the perspective of the participant (child or teenager with ASD) who was receiving the intervention using standardized assessments, questionnaires, and/or interviews about the frequency and quality of their own behavior, emotions, and/or knowledge. These informant-rated questionnaires largely overlap with the National Institute of Mental Health Research Domain Criteria (RDoC; Insel et al., 2010; Morris & Cuthbert, 2012) "Subjective/Self-Reports" unit of analysis within the social processes domain. Observer-report was defined as behavioral observation data on the frequency, duration, and/or degree of appropriateness of participant's social behavior, usually in the context of a dyadic or group interaction, typically rated by at least two trained observers that are assessed for the reliability of their observations using a standardized coding system (Kamps et al., 2015; Koning et al., 2013; Rodgers et al., 2015). The observer-report outcome data corresponds to the "Behaviors" unit of analysis within the RDoC social processes domain. Task-based source was defined as data collected through the completion of a task or activity in which the participant must utilize specific skills and knowledge related to social competence, such as emotion recognition or Theory of Mind. The assessments could be completed independently by the participant, on a computer or electronic device, or administered by a researcher. The task-based outcome data corresponds to "Paradigms" unit of analysis, which refers to scientific tasks that are especially useful for studying the construct (Morris & Cuthbert, 2012; Sanislow, Quinn, & Sypher, 2015), within the RDoC social processes domain.

2.4.2. Statistical analyses

The effect size statistic provides information about the direction and magnitude of quantitative research findings (Lipsey & Wilson, 2001). The effect size (g), is calculated using the difference between means of the treatment group and the control group, divided by the standard deviation, and weighted for sample size to correct for small sample bias (Hedges & Olkin, 1985; Lipsey & Wilson, 2001). An effect size of 0.2 is considered to be a small effect, 0.5 is considered a medium effect, and above 0.8 is considered a large effect (Cohen, 1992).

Mean gain scores were used for the treatment and control groups to calculate Cohen's d. This was used to yield better estimates of the treatment effects by taking into account pretest differences (Durlak, 2009). Effect sizes (d) were calculated for each measure, and then averaged together to make an overall effect size for each study. Similarly, for the informant-analyses, effect sizes for the relevant informant measures were averaged together to create a single informant effect size for each study. The Standardized Mean Difference using Hedges' g for small sample correction was calculated using Comprehensive Meta Analysis, Version 2 (CMA-2; Borenstein, Hedges, Higgings, Rothstein, & Englewood, 2007). A random-effects model was used in all calculations. For each analysis, if variation was detected, (Q; I^2) moderator analyses were conducted. The Q-test instructs whether there is heterogeneity by summing the squared deviation from each study's effect size from the overall effect size, and weighing each study by variance (Higgins & Green, 2011; Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). The I^2 measures the degree of heterogeneity and provides a percentage of the amount of variance that is attributable to between-study variation (Huedo-Medina et al., 2006). To evaluate whether it would be appropriate to conduct moderator analyses on an obtained effect, the following criteria were established: (a) at least 10 studies included in the analysis; and (b) in the absence of significant Q statistics, evidence of at least a nontrivial amount of heterogeneity according to the I^2 statistic (≥20%; Huedo-Medina et al., 2006). If these criteria were met, fixed effects meta-regression moderator analyses were conducted for potential moderators. The a priori moderators of interest coded during data extraction were age, gender, overall cognitive ability, verbal ability, medication status, presence of psychiatric comorbidity, intervention length, and inclusion of a peer tutor (Lerner & White, 2015; Wang et al., 2011).

The continuous moderators (age, overall cognitive ability, verbal ability, intervention length, percent of total variance of self-report, percent of total measures of self-report) were conducted using analogue to regression and the categorical moderators (gender, medication status, comorbidity, inclusion of a peer tutor, presence of a social knowledge measure) were conducted using analogue to ANOVA.

Due to qualitative differences between child's report of his/her knowing what to do in social situations versus of actually doing such things (Lerner, Calhoun et al., 2012), we considered inclusion of social knowledge measures (binary variable: social knowledge measure included vs. excluded) as a potential moderator of self-report effect. A social knowledge measure was defined as a test that directly measured

what the participant knew about social competence and *what* they were supposed to do (e.g., "The most important part of having a conversation is to...") vs. answering a question or rating a statement about whether the person actually *does* them (e.g., "I make friends easily," or "I try to understand how others feel"). If the binary social knowledge measure was a significant predictor in the self-report meta-regression, we further examined the effect of including social knowledge measures in two additional ways. First, we calculated the proportion of the total number social knowledge measures relative to the total number of self-report measures in each study (e.g., if 4 self-report measures were used and 1 of them was a social knowledge measure, this value would be 25%), and re-ran the meta-regression with this variable included. Second, we calculated the percent of variance in change in self-reported social skills attributable to the social knowledge measures (e.g., if the changes in social knowledge measures accounted for 25% of the total effect of change in social skills according to child self-report, this value would be 0.25), and re-ran the meta-regression with this variable included. If social knowledge was a significant predictor in all of these moderator models, an additional self-report meta-analysis was conducted in which all social knowledge measures were excluded (i.e., only "pure" self-report of social skills was included).

In an effort to better measure true within-group change between pretest and posttreatment over the course of intervention, we calculated all effect sizes for the primary analyses as mean gain scores (the difference between the posttest mean and the pretest mean; Dimitrov & Rumrill, 2003). The mean gains score effect sizes were then compared to the traditional method of calculating an effect size (using the unadjusted posttest scores for the treatment group and the control group). The differences in *g* values divided by the square root of the sums of the variances of the individual *g* is distributed as Z, and we used this *Z*-distributed statistic to test the significance of the difference between two Hedges' *g* values as outlined by Rosenthal (1991, p. 65).

2.4.3. Tests for publication bias

Publication bias was assessed when appropriate ($k > 10$) using funnel plots (plots represent a symmetrical, inverted funnel, with smaller studies spread across the bottom; Egger & Davey Smith, 1998) and a combined tandem method suggested by Ferguson and Brannick (2012). This method includes Egger's regression test, wherein significant findings suggest publication bias (Egger & Davey Smith, 1998); the trim-and-fill method (this method analyzes an asymmetrical funnel plot, identifies the unbalanced plots, "trims" the studies responsible for asymmetry, and assigns new effect sizes to correct for suspected publication bias, if the effect is no longer significant, then publication bias is suspected; Duval & Tweedie, 2000); and Orwin's Fail Safe *N* (the number of non-significant missing studies [i.e., file-drawer articles] needed for the effects to be no longer significant is lower than the number of studies in the analysis; Ferguson & Brannick, 2012). If indicated by all three criteria, publication bias was deemed "probable," if indicated by one or two criteria met, bias was deemed "possible," and if no evidence of bias was found, it was deemed "unlikely."

3. Results

3.1. Descriptive characteristics

For the 18 studies included in the overall meta-analysis, data were collected from 735 participants (see Appendix B). Sample sizes ranged from 11 to 97 participants, M (SD) = 40.83 (25.56). The age of participants ranged from 5.30 to 20.42 years, M (SD) = 10.54 (4.18). 33.3% of studies had study samples with >90% male, and all other samples were between 50% and 90% male. The mean overall standardized cognitive ability of participants was 102.27, ranging from 87.55 to 112.45 across studies. The mean standardized verbal ability of participants was 100.01, ranging from 86.3 to 106.26 across studies. 44.4% of studies reported data on comorbidity of participants, and 50% of studies included participants taking medications. Intervention length ranged from 5 to 97 sessions. 22.2% of the studies included peer tutors.

3.2. Overall analysis

The effect sizes (g) ranged in magnitude from $g = 0.20$ to $g = 1.19$, with positive effects indicating increases in ratings of social competence (see Table 1). Fig. 2 shows individual effect sizes for this analysis.

Participants who received treatment made significantly greater improvements on measures of social competence compared to those in the control group ($g = 0.51$, K = 18, 95% [CI 0.30, 0.72], Z = 4.75, $p < 0.001$). This is a medium effect. While the number of studies included in the overall analysis was sufficient, the I^2 (0.00) was not large enough to justify proceeding with moderator analyses.

3.2.1. Publication bias analysis

Evidence of publication bias was found via Egger's regression test ($b = 0.93$, $p < 0.01$), implying asymmetry of studies was detected in the funnel plot (See Appendix C). Publication bias was not evident according to the trim and fill analysis, where six studies were removed to the left of the mean, making the adjusted effect of GSSI intervention smaller ($g = 0.39$, 95% [CI 0.20, 0.58]), though still significantly different from zero. In contrast, no evidence of publication bias was found according to the Fail Safe *N* (98 studies). The combined tandem criteria suggest publication bias is possible.

3.3. Informant analysis

In order to investigate the effect of informant on ratings of social competence, five separate meta-analyses were conducted which included measures reported exclusively by parent, teacher, self, observer, or completed as a task. Moderator analyses were conducted when appropriate.

3.3.1. Parent-report

Sixteen studies included parent-report measures. The effect sizes for parent-report measures ranged from $g = 0.06$ to $g = 1.03$. Fig. 3 displays the individual effect sizes for the parent-report analysis. According to parent-report, participants who received treatment had significantly greater improvements in social competence relative to controls ($g = 0.47$, K = 16, 95% CI [0.24, 0.70], $Z = 4.01$, $p < 0.01$). This is a small effect. Although the sample of studies was sufficient, the I^2 (0.00) was not large enough to justify proceeding with moderator analyses.

3.3.1.1. Publication bias analysis. No evidence of publication bias was detected according to Egger's regression test ($b = 0.59$, $p = 0.14$), implying symmetry of the funnel plot (See Appendix D). Publication bias was not evident according to the trim and fill method, as three studies were removed to the left of the mean and the adjusted effect of intervention was smaller ($g = 0.41$, 95% [CI 0.20, 0.63]), but still significantly different from zero. Further, no evidence of publication bias was found according to the Fail Safe *N* (55 studies). Thus, no evidence for publication bias was found using the tandem method, suggesting such bias is unlikely.

Table 1
Aggregate effect sizes for all analyses.*

Informant	*k*	Total *N*	Effect size (*g*)	Q	I^2
Overall combined	18	745	0.51**	6.36	0.00
Parent	16	632	0.47**	4.08	0.00
Teacher	4	318	0.41	5.27	43.06
Self	10	365	0.92**	11.52	21.87
Observer	5	228	0.40**	1.16	0.00
Task	8	325	0.58**	1.64	0.00

Note. ** $p < 0.01$.

Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Andrews et al., 2013	0.474	0.356	0.127	-0.223	1.172	1.332	0.183
Begeer et al., 2011	0.285	0.329	0.108	-0.360	0.929	0.867	0.386
Begeer et al., 2015	0.289	0.230	0.053	-0.161	0.739	1.261	0.207
Corbett et al., 2015	0.497	0.502	0.252	-0.486	1.481	0.991	0.321
Frankel et al., 2010	0.303	0.344	0.118	-0.371	0.977	0.881	0.379
Gantman et al., 2012	0.898	0.680	0.462	-0.434	2.230	1.321	0.186
Ichikawa et al., 2013	0.689	0.574	0.330	-0.437	1.815	1.200	0.230
Kamps et al., 2015	0.200	0.545	0.297	-0.869	1.268	0.366	0.714
Koenig et al., 2010	0.229	1.994	3.976	-3.679	4.137	0.115	0.909
Koning et al., 2013	0.898	0.714	0.510	-0.502	2.299	1.257	0.209
Laugeson et al., 2009	0.995	0.502	0.252	0.012	1.978	1.984	0.047
Laugeson et al., 2015	1.193	0.630	0.397	-0.042	2.429	1.893	0.058
Lopata et al., 2010	0.605	0.454	0.206	-0.284	1.495	1.333	0.182
Schohl et al., 2014	0.687	1.099	1.207	-1.466	2.840	0.625	0.532
Solomon et al., 2004	0.870	0.648	0.420	-0.399	2.140	1.343	0.179
Thomeer et al. 2012	0.574	0.478	0.228	-0.362	1.510	1.202	0.229
White et al., 2013	1.031	0.520	0.270	0.013	2.050	1.984	0.047
Yoo et al., 2014	0.454	0.400	0.160	-0.331	1.238	1.133	0.257
	0.506	0.106	0.011	0.297	0.715	4.752	0.000

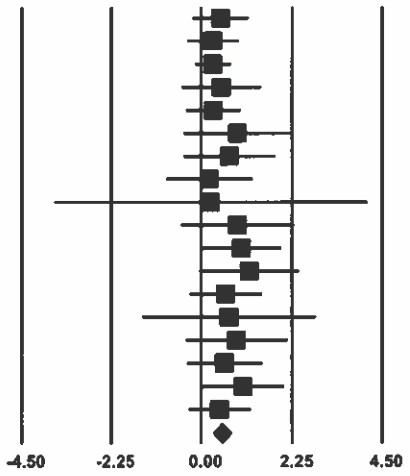

Fig. 2. Overall effect sizes for all measures of social competence, regardless of informant or source. All models are random effects. All effect sizes are Hedges' *g*. Plots with a square indicate Hedges' g for individual studies within the analysis. Diamond indicates overall effect size for the analysis.

3.3.2. Teacher-report

Four studies contained teacher-reported measures of social competence. The effect sizes (*g*) for teacher-report ranged from 0.11 to 0.98. Fig. 4a displays the individual effect sizes for the teacher-report analysis. According to teacher-report, there was not a statistical difference in social competence between the treatment and control groups ($g = 0.41$, K = 4, 95% CI [−0.10, 0.93], $Z = 1.58$, $p = 0.11$). This is a small effect size. While the I^2 (43.06) value was sufficient to support exploratory moderator analyses, the sample of studies was too small to do so; for the same reason, publication bias could not be analyzed.

3.3.3. Self-report

There were 10 studies that included self-report measures. The effect sizes (*g*) for child-report measures ranged from $g = 0.13$ to $g = 2.15$. Fig. 4b shows the individual effect sizes for the self-report analysis. According to self-report informants, those who received treatment showed significantly greater improvements on measures of social competence compared to controls ($g = 0.92$, K = 10, 95% CI [0.58, 1.26], $Z = 5.26$, $p < 0.01$). This is a large effect. The I^2 (21.87) value was nontrivial, and there were at least 10 studies included; thus, exploratory putative moderator analyses were conducted (see Moderator Analysis below). Evidence of publication bias was found via Egger's regression test ($b = 3.01$, $p = 0.03$), implying asymmetry of studies in the funnel plot (See Appendix E).

3.3.3.1. Publication bias analysis. Publication bias was not indicated by the trim and fill method: while three studies were removed to the left of the mean and the adjusted effect of intervention was smaller ($g = 0.72$, 95% [CI 0.45, 0.99]), it was still significantly different from zero. No evidence of publication bias was found according to the Fail Safe *N* (92 studies). Thus, the combined tandem criteria suggest publication bias is possible.

3.3.4. Observer-report

Five studies contained observer-report measures related to social competence. The effect sizes (*g*) for observer-report measures ranged from 0.07 to 0.84. Fig. 5a displays the individual effect sizes for the observer-report analysis. According to observer report, participants who received treatment had significantly greater improvements in social

Subgroup	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Parent	Andrews et al., 2013	0.424	0.353	0.125	-0.268	1.116	1.202	0.229
Parent	Begeer et al., 2011	0.057	0.462	0.213	-0.848	0.962	0.123	0.902
Parent	Begeer et al., 2015	0.371	0.286	0.082	-0.190	0.932	1.297	0.195
Parent	Corbett et al., 2015	0.586	0.512	0.263	-0.419	1.590	1.143	0.253
Parent	Frankel et al., 2010	0.324	0.340	0.116	-0.343	0.992	0.953	0.341
Parent	Gantman et al., 2012	0.923	0.671	0.450	-0.392	2.238	1.375	0.169
Parent	Ichikawa et al., 2013	0.970	0.810	0.656	-0.617	2.558	1.198	0.231
Parent	Koenig et al., 2010	0.229	1.994	3.976	-3.679	4.137	0.115	0.909
Parent	Koning et al., 2013	0.136	0.689	0.475	-1.215	1.487	0.197	0.844
Parent	Laugeson et al., 2009	0.660	0.487	0.237	-0.295	1.614	1.354	0.176
Parent	Laugeson et al., 2015	0.838	0.621	0.386	-0.379	2.056	1.350	0.177
Parent	Lopata et al., 2010	0.465	0.463	0.215	-0.443	1.373	1.005	0.315
Parent	Schohl et al., 2014	0.448	0.369	0.136	-0.276	1.171	1.213	0.225
Parent	Thomeer et al., 2012	0.550	0.479	0.229	-0.388	1.489	1.150	0.250
Parent	White et al., 2013	1.031	0.519	0.269	0.015	2.048	1.988	0.047
Parent	Yoo et al., 2014	0.331	0.408	0.166	-0.468	1.130	0.811	0.417
		0.468	0.114	0.013	0.244	0.692	4.089	0.000

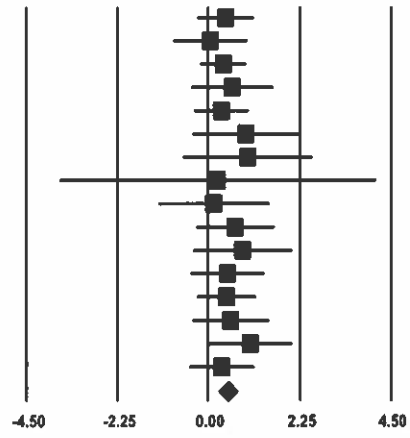

Fig. 3. Effects sizes for parent-report measures of social competence. All models are random effects. All effect sizes are Hedges' g. Plots with a square indicate Hedges' g for individual studies within the analysis. Diamond indicates overall effect size for the analysis.

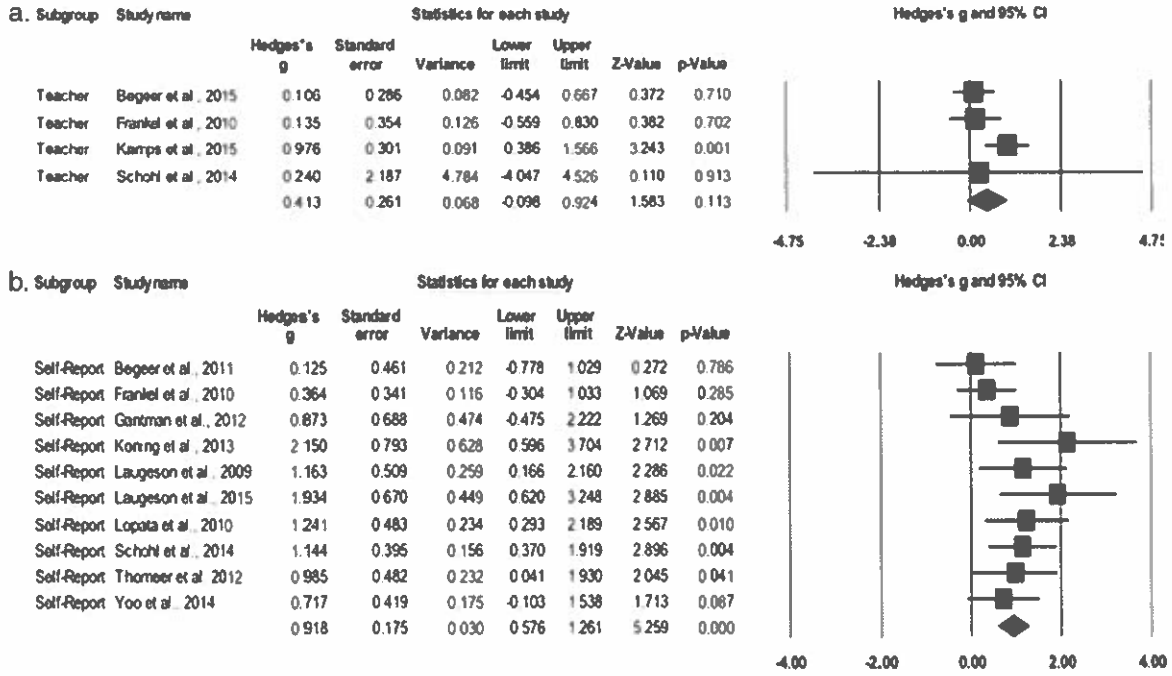

Fig. 4. 4a. Effects sizes for teacher-report measures of social competence. 4b. Effects sizes for self-report measures of social competence. All models are random effects. All effect sizes are Hedges' g. Plots with a square indicate Hedge's g for individual studies within the analysis. Diamond indicates overall effect size for the analysis.

competence than controls ($g = 0.40$, K = 5, 95% CI [0.28, 0.52], $Z = 6.75$, $p < 0.001$). The sample of studies was not sufficient and the I^2 (0.00) did not meet the criteria to justify proceeding with moderator or publication bias analyses.

3.3.5. Task-based measures

Eight studies contained task-based measures of social competence. The effect sizes (g) for task-report ranged from 0.26 to 1.07. Fig. 5b displays the individual effect sizes for the task-source analysis. According to task-based measures, those children who received treatment performed significantly better on task-based measures relative to those in the control groups ($g = 0.58$, K = 8, 95% CI [0.24, 0.92], $Z = 3.314$, $p < 0.01$). This is a medium effect. The sample of studies was not sufficient and the I^2 (0.00) did not meet the criteria to justify proceeding with moderator or publication bias analyses.

3.4. Moderator analysis

Exploratory analyses of putative moderators were conducted for the self-report informant meta-analysis. All of the putative descriptive moderators (i.e., age, gender, overall cognitive ability, verbal ability, intervention length, comorbidity, medication, and peer tutors) were non-significant. Interestingly, the three self-report social knowledge moderators did demonstrate significant variability.

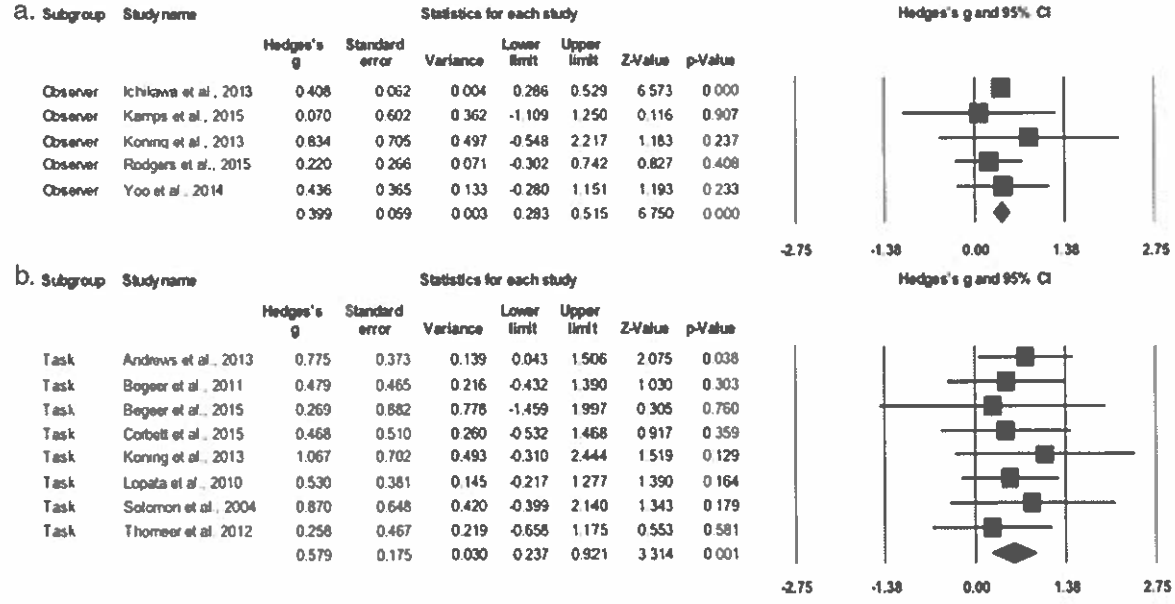

Fig. 5. 5a. Effects sizes for observer-report measures of social competence. 5b. Effects sizes for task-report measures of social competence. All models are random effects. All effect sizes are Hedges' g. Plots with a square indicate Hedges' g for individual studies within the analysis. Diamond indicates overall effect size for the analysis.

3.4.1. Social knowledge - presence

The categorical variable of presence of a social knowledge measure was significant ($Q(1) = 7.01$, $p = 0.01$). Effect sizes were larger when a social knowledge self-report assessment was included ($g = 1.149$, K = 8, 95% CI [0.80, 1.50], Z = 6.35, $p < 0.01$) than when they were not ($g = 0.280$, K = 2, 95% CI [−0.28, 0.82], Z = 1.02, $p = 0.31$).

3.4.2. Social knowledge - percent of total measures

The variable of percent of total measure was significant, $Q(1) = 7.27$, $p = 0.01$. Effect sizes were larger when a greater total percentage of self-report measures were social knowledge assessments, $\beta = 1.05$, $SE = 0.331$, 95% CI [0.29, 1.82].

3.4.3. Social knowledge - percent of variance

The variable of percent of variance was significant $Q(1) = 6.74$, $p = 0.01$. Effects were larger when the percentage of the overall effect of change in self-reported social skills that is attributable to social knowledge was greater, $\beta = 0.889$, $SE = 0.346$, 95% CI [0.220, 1.578].

3.5. Post-hoc analyses

3.5.1. Self-report meta-analysis without social knowledge

A post-hoc analysis of the self-report data excluding the social knowledge measures was conducted. Six studies were included in this analysis. Effect sizes ranged from $g = 0.06$ to $g = 1.095$. When social knowledge measures were excluded from the analyses, there was no significant difference from controls $g = 0.20$, K = 6, 95% CI [−0.137, 0.54], $Z = 1.17$, $p = 0.14$. That is, improvements in self-report were only found for measures of social knowledge. The test of heterogeneity was not significant ($Q(5) = 2.99$, $p = 0.70$; $I^2 = 0.00$).

3.5.2. Post-test SMD

Post-hoc analyses comparing the gain score SMD to post-test SMD scores for each meta-analysis were conducted (Table 2). None of the Hedges' g scores calculated using post-test SMD were significantly different from mean gain scores (all $p > 0.13$). Moderator analyses were not conducted for the post-test SMD analyses.

4. Discussion

This study was the largest meta-analysis conducted to date evaluating the efficacy of GSSIs for youth with ASD. Moreover, this was the first study to examine effect sizes by varying reporting sources of social competence. Results indicated that GSSIs led to moderate overall improvements in social competence, reflected in data from parents, youth, observers, and tasks, but not teachers, supporting variations by reporting sources. Notably, the large self-report effect was wholly attributable to increased social knowledge, but not perceived changes in their own social behavior.

4.1. Comparison with other meta-analytic studies

The effect size found in the overall meta-analysis ($g = 0.51$) was comparable to the only other meta-analysis of GSSI to date ($g = 0.47$; Reichow et al., 2012), suggesting medium effects of GSSI interventions on social competence. This was, again, similar in magnitude to the effect found for interventions affecting social skills for youth with ADHD (Daley et al., 2014) and schizophrenia (Kurtz & Mueser, 2008), but larger than that for youth with learning disabilities ($g = 0.21$; Forness & Kavale, 1996). It was also larger than the effects of school-wide ($g = 0.15$; January, Casey, & Paulson, 2011) and after-school ($g = 0.19$; Durlak, Weissberg, & Pachan, 2010) interventions focusing on improving social skills in general populations of children and adolescents. This suggests that social skills intervention efficacy may be augmented somewhat for populations with primary (rather than secondary) deficits in this domain, suggesting a "deficit consonance" for this treatment modality.

Interestingly, though, the effect was broadly similar to that found across *all* child and adolescent group treatment ($d = 0.61$; Hoag & Burlingame, 1997), indicating that grouping youth with common concerns and providing a venue to directly, collaboratively, and strategically address them may yield a generalized benefit, perhaps via a common, nonspecific factor such as group cohesion (Lerner et al., 2013).

Further, a recent meta-analysis of CBT for individuals with ASD (Weston, Hodgekins, & Langdon, 2016) across all age ranges and treatment modalities (group and individual) found similarly small and non-significant effects for self-report ($g = 0.25$) and medium effects ($g = 0.48$) for informant (e.g., parent-)report of ASD symptoms; however, the effect of CBT for task-based measures was small ($g = 0.35$), in comparison to a medium effect found in the present meta-analysis. Thus, GSSIs for youth with ASD may produce similar (and, according to some tasks, larger) effects on ASD symptoms than more traditional CBT, while CBT may be more effective for treating anxiety in this population. This contrast provides foundational guidance for symptom-specific treatment recommendations for individuals treating youth with ASD.

4.2. Variations by sources in intervention effect

Results of the parent-report meta-analysis revealed a small effect of GSSIs on social competence. Past literature has demonstrated that parents tend to stably report positive effects of intervention, possibly due to expectancy effects reflecting their investment in and allegiance to the intervention and/or hope and expectations for intervention to increase skills (McMahon, Lerner et al., 2013). That said, intervention effects reported by parents in this study were small. Several elements may contribute to this finding: social competence is a complex and multidimensional construct and many parent-report measures combine assessment of both social knowledge and social performance. Previous literature suggests that while parents generally report high satisfaction with the GSSIs and gains in social knowledge, their report of changes in behaviors in naturalistic settings is infrequent (White et al., 2007). Thus, the small parent-report effect may be attributable specifically to gains in

Table 2
Social skills intervention effect sizes according to Mean Gain Score SMD vs. Post-Test only SMD.

Informant	*k*	Mean gain score SMD (*g*)	Mean gain score 95% CI	Post-test SMD (*g*)	Post-test 95% CI	*Z*[1]
Overall	18	0.51**	0.20, 0.58	0.49**	0.354, 0.64	0.06
Parent	16	0.47**	0.24, 0.70	0.47**	0.31, 0.62	0.01
Teacher	4	0.41	−0.10, 0.93	0.44**	0.15, 0.73	0.88
Self	10	0.92**	0.58, 1.26	0.78**	0.47, 1.09	0.58
Observer	5	0.40**	0.28, 0.52	0.18	−0.10, 0.45	1.45
Task	8	0.58**	0.24, 0.92	0.59**	0.30, 0.89	−0.06

Note. ** $p < 0.01$. [1]No *Z* scores reached the 0.05 significance threshold. *SMD - Standardized Mean Difference. Z* = differences in *g* between the two SMD scores, divided by the square root of the sums of the variances of the individual *g*; this produces a *Z*-distributed statistic for the difference in effect size between the two SMD scores.

only a limited number of settings. Alternatively, due to expectancy effects, parents may already anticipate some changes in the behaviors of their children as a result of participating in the intervention at all; thus, they may report small effects even if robust gains are not being seen.

On the other hand, no differences were found between treatment and control groups in the effect of GSSIs according to teacher-report. There may be several reasons for this. Teachers often may not be aware of the skills being targeted in the GSSI, making them less susceptible to expectancy effects or allegiance effects in their reports of improvement. This supports the proposition that the aforementioned small parent-report effects may be a function of expectancy effects rather than robust, cross-contextual changes. Relatedly this finding provides further support for differential expression of psychopathology across settings (Achenbach, McConaughy, & Howell, 1987; De Los Reyes, Henry, Tolan, & Wakschlag, 2009). Generalization of acquired skills may be especially difficult in school settings where social demands are generally greater than (or at least different from) home or intervention settings. For example, classmates may continue to show negative bias, even when participants do improve in their social skills (Mikami, Lerner, & Lun, 2010). Conversely, it is possible that teachers may not have sufficient opportunity to observe certain social skills in the classroom, so they may need more observation opportunities to see any actual changes that may be evident.

Self-reported measures of social competence revealed a large effect. This finding is interesting compared to the small effects seen by parents, and a stark contrast to the lack of treatment effects seen by teachers. However, it is consistent with past literature suggesting a consistent tendency in youth with ASD to overestimate their social functioning relative to their parents (Lerner, Calhoun et al., 2012). Moreover, they also tend to show expectancy effects similar to parent-report, as children also consistently report high satisfaction with GSSIs (McMahon, Lerner et al., 2013). Taken together, these tendencies may contribute to greater estimation of their intervention-related improvements.

That said, moderator analyses indicated that the use of self-reported social knowledge measures was wholly responsible for the large effect shown in the self-report analysis. That is, while participants report gains in their social knowledge, they do not report changes in their social behaviors (Lerner, White et al., 2012). This finding suggests that the common approach in GSSIs of didactically teaching social skills may not provide opportunities to allow adequate application of social skills and rehearsal of these behaviors. As intervention characteristics (e.g., social knowledge-based vs. social performance-based methods) may affect gains in these constructs separately, this highlights the importance of GSSIs providing opportunities for participants to actively practice these skills in social situations (Lerner & Mikami, 2012; Lerner, Mikami, & Levine, 2011).

Further, this finding reveals valuable insights about the participants' self-awareness of their own social competence. Individuals reported that they had improved in knowledge of correct social skills, but also that they were not actually performing these skills in social settings, which is more consistent with reports by parents and teachers. This indicates that the participants in the interventions themselves did not actually believe the intervention was helping them improve how they perform social skills in real-life situations. This stands in contrast to theories stating individuals with ASD have limited insight into their social competence (e.g., Frith & Hill, 2003; Williams, 2010), in that they may be able to differentiate between reflecting on their own knowledge of a behavior, versus enactment of it.

All other putative moderators (mean age, gender composition, overall cognitive ability, verbal ability, comorbidity, medication status, and inclusion of peer tutors) did not predict self-report intervention effects. Importantly, this was the only reporting source for which moderator analyses could be run. Thus, these child and group-level variables may indeed still predict outcomes according to different rater; as additional studies in this domain are published, these potential moderators should surely be explored. At present, however, this suggests that the heterogeneity in outcomes in self-report was not explained by any of these participant or intervention characteristics.

Observer-report studies revealed a small effect of GSSIs on social competence. This demonstrates that modest improvements in naturalistic social behaviors are being observed as a result of GSSI, even though participants themselves may not report this. Further, it lends support to the idea that these behaviors are malleable to intervention. That said, consistent with the findings from the parent-report analyses, the small effect suggests that large gains in social performance may indeed be difficult to achieve with current GSSIs approaches. Thus, identifying elements of GSSIs that do indeed potentiate naturalistic social behavior would be valuable.

Task-report studies yielded a medium effect of GSSIs on social competence. Many GSSIs utilize strategies of teaching specific skills and knowledge required to complete a given task (e.g., Theory of Mind) by providing explicit feedback on their performance on the task (e.g., giving them the right answer and "teaching to the test"). The medium effects are consistent with the literature that children with ASD can successfully learn these skills following didactic instructions (e.g., Wellman et al., 2002). However, the degree of improvement in tasks may not be mirrored in actual social skills use (Ozonoff & Miller, 1995). Therefore, it is important to examine whether changes in task-based measures represent generalized skill learning vs. simply effects of teaching to the test.

Across meta-analyses, no significant differences were found between the mean gain score SMD and post-test SMD scores. This finding may suggest that randomization in each study was done successfully to yield comparable pretreatment scores across treatment and control groups, and supports the use of either method in future meta-analyses.

4.3. Publication biases

Evidence for possible publication bias was found in the overall and self-report meta-analyses, suggesting that "true" effects may be smaller than what are currently reported in the literature. This finding suggests that studies with smaller effects (though, importantly, *not* a large number of null findings) are being omitted from the literature, perhaps due to the fact that most GSSI studies aim to evaluate "novel" treatments (i.e. studies that have a new name, even if not materially different in content from other interventions) rather than replicating and extending the current literature. Consistent with "first studies" throughout science (e.g., Tuttle et al., 2015), these "novel" GSSIs tend to show larger effects (e.g., Kamps et al., 2015; Koning et al., 2013; Lopata et al., 2010); thus, the current published literature may be selecting for these types of studies, thereby inflating overall effects. Especially considering the structural similarity of many of these interventions (see Lerner & Mikami, 2012; Lerner & White, 2015) future research should focus on follow-up and replication studies of existing GSSIs (e.g., Van Hecke et al., 2015).

Conversely, the findings here could be a result of "small study" effects (effects due to systematic methodological differences between studies with small vs. large sample size) rather than true publication bias (Ferguson & Brannick, 2012). Therefore, a greater number of studies, as well as studies that include a larger sample of participants, are needed.

Findings from the publication bias analyses bolster the importance of considering variations in intervention effects by sources. There was some evidence of publication bias in the overall meta-analysis, which included an aggregate of several sources, including those for which we could not conduct publication bias analyses (i.e., teacher, observer, and tasks sources). Results from the parent-report meta-analysis suggest that publication bias is unlikely in this domain. This finding reinforces the aforementioned prospect that parent-report may be influenced by expectancy effects; that is, these effects may provide a "floor" for parent-reported effect sizes, contributing to their stability, even in cases where objective changes may not be evident. They also

highlight the differences in reporting patterns among sources and suggest that the evidence of publication bias found in the overall report may be influenced by other sources. For instance, given the above self-report findings, it may be that unpublished null findings on self-reported social skills (without social knowledge measures) may contribute to the observed bias. Further, given the nonsignificant findings in the teacher-report analyses, it is reasonable that unpublished, nonsignificant studies using teacher-report measures may contribute as well.

4.4. Implications for practice

GSSI are among the most widely used methods to improve social skills in school-age and teenage individuals with ASD (McMahon, Lerner et al., 2013). Consistent with the past meta-analysis (Reichow et al., 2012), findings from this study suggest that participants of GSSIs show some improvement in social competence after GSSIs.

Further, important variations in the reports of gains by sources reflect multidimensionality of and contextual variations in participant's social skills and behavior (De Los Reyes et al., 2009; Murray et al., 2009). Providers of intervention may observe significant variations in participant's behavior across contexts and may need to foster appropriate strategies that will be effective in a specific context (e.g., school vs. home environment). Developing intervention approaches that support enactment of successful social behavior across contexts may support more robust gains. Moreover, results identifying variations in self-reported gains in social competence when assessed via a social knowledge measure vs. social performance measure suggest the importance of considering and interpreting these separate constructs differently (Lerner & White, 2015; McMahon, Lerner et al., 2013). Thus, it would be important for the providers to implement strategies that aim to provide more opportunities for participants to practice the performance of these learned skills in real situations. Further, social knowledge and social performance measures divulge substantively different information on the improvement of social skills in interventions, suggesting that providers should be careful, specific, and circumspect in their use and interpretation of such measures. Moreover, the findings suggest a vital need to carefully consider variations according to source and differentiate social knowledge and social performance when assessing intervention effects.

Further, some analyses reported a nontrivial amount of heterogeneity, but this heterogeneity could not be accounted for using the demographic or intervention variables assessed in the analysis. This suggests that GSSIs may be beneficial for participants with wide range of demographic characteristics, or that additional individual differences should be considered in future RCTs of GSSIs.

4.5. Limitations and future research

The current study had several limitations that future research could address. First, we evaluated different GSSI approaches, including both social knowledge-based approaches and social performance-based approaches (Lerner & Mikami, 2012; Lerner & White, 2015). Future studies should more thoroughly identify differences between features of interventions and conduct moderation analyses in order to identify participant characteristics for which specific intervention approaches are most likely to be beneficial.

Moreover, although this was the largest meta-analysis conducted on GSSIs for youth with ASD, the total *k* was modest, especially considering individual source effects. As such, we were not able to conduct moderator analysis or publication bias analysis for some sources of effects.

Also, it is important to note that the reported effect sizes only provide information about improvement in social competence when compared to a participant's own levels just before participating in a GSSI and therefore do not provide information on the level of social competence compared to individuals without ASD. Therefore, future studies may wish to consider clinically meaningful improvements (Jacobson & Truax, 1991) as well as statistical change.

Furthermore, the efficacy of GSSIs in this study is demonstrated based on RCTs with waitlist or no-treatment control groups. However, it is unclear whether the effects are attributable simply to working together in a supported group context, which has itself been shown to be beneficial for youth with ASD (e.g., Bohnert, Lieb, & Arola, 2016). Therefore, use of attention control groups that are matched for structure and contact would provide information as to whether GSSIs outperform active conditions that control for attention and other nonspecific factors (e.g., time spent with peers). In addition, it would be important to evaluate the effectiveness (rather than just efficacy) of GSSIs to assess whether they are implemented with fidelity in community settings, and whether such fidelity contributed to obtained effects.

Lastly, this study does not include follow-up and long-term comparisons of treatment and control conditions, as most studies did not include follow-up assessments. More studies with follow-up data are needed with the same control condition throughout the follow-up period.

4.6. Summary

This meta-analysis suggests that GSSIs lead to moderate overall improvements in social competence in youth with ASD relative to non-treatment or waitlist controls. This study also indicates that parents and observers report small effects of GSSIs, and task-based measures yield medium effects. Teachers appear not to see effects of GSSIs. While youth with ASD self-report large effects, these changes appear entirely attributable to changes in social knowledge; when social knowledge measures are excluded, youth self-report no changes in GSSIs. Overall, larger and more well-controlled studies using a broad array of appropriate measures are needed to advance the study of GSSIs and identify when, how, and for whom they can be most effective.

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Contributors

JAG and MDL designed the study and wrote the protocol. JAG and EK conducted literature searches and provided summaries of previous research studies. JAG, EK, and MDL conducted the statistical analysis. JAG wrote the first draft of the manuscript, and all authors contributed to subsequent drafts, and have approved the final manuscript.

Conflict of Interest

The authors declare no financial or personal conflicts of interest.

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Appendix A

Measures used for each study by source.

Citation	Parent	Teacher	Self-report	Observer	Task
Andrews et al., 2013	– Affection for Others Questionnaire – General Affection Questionnaire – Social Competence with Peers Questionnaire	–	–	–	– Walk in the Forest
Begeer et al., 2011	– The Children's Social Behavior Questionnaire	–	– The Index of Empathy for Children and Adolescents	–	– Levels of Emotional Awareness Scale for Children – The Theory of Mind Test
Begeer et al., 2015	– Social Responsiveness Scale – Social Skills Questionnaire – Theory of Mind Behavior Checklist	– Social Skills Questionnaire	–	–	– Advanced Theory of Mind Test – Levels of Emotional Awareness Scale for Children – The Theory of Mind Test
Corbett et al., 2015	– Adaptive Behavior Assessment System	–	–	–	– Developmental NEuroPSYchological Assessment
Frankel et al., 2010	– Social Skills Rating Scale	– Pupil Evaluation inventory	– Piers-Harris Self-Concept Scale – The Loneliness Scale	–	–
Gantman et al., 2012	– Social Responsiveness Scale – Social Skills Rating Scale	–	– Social Skills Inventory – Test of Young Adult Social Skills Knowledge	–	–
Ichikawa et al., 2013	– Strengths and Difficulties Questionnaire	–	–	– Interaction Rating Scale	–
Kamps et al., 2015	–	– Teacher Impression Scale	–	– Study-Developed Observation Form	–
Koenig et al., 2010	– Social Competence Inventory	–	–	–	–
Koning et al., 2013	– Social Responsiveness Scale – Vineland Adaptive Behavior Scale	–	– Social Knowledge	– Peer Interaction Measure	– The Child and Adolescent Social Perception measure
Laugeson et al., 2009	– Social Skills Rating Scale	–	– Test of Young Adult Social Skills Knowledge	–	–
Laugeson et al., 2015	– Social Responsiveness Scale – Social Skills Rating Scale	–	– Friendship Qualities Scale – Test of Young Adult Social Skills Knowledge	–	–
Lopata et al., 2010	– Adapted Skillstreaming Checklist – Behavior Assessment System for Children – Social Responsiveness Scale	–	– Skillstreaming Knowledge Assessment	–	– Diagnostic Analysis of Nonverbal Behavior
Rodgers et al., 2015	– The Facial Affect Rating Form	–	–	–	–
Schohl et al., 2014	– Social Responsiveness Scale – Social Skills Rating Scale	– Social Responsiveness Scale – Social Skills Rating Scale	– Friendship Qualities Scale – Social Interaction Scale – Test of Adolescent Social Skills Knowledge	–	–
Solomon et al., 2004	–	–	–	–	– Diagnostic Analysis of Nonverbal Behavior – Faux Pas Stories Task – Strange Stories Task
Thomeer et al., 2012	– Adapted Skillstreaming Checklist – Behavior Assessment System for Children – Social Responsiveness Scale	–	– Skillstreaming Knowledge Assessment	–	– Diagnostic Analysis of Nonverbal Behavior
White et al., 2007	– Social Responsiveness Scale	–	–	–	–
Yoo et al., 2014	– Asperger Syndrome Diagnostic Scale – Social Communication Scale – Social Responsiveness Scale – Vineland Adaptive Behavior Scale	–	– Friendship Qualities Scale – Social Skills Rating Scale	– Autism Diagnostic Observation Schedule	– Autism Diagnostic Observation Schedule

Appendix B

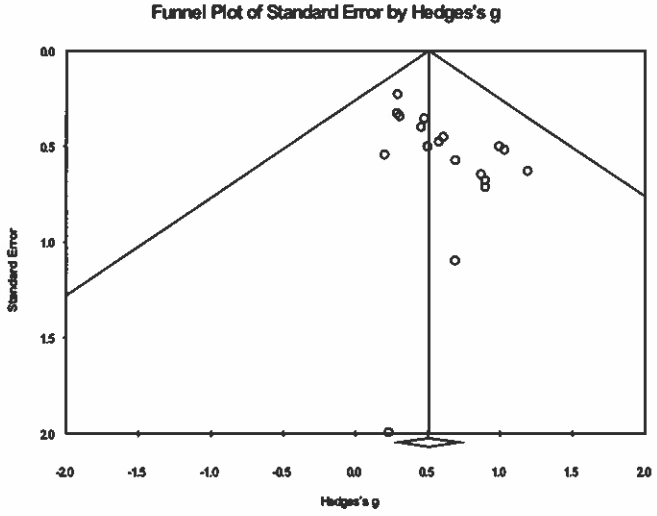
Descriptive information for each study.

Citation	M_{age}	N	% Male	Mean Overall Cognitive Ability	Mean Verbal Ability	Intervention length	Comorbidity data	Medication	Peer Tutors	Sources
Andrews et al., 2013	9.02	58	50–90%	112.45	N/A	5 Sessions	N/A	N/A	No	P, TA
Begeer et al., 2011	10.3	36	≥90%	101.39	105	16 Sessions	Yes	N/A	No	P, S, TA
Begeer et al., 2015	9.6	97	≥90%	N/A	106.26	8 Sessions	Yes	Yes	No	P, T, TA
Corbett et al., 2015	11.04	30	50–90%	101.64	101.19	10 Sessions	N/A	Yes	Yes	P, TA
Frankel et al., 2010	8.53	68	50–90%	N/A	103.8	12 Sessions	N/A	No	No	P, S, T
Gantman et al., 2012	20.4	17	50–90%	102.3	95.93	14 Sessions	Yes	Yes	No	P, S
Ichikawa et al., 2013	5.3[a]	11	50–90%	87.55[a]	98.5	20 Sessions	N/A	N/A	No	P, O
Kamps et al., 2015	5.8	95	50–90%	N/A	86.3	97 Sessions	N/A	N/A	Yes	T, O
Koenig et al., 2010	9.24	41	50–90%	96.2	N/A	16 Sessions	N/A	Yes	Yes	P
Koning et al., 2013	11.07	15	≥90%	109.3	102.31	15 Sessions	Yes	Yes	No	P, S, O, TA
Laugeson et al., 2009	14.6	33	50–90%	95.24	92.27	12 Sessions	No	Yes	No	P, S
Laugeson et al., 2015	20.42	20	50–90%	105.03	98.17	16 Sessions	Yes	N/A	No	P, S
Lopata et al., 2010	9.47	36	≥90%	103.04	104.32	30 Sessions	N/A	N/A	No	P, S, TA
Rodgers et al., 2015	9.33	60	50–90%	102.77	104.03	30 Sessions	N/A	N/A	No	O*
Schohl et al., 2014	13.65	58	50–90%	100.34	100.31	14 Sessions	Yes	Yes	No	P, S, T
Solomon et al., 2004	9.37	18	≥90%	105.22	105.94	20 Sessions	N/A	N/A	No	TA
Thomeer et al., 2012	9.31	35	50–90%	103.83	103.6	30 Sessions	N/A	N/A	No	P, S, TA
White et al., 2013	14.58	30	50–90%	N/A	97.39	20 Sessions	Yes	Yes	Yes	P
Yoo et al., 2014	13.78	47	≥90%	99.87	100.04	14 Sessions	Yes	Yes	No	P, S, O

Note. P- Parent, S-Self, O- Observer, T- Teacher, TA- Task, [a]Median score. *-This study was not included in the overall analyses due to sample overlap with Lopata et al. (2010) and Thomeer et al., (2012). However, it was included in the Observer-report analyses. The Mean Cognitive Ability and Mean Verbal Ability are standard scores. Medication use was categorized by "Yes," "No," or "N/A = not available," if it was indicated by the article or through communication with the author that any of the participants of the intervention were taking medication. Inclusion of a peer tutor was defined as the presence of a typically developing peer that assists or participates in the group social skills intervention.

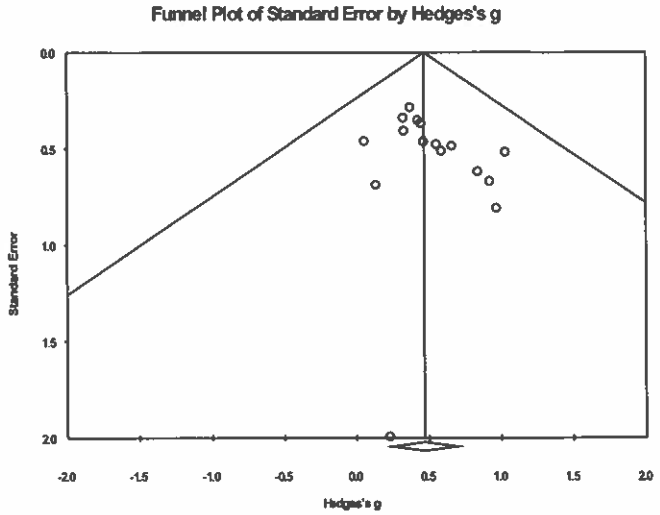
Appendix C

Funnel plot for examining publication bias for overall analysis. Here, Y-axis stands for the standard error of the Hedges' *g* and X-axis stands for the Hedges' *g*. Each dot stands for an individual study.



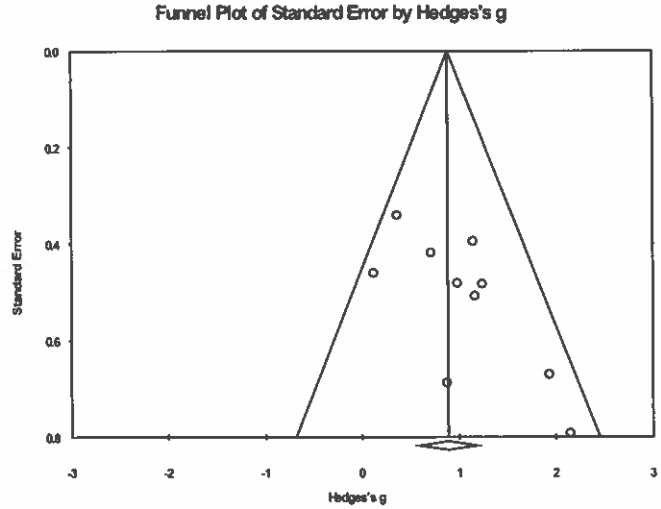
Appendix D

Funnel plot for examining publication bias for parent-report analysis. Here, Y-axis stands for the standard error of the Hedges' *g* and X-axis stands for the Hedges' *g*. Each dot stands for an individual study.



Appendix E

Funnel plot for examining publication bias for self-report analysis. Here, Y-axis stands for the standard error of the Hedges' *g* and X-axis stands for the Hedges' *g*. Each dot stands for an individual study.



Appendix F

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ORIGINAL CONTRIBUTION

Social skills group training in children with autism spectrum disorder: a randomized controlled trial

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Abstract

In 122 high-functioning children with autism spectrum disorder (ASD; 9–13 years; 19 girls), we investigated the effectiveness of a 15-session social skills group training (SST) with and without parent and teacher involvement (PTI) in a randomized controlled trial with three conditions: SST ($n=47$), SST–PTI ($n=51$), and care-as-usual (CAU, $n=24$). Hierarchical linear modeling was used for immediate and 6-month follow-up analyses. Measures were administered before randomization (blind), post-treatment and at follow-up (not blind). Trial registration: Dutch Trial Register; http://www.trialregister.nl; NTR2405. At post-treatment, children in both SSTs had improved significantly more than CAU on the primary outcome, Vineland Socialization (SST: Cohen's $d=0.39$; 95% CI −2.23 to 3.11 and SST–PTI: $d=0.43$; 95% CI −2.19 to 3.15) and on the secondary outcome parent-SSRS "Cooperation" (SST: $d=0.43$; 95% CI −0.23 to 1.15 and SST–PTI: $d=0.45$; 95% CI −0.21 to 1.17), with no difference between post-treatment and follow-up. Additionally, children in SST–PTI improved significantly more on the teacher-SSRS than in CAU ["Cooperation" $d=0.42$ (95% CI −0.33 to 1.13); "Assertion" $d=0.34$ (95% CI −0.39 to 1.11); "Self-Control" $d=0.61$ (95% CI −0.08 to 1.34)] and in SST ["Cooperation" $d=0.34$ (95% CI −0.37 to 1.05); "Self-Control" $d=0.59$ (95% CI −0.13 to 1.32)]. The current study corroborates earlier findings in smaller samples and wider age ranges, with small but statistically significant effects of SST for high-functioning pre-adolescent children with ASD. Parental and teacher involvement intensified treatment, yet did not yield an additional effect relative to SST for children only, as reported by parents. 6 months after training, no further improvement or decline was found.

Keywords Social skills training · Effectiveness · Autism spectrum disorder · Randomized controlled trial

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Introduction

To improve social-communicative skills in children with autism spectrum disorders (ASD), group-based Social Skills Trainings (SSTs) are widely provided in clinical practice. The short-term effectiveness of SST has been demonstrated in two recent meta-analyses [1, 2]. Effect sizes varied for different sources of treatment evaluation. Parents and external observers generally reported small effects of training, teachers reported no effect, and children and adolescents reported large effects, all compared to no-treatment or waiting-list conditions. The latter effects mainly reflect improvement in social knowledge rather than actual social behavior. Besides informants, the exact instruments used seem to affect the effect, with moderate to large parent-reported effects in the meta-analysis [2] on the Social Skills Rating System (SSRS [3]), and Social Responsiveness Scale (SRS [4]).

One of the ultimate aims of SST in ASD is to improve social skills beyond the duration of the training. Since longer term follow-up data are often lacking, the authors of recent meta-analyses could not draw conclusions regarding the long-term effects [1, 2]. For studies with 3 months follow-up assessments for treated and non-treated groups, the outcomes varied: the immediate effect of group-based SST reported by Soorya et al. [5] did not sustain at 3 months' follow-up, whereas Freitag et al. [6] and Deckers et al. [7] reported a significant effect at 3 months' follow-up. Choque Olsson et al. [8] did not find an effect of training on children, and the effect found for adolescents was shown immediately post treatment only, and not at 3 months follow-up.

Another important aim of SST is to improve social skills in situations beyond the training situation, i.e., in daily life. Research into SSTs could not draw conclusions about how to reach generalization of skills to real life [9]. One way to improve the generalization of children's social skills may be involving parents and/or teachers in the SST intervention, reasoning that they can directly support children to put their training into practice in daily life. Wolstencroft et al. [2] showed that all children in an SST improved, independent from parental involvement, yet with a large effect size in the group with parental involvement and moderate in the group without. However, due to other differences between the studies (e.g., participant characteristics, measures used), direct comparisons are complicated.

The current study [Efficacy of Social skills Training In Autism (ESTIA)] is a randomized controlled trial (RCT) into the effectiveness of a manualized group SST with and without parental and teacher involvement for high-functioning children with ASD in the last two and a half years of primary education, in a large and well-characterized sample of 122 children, with a 6-month follow-up in all conditions. We aimed to investigate two main questions: (1) what is the immediate and long-term effect of group-based SST for high-functioning children with ASD compared to no training (care-as-usual, CAU) based on social skills applied in school and in home-based daily life situations? and (2) what is the additional immediate and long-term effect of parental and teacher involvement on generalization of social skills in daily life of children with ASD compared to group-based SST for the children only?

We hypothesized that (1) children in an SST would improve more on measures of social skills compared to children without an SST; (2) children with SST and additional parent and teacher involvement (SST–PTI) would improve more on measures of social skills, compared to children without this support (SST); (3) children with additional support (SST–PTI) would better maintain these skills after training, compared to children without such support (SST).

Methods

Design

The RCT had three conditions: group SST only, group SST–PTI, and care-as-usual without SST. We collected measures at three time points: pre-treatment (T1), immediately post treatment or after the same amount of time in CAU (T2), and follow-up 6 months post treatment or after the same amount of time in CAU (T3). We could only collect teacher information at T1 and T2, due to change of class (and teacher) with changing school year. The first measurement took place before randomization, at later measurements informants or interviewers were not blind to condition. Before participation, parents, teachers, and children (if aged 12) signed an informed consent. The study followed the CONSORT guidelines for RCTs [10] (see Supplementary Table 1 for CONSORT checklist). The Institutional Review Board of the University Medical Center Groningen had approved the study. The study was registered in the Dutch Trial Register (NTR2405; http://www.trialregister.nl). Figure 1 shows the flowchart of study recruitment, treatment allocation, and assessment. For a detailed description, we refer to the research protocol [11].

Participants

Participants were 122 pre-adolescent high-functioning children with ASD from one of four outpatient mental health care clinics in the northern Netherlands (103 boys, 19 girls). The inclusion criteria were (1) clinical DSM-IV-TR ASD diagnosis [Autistic disorder, Asperger's disorder, or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS)], based on thorough diagnostic procedures (developmental history, current problems, child observation, and information from school) in expert teams including at least a child psychologist and a child psychiatrist; (2) the child's clinician indicated SST as first appropriate treatment; (3) parents and child were motivated for SST, as established during a meeting with the clinician, parents and child; (4) preferably IQ $\geq$ 80. Children with IQs slightly below 80 were included when therapists established they could follow an SST; (5) being in the last two and half years of primary education; (6) no physical condition affecting participation; and (7) the child could travel to the child mental health center for training. Note that three of the criteria were slightly different from the original design registered in the trial register, to more closely approximate the regular decisions in clinical practice. The three original inclusion criteria were (1) ASD

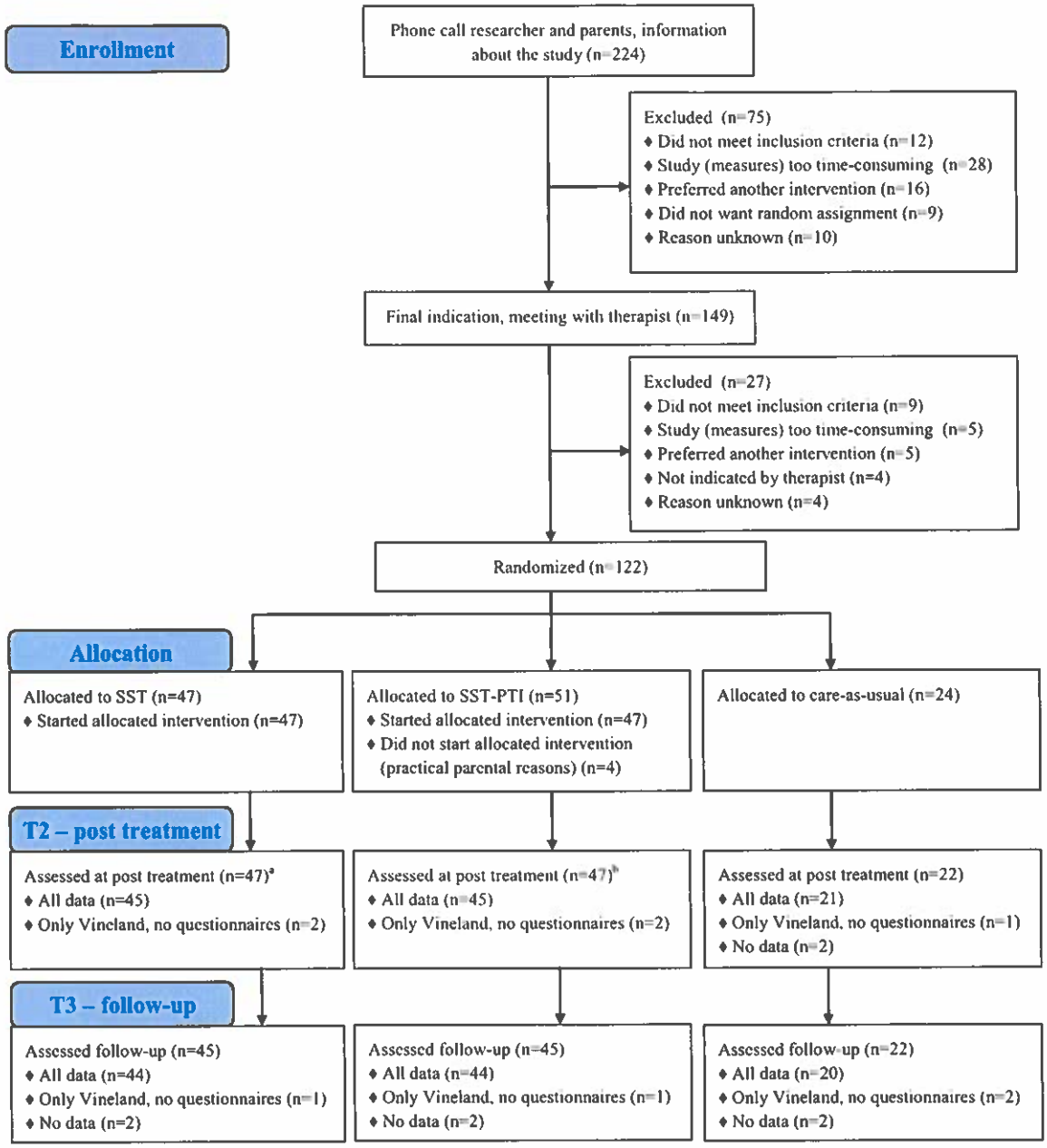

Fig. 1 CONSORT diagram of study recruitment, treatment allocation, and assessment. [a]Two children participated in less than half of the child sessions; [b]two children participated in less than half of the child sessions, two parents participated in less than half of the parent sessions (one from the same family as one of the children who participated in less than half of the child sessions), one teacher did not participate

diagnosis was either supported by an Autism classification on the Autism Diagnostic Interview-Revised (ADI-R) or maximally two points below the cut off for Autism but with an ASD classification on the ADOS, (2) IQ ≥ 80, and (3) being in the last 2 years of primary education.

Seventeen participants had a DSM-IV-TR diagnosis of autistic disorder (14%), 25 of Asperger's disorder (20%), and 80 of PDD-NOS (66%). The conditions did not differ on ASD diagnosis (Pearson χ^2 0.45; $p = 0.978$). Of all children, 32% had one comorbid diagnosis, 4.1% had two comorbid diagnoses (24 Attention Deficit Hyperactivity Disorder, 19.7% of all participants; 8 Tic disorder, 6.5%; four Anxiety Disorder, 3.2%; four Oppositional Defiant Disorder, 3.2%; four other, 3.2%). The conditions did not differ on comorbid secondary diagnoses (Pearson χ^2 0.39.62; $p = 0.166$) or tertiary diagnoses (Pearson χ^2 12.61; $p = 0.246$). Mean age at start was 11 years (SD = 0.75; range 9.5–13.0), mean total IQ was 101.5 (SD = 15.3; range 72–135). Male sex proportion

was similar over the conditions (Pearson χ^2 2.63; $p=0.268$). The conditions did not differ on psychotropic medication use between start and post-treatment. Between post-treatment and follow-up, more children in the CAU condition (22.7%) used anti-psychotic medication compared to SST (6.7%) and SST–PTI (4.4%; Pearson χ^2 6.55; $p=0.038$). Most children had at least one parent of Dutch descent ($n=121$, including 88 with two Dutch parents). Table 1 presents the participant characteristics at baseline.

Interventions

SST was manualized, based on behavioral therapeutic principles and the social learning theory (Van Warners, Vet, Van der Veen-Mulders and Van den Hoofdakker, 2010; internal publication). The training had 15 weekly 90 min basic group sessions and three additional 90 min booster group sessions, planned between 2 and 6 months after the 15th session. Each session followed a structure: conversation, homework review, introducing a new topic, practice and role play, new homework, and play time. Children received a workbook with summaries of the trained skills and homework. The goal of the first four sessions was to create a safe environment. Sessions 5 through 15 covered specific topics, e.g., "asking something to someone", "responding to bullying". A full overview of the session topics can be found in Supplementary Table 2. Children received training through instruction, directed positive feedback, observation, role play, and homework. The therapists analyzed the behavior of the children, defined individual positive target behaviors and elicited positive behavior. Negative behavior was ignored when possible, while differentially reinforcing alternative or incompatible positive behavior. In the booster sessions, children rehearsed their individual target behaviors. The SST groups consisted of four to six children, led by two therapists, i.e., psychologists with at least a psychology master. The therapists received training in the SST by behavioral therapists before and supervision during SST to increase

Table 1 Baseline participant characteristics ($N=122$), including observed sample mean, standard deviation, range and sample size, per condition and per outcome measure

	SST ($N=47$; 87% male)		SST–PTI ($N=51$; 78% male)		CAU ($N=24$; 92% male)		Statistics
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	ANOVA p value
Age (years)	10.9 (0.7)	9.9–12.6	10.9 (0.8)	9.6–12.7	11.2 (0.9)	9.8–13.0	0.12
ADOS							
Social effect	8.7 (4.5)	2–20	7.9 (3.8)	0–20	8.6 (3.3)	3–15	0.58
Restricted and repetitive behavior	1.0 (0.9)	0–30	1.3 (1.1)	0–50	1.1 (1.2)	0–40	0.38
Calibrated Severity Score	5.6 (2.4)	1–10	5.4 (2.3)	1–10	5.7 (2.1)	2–90	0.85
ADI-R							
Social interaction	15.0 (6.1)	4–27	13.7 (5.6)	3–26	13.7 (4.5)	2–22	0.46
Communication	12.5 (4.9)	2–23	11.3 (4.4)	3–21	12.2 (4.6)	0–19	0.44
Restricted and repetitive behavior	3.0 (2.1)	0–8	3.4 (2.1)	0–10	3.0 (2.2)	0–8	0.70
Vineland							
Communication	111.4 (8.0)	95–126	112.1 (8.6)	88–129	115.3 (8.1)	94–128	0.19
Daily living skills	120.2 (14.7)	70–145	121.2 (13.7)	93–149	125.6 (13.1)	98–150	0.29
Socialization	79.5 (12.9)	53–107	82.4 (16.1)	26–118	86.8 (14.8)	52–115	0.14
ESTIA-TS SSRS-P							
Training-specific social skills	73.0 (15.4)	42–106	68.6 (12.8)	47–102	74.4 (12.5)	53–103	0.15
Cooperation	7.5 (4.1)	1–17	8.2 (3.2)	2–13	7.8 (4.2)	2–16	0.67
Assertion	9.8 (3.0)	4–19	10.6 (3.1)	3–19	10.3 (2.6)	4–15	0.40
Self-control	7.2 (3.5)	0–16	7.7 (3.3)	1–16	7.5 (3.5)	3–13	0.70
Responsibility	9.7 (3.6)	0–18	10.9 (3.2)	3–17	10.7 (2.4)	7–17	0.20
SSRS-T							
Cooperation	13.5 (4.0)	4–20	13.0 (4.7)	2–20	12.4 (4.5)	7–20	0.59
Assertion	9.2 (4.1)	0–16	8.2 (4.0)	1–17	8.5 (4.2)	0–17	0.52
Self-control	10.5 (4.1)	3–20	9.0 (4.3)	2–18	9.0 (3.7)	4–18	0.15
IQ	102.5 (14.8)	72–135	98.7 (16.4)	73–132	105.6 (13.1)	73–126	0.17

ADOS autism diagnostic observation schedule, *CAU* care-as-usual, *ESTIA-TS* efficacy of social skills training in autism—training specific, *SSRS-P* social skills rating scale-parents, *SSRS-T* social skills rating scale-teacher, *SST* social skills training, *SST–PTI* social skills training—parent and teacher involvement, *Vineland* Vineland Adaptive Behavior Scales

treatment integrity. We refer to the research protocol [11] for a more comprehensive description of the procedures for therapists.

The SST–PTI condition consisted of the SST, with additional parent and teacher involvement (Van Warners and Vet, 2010; internal publication), aiming to enhance generalization of learned social skills. Parents participated in three group sessions before and five during SST. The first three sessions covered psycho-education and interventions for enhancing desired behaviors. The other sessions were related to the SST sessions and focused on how to support the child in practicing the trained social skills. Parent sessions included instruction, behavioral exercises, role play, and practicing learned skills at home.

Teacher support was provided through teacher–therapist meetings before the SST, to discuss the training and the skills aimed to address. During SST, the teacher had five telephone meetings with the therapist to discuss opportunities to support the child in practicing skills at school.

Participants in the CAU condition did not receive SST, defined as a manualized, child-specific training or program. Parent counseling, not focused on social skills, was allowed, e.g., psycho-education, counseling for family functioning, support in finding the right school or medication control, depending on the need of each participant. The conditions did not differ in the CAU delivered. Sessions with parents, with the child, or with parents and child, telephone contact, medication control, personalized support at home or school, a special program in school, or other help or support were equally present in all conditions, as reported by parents. After follow-up, children from CAU could enroll in SST.

In all conditions, delivery of SST outside the study was monitored.

Treatment fidelity and adherence

After each session, therapists rated whether they had addressed each component of the session. Therapists adhered to the protocol in 97.6% of the time in the SST basic sessions, 97.5% in the parent sessions, 93.3% in the initial teacher session, and 86.5% in the children's booster sessions.

Baseline assessment

The severity of ASD symptomatology was measured with the Autism Diagnostic Interview-Revised (ADI-R [12]) and the Autism Diagnostic Observation Schedule (ADOS) module 3 [13, 14], by trained psychologists who met research requirements for reliability. Cognitive ability was assessed with the Wechsler Intelligence Scale for Children—3rd edition (WISC-III [15]).

Outcome measures

Our primary outcome, reflecting the main aim of training and evaluating the effectiveness of SST in daily life, was the level of social functioning as measured with the raw total "Socialization" domain scores of the Vineland Adaptive Behavior Scales—Survey version (Vineland [16]). As secondary outcome measure we evaluated the specific social skills trained during SST with the ESTIA training-specific skills (ESTIA-TS; Vet et al., 2010; unpublished questionnaire). This 30-item parent questionnaire evaluated the difficultyfor the child of performing the specific skills taught in the training. We also evaluated the frequency of general social skills in home and school situations as reported by parents and teachers with the subscales "Cooperation", "Assertion", "Self-control", and "Responsibility" of the 38-item Social Skills Rating Scale parent version (SSRS-P) and corresponding subscales "Cooperation", "Assertion", and "Self-control" of the 30-item teacher version (SSRS-T [3]).

Randomization

From September 2010 through September 2013, training groups were started (September and February). All children finished the training within one school year. When four to six participants were included in the study in a setting, they were randomized into one of the conditions as a group, in a 2:2:1 ratio (SST:SST–PTI:CAU), after the first assessment. Randomization was done in blocks of five groups per stratum, based on setting, using a computer-generated list of treatment allocations, performed by research assistants, unaware of the randomization algorithm and unable to access the computer-generated list to conceal the sequence of allocation.

We aimed to include 48 children in both SSTs and 24 children in CAU, based on a required power of 0.99 and a significance level of 0.01 on the primary outcome measure Vineland for the time effect (i.e., from T1 to T3) and the differential time effects between conditions, taking into account a supposed drop-out rate of 10%. The presumed effect sizes across time in the comparison between the SST and CAU groups were based on previous research with the Vineland as outcome measure [17]. For the comparison between the SST and the ST-PTI groups, we considered an effect size of 0.60 SD of the mean to be clinically relevant. Due to the variation in defined differences between the compared groups, a larger amount of children was needed for comparing SST and SST–PTI than for comparing SST to CAU. For a detailed description of the sample size calculation, we refer to the research protocol [11]. Due to differences in group size (four to six participants), the treatment conditions

differed in size (SST $n=47$, ten groups, SST–PTI $n=51$, ten groups).

Statistical analyses

First, we tested differences in baseline background variables, age, IQ, and the outcome measures using analyses of variance (ANOVAs) with allocated treatment as independent variable. Second, we evaluated the effectiveness of the treatment conditions compared to CAU with hierarchical linear modeling using the intent-to-treat principle, including all available data points. We built separate models for the Vineland and the subscales of the SSRS-P, SSRS-T, and ESTIA-TS. The structure of the model consisted of three levels: the measurement occasions (level 1) were nested in the participants (level 2) which were nested in the treatment group (level 3). To assess the treatment effects across time, we built a fully multivariate model for each subscale of each outcome measure. The model accounted for effects of measurement occasion (T1, T2, and T3), condition (SST, SST–PTI, and CAU), and its interaction, while only keeping fixed effects that we hypothesized to be present, or that proved significant. We hypothesized time effects for the treatment conditions (SST and SST–PTI) and their interaction, and therefore kept those effects. Furthermore, we expected no difference between conditions at T1, because of randomization, and we expected no improvement on the outcome measures for the children in the CAU condition, thus we only preserved those effects when significant. Dummy coding was used to model the effects of measurement occasion and treatment, taking T1 and the CAU condition, respectively, as reference conditions. We tested the statistical significance of the fixed effects using the approximate t test. The exception was testing the differences between the two treatment groups; this was done using the deviance test, comparing the models mentioned above with a model including both treatment groups together in a single category, and contrasted to the CAU. Additionally, we calculated effect sizes (ES, Cohen's d) on pre- versus postmeasurement and for post- versus follow-up-measurement, for the significant condition differences. ES was derived from differences between conditions at time points, based on the estimated fully multivariate model. In all tests, the significance level was $\alpha=0.05$.

Results

At baseline, the three conditions did not differ significantly on any measure. Therefore, we excluded those effects from the model (see Table 1). In building the models, the level 3 random effects (i.e., referring to the treatment group) explained only part of the variance for the subscales "Cooperation" and "Self-control" of the SSRS-T, not for the other measures. Therefore, we only included level 3 in the hierarchical linear model for these subscales.

Table 2 presents the estimated coefficients, significance levels, and standard errors of the multilevel models for the parent measures. Table 3 presents these for the teacher measure. The random effects of the models are available

Table 2 Parameter estimates of the multilevel models of the parent measurements (Vineland, SSRS-P, ESTIA-TS)

Fixed effects	Vineland SOC Estimate (SE)	ESTIA-TS Estimate (SE)	SSRS-P COO Estimate (SE)	SSRS-P ASS Estimate (SE)	SSRS-P SCO Estimate (SE)	SSRS-P RES Estimate (SE)
Intercept (mean score T1 CAU)	82.6 (1.3)[a]	71.4 (1.3)[a]	7.9 (0.3)[a]	10.3 (0.3)[a]	7.5 (0.3)[a]	10.4 (0.3)[a]
Contrast T1–T2 (CAU)	–	−7.9 (2.1)[a]	–	1.6 (0.5)[b]	1.3 (0.6)[c]	1.8 (0.5)[a]
Contrast T2–T3 (CAU)	–	–	–	–	–	–
SST at T1	–	–	–	–	–	–
SST–PTI at T1	–	–	–	–	–	–
Contrast T1–T2×SST	5.8 (1.7)[b]	1.2 (2.5)	1.7 (0.4)[a]	−0.5 (0.7)	1.2 (0.7)	−0.6 (0.6)
Contrast T1–T2×SST–PTI	6.4 (1.7)[a]	2.4 (2.5)	1.7 (0.4)[a]	0.3 (0.7)	1.3 (0.7)	0.0 (0.6)
Contrast T2–T3×SST	0.6 (1.7)	0.3 (1.4)	0.1 (0.3)	−0.4 (0.4)	−0.5 (0.4)	0.6 (0.4)
Contrast T2–T3×SST–PTI	2.3 (1.7)	−2.5 (1.4)	−0.4 (0.3)	−0.2 (0.4)	0.2 (0.4)	0.5 (0.4)

CAU care-as-usual, *ESTIA-TS* efficacy of social skills training in autism—training specific, *SSRS-P* social skills rating scale-parents, (*COO* cooperation, *ASS* assertion, sco self-control, *RES* responsibility), *SST* social skills training, *SST–PTI* social skills training—parent and teacher involvement, *Vineland* Vineland Adaptive Behavior Scales (*SOC* socialization),—means that this effect was not included in the model, because it was not hypothesized and appeared nonsignificant when including the effect

[a] $p<0.001$

[b] $p<0.01$

[c] $p<0.05$

Table 3 Parameter estimates of the multilevel models of the teacher measurements (SSRS-T)

Fixed effects	SSRS-T COO Estimate (SE)	SSRS-T ASS Estimate (SE)	SSRS-T SCO Estimate (SE)
Intercept (mean score T1 CAU)	13.1 (0.5)[a]	8.8 (0.4)[a]	9.6 (0.5)[a]
Contrast T1–T2 (CAU)	–	–	–
SST at T1	–	–	–
SST–PTI at T1	–	–	–
Contrast T1–T2 × SST	0.4 (0.5)	0.2 (0.4)	0.4 (0.5)
Contrast T1–T2 × SST–PTI	1.7 (0.5)[a,d]	1.4 (0.4)[b]	2.4 (0.5)[a,d]

CAU care-as-usual, *SSRS-T* Social Skills Rating Scale-Teachers (*COO* cooperation, *ASS* assertion, *SCO* self-control), *SST* social skills training, *SST–PTI* social skills training—parent and teacher involvement,— means that this effect was not included in the model, because it was not hypothesized and appeared nonsignificant when including the effect

[a] $p < 0.001$

[b] $p < 0.01$

[c] $p < 0.05$

[d] also a significant difference with SST condition

upon request from the first author. Figure 2 presents the expected means in the built multi-level model. The actual scores on the instruments in all conditions can be found in the Supplementary Tables S3 and S4.

Primary outcome

Vineland socialization

Children in the SST and the SST–PTI conditions improved significantly more on Vineland Socialization than children in CAU (who did not significantly improve) from T1 to T2 (ES SST: Cohen's $d = 0.39$; 95% CI −2.23 to 3.11 and ES SST–PTI: Cohen's $d = 0.43$; 95% CI −2.19 to 3.15). SST and SST–PTI did not differ significantly from each other. All conditions showed stable Vineland Socialization scores from T2 to T3. The trajectory of each condition is presented in Fig. 2a.

Secondary outcomes

ESTIA-TS

As shown in Fig. 2b, parents in CAU reported significantly lower difficulty scores for the social skills covered in the training at T2 compared to T1 (ES: Cohen's $d = -0.56$; 95% CI −3.02 to 2.16). From T2 to T3, no significant difference existed for CAU. Parents in both treatment conditions reported a similar pattern from T1 to T2 or T2 to T3.

SSRS-P

Figure 2c–f show change as measured with the SSRS. Children in both treatment conditions improved significantly more on "Cooperation" than children in CAU (who did not improve) from T1 to T2 (ES SST: Cohen's $d = 0.43$; 95% CI −0.23 to 1.15 and ES SST–PTI: Cohen's $d = 0.45$; 95% CI −0.21 to 1.17). They did not differ significantly from each other. From T2 to T3, "Cooperation" scores were stable for all conditions.

On the subscales "Assertion", "Self-control", and "Responsibility", children in CAU improved significantly from T1 to T2. The ES (Cohen's *d*) were 0.51 (95% CI −0.02 to 1.12), 0.40 (95% CI −0.2 to 1.01), and 0.56 (95% CI −0.01 to 1.17). Children in the CAU condition did not improve significantly from T2 to T3 on these subscales. Both treatment conditions showed similar patterns as CAU.

SSRS-T

Children in CAU did not improve significantly on the SSRS-T subscales from T1 to T2 (Fig. 2g–i). Children in the SST condition resembled the CAU condition. Children in the SST–PTI condition improved significantly more between T1 and T2 than CAU, with ES (Cohen's *d*) 0.42 (95% CI −0.33 to 1.13) for "Cooperation, 0.34 (95% CI −0.39 to 1.11) for "Assertion", and 0.61 (95% CI −0.08–1.34) for "Self-Control". On the subscale "Cooperation" and "Self-Control" the children in SST–PTI improved also significantly more than the SST condition, with ES (Cohen's *d*) 0.34 (95% CI −0.37 to 1.05) and 0.59 (95% CI −0.13 to 1.32), respectively.

Discussion

This study demonstrated that children improved in social functioning in daily life and broad social skills, reported by parents, immediately after group SST. However, no differences existed between the three conditions on the specifically trained social skills and the other SSRS-P subscales.

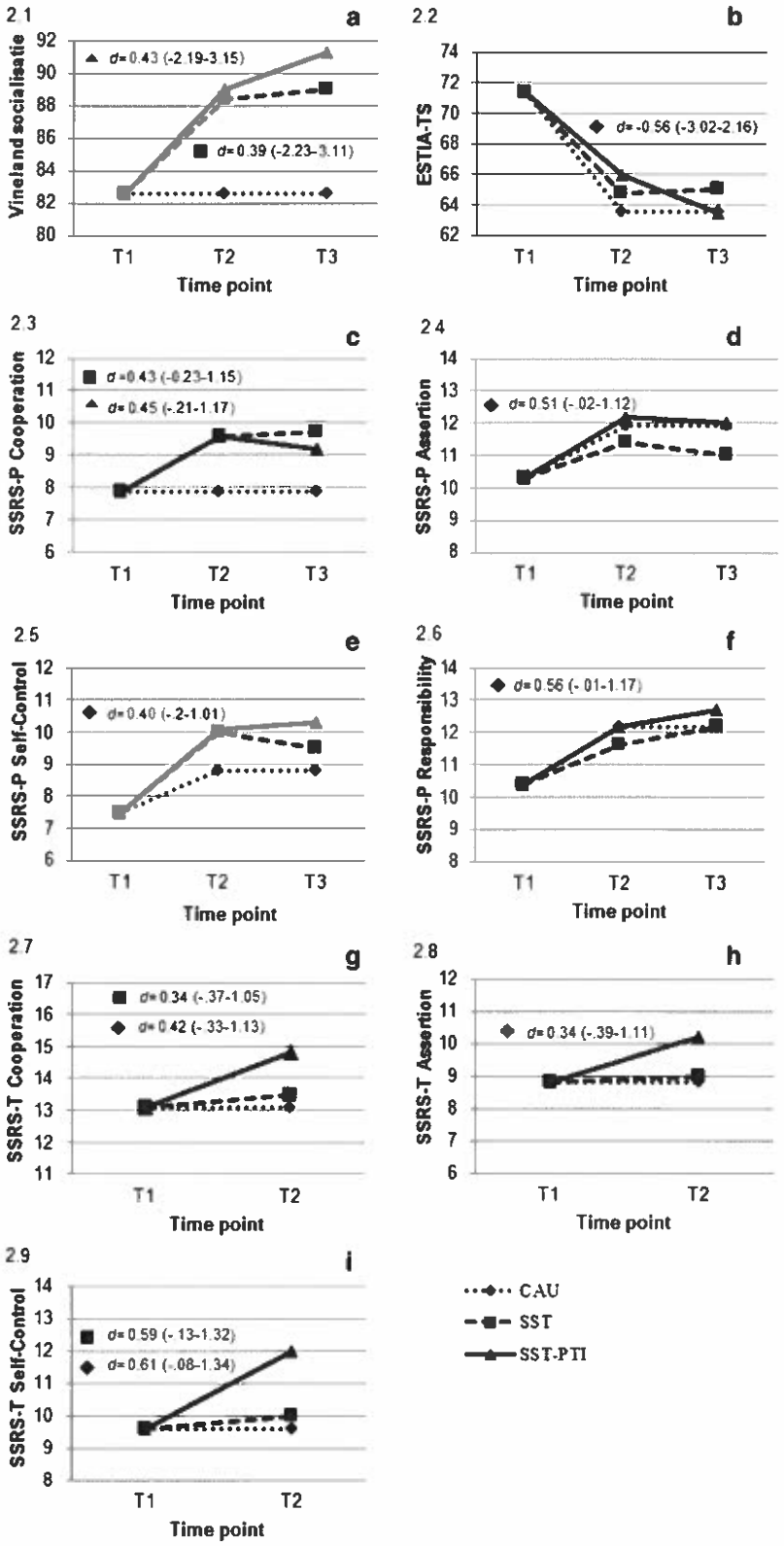

Fig. 2 Expected mean per time point and per condition, as based on the fixed part of the multilevel models of the measurements for parents and teachers. Parents: effect sizes in the figures represent significant changes in the specified condition (by symbol), compared to CAU. Significant effect sizes were only present for the comparison between T1 and T2. Teachers: effect sizes in the figures represent significant changes in the social skills training with parent and teacher involvement, compared to CAU (diamond) or compared to SST (square). Each measure is presented in a separate panel. For parent measures: **a** Vineland Socialization; **b** ESTIATS; **c** SSRS-P Cooperation; **d** SSRS-P Assertion; **e** SSRS-P Self-Control; **f** SSRS-P Responsibility. For teacher measures: **g** SSRS-T Cooperation; **h** SSRS-T Assertion; **i** SSRS-T Self-Control

Contrary to our expectations, actively involving parents and teachers in the training did not increase the immediate effect, or the generalization of social skills to situations outside the training or beyond the duration of the training, observed by parents. Six months after training, social skills had not further improved in any group. Note that adding three booster

sessions [5, 18] did not contribute to further improvement of social skills either.

The small to medium effect sizes in our study correspond to the findings of Gates et al. [1] in their meta-analysis. They also resemble the results from Deckers et al. [7] in a comparable, Dutch, high-functioning population from a regular outpatient clinic ($n = 52$; effect size 0.34), although measured with a different instrument (the Social Skills Observation; SSO [19]). Compared to the meta-analysis of Wolstencroft et al. [2], we found a smaller effect on the SSRS, and only for the subscale "Cooperation". Perhaps this difference in effect size is due to the significant improvement of children in the CAU condition in the current study on the subscales "Assertion", "Self-control", and "Responsibility". Although this could reflect natural growth in time, other explanations are also possible. First, parents may have changed in their observation, e.g., the assessment may have included behaviors that parents had not noticed before the first measurement, yet actively looked for after completing the SSRS for the first time. Second, all children in this study, including the children in CAU, wanted to improve social skills and were motivated for training by definition of the inclusion criteria. Parents of children in the CAU condition may thus have tried to improve their child's social skills in other ways (e.g., reading about social skills/ASD, explaining social situations, stimulating their child to make play dates). Third, many children with PDD-NOS (66%) and the relatively high-functioning character of the sample, may have affected the outcomes.

Our study is one of few that compared long-term outcomes in the treated and CAU conditions [1]. Two earlier studies reported a significant effect after 3 months [6, 7], and no effect was found after 3 months in two other studies [5, 8]. We expected children in the SST–PTI condition to continue improving, based on their parents' training in how to support them learn and apply social skills. However, this support did not seem to affect further development after training. Practicing may have evanesced after training was over, with its accompanying homework. Moreover, social skills appeal to social insight, and the question is whether that can be trained in a (15-session) SST.

Teachers only reported significant improvement after SST–PTI compared to CAU (all subscales) and SST ("Cooperation" and "Self-control" subscales of the SSRS-T). This finding could indicate the effect of parent and teacher involvement in the training on generalization of learned skills to the school situation. Alternatively, teachers more intensively involved may see improvement for other reasons, e.g., they may have learned how to observe or interpret social behaviors, or they may expect change after their effort in the training, and conform to the expectancy bias in parents [1, 2]. Although in line with the teacher findings of Deckers et al. [7], our finding is in contrast with the meta-analysis of Gates et al. [1], who found no effect of SST as reported by teachers. Since we have no follow-up data of the teachers, we cannot draw conclusions on generalization to the school situation beyond the duration of the training.

Limitations

Unfortunately, parents and teachers were not blind for condition in the post-treatment measures. A blind observation of the child in a naturalistic situation [20–22], added to parent and teacher report, would have contributed to a more reliable measure of changes in social skills after training, unbiased by either knowledge of treatment condition or actual contributions to training. However, no well-described and valid instruments were available for such observation. Gates et al. [1] found only five studies in their meta-analysis reporting on observer information. Even in this small sample all studies used other instruments, ranging from the ADOS, measuring social communication in a semi-structured situation with one adult, to 5-min observations of mother–child interaction in a structured situation (playing a puzzle), and to peer interactions measured with different instruments.

Additionally, we only used general social skills measures, including social functioning in daily life, and did not focus on ASD-specific social skills. For future studies, we recommend to add ASD-specific social skills measures. We are aware that the Vineland was not developed as an outcome measure for SST. However, using it as our primary measure was an approach to assessing improvements in social functioning in daily life, the ultimate aim of SST. Earlier SST studies including the Vineland did not report strong effects either, i.e., only trending significant changes [17], no differential changes [18], or mixed results on various subscales [23].

Implications

The current study corroborates earlier findings in smaller samples and wider age ranges, indicating small but statistically significant effects of SST in daily life for high-functioning pre-adolescent children with ASD. Parental and teacher involvement intensified the treatment for therapists, parents and teachers, yet did not yield the expected additional effect relative to SST for children only as reported by parents. More research on who benefits from what form of SST is needed, to enable clinicians to decide who to provide with (what form of) SST.

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Compliance with ethical standards

Conflict of interest Author AdB received the grant that funded this study (the Netherlands Organization for Health Research and Development; ZonMw, nr 157003005). The agency had no role in data analyses, the decision to publish, or the preparation of the manuscript. She also is first author on the Dutch ADOS manual for which Accare receives enumeration. SvW, LV, BvdH and LvdV were authors of the SST manual, and LV and SvW were authors of the SST–PTI manual, both used in the current study. The manuals are not commercially available, hence the authors do not have a financial interest in the outcomes of the current study. The other authors declare that they have no conflict of interest.

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ORIGINAL PAPER

A Group-Administered social Skills Training for 8- to 12- Year-Old, high-Functioning Children With Autism Spectrum Disorders: An Evaluation of its Effectiveness in a Naturalistic Outpatient Treatment Setting

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Abstract A social skills training (SST) for high-functioning children with autism spectrum disorders (ASD) was evaluated in an outpatient setting using a combined between- and within-subject design in which SST and a waiting list condition were compared. According to parents and teachers, the SST produced greater improvement of social skills than the waiting list, and these effects were maintained at 3 months follow-up. No between-group effects were found for loneliness, although in general scores on this outcome measure decreased from pre- to follow-up. The effects of SST were unaffected by social anxiety, ADHD symptoms, Theory of Mind, or desire for social interaction. Altogether, SST seems an effective intervention for high-functioning children with ASD that can be applied in daily clinical practice.

Keywords Social skills · Autism spectrum disorders · Children

Introduction

Engaging in social interaction is an inevitable and significant element of daily life. An extensive line of research has shown that positive interpersonal relationships are important for both the physical and emotional welfare of human beings (Baumeister and Leary 1995). However, for children with autism spectrum disorders (ASD) such relationships can by no means be taken for granted because of their significant deficits in communication and social interaction (American Psychiatric Association 2013). Impaired social skills are a core feature of ASD (Rao et al. 2008) and an increasing number of studies has demonstrated that children with ASD encounter elevated levels of social difficulties in their daily lives. For example, Calder et al. (2013) found that children with ASD have fewer reciprocal friendships and lower friendship quality as compared to their peers. In addition, children with ASD are more isolated and have a less central position in social networks (Kasari et al. 2011; Rotheram-Fuller et al. 2010). Furthermore, children with ASD are more often a victim of bullying (Rowley et al. 2012). The finding that children with ASD also report elevated levels of loneliness (e.g., Bauminger and Kasari 2000) suggests that they are not satisfied with their social functioning. Finally, the importance of social skills is not restricted to social functioning but also affects the educational progress of children and as such has a long-term impact on occupational functioning and well-being in later life (Hartup 1989; Howlin et al. 2004).

Social skills training (SST) is one of the interventions that can be applied in order to facilitate socialization in children with ASD (Rogers 2000). This type of intervention is preferably provided in a group format because of the convenience of naturally occurring interactions and practicing opportunities with peers (Lopata et al. 2008). Despite the widespread application of group SST for children with ASD–especially for those who are high-functioning–the empirical evidence for this type of intervention is still limited (Reichow and Volkmar 2010). In their review, Rao

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et al. (2008) concluded that the majority of the 10 studies so far conducted in high-functioning children with ASD have documented positive outcomes for this type of intervention. However, the authors also noted that most of this research suffers from methodological limitations such as lack of standardized treatment manuals, small sample sizes, absence of control groups, and no inclusion of follow-up assessments. In a similar vein, Reichow et al. (2012) systematically reviewed the evidence for the effectiveness of SST in youth with ASD and identified only five RCTs. They pointed at the limited amount of research, but also noted findings that were quite encouraging for clinical practice as this type of intervention appears to promote social competence and friendships, while decreasing feelings of loneliness. Another important shortcoming of previous research on the effects of SST concerns the generalization of social skills outside the treatment setting. Obviously, the ultimate goal of this type of intervention is that children with ASD are able to deploy the newly acquired social skills in social situations such as at home and in school. Most studies to date employed SST interventions that did not include strategies to enhance this type of generalization, or did not include a measurement for evaluating whether and to what extent the trained social skills actually generalize outside the treatment setting. Rao et al. (2008) strongly recommended that future research in this area should make the effort to promote generalization of SST and to measure its effects in everyday social situations outside the therapeutic setting (see also Krasny et al. 2003; Williams White et al. 2007).

Children with ASD constitute a very heterogeneous group with variable clinical and psychological features. It may well be that a number of these features have an impact on the efficacy of a group SST intervention. A first characteristic concerns the presence of comorbid psychiatric symptoms (e.g., Mattila et al. 2010; Simonoff et al. 2008; Steensel et al. 2013a), of which social anxiety and ADHD seem particularly relevant. For instance, it has been demonstrated that high levels of social anxiety are linked to lower levels of social functioning (Chang et al. 2012), and it is also suggested that this relation is bidirectional (Bellini 2006). From this one might expect that children with ASD and high social anxiety will profit less from SST. The latter could also be true for children with ASD and comorbid ADHD as inattention may interfere with the learning of social skills, hyperactivity may disrupt their functioning in the group sessions, and impulsivity may hinder the application of the acquired abilities in daily situations. Interestingly, Antshel et al. (2011) examined the influence of these common psychiatric comorbidities on group SST outcomes for children with ASD. As hypothesized, it was found that group SST was less effective in children with comorbid ASD and ADHD (all subtypes combined): the social skills of these children did not improve over the course of the treatment. It was surprising to see, however, that children with comorbid ASD and anxiety disorders profited equally from this type of intervention when compared to children with ASD alone. Apparently, "the structured group setting and the focus on social problem solving are well suited to the needs of children with ASD [and anxiety disorders]" (Antshel et al. 2011; p. 444), so that their comorbidity was no obstacle for a positive response to group SST. Altogether, research suggests that group SST is a valuable intervention for children with ASD even when a comorbid anxiety disorder is present, however group SST seems less effective in ASD children with comorbid ADHD. Before definitively accepting this conclusion, more research is required.

A second feature that might influence the efficacy of group SST for children with ASD concerns the developmental level of Theory of Mind (ToM). ToM has been defined as the ability to ascribe thoughts, feelings, ideas, and intentions to others and to employ this ability to anticipate the behavior of others (Premack and Woodruff 1978). ToM is generally seen as important for understanding the social environment and for engaging in socially competent behavior (Wellman 1990). It has been proposed (e.g., Baron-Cohen 2000; Baron-Cohen et al. 1985) that the social impairments seen in children with ASD are due to marked deficits in their ToM. From this, it can be hypothesized that the level of ToM may be a significant predictor of the outcome of SST for children with ASD. More specifically, given that there are clear individual differences in ToM ability across children with ASD, it may well be that children with ASD and severe ToM deficits will profit less from SST than children with ASD who have relatively high levels.

Finally, interest and motivation are important requirements for learning (e.g., Krapp 1999), and this also seems to apply to the acquisition of social skills (e.g., Van Doesem et al. 2013). Chevallier et al.(2012) have put forward the social motivation theory of autism, which implies that the social problems of children with ASD can be traced back to the lack of intrinsic desire to interact with others, and there is indeed tentative empirical support for this notion (Deckers et al. 2014). So it may well be the case that the desire for social interaction of children with ASD is an important moderator of the treatment effects of a SST intervention. That is, if children with ASD have too little desire to engage in social interactions, they will probably be less motivated for participating in this type of training, which in turn may seriously interfere with the acquisition of social skills. In contrast, children with ASD who have a strong desire for social interaction may be more responsive to SST.

The purpose of the present naturalistic clinical study was to evaluate a group SST for 8- to 12 year-old, high-

functioning children with ASD in an outpatient treatment setting. Effort was made to implement the essential ingredients and requirements of this type of intervention, which have been described in detail by (Krasny et al. 2003). So, the most important aim of this group SST was not to improve social skills in the clinical setting, but to promote transference of such abilities in order to enhance social functioning in daily life. Further, a standardized training manual was employed which facilitates implementation in other clinical settings as well as replication of the research. Treatment outcome was evaluated using a multi-informant approach that included parents and teachers who were asked to rate the social skills of the children based on observations at home and in school. This enabled us to measure the generalization of treatment effects in daily life. In order to evaluate the effect of the SST on the perception of their own social functioning, children completed a scale measuring loneliness as a secondary outcome measure. Finally, the study also included a waiting list control condition against which the effects of the group SST were compared.

The study set out to test a number of hypotheses: (1). On the between-group level, children in the group SST condition were expected to show a larger increase in parent- and teacher-rated social skills (i.e., the primary outcome measure) as compared to children in the waiting list control condition (WLC); (2). In addition, children in the SST condition would show a larger decrease in loneliness (i.e., the secondary outcome measure) as compared to children in the WLC; (3). On the within-subjects level, both parent- and teacher-rated social skills would improve, whereas child-reported loneliness would decline following the group SST; (4). The positive effects of SST, where found, were expected to be still visible at the follow-up assessment; and (5). Comorbid symptoms, in particular those related to ADHD, would have a negative influence on treatment outcome, whereas a more advanced level of ToM and a stronger desire for social interaction would have a positive impact on the effect of the group SST.

Method

Design

The group SST was evaluated in an outpatient treatment setting with clinically referred children. A combined between- and within-subjects design was applied. Half of the participants were first on a natural waiting list condition (WLC) before the group SST started, while the other half of the participants immediately started with the group SST. This implies that participants in the WLC were measured on four time points, whereas the other participants were assessed on three time points. The first assessment of the WLC took place 3 months prior to the start of the group SST (BASELINE). Both groups of participants were measured immediately prior to the group SST (PRE), directly after this intervention (POST), and at 3 months follow-up (FU; see Fig. 1). Multiple informants were involved in the assessments conducted for this study and included children, parents, and teachers.

Procedure

Participants were recruited at a community mental health center (Virenze-RIAGG Maastricht, the Netherlands). The inclusion criteria were a formal diagnosis of Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), Asperger's Disorder, or Autistic Disorder; an age between 8 and 12 years; and the absence of severe cognitive and language impairments. The presence of comorbid (psychiatric) diagnoses was not an exclusion criterion. All children who met these criteria according to the specialized, multidisciplinary team of the community mental health center and, who were indicated for participation in the group SST by this team were invited to participate. Some children were placed on a waiting list, as groups of four children were formed (children's chronological and mental age were taken into account when composing the groups in order to maximize interpersonal match) and therapists were not always directly available to run the group. In addition, there were time constraints: we wanted to deliver the SST during 12 consecutive weeks, without a disruption by school holidays. Children who had to wait 3 months, were assessed again prior to the start of the intervention, and thus formed a natural WLC. Children who did not have to wait, were assessed for the first time and then entered the SST group shortly after. Thus, the allocation to either the WLC or SST condition can be considered as quasi-random. Because of ethical considerations, additional types of treatment for the child and/or the parents were allowed prior (thus, also during wait) or in parallel with the group SST.

For each child, the formal DSM-IV-TR diagnosis (American Psychiatric Association 2000) was established according to the Longitudinal-Expert-All Data (LEAD) principle (Spitzer 1983). A specialized multidisciplinary team consisting of licensed child psychologists and child psychiatrists made the classification on the basis of extensive assessments, using multiple informants during a longitudinal diagnostic process (Roelofs et al. 2015). More precisely, a clinical interview was carried out with parents and the child to identify the presence of psychopathology in general. In addition, a diagnostic interview specifically focusing on autism spectrum characteristics was completed with the parents to explore the developmental history of the

child, and its current social functioning, communication, and behavior. Teachers were also interviewed regarding the child and his/her interactions with peers, communication, behavior, and didactic functioning in school. In addition, the child was observed by a psychologist or psychiatrist in a playroom setting. In case of educational delays and/or suspicion of limited cognitive abilities of the child, an IQ test was administered.

Participants

Of 81 children eligible for group SST, 29 children did not participate due to practical problems, lack of motivation, or because they did not want to participate in research (see Fig. 1). The final sample hence consisted of 52 children (47 boys and 5 girls) with ASD, including (high-functioning) Autistic Disorder ($n = 4$), Asperger's disorder ($n = 13$), and PDD-NOS ($n = 35$; see Table 1). The different types of ASD were equally distributed across the SST and WLC. The two groups did not differ in terms of parent-rated autistic behaviors, as measured with the Children's Social Behavior Questionnaire (CSBQ; Luteijn et al. 2002; $t(49) < 1$). For the total sample, the mean score on the CSBQ was 42.6 ($SD = 14.46$), indicating symptoms levels in the clinical range (Van Steensel et al. 2015).

About 58 % of the participants had at least one comorbid diagnosis and 23 % had multiple comorbidities. The most common comorbidity was ADHD, which was seen in 40 %. Anxiety disorders, mood disorder, (parent–child) relational problems, adjustment disorder, disruptive behavior disorder, and tic disorder were also reported, but at lower frequencies. The percentage of participants with comorbidity across the two groups was not significantly different.

Most of the children attended regular education ($n = 41$), whereas the others were in special schools ($n = 11$). The mean age of the total sample was 10.1 years ($SD = 1.27$), and did not differ significantly between the WLC and SST (mean ages being 10.0, $SD = 1.10$ versus 10.2, $SD = 1.43$, respectively; $t(46.8) < 1$). The male/female ratio was also comparable for both conditions (WLC: 23 boys and 3 girls; SST: 24 boys and 2 girls).

In 79 % of participants other types of treatment were used either before or in parallel with the group SST. Non-pharmacological treatments ranged from psycho-education sessions for parents to individual child therapy. In addition, 38 % of the sample received some form of psychoactive medication. Medication use was comparable across the groups: most commonly children received methylphenidate (WLC: 31 %; SST: 35 %), while a minority received methylphenidate and Risperidone (WLC: 4 %; SST: 4 %) or Risperidone alone (WLC: 0 %; SST: 4 %). The type of medication and the dosage were kept stable as far as possible over the group SST and this was achieved in 75 % of the cases. The percentage of participants with an adjustment in medication was similar in both groups (i.e., WLC and SST: 25 %).

The majority of participants (88 %) completed the SST (classified as having attended at least 10 of the 12 training sessions). For these children, outcome data (provided by at least one of the informants) were available for 96 % at PRE, 89 % at POST, and 85 % at the FU assessment.

Intervention

The protocol for the group SST (Deckers et al. 2013) consisted of 12 weekly 1 hour child sessions and three 1 hour parent sessions. Each SST group consisted of four children with ASD, a trained psychologist who guided the group, and a co-therapist. The children received a workbook including the themes and guidelines as well as the homework for each session. Parents also got a workbook providing an overview of the child sessions and instructions to stimulate generalization.

For each child personal learning goals were formulated prior to the group SST. These learning goals were related to the skills that were trained during the group SST as specified in the manual. Examples included asking a question to an unfamiliar person, joining a group of children for play, and waiting for one's turn. During the group SST two basic themes were repeatedly and consistently addressed, namely basic social skills (consisting of eye contact, voice volume, distance, and posture), and "one good turn deserves another" (if you are kind to another person, then this person will be more likely to be kind to you in return). In addition, more advanced social skills such as listening, recognizing emotions, asking others, having a conversation, joining a group, responding to rejection, responding to emotions of another person, giving and receiving compliments, saying no, and dealing with bullying were covered in the training.

The sessions were highly structured and made predictable with weekly routines and clear group rules. Each SST group session followed a consistent routine: (1). Welcome and overview (i.e., children received a brief outline of the session); (2). Personal highlights of the past week (i.e., participants sharing experiences); (3). Discussion of children's homework assignments as conducted during the past week; (4). The new topic for the session was introduced, and concrete step-by-step guidelines are given; (5). The children practiced with each other in role play and were provided with instructions and feedback on how to apply the guidelines thereby focusing on their personal learning goals; and (6). New homework was provided for the upcoming week. A group reward system was used to promote practicing at home, obeying to the group rules, and the achievement of personal goals; and thereby working together to earn and share the reward.

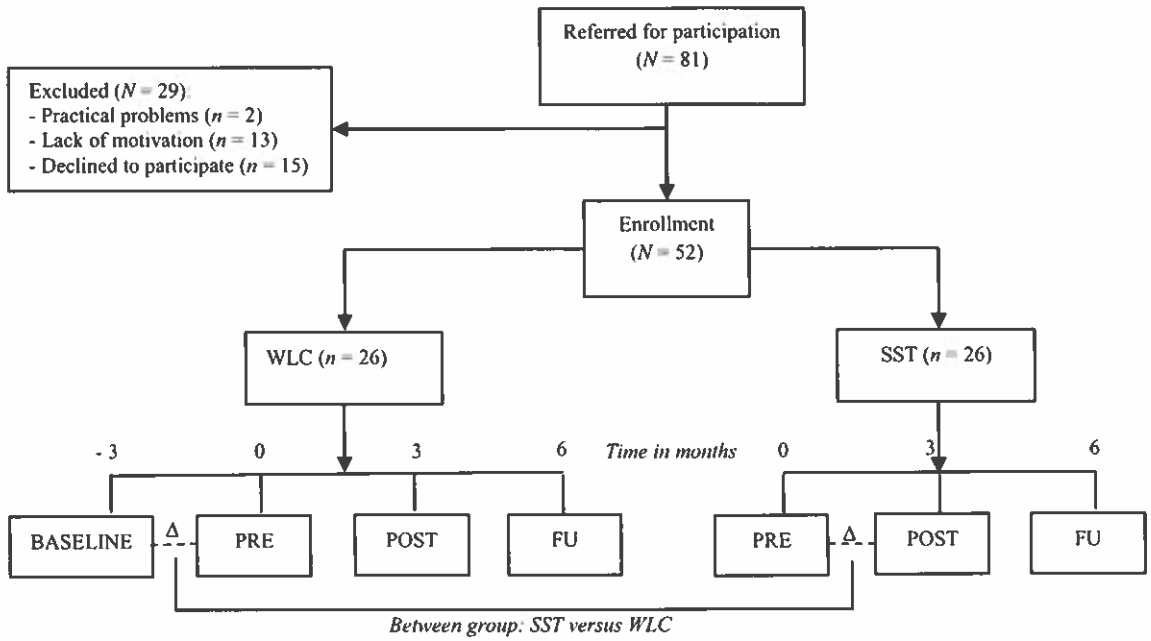

Fig. 1 Enrollment and allocation of the participants and a visual representation of the study design (assessment points are displayed for both conditions). Note. *WLC* waiting list condition, *SST* social skills training

In order to enhance generalization, children received homework and parents were instructed on work to do with their child outside the sessions. Each week the therapist contacted the child and his/her parents by e-mail. In the e-mail the topic of the past session and the accompanying homework were described. In addition, brief feedback was provided about the behavior and skills of the child during the past session and corresponding tips for exercising at home were given. The homework included exercises to practice the new topic and social skills outside the group and to reflect on them. The child and parent reported back on achievements and problems to the therapist prior to the next session. In the parental sessions, the parents were more extensively instructed how they could help their child to apply the new skills.

Assessment

Primary Outcome Measure

The primary outcome measure was a paper-and-pencil version of the social skills observation (SSO) as developed by Barry et al. (2003), which was completed by both parents and teachers. The SSO items refer to specific social skills during greeting (11 items), conversation (14 items), and play (11 items) as well as more general social skills (7 items). Parents and teachers asked to indicate whether or not the child or adolescent engaged in these types of social interactions with other persons. After a positive response, questions about the specific social skills had to be completed, such as 'Did he/she make eye contact?', 'Did he/she ask a social question (about feelings or preferences)?', 'Did he/she make a positive statement about the play activity?', 'Did he/she remain at an appropriate distance from the other person?', and 'Did he/she stay calm if teased?' For each question parents and teachers had to indicate whether their child did or did not apply the specific skill by either responding with "yes" or "no", or not applicable. A composite score was calculated by summing the "yes" responses. So far, no study has explicitly examined the psychometric properties of the paper-and-pencil version of the SSO. However, in a recent investigation (Deckers, Muris, & Roelofs, manuscript in preparation), we obtained evidence showing that (a) SSO parent- and teacher SSO scores correlated substantially and in a meaningful way with several measures of social functioning in a sample of ASD, clinical control, and non-clinical children aged 7–11 years, and (b) SSO scores of children with ASD were significantly lower than the scores of children in the non-clinical group, which convincingly supports the concurrent and discriminant validity of this observation-based rating scale. In the current study, Cronbach's alphas of both the parent ($\alpha = .92$) and the teacher ($\alpha = .88$) version of the SSO appeared to be good.

Secondary Outcome Measure

Loneliness was measured by means of a subscale of the Loneliness and Aloneness Scale for Children and Adolescents (LACA; formerly known as the Louvain Loneliness

Table 1 Demographic and clinical characteristics of the total sample of ASD children and a comparison between the two conditions

	Total sample ($N = 52$)	WLC ($n = 26$)	SST ($n = 26$)	χ^2	P
Gender				.221	.638
Male	47	23	34		
Female	5	3	2		
Education				1.038	.308
Regular	41	22	19		
Special	11	4	7		
Diagnosis				.105	.949
Autism	4	2	2		
Asperger	13	6	7		
PDD-NOS	35	18	17		
Medication				.325	.569
Yes	20	9	11		
No	32	17	15		
Comorbidity				2.836	.092
Present	30	18	12		
Absent	22	8	14		
Comorbid ADHD				1.997	.158
Present	21	13	8		
Absent	31	13	18		

WLC waiting list condition, *SST* social skills training

Scale for Children and Adolescents; Marcoen et al. 1987), which was completed by the children. For each of the 12 items (e.g., 'Making friends is hard for me' and 'I feel sad because I have no friends'), children indicated how often the item applied to them, using a Likert scale ranging from never (1) to often (4). A composite score was calculated with higher scores indicating higher levels of loneliness. The internal consistency of the LACA is high (in the present study, Cronbach's α was .90) and the validity is satisfactory (Goossens and Beyers 2002).

Moderators

The social anxiety subscale of the Screen for Child Anxiety and Related Emotional Disorders (SCARED-71; Bodden et al. 2009) was used to assess children's level of social anxiety. The parents had to indicate for 9 items how often their child experienced social anxiety symptoms using a 3-point Likert scale with 0 = almost never, 1 = sometimes, and 2 = often. The reliability and validity of the SCARED-71 are convincing (Steensel et al. 2013b), and this is also true for the social anxiety subscale (see Muris et al. 2000; in the current study, Cronbach's α was .90).

In order to assess the typical ADHD symptoms of inattention, hyperactivity, and impulsivity, the ADHD questionnaire (ADHD-Q; Scholte and van der Ploeg 2005) was administered. Parents had to indicate for 18 items how often their child showed ADHD-related behaviors on a 5-point Likert scale ranging from 0 = never to 4 = very often. The reliability and validity of the AVL are good (Evers et al. 2000). In the present study, Cronbach's α was .90.

The Wish for Social Interaction Scale (WSIS; Deckers et al. 2014) was administered for measuring children's desire for social interactions with other people. The WSIS consists of 8 closed questions about potential social activities with unknown persons (e.g., "Would you like to have a little chat with this person?" and "Would you like to play with this person?"). For each of these eight questions side-view pictures of faces (boys, girls, men and women) were displayed one by one on the computer screen and the children were asked to answer each of these eight questions for 8 people. A total score was calculated by summing the number of positive responses (range 0–64). The internal consistency of the WSIS in the current study was good (α = .92).

The Theory of Mind test-Revised (ToM test-R) of Steerneman and Meesters (2009) was administered in order to assess individual differences in children's level of ToM. The ToM test-R is a (semi-) structured interview for children containing 36 questions divided in 14 items consisting of stories, questions and tasks. Correct answers are coded as 1 and incorrect answers as 0. The total score of the ToM test-R was calculated by summing the correct answers (range 0–36). The reliability of the total score was moderate, with a Cronbach's alpha of .67 (see also Steerneman and Meesters 2009).

Statistical Analyses

Multilevel analyses were used to estimate the change in social skills and the change in loneliness over time in both groups. The social skills as observed by the parents and the teachers and the level of loneliness as indicated by the children were the dependent variables. The results were analyzed according to the intention-to-treat principle. The fact that the participants were nested within their training group and might be more similar was taken into account in the multilevel analyses.

Firstly, between-group analyses were conducted. To examine whether the SST group showed a greater increase of social skills as compared to the WLC group, the change in social skills between the two conditions was compared for the parent and teacher ratings of children's social skills. More specifically, the change in social skills between PRE and POST in the SST group was compared with the change in social skills between BASELINE and PRE in the WLC group (see Fig. 1). A compound symmetry covariance structure for repeated measures was applied as having the best fit, with time point (coded BASELINE = 0 and PRE = 1 in WLC group, and coded PRE = 0 and POST = 1 in SST group), condition (coded WLC = 0 and SST = 1), and time point x condition as fixed effects. The difference between SST and WLC was represented by the time point x condition interaction in the model. The effect sizes expressed in Cohen's r (Cohen 1988; $r = \sqrt{(F/(F + df))}$ were computed from the multilevel estimates. This between-group analysis was also carried out with loneliness as the dependent variable.

Secondly, the within-subject analyses were conducted. The change in social skills over time within the total sample was analyzed and the hypothesized moderators were tested for parent and teacher ratings of social skills separately. Multilevel analyses with a compound symmetry covariance structure for repeated measures were applied. To test whether initial social anxiety, ADHD symptoms, level of ToM, and the desire for social interaction moderated the change in social skills, the centered SCARED, ADHD-Q, ToM test-R, and WSIS scores (obtained at pre-treatment) and their interactions with time points were added as fixed factors to the model. A backward procedure was applied, in which non-significant predictors were stepwise deleted from the model. A similar within-subject analysis, without moderators, was also carried out with loneliness as the dependent variable.

Results

SST versus WLC: Primary Outcome Measure (Hypothesis 1)

Table 2 and Fig. 2 show the estimated means on the different time points for both conditions with regard to both the parent- and teacher-rated social skills (primary outcome measure). Table 3 summarizes the results of the accompanying multilevel analysis. With respect to the parent-rated social skills, the Time point × Condition interaction was found to be statistically significant ($p < .05$, $r = .34$), reflecting a greater increase in social skills over time in the SST group as compared to the WLC. The interaction of Time point and Condition was also significant for the teacher-rated social skills ($p < .01$, $r = .46$), again indicating a greater increase of social skills over time in the group SST condition as compared to the WLC. Note that the effect sizes for both interaction effects were in the medium to large range.

SST versus WLC: Secondary Outcome Measure (Hypothesis 2)

In contrast to our expectations, the Time point × Condition interaction for the secondary outcome measure of loneliness was non-significant ($p = .54$, $r = .09$), which indicates that children in the SST condition did not show a larger decrease in loneliness over time as compared to children in the WLC.

Short-Term and Long-Term Effects of Group SST for the Total Sample (hypotheses 3 and 4)

The multilevel analyses performed on the BASELINE, PRE, POST and FU parent-rated social skills data of the total sample revealed no change between BASELINE and

Table 2 Between-group analyses: Mixed regression-based estimated means comparing parent-rated social skills, teacher-rated social skills, and loneliness between the WLC and SST conditions

Condition	Time point	Social skills parent		Social skills teacher		Loneliness	
		M	SE	M	SE	M	SE
WLC	Time point 0	18.28	2.22	20.03	1.63	24.69	1.56
	Time point 1	16.86	2.26	19.43	1.74	22.72	1.56
SST	Time point 0	21.34	2.19	16.34	1.81	21.42	1.57
	Time point 1	26.69	2.36	23.01	1.93	18.58	1.61

WLC waiting list condition, *SST* social skills training

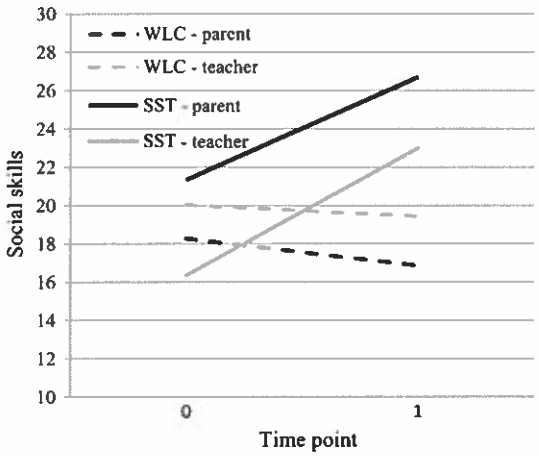

Fig. 2 Between-group analyses comparing WLC and SST with regard to parent- and teacher-rated social skills. Note. *WLC* waiting list condition, *SST* social skills training

PRE but did indicate a significant increase in social skills between PRE and POST and between PRE and FU (see Table 4; Fig. 3). In other words, according to parents, the group SST produced a significant improvement of children's social skills, and this positive change was still visible at a follow-up of 3 months. Note that the course in social skills as rated by the teachers showed a highly comparable pattern. That is, no change was observed between BASELINE and PRE, but between PRE and POST children's social skills clearly increased and this improvement was still present at the FU assessment.

As can be seen in Table 4, the level of loneliness remained fairly stable from BASELINE to PRE. However, between PRE and POST a marginally significant decrease of loneliness was noted, whereas from PRE to FU a significant decline of loneliness was observed.

Effects of Moderators (Hypothesis 5)

None of the hypothesized variables (social anxiety, ADHD symptoms, ToM, and the desire for social interaction) moderated the change in parent-rated social skills between PRE and POST or between PRE and FU. However, social anxiety [$\beta = -4.20$, $t(45) = -3.71$, $p = .001$] and level of ToM [$\beta = 3.15$, $t(46) = 2.81$, $p = .007$] did have a main effect on the level of social skills. Note that the relation between social anxiety and social skills was negative and that between ToM and social skills positive. This indicates that in general higher levels of social anxiety were associated with lower levels of social skills, whereas higher levels of TOM were generally linked to higher levels of social skills.

When using teacher-rated social skills as the outcome variable in the moderator analysis, it was again found that social anxiety, ADHD symptoms, ToM, and the desire for social interaction did not have an effect on the change in social skills over time. Only a main effect of social anxiety was found [$\beta = -2.65$, $t(44) = -2.72$, $p = .009$] the negative relation again showed that in general higher levels of social anxiety were associated with lower levels of social skills.

Table 3 Results of multilevel analyses comparing the WLC and SST conditions

Mixed model analyses					
	B	95 % CI (*B*) ($n = 26$)	T	Df	*P*
Social skills parent					
Intercept	26.68	21.98; 31.39	11.33	67.90	<.001
Condition	−9.83	−16.35; −3.31	−3.01	66.43	.004
Time	−5.34	−9.97; −.72	−2.35	34.13	.025
Time point × condition	6.76	.31; 13.22	2.13	33.80	.040
Social skills teacher					
Intercept	23.00	19.14; 26.87	11.89	65.31	<.001
Condition	−3.58	−8.77; 1.62	−1.38	64.20	.174
Time point	−6.67	−10.61; −2.72	−3.44	34.54	.002
Time point × condition	7.27	2.19; 12.34	2.92	31.68	.006
Loneliness					
Intercept	18.58	15.36; 21.79	11.54	65.23	<.001
Condition	4.15	−.34;8.63	1.85	62.46	.069
Time point	2.84	.71; 4.97	2.69	47.08	.010
Time point × condition	−.87	−3.75; 2.00	−.61	46.29	.544

WLC waiting list condition, *SST* social skills training

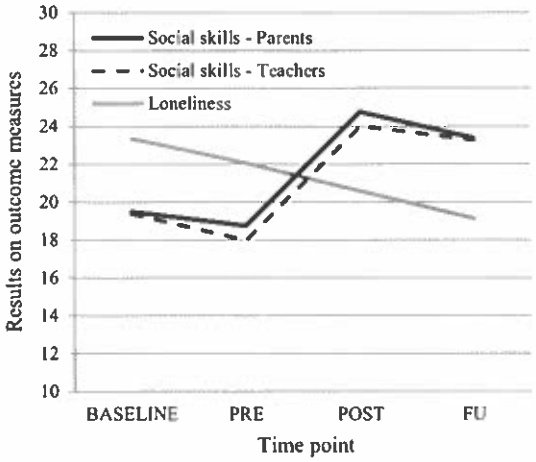

Fig. 3 Change in parent- and teacher-rated social skills and child-rated loneliness over time

Discussion

The present study evaluated a group SST for high-functioning children with ASD in an outpatient community mental health center. The findings clearly support the effectiveness of this type intervention for children with these pervasive developmental problems. That is, social skills improved significantly according to both parents and teachers, suggesting a successful generalization of the newly learned skills. The follow-up assessment showed that the positive effects were still present at 3 months follow-up. Results revealed that children's feelings of loneliness did not change to the same degree as their improvement in social skills. This is understandable as the improvement in social skills will not immediately result in higher levels of positive social interactions. Over time, however, it can be expected that the improved skills will lead to a higher frequency of positive encounters with other children, with a consequent reduction in feelings of loneliness. The results of this study also demonstrated that the level of social anxiety, ADHD symptoms, ToM, and desire for social interaction did not moderate the treatment outcome. Altogether, group SST seems suitable for a quite heterogeneous group of (high-functioning) children with ASD.

The present study contributes to the existing research about group SST for children with ASD (Dawson and Burner 2011; Rao et al. 2008; Reichow and Volkmar 2010; Reichow et al. 2012). The study was ecologically sound being based in a regular community mental health center using a subject group which was fairly typical of the referred population. Effort was made to keep balance between a faithful reflection of regular clinical practice and a methodologically sound research design. Clinicians working in daily practice provided the training to representative ASD children and their parents in this mental health care setting. The results of the between-group analyses demonstrated that the increase in social skills can be ascribed to the SST rather than to time or assessment effects. One could argue that parents closely followed the clinical process of their children and hence were not blind to the treatment condition. However, the teachers were not actively involved in the treatment process and thus observed the children with more distance. Even though parents and teachers observed the children in a different

Table 4 Results of multilevel analyses comparing the change in social skills and loneliness over time (for parent-rated social skills the centered SCARED and ToM-test R and for teacher-rated social skills the centered SCARED were added as covariates to the model)

Pairwise comparisons (based on estimated marginal means)					
	Mean difference	95 % CI difference	T	Df	*P*
Social skills parent					
BASELINE—PRE	.75	−2.69; 4.20	.43	80.42	.665
PRE—POST	−6.02	−8.95; −3.08	−4.08	78.61	<.001
PRE—FU	−4.66	−7.63; −1.69	−3.12	79.25	.003
POST—FU	1.36	−1.76; 4.48	.87	76.68	.387
Social skills teacher					
BASELINE—PRE	1.41	−1.79; 4.60	.88	60.66	.382
PRE—POST	−6.01	−9.15; −2.87	−3.83	59.68	<.001
PRE—FU	−5.32	−8.90; −1.73	−2.97	59.91	.004
POST—FU	.70	−3.20; 4.59	.36	61.56	.722
Loneliness					
BASELINE—PRE	1.31	−.77; 3.39	1.25	106.59	.215
PRE—POST	1.47	−.25; 3.19	1.70	105.16	.093
PRE—FU	2.91	1.04; 4.78	3.08	106.26	.003
POST—FU	1.44	−.46; 3.33	1.51	104.28	.135

WLC waiting list condition, *SST* social skills training

context, the pattern of findings was highly similar, which emphasizes the robustness of the results. Although we employed a thorough and detailed diagnostic procedure to classify children with ASD, an obvious limitation of the current study was the absence of standardized diagnostic instruments for autism spectrum problems, such as the Autism Diagnostic Interview-Revised (Lord et al. 1994) or the Autism Diagnostic Observation Schedule (Lord et al. 1999). Note further that diagnoses were made in terms of the DSM-IV-TR (American Psychiatric Association 2000) and that almost two-thirds of the children were classified as having PDD-NOS, a diagnosis that no longer exists in the latest edition of the DSM (DSM-5; American Psychiatric Association 2013). Thus, it is possible that in terms of the current diagnostic criteria, many children of this study would qualify for 'mild' to 'moderate' ASD or that they may fulfill the criteria for an alternative classification such as social communication disorder (see Smith et al. 2015; Van Steensel et al. 2015). Please note that the core deficits in ASD are social communication and interaction and this still plays a major role in the DSM-5 categories for which social skills training is of paramount importance. In addition, as the group SST was administered as a component of a personalized treatment plan, the pure effects of the group SST remain unknown. On the other hand, adjacent treatment(s) were also provided for WLC participants, yet the SST-WLC comparison yielded clear evidence for the effectiveness of SST, at least as reported by teachers and parents.

The experiences and results of the present study may have some implications for clinical practice. In the first place, the results are promising and encourage the implementation of group SST for high-functioning children with ASD. However, in clinical practice different types and variations of group SST are available. There are some specific factors that might have contributed to the success of the present group SST, which may be valuable to consider for other clinicians. In the current group SST, effort was made to optimally match the training context to the specific needs of children with ASD. That is, the sessions had a predictable routine, visual support was used, concrete group rules and concrete step-by-step instructions were provided and consequently applied (Krasny et al. 2003). Within the structured context of the group sessions, there was still some room to attend to individual learning goals and to provide each child with instructions and feedback tailored to his/her own level. Like in other treatment settings, we think that common factors and the therapeutic relationship were important (Lambert and Barley 2001). We invested in a working relationship with the child and its parents and established a secure atmosphere within the group. In addition, two basic themes were repeatedly and consistently addressed (basic social skills and "one good turn deserves another") and the children were encouraged to implement these principles in multiple situations. It turned out that the children quickly got familiar with these principles and were able to apply this new knowledge in other situations. The involvement of the parents seemed to contribute to this effect as well, as they were explicitly instructed to provide their child with feedback regarding these principles in daily life. We experienced that the weekly e-mail contact intensified the involvement of the parents and the children in several ways: this was an additional contact in-between the group sessions, which helped to stimulate the child to transfer the newly learned skills to their natural environment; parents got an active role and shared responsibility; personalized feedback and instructions were provided so parents could adapt their feedback and support more easily to the level of their child; and the child itself also received additional tips on how to apply the newly learned skills in daily practice.

Future research is needed to further examine the long-term effectiveness of group SST and to explore working mechanisms of this type of intervention, which are responsible for the improvement and generalization of social skills in children with ASD. Although social interaction deficits are a core feature of ASD and are considered to be pervasive, social skills turn out to be accessible and responsive to intervention. We have to realize that even small improvements in social skills may have significant implications in the daily life of a child with ASD and other social communication and interaction problems and his/her surroundings.

Author Contributions AD conceived of the study, participated in its design, performed its coordination, performed statistical analysis, interpreted the data and drafted the manuscript; PM participated in the interpretation of the data and helped to draft and write the manuscript; JR conceived of the study, participated in the design of the study and helped to draft the manuscript; AA participated in the design of the study, performed the statistical analysis and interpreted the data. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Written informed consent was obtained from all individual participants included in the study.

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A randomized controlled study of a social skills training for preadolescent children with autism spectrum disorders: generalization of skills by training parents and teachers?

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Abstract

Background: Social skills training (SST) is a common intervention for children with autism spectrum disorders (ASDs) to improve their social and communication skills. Despite the fact that SSTs are often applied in clinical practice, the evidence for the effectiveness of these trainings for children with ASD is inconclusive. Moreover, long term outcome and generalization of learned skills are little evaluated. Additionally, there is no research on the influence of involvement of parents and teachers on effectiveness of SST and on the generalization of learned social skills to daily life. We expect parent and teacher involvement in SST to enhance treatment efficacy and to facilitate generalization of learned skills to daily life.

Method/Design: In a randomized controlled trial (RCT) with three conditions, 120 participants with ASD at the end of primary school (10–12 years of calendar age) have been randomized to SST, SST-PTI (SST with Parent & Teacher Involvement), or care-as-usual. The SST consists of 18 group sessions of 1.5 hours for the children. In the SST-PTI condition, parents additionally participate in 8 parent sessions and parents and teachers are actively involved in homework assignments. Assessment takes place at three moments: before and immediately after the intervention period and at 6 months follow-up. Primary outcome is socialization, as an aspect of adaptive functioning. Secondary outcomes focus on specific social skills children learn during SST and on more general social skills pertaining to home and community settings from a multi-informant perspective. Additionally, possible predictors of treatment outcome will be assessed.

Discussion: The current study is an RCT study evaluating SST in a large sample of Dutch children with ASD in a specific age range (10–12 years). Strengths of the study are the use of one manualized protocol, application of standardized and internationally used rating instruments, use of multiple raters, investigation of generalization of learned skills to daily life, and the evaluation of efficacy in the longer term by follow-up measures at 6 months after the end of training.

Trial registration: NTR2405

Keywords: Social skills training, Autism spectrum disorder, RCT, Primary school, Treatment efficacy

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Background

Autism spectrum disorders (ASDs) are defined in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) as a neurodevelopmental disorder and are characterized by severe and pervasive impairment in two developmental areas: limitations in social communication and the presence of restricted, repetitive behaviors [1]. The Social Communication domain as defined in the DSM-5 contains symptoms from the Social and Communication domain which were separate domains in the DSM-IV-TR. In the DSM-IV-TR, classifications within the autism spectrum were separated as well (i.e. autistic disorder [AD], Rett's disorder, childhood disintegrative disorder [CDD], Asperger's disorder and pervasive developmental disorder- not otherwise specified [PDD-NOS; [2]]), whereas the DSM-5 no longer contains specific ASD classifications. The symptoms are now seen as a continuum, ranging from mild to severe expression [3].

This revised perspective on ASDs reflects empirical research into the underlying factors for ASDs [3] and is in line with clinical presentation in daily practice. ASDs typically emerge during young childhood and they persist throughout the lifespan. The etiology of ASDs remains unclear. There is a strong involvement of genetic factors in ASD [4]. The prevalence of ASDs is estimated at 1 per 150 children and adolescents [5], with the ratio of boys to girls being 4:1.

Children with ASDs lack the behavioral repertoire that is necessary to interact with others. Deficits vary over children with ASDs and may include lack of orientation towards social stimuli, inadequate use of eye contact, no or inadequate initiation of social interaction, difficulties in interpreting verbal and nonverbal social cues, inappropriate emotional responses, and lack of empathy for others' distress or emotions [6]. Besides variation between individuals with ASDs, the social communication within children with ASDs varies over time as well. Although limitations in the communication domain are the core symptoms of ASDs, this does not mean that there can be no development in this area at all [7]. However, learning and implementation of the behaviors necessary for social interaction may always remain harder, go slower, and be less automatic for children with ASDs than for other children [8,9].

At least part of the children with ASDs has a desire for more peer social interaction [7], but they do not act in the right way to generate fluent social interaction with peers. Children with ASDs often show substantial social relational problems when compared to typically developing children, because they have difficulty sharing affective experiences or understanding the perspective of others, which is important for social reciprocity and the development of friendships [6]. Additionally, parents and teachers have reported larger deficiencies in cooperation, assertion, and self-control than a matched group of their typically developing peers [6]. This may result in an increased risk for peer rejection and social isolation.

The social problems encountered already early in life may have serious consequences, often leading to major deviances in development as compared to typical development. From several studies it is known that social problems may also affect the achievement of normal developmental milestones and the establishment of satisfying peer and familial relationships [6,10]. Further on, social deficits continue to negatively impact social and occupational functioning into adulthood. Adults with ASDs or high-functioning autism (HFA) are much more likely to be un(der)employed than the general population and are much less likely to have satisfying social relationships [6]. Apart from the consequences for development in general, social skills deficits predict specific problems later in development such as mood and anxiety problems [7].

There are different types of interventions for individuals with ASDs. Most psychological interventions are developed from a behavioral perspective [11]. Because of the importance of the social communication skills in ASDs, treatment has focused on improving these skills. Over the last decades, several methods have been developed with that aim, e.g. social stories [12], peer-mediated interventions [13], parents-assisted interventions [9], computer-based interventions [14], and social skills groups [15].

Specific group-based social skills training (SST) has become an important part of treatment for children with ASDs in clinical practice and in schools [16,17]. An SST is a child specific intervention based on behavioral and social learning, during which children are taught specific skills, as for instance making eye contact, initiating a conversation, and cooperation [7]. SST is supposed to help children develop those skills that are most severely affected and at the same time most crucial for developing relationships with others. For children with social phobia or specific learning disabilities, SST has been shown to be an effective treatment [18,19]. However, the evidence for the effectiveness for SST for children with ASDs seems inconclusive [6,7,20,21].

The studies into SSTs so far show design limitations with respect to lack of a control group and randomized assignment, lack of adequate measurement of social skills and deficits associated with ASD, limited sample size, not using multiple informants, not including follow-up measurements, and lack of assessment of generalization of learned skills in daily life. Moreover, most of the studies have been performed in the US [6,7], except Yoo and colleagues [22].

In a recent meta-analysis, Reichow, Steiner & Volkmar [23] found only five studies, including a total of 196 participants, that were based on a randomized controlled trial design (RCT). All five studies included a control group that did not receive an intervention for social skills. They included studies until December 2011 in their analysis, all performed in the US. To the best of our knowledge, only one RCT study into group SST for children with ASDs has been published since, that included a randomized control group that did not receive an intervention for social skills. Additionally, this was the first study outside the US [22].

A summary of study characteristics and outcome measures of these studies is shown in Table 1. As can be seen in Table 1, the age ranges were broad (ages of included children 6–17 years). Setting, frequency, and duration of the intervention also varied between the studies. One study investigated an intensive five-week summer intervention with five 70-minute treatment cycles every day [21] and the other studies had weekly training sessions of 60–90 minutes [8,9,13,16,22]. The protocol underlying the SSTs differed between the studies and involvement of parents or peers varied as well. Involvement of teachers was scanty, if at all. In two studies [9,13] peers were involved in the sessions of the SST and in four studies the parents were involved in the training [8,9,16,21,22]. Based on their meta-analysis, Reichow, Steiner & Volkmar [23] concluded that no firm conclusions can be drawn on the efficacy of SSTs for ASDs with respect to improving social competence, social communication, emotion recognition, and quality of life for children with ASDs, due to all the differences between the studies and the outcomes. In more detail: In three studies the children in the SST condition improved significantly (small-medium effect size) compared to the control condition. In the two other studies, no difference was found between the treatment and the control groups. More information on the conclusions of the separate studies is provided in the last column of Table 1.

With respect to limitations of the studies, Reichow, Steiner and Volkmar reported that the studies in their meta-analysis had the same limitations as mentioned before. Additionally, Gillies, Carroll & Loos [24] commented on their meta-analysis [23] with additional potential sources of bias, regarding families that could not be blinded for their condition, the exclusion of participants with intellectual disability and the inclusion of only group-based skills training.

As reported in Table 1, the studies used different outcome measurements. Some used specific intervention-related instruments, others used more general social skills instruments. The difference between the concepts behind each instrument and thus the exact outcome of each of the studies, complicates comparison between them. The use of standardized, internationally used and well validated instruments would facilitate measuring efficacy of SSTs and comparison between studies.

To clarify the effectiveness of SSTs for children with ASD, follow-up measurement is also important [24]. None of the studies reported in Table 1 had follow-up measurements for the treatment as well as for the control groups beyond post-treatment, therefore no information is available on the longer term effects of the SST compared to not receiving SST.

Another important issue, which was not addressed in the evaluated studies, is to find out whether the learned skills generalize to situations in the child's daily life [24]. To assess this aspect, one should measure social skills from everyday life of the child instead of very specific and discrete behaviors learned at the investigated intervention [13]. The use of multiple informants (e.g., parents and teachers) increases the insight into the extent to which the child uses learned social skills in daily life.

Another aspect understudied so far is the benefit of parental involvement in the SST [24]. The clinical impression is that parental involvement in interventions increases generalization of the learned skills. Parents may remind children to practice and to apply their learned skills in various situations in daily life. This may be especially beneficial to children with ASDs who generally have difficulty to learn and change behavioral patterns. A part of the studies investigated an SST with parental involvement [8,9,16,21,22] but only one study compared an SST with and without parental involvement [15]. However, it was unclear whether the significant differences between the two groups, with respect to skills awareness and motivation were due to parental involvement or to the specificity of the training for ASD, since it compared an SST with parental involvement specifically developed for children with HFA to an SST without parent participation not specifically developed for children with ASD.

The best age when to provide an SST is subject to discussion. In clinical practice, SSTs are provided to younger and older children, adolescents, and adults. In early adolescence and adulthood, lack of social skills can result in peer ridicule and rejection [6]. Therefore, it seems important to offer an SST in preadolescence, to prevent children from experiencing more impairment, distress, and internalizing problems [7,15]. The younger a child masters social and communicational skills and concepts, the earlier he or she can apply these in daily life. If effective, the child's development may then deviate less than without training. Herbrecht and colleagues [25] have found in their study that the children's group (8 to 13 years old) benefited more from the training than the adolescents' group (13 to 19 years old). Although the interventions differed in frequency and duration, they

Table 1 Characteristics of published RCTs with control condition on SSTs in children with ASDs

Auteur	N (INT/CON)	In-/exclusion criteria	Intervention	Follow-up	Outcome measures	Conclusion (pre/post treatment)
Frankel et al. (2010) [9]	76 randomized, 68 completed training (35/33)	ADOS/ADI-R ASD	Parent-assisted Children's Friendship Training (CFT).	Only intervention group after 3 months	- Parent	
		2^{nd}-5^{th} grade regular classroom			o QPQ (Ho, Gu, Con, Eng, Dis)	$p < .0001$ (Ho, Dis)
		VIQ > 60	12 weekly sessions of 60 minutes with concurrent sessions for child and parents. Class size was usually 10, with no more than 4 children with ASD.		o SSRS social skills (As, SC)	$p < .05$ (SC)
		Knowing rules of board and school yard games			o SSRS problem behavior (In, Ex)	ns
		Able to switch topics in conversation			- Child	
					o PHS	$p < .025$
		Excl: psychotropic medication			o The Loneliness Scale	$p < .025$
		Thought disorder			- Teacher	
		Clinical seizure disorder, gross neurologic disease or other medical disorder			o PEI (Wi, Ag)	ns
Laugeson et al. (2009) [8]	33 (17/16)	Clin dx ASD	Program for the Education and Enrichment of Relational Skills (PEERS).	No	- Parent	
		Age 13–17			o SSRS social skills	$p < .05$
		IQ > 70	12 weekly sessions of 90 minutes with concurrent sessions for child and parents.		o SSRS problem behavior	ns
		English fluency (child and parent)			o QPQ (Ho, Gu, Con)	ns
					- Teens	
		Parent want to participate			o QPQ (Ho, Gu, Con)	$p < .025$ (Ho)
					o TASSK	$p < .0001$
		Social problems			o FQS	$p < .05$
					- Teacher (n = 13)	
		Excl: history of major mental illness			o SSRS social skills	ns
		Hearing, visual or physical impairments			o SSRS problem behavior	ns
Koenig et al. (2010) [13]	44 (25/19)	Clin dx ASD	16 weekly sessions of 75 minutes; 4 to 5 children/2 peer/ 2 licensed clinicians.	No	- Parent	
		ADOS/SCQ/PDD-BI score ASD			o CGI – improvement	$p = .001$
		Age 8–11			o SCI (PSI, SI)	ns
		IQ > 70				
		Excl: need for different treatment				
		ABC irritability > 18				
		CSI clinically				

Table 1 Characteristics of published RCTs with control condition on SSTs in children with ASDs *(Continued)*

Lopata et al. (2010) [21]	36 (18/18)	Clin dx HFASD Age 7–12 IQ > 70 VCI/PRI > 80 Expressive language score > 80	Summer training program. 5 weeks intervention with Five daily 70-minute treatment cycles every day; 3 therapists/6 children.	No	- Parent o ASC o SRS o BASC-2-PRS – withdrawal o BASC-2-PRS – social skills - Child o SKA o DANVA-2 (CF)	$p = .006$ $d = .584$ $p = .003$ $d = .625$ $p < .001$ $d = 1.055$ ns $d = .365$ $p < .001$ $d = 1.272$ ns $d = .532$		
Solomon et al. (2004) [16]	18 (9/9)	Clin dx ASD ADOS ASD, ADI-R AD Also met DSM-IV criteria of ASD based on a clinical interview Age 8–12 IQ > 75 Able to pass first theory of mind task Excl: serious conduct problems	The Social Adjustment Enhancement Curriculum. 20 weekly sessions of 90 minutes with concurrent sessions for child and parents; 3 therapists/5 children.	No	- Child o DANVA-2 (AF, CF) o Strange Stories Task o Faux Pas Stories Task o TOPS-ER	$p < .05$ (AF, CF) ns ns $p < .05$		
Yoo et al. (2014) [22]	55(28/27)	Clin dx ASD Age 12–18 School 6th grade elementary school to 3rd grade high school Social difficulties VIQ ≥ 65 Substantial treatment motivation No history of major mental illness	The PEERS Treatment Manual. 14 weekly sessions of 90 minutes with concurrent sessions for child and parents.	Only intervention group after 3 months	- Child o TASSK-R o QPQ (Gu, Con) o QPQ (Ho) o K-SSRS (As, Co, Em, SC, T) o CDI o STAIC-T o STAIC-S o ADOS (Ic-a, Ic-t) o ADOS (rsi-a, rsi-t) - Parents o SCQ o SRS o QPQ (Gu, Con) o QPQ (Ho) o ASDS (L, SI, BP, CA, SP)	I $p < .01$ ns ns ns $p = .04$ ns ns ns $p = .01$ $p < .01$ ns ns ns ns	II $p < .01$ ns ns ns $p = .03$ ns ns ns $p < .01$ $p < .01$ ns ns ns $p = .03$ ns	III $p = .01$ ns $p = .04$ ns ns ns ns $p < .01$ $p < .01$ ns ns ns $p = .03$ ns

Table 1 Characteristics of published RCTs with control condition on SSTs in children with ASDs *(Continued)*

No current problems with aggressive behavior or severe oppositional tendency	○ K-CBCL An/dep	p = .03	ns	p = .02
	○ K-CBCL In	p = .02	ns	p = .03
No hearing, visual, or physical disabilities preventing outdoor sport activities	○ AHWA-VABS socialization	p < .01	p < .01	p < .01
	○ BDI (F, M)	ns	ns	ns
	○ STAI-T (F, M)	ns	ns	ns
No clinically significant physical or neurological illnesses inhibiting treatment.	○ STAI-S (M)	p < .01	p = .01	p = .04
	○ STAI-S (F)	ns	ns	ns

ABC, Aberrant Behavior Checklist; AD, Autism Disorder; ADI-R, Autism Diagnostic Interview-Revised; ADOS, Autism Diagnostic Observation Schedule (lc-a, language and communication algorithm; lc-t, language and communication total; rsi-a, reciprocal social interaction algorithm; rsi-t, reciprocal social interaction total); AHWA-VABS, Korean Version of the Vineland Adaptive Behavior Scale); ASC, Adapted Skillstreaming Checklist; ASD, Autism Spectrum Disorder; ASDS, Asperger Syndrome Diagnostic Scale (L, Language; SI, Social Interaction; BP, Behavioral Problems; CA, Cognitive Ability; SP, Sensorimotor Problems); BASC-2-PRS, Behavior Assessment System for Children, Second Edition-Parent Rating Scales; BDI, Beck Depression Inventory (F, Father; M, Mother); CASL, Comprehensive Assessment of Spoken Language; CDI, Child Depression Inventory; CGI, Clinical Global Impressions Scale; Clin dx, clinical diagnosis; CON, Control condition; CSI, Children's Symptom Inventory; DANVA-2, Diagnostic Analysis of Nonverbal Accuracy-2 (AF, Adult Facial Expression; CF, Child Facial Expression); Excl, exclusion criteria; FQS, Friendship Qualities Scale; HFASD, High-Functioning Autism Spectrum Disorder; INT, Intervention; K-CBCL, Korean Version of the Child Behavior Checklist (An/dep, anxiety/depression; In, Internalizing problems); K-SSRS, Korean Version of the Social Skills Rating System (As, Assertion; Co, Cooperation; Em, Empathy; SC, Self-Control; T, Total score); PDD-BI, Pervasive Developmental Disorders: behavior Inventory; PEI, The Pupil Evaluation Inventory (Wi, Withdrawal; Ag, Agression); PHS, Piers-Harris Self-Concept Scale; PRI, Perceptual Reasoning Index; PSS, Parent Satisfaction Survey; QPQ, Quality of Play Questionnaire (Con, Conflict ; Dis, Disengage; Eng, Engage; Gu, Guest; Ho, Host); SCI, Social Competence Inventory (PSI, Pro-Social Index; SI, Social Initiation Index); SCQ, Social Communication Questionnaire; SKA, Skillstreaming Knowledge Assessment; SRS, Social Responsiveness Scale; SSRS, Social Skills Rating System (As, Assertion; SC, Self-Control; In, Internalizing behavior; Ex, Externalizing behavior); STAI, State and Trait Anxiety Inventory (T, Trait; S, State; M, Mother; F, Father); STAIC, State and Trait Anxiety Inventory for Children (T, Trait; S, State; M, Mother; F, Father); TASSK, Test of Adolescent Social Skills Knowlegde; TASSK-R, Test of Adolescent Social Skills Knowledge-Revised; TOPS-ER, Test of Problem Solving-Elementary Revised; VCI, Verbal Comprehension Index; VIQ, Verbal IQ; I, no covariates are controlled; II, controlled teen's age, sex, IQ and medication as covariates; III, controlled socioeconomic status, maternal education, and age as well as teen's age, sex, IQ and medication as covariates.

interpreted this as a possibility that children are more receptive to intervention than adolescents, because of a higher ongoing natural maturation effect in children or because the psychopathology in children is probably less chronic yet than in adolescents. However, a child can be too young for SSTs as well, because the attention span must be long enough [25], the didactic presentations must not be overwhelming to allow benefit [9], and the children must be able to read and write their homework.

The current study investigates the efficacy of a comprehensive manualized SST, specifically developed for children with ASDs, in the last two years of primary school. In the Dutch school system, children are typically 10–12 years old in these final years of primary school. The study is designed as an RCT with three conditions: SST consisting of 18 group sessions; SST (same content, frequency and duration) plus parent and teacher involvement (so called SST-PTI); and care-as-usual. The study has aimed for a large sample size (n = 120) and pays particular attention to generalization of learned skills in daily life. Possible improvement is measured with standardized, internationally used instruments for specific behaviors and broader functioning in daily life from a multi-informant perspective. Follow-up measures will add to the knowledge of the efficacy of SSTs on the longer term.

Research aims and hypothesis

The main aim of the current study is to investigate the efficacy of SST as compared to care-as-usual in 10–12 year old children with ASDs. The efficacy is investigated at several levels: on the level of specific behaviors instructed during the intervention and on the level of general social skills at home and at school. Data are collected from multiple informants: children, parents, teachers, and independent observers. The hypothesis is that children participating in SST show greater improvement on all levels than children in the care as usual condition.

The secondary aim is to investigate the efficacy of an enhanced SST (i.e. SST-PTI, involving parents and teachers) as compared to non-enhanced SST, specifically on the generalization of the learned skills. We expect that generalization increases when parents and teachers learn behavioral therapeutic principles to support the child at home or at school in practicing and implementing social and communicative behaviors.

Additionally, the study aims to investigate factors that possibly influence the effectiveness of SST, searching for information on whether and if so which specific groups of children with ASDs improve more or less with SST.

Methods/Design

The efficacy of the SST is investigated in an RCT, including two intervention conditions (SST and SST-PTI) and a care-as-usual condition [Efficacy of Social skills Training In Autism (ESTIA)].

Two Dutch child mental health centers participate in the study: Accare University Center for Child and Adolescent Psychiatry (with locations in the cities Groningen and Drachten) and Lentis Jonx Autism Team North-Netherlands (ATN; also with locations in the cities Groningen and Drachten). All four locations have a regional function. Participants have been recruited through the four locations and all four provide training groups.

Participants

Participants in the study are children with a best estimate clinical DSM-IV-TR diagnosis of ASD, including Autistic disorder, Asperger's disorder, or PDD-NOS, assigned in a multidisciplinary team including a child psychiatrist and psychologist. The diagnostic procedure consisted of an interview with parents on the current behavior and on developmental history of the child and observation of the child in a standardized, playful situation (most often the ADOS). For inclusion in the study, the Autism Diagnostic Interview-Revised (ADI-R [26]; Dutch version [27]) and the Autism Diagnostic Observation Schedule (ADOS [28]; Dutch version [29]) were administered. Participants had been referred to one of the four participating child mental health care centers. Their clinician advised them to participate in a social skills training. Motivation of the child and parents for training is established. Their IQ is above 80, they are in the last two and a half years of primary education and 10 to 12 years old.

Children with a physical condition that hampers participation or who cannot arrange visiting the child mental health center for the training have been excluded from participation. However, medication or co-morbid disorders were no reason for exclusion.

Informed consent

When an SST was indicated, the therapist introduced this form of treatment to the parents and children and informed them about the study. Sometimes, parents or children were the ones who expressed interest in participating in a social skills training. In that case, the therapist discussed the appropriateness with parents and child and then introduced the study. If parents and children were interested in participating, they agreed that the research team would call them to give more detailed information and would send written information. When the parents and children understood the information from the researchers and were willing to participate, an appointment was scheduled with a therapist. The therapist assessed whether SST was indeed appropriate for the child and the child and parent had the chance to receive more information on the training. If parents, child, and

therapist agreed on the appropriateness of treatment and participation in the RCT, the informed consent form was signed by the parents and the child, if aged 12. The researcher informed the teacher and asked for participation after parents had agreed on doing so and the teacher signed informed consent as well. All participants had the right to withdraw from the study at any time, without explanation. Refraining from the study would not affect regular treatment at the child mental health centers. Figure 1 is a flowchart with the phases of the research procedure.

Therapists

All therapists participating in this study were psychologists who worked at one of the child mental health centers. Two therapists led one group of four to six children. At least one of the (child) psychologists had finished an additional postmaster clinical training. The other had at least a master in Psychology. Both had experience in the broader treatment of children with ASDs and had received training in the theoretical backgrounds and application of cognitive behavioral therapy. Before applying the SST, all therapists participated in a training in the specific protocol. This training lasted six hours for groups of trainers or two hours individually. Trainers received the protocol with all sessions and preparation guidelines. The training focused on the theoretical background, the manualized protocol, the content of the sessions, the physical context of the sessions, the importance of adherence to the protocol, and to the study requirements in general. During the intervention period, therapists had brief meetings or phone calls to discuss the progress of the children or the difficulties in the ongoing groups. These sessions had also been set up to enhance treatment adherence and to prevent therapists to drift from the protocol. In the beginning of the intervention, these meetings were planned weekly,

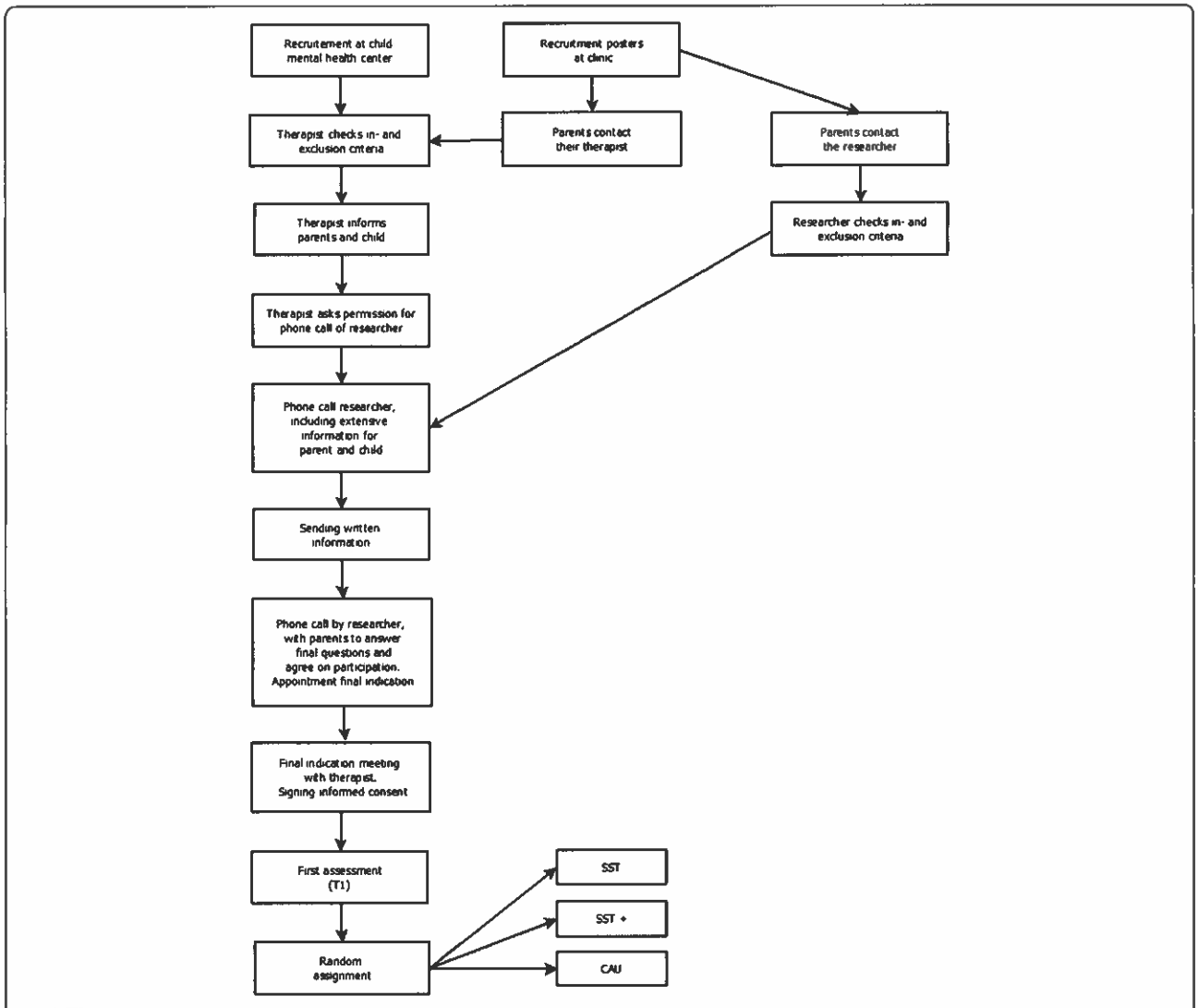

Figure 1 Flow chart of the phases of the RCT.

later they were planned once every two weeks. One of the senior therapists of this specific SST supervised these sessions and carefully watched over treatment adherence.

Randomization

The RCT contains three conditions: SST, SST-PTI, and care-as-usual. As soon as 4–6 children in a treatment center had finished the pretreatment assessment, that group was randomized to one of these three conditions. We used a randomized block design with blocks of 5 with a 2-2-1 ratio (2 SST, 2 SST-PTI, 1 CAU). This balanced randomization procedure was used, striving for unbiased comparison groups, but also for comparison groups of about the same size throughout the trial. The training groups were embedded in three treatment locations that have specific characteristics (Accare Groningen; ATN Groningen; Drachten [including ATN and Accare]). Therefore, we stratified the randomization by the three treatment locations. Research assistants logged in to a web-based program, that allocated groups to treatment condition (randomized on group-level in blocks of 5, stratified per treatment location).

During the inclusion period, the recruiting team was blind to the exact details of the randomization process. To conceal the predictability of the randomization process, research assistants not only entered the treatment location, but also information on the sex of the participants and the number of children in each group (4–6). Sex and group size were in fact not weighed in the randomization.

Randomization took place after all measures of the first assessment were completed. Thus, pre-treatment assessments are independent of the participant's knowledge of treatment condition.

Intervention

Social skills training

The manualized SST consists of 15 weekly sessions (except for school vacations), followed by three booster sessions starting two months after the 15th session. An SST group consists of four to six children and two therapists. Each session lasts 90 minutes and is video-taped. The SST is based on behavioral therapeutic principles and the social learning theory. The purpose of the SST for children is to learn to interact with other children and to experience that interacting with other children can be fun. Children are taught through instruction, directed positive feedback, observation, and role-play. The therapists analyze the behavior of the children, define individual positive target behaviors, and elicit positive behavior. Negative behavior is ignored when possible, while differentially reinforcing alternative or incompatible positive behavior.

As shown in Table 2, in sessions 1 to 4, the first phase of the SST, the most important aim is to create a safe environment for the children to practice. In sessions 5 to 15, the second phase, nine skills are discussed, practiced, and rehearsed, for instance 'asking something to someone', or 'apologizing to someone'. Sessions 16 to 18 are the so called booster sessions, in which the most relevant skills for each individual child are rehearsed.

Before the start of the training, one of the therapists meets with the child and his/her parents in order to get to know each other and to give practical information. Additionally, this meeting serves as the moment for determining five individual goals of the participant. The parents, child, and therapist together choose five specific behaviors that the child and therapist will focus on during the training.

In order to evaluate the training, the child, parents, and therapists meet and discuss the training and learned skills after the fifteenth session. After the booster sessions, the therapists call the parents for a final evaluation.

For children in this condition, only medication is allowed as an additional treatment.

Social skills training – parent & teacher involvement

In the SST-PTI condition, each child follows the exact same procedure as described above for the SST condition. Additionally, his/her parent(s) participate in eight parent sessions. Preferably, both parents participated, however, in many cases only one parent was able or willing to participate. Another addition is that the teacher is coached to support the child in school. An overview of the parent sessions and teacher involvement is presented in Table 2.

The parent sessions are directly linked to the SST sessions and focus on how to support and assist the child in performing the social skills as learned in the training. The sessions consist of instruction on and explanation of behavioral therapeutic principles, behavioral exercises, role-play, and homework. Three parent sessions take place before the children's SST sessions start. In these sessions, antecedent and consequent interventions are discussed. The parent(s) learn to distinguish desirable social behavior from undesirable social behavior and to elicit the desirable behavior. The other five sessions take place at determined moments during the SST and these are focused on how to support their child in learning and practicing social skills, based on the parental skills from the first three sessions.

Before the children start with their SST sessions, the teacher has one meeting with the therapists concerning (further) education on ASDs, explanation of the SST and specific behavioral instructions. The teachers receive a file with all child sessions and the weekly homework.

Table 2 Topics of the social skills training

Children sessions (in SST and SST-PTI)		
1	Phase 1 (weekly): Create a safe environment	Introduction
2		Saying nice things about yourself and to others
3		Feelings (showing how you feel and see how another feels)
4		Personal presentation (posture, eye contact and use of voice)
5	Phase 2 (weekly): Practice skills	Asking something to someone
6		Conversation
7		Asking for a play date
8		Asking to participate
9		Discussing with someone
10		Playing a social game
11		Saying no
12		Indicating annoyance
13		Apologizing to someone
14		Responding to bullying
15		Final session, children chose a social activity
16	Phase 3 (2 weekly-monthly): Booster sessions	Repeating the above mentioned skills, focusing on individual goals
17		Repeating the above mentioned skills, focusing on individual goals
18		Repeating the above mentioned skills, focusing on individual goals
Parents sessions (in SST-PTI)		
1	Phase 1 (weekly): Before child sessions	Psycho-education
2		Antecedent interventions
3		Consequent interventions
4 (SST 2)	Phase 2 (2 weekly): During child sessions	Discrimination training
5 (SST 4)		Eliciting desired behaviors and creating opportunities
6 (SST 6)		Energizing desired social behavior
7 (SST 8)		Responding to and redirecting socially awkward behaviour
8 (SST 11)	Phase 3	Continuation and persevere
Teacher (in SST-PTI)		
1	One meeting with the therapist before the start of the SST for the children en five telephone contacts during the SST (after session 2, 4, 7, 10 and 13).	

Additionally, one of the therapists is in contact with the teacher five times throughout the 15 weeks that the child participates in the SST sessions, in order to discuss the possibilities for practicing the weekly homework skills in school and the individual goals.

Also for children in this condition, only medication is allowed as an additional treatment.

Care-as-usual

Children in the care-as-usual condition receive no SST. Medication, parent training, and other treatments are allowed and content, frequency, and duration are registered by the researchers. However, parents or child do not receive psychological interventions primarily focusing on improving social skills. Participants in the care-as-usual condition can take part in an SST after the follow-up assessment, one year after start of the SST in the treatment conditions.

Assessments

Assessments were planned at three moments: before randomization, immediately after the intervention period, and at 6 months follow-up after the end of intervention. The first assessment (T1) was planned after inclusion of the child and the decision of parents and child to participate. This assessment comprises questionnaires for children, parents, and teachers, interviews with parents, and observations of children. Six months later (after SST session 15) the second assessment (T2) was planned, including questionnaires for parents, child, and teacher, an interview with parents, and observations of the child. Another six months later the follow-up (T3) was planned, with all instruments included at T2 for parents and child. No teacher information was going to be collected at this point, since children often have a different teacher on T3 than on T1 and T2 (due to change of class in the end of the school year). In the care as usual condition, T2 was planned six months after T1 and T3 twelve months after T1. Currently, T1 and T2 have been completed. The last group will complete T3 in the summer of 2014.

Primary outcome

The primary outcome is adaptive functioning, measured with the Dutch translation of the Vineland Adaptive Behavior Scales - Survey Version (VABS [30]; Dutch Version [31]; measured at T1, T2, and T3), in order to measure the efficacy of the SST in daily life. Adaptive functioning is defined as the performance of daily living activities that are necessary for personal and social functioning of a person [30] and reflects how well children are able to function in daily life. The Vineland measures this competence with three subscales, in the manual called domains: 'Communication', 'Daily Living Skills', and 'Socialization'. It is an open-ended interview with one or both of the parents. Because the SST does not focus on the domains 'Daily Living Skills' and 'Communication' of the Vineland, only the domain 'Socialization' will be used in the analyses.

Secondary outcomes parent measures

The Social Skills Rating Scale (SSRS [32]; measured at T1, T2, and T3) is a 38-item standardized parent questionnaire that measures social skills pertaining to home and

community settings for children in primary education, completed by the primary caregiver. The subscales included in the analyses are 'Cooperation', 'Assertion', 'Responsibility' and 'Self-Control'.

The ESTIA - training specific questionnaire (ESTIA-TS; Unpublished manuscript, 2010; measured at T1, T2, and T3) is a 30-item parent-report questionnaire about the specific social skills children learn during the SST. The questionnaire was developed with the aim to investigate change in the specific behaviors as taught in the SST, such as eye contact, recognizing feelings, and apologizing. Parents report on a scale from 0 to 5 how difficult each skill is for their child. They also report on the frequency of each of the skills.

Secondary outcome teacher measure

The Teacher version of the Social Skills Rating Scale (SSRS [30]; measured at T1 and T2) has 30-items in three subscales: 'Cooperation', 'Assertion', and 'Self-Control'. All three will be included in the analyses.

Other measures

Additionally, possible mediators and moderators of treatment outcome will be assessed, e.g. treatment attendance, genetic factors, severity of ASD, intelligence, symptoms of depression, anxiety, attention deficit, hyperactivity, impulsivity, oppositional behaviors, and parental stress.

Drop-outs

Children in the intervention groups who dropped out after the start of the SST were encouraged to still participate in the assessments. Post-treatment assessment was organized as soon as the child dropped out of treatment, if the drop out was before session 8. For the follow-up assessment the regular schedule has been followed. Children who dropped out after session 8 were invited for the regular post-treatment assessments.

Sample size calculation

We computed the minimally required sample sizes for two repeated-measures (RM-)ANOVAs on the primary outcome measure VABS, with one between-subject factor (group; 2 levels) and one within-subject factor (time; 2 levels: T3 versus T1); in one test, the SST and care-as-usual groups will be compared and in the other the SST and SST-PTI groups. For each test, we required a power of .99, a significance level of .01, and assumed a correlation between repeated measures of the VABS of .5. Calculations were performed with the program G*Power 3.1.7 [33].

The expected difference between the SST and the care-as-usual group is based on the results of the study into SST of Owens et al. [34], who found a difference between the treated and untreated group of 0.90 SD of the mean VABS outcome. Assuming no effect in the untreated group, the associated effect size f = .4, yielding a minimal sample size of 21 per group. We expect that comparing the two treatment conditions yields lower values of difference. No literature on the comparison of two SST training conditions was available, therefore we defined the difference to detect based on clinical relevance of a difference found. This resulted in a difference between SST and SST-PTI of 0.60 SD of the mean VABS outcome, with associated effect size f = .3, yielding a minimal sample size of 36 per group. Based on our experiences in past research, we presumed a drop-out rate of 10%, implying a minimal sample size of 21/.9 = 24 children in the care-as-usual condition and 36/.9 = 40 in each of the treatment conditions. Because we could include more children in the treatment groups, yielding an even larger power, we aimed 48 in each of the treatment conditions and 24 children in the care-as-usual group (total n = 120).

Statistical analyses

First, the three groups will be compared with respect to background, age, IQ, and other data in order to assess the comparability between them.

Second, intervention efficacy will be established with hierarchical linear modeling. All data will be analyzed using the intent-to-treat principle. The comparative efficacies of SST, SST-PTI, and care as usual will be investigated with hierarchical linear modeling. The first will test the primary outcome, the socialization domain of the VABS. The other multilevel analyses will be done on each secondary outcome, including 1) parent reported training-specific social skills and 2) more general social skills pertaining to home and community settings, reported by parents and 3) more general social skills pertaining to home and community settings, reported by teacher.

Third, in the completers, the same analyses will be applied, while taking into account possible drop-out and treatment non-adherence. The possible mediators and moderators will be included as explanatory variables into the hierarchical linear models.

Ethical approval

The Medical Ethical Committee of the University Medical Center in Groningen has assigned ethical approval for the study (METC nr 2009.320).

Discussion

The current study investigates the efficacy of SST for children with ASDs in the age of 10–12 years. Focusing on the limitations in knowledge so far, the study also investigates generalization of learned skills, long term efficacy, and the influence of parent and teacher involvement in an RCT in a non-US group of 120 children.

Strengths and limitations

The random assignment of children to one of the treatment conditions or the care-as-usual condition is an important strength of the study. With this design, the two treatment conditions can be compared to the care-as-usual condition and to each other. A detected improvement of efficacy can thus be controlled for development over time. A second important strength of the study is that this is the first study on SST to include a follow-up assessment one year after start of the training in the treated as well as in the control condition. With this follow-up, the long term effect of the SST can be examined. Another strength is the fact that many measures are incorporated in the study, amongst which standardized, international instruments. This may give insight into efficacy at various levels: from specific behaviours and skills to general social functioning in school. Furthermore, if one or both of the interventions show to be effective, the measures may help evaluate why some children improve and others improve less or not at all. Additionally, as recommended in previous studies [6,7,23] the current study has a large sample size (120 participants), in a homogeneous age range, uses a manualized protocol, takes place outside the United States, and involves multiple informants (parents, teacher and child).

A limitation of the study is that only the first assessment could be blinded. During the interventions (or care-as-usual) and at the second and third assessment all therapists, most interviewers, some observers, all children, all parents, and all teachers knew the treatment condition. Future research should aim at blinded interviewers and observers, however, this is very difficult in the setting of the current study as it will be in many other settings.

Implications for practice

Many parents ask for an SST for their child when they have received an ASD diagnosis and have learned about symptoms and forms of treatment. Additionally, many health care institutions provide SSTs because clinical impression indicates that such a treatment is valuable for a child with ASD. Due to the time-consuming character of SSTs for children, parents, and therapists it is very important to evaluate whether these trainings are effective and if so, for whom.

Additionally, in some of the SSTs parents and teachers are involved on top of the child sessions. In that case, they also invest their time, so information is needed on the added value of their participation for the efficacy of an SST and generalization of learned skills. Before the start of the current study, SSTs were already given in the participating child mental health centers, so the results of this study can be implemented directly.

Trial status

Participant recruitment started in May 2010 and was finished in September 2013. Currently, in May 2014, all participants have been randomized and completed assessments at T1 and T2. The measurements in the last groups for T3 will take place in summer 2014.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

VD and AdB drafted the manuscript, EJM, MHN, MET added to and modified the manuscript. All authors read and approved the final manuscript. MHN, EJM and AdB developed the study. MHN, EJM, VD and AdB contributed to the further development of the intervention protocols used in the study, which were based on a protocol initially developed by therapists at Accare. (Barbara van den Hoofdakker, Lianne van der Veen, Sjoukje van Warners, and Leonieke Vet). MET contributed to the statistical underpinning of the study, including sample size calculation and statistical analyses.

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CLINICAL PSYCHOLOGY REVIEW

Social incompetence in children with ADHD: Possible moderators and mediators in social-skills training

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Abstract

Children with attention-deficit/hyperactivity disorder (ADHD) often encounter problems in social interactions with peers and are confronted with peer rejection and social isolation. The most common approach to social problems in children is social skills training. This intervention concept represents a variable mixture of cognitive-behavioral intervention elements. In this article the outcome of social skills training (SST) for children with ADHD is reviewed. Four experimental SSTs are detected and analyzed for potential mediators and moderators of treatment efficacy. Candidate mediators (social cognitive skills, parenting style and medication-induced reduction of key symptoms) are discussed within an empirical and theoretical context. Candidate moderators (subtype, comorbidity, gender and age) are evaluated for their empirical support. It is argued that, although fragmented, there is ample evidence and knowledge to adapt the SST-paradigm towards the specific needs of children suffering from ADHD and to guide future research towards more effective, "well established" interventions.

Keywords: ADHD; Children; Social skills training; Review; Moderators; Mediators

1. Introduction

Children with attention-deficit/hyperactivity disorder (ADHD; American Psychiatric Association, 1994) persistently display levels of activity that are far in excess of their age group; they are unable to sustain attention, interest, and persistence to tasks as well as to interactions with peers, and their self-regulation lags far behind expectations for their developmental level. Children with ADHD often suffer from comorbid disorders, such as oppositional-defiant disorder, conduct disorder and internalizing disorders (Barkley, 2003).

Children with ADHD are very likely to be impaired in the social, academic, familial, and, later, occupational domains of life (Barkley, 2003, for an extensive review). Among the diverse symptom pictures evidenced by children with ADHD, severe social incompetence and peer relationship difficulties play a prominent role (Kolko, Loar, & Sturnick 1990; Landau & Moore, 1991; Pelham & Bender, 1982; Van der Oord et al., 2005). In the DSM IV (APA, 1994), these problems are characterized as frequent shifts in conversation, not listening to others, initiating conversations at inappropriate times, frequently interrupting or intruding on others, and clowning around. Also, children with ADHD

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display high rates of off-task, disruptive, noisy and rule-violating behavior (Landau & Moore, 1991) making them vulnerable to social rejection (Guevremont & Dumas, 1994). It takes normal children about 30 min and a few social exchanges to classify the child with ADHD as disruptive, unpredictable, and often also aggressive and to react to them with criticism, rejection and withdrawal (Milich & Landau, 1982; Pelham & Bender, 1982; Pelham & Milich, 1984). Bagwell, Molina, Pelham, and Hoza (2001) found that the social problems in children with ADHD are still highly salient in adolescence.

Adequate social functioning and healthy peer relationships are considered a primary condition for children's optimal development (Parker & Asher, 1987). In general, social impairment is a significant predictor of an adverse long-term outcome in adolescence (Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997; Greene et al., 1999). Therefore, social incompetence is a serious debilitating condition.

In answer to the pressing need for intervention, social skills training (SST) has become a widely accepted treatment in clinical practice (Mrug, Hoza, & Gerdes, 2001; Nixon, 2001). SST has been demonstrated to be effective in improving social functioning for aggressive and antisocial children (Webster Stratton, Reid, & Hammond, 2001). However, for children with learning disabilities, children with ADHD and children with internalizing disorders results are less positive and mixed (see Forness & Kavale, 1996; Kolko et al., 1990; Tiffen & Spence, 1986). Researchers have not found compelling evidence that social skills learned in treatment, generalize to the home and the classroom (DuPaul & Eckert, 1994), and long-term effects have not been established (Beelman, Pfingsten, & Lösel, 1994). Pfiffner and McBurnett (1997) stated that for children with ADHD there is a lack of controlled outcome studies and that it is doubtful whether SST is an effective treatment for their social difficulties.

The aim of this article is to review SST-outcome studies for children with ADHD, which are published after 1994. First, we will evaluate SST-outcome studies. Second, we will analyse efficacious treatments to detect mechanisms (mediators) that are hypothesized to cause therapeutic change. Third, the treatment-outcome studies will be analysed for factors that are hypothesized to moderate therapeutic change. Moderating factors and mediating mechanisms will then be discussed in the context of empirical evidence and theories about the nature and causes of social problems in children with ADHD. Finally, directions for clinical practice and future research will be discussed.

2. Method

In this review we follow the guidelines provided by the Division 12 (Clinical Psychology) Task Force on Promotion and Dissemination of Psychological Procedures (1995) to determine efficacy status of an intervention. An SST is 'well established' if its efficacy is supported by two independently conducted randomized controlled trials (RCT), if the SST proved superior to active control conditions, and if the SST has been manualized. An SST can be labeled 'probably efficacious' if two RCTs have proven its efficacy by comparing the SST to a waiting list condition or when the SST proved efficacious in only one RCT compared to an active control condition. SSTs that do not meet these standards are considered to have an experimental status.

The computer databases, PsycInfo and Medline, were used for a search with the keywords: social competence, social skills, and social behavior in combination with ADHD and intervention and efficacy/effectiveness. Next, we scrutinized reference lists and bibliographies from research reports and used several keyword search routines to identify other group comparison studies. The following criteria for inclusion were applied: (1) studies were published between January 1, 1995, and January 1, 2005, (2) children had a primary diagnosis of ADHD, (3) the SST was described in a manual, (4) the treatment content focused on social functioning, (5) the treatment outcome could be related to the SST. This last criterion resulted in the exclusion of multimodal intervention programs in which the SST was part of a variety of empirically based behavioral components as in the Summer Treatment Programs of the MTA study (see MTA Cooperative Group, 1999; Pelham et al., 2000). Although multimodal treatment programs of ADHD are excluded in our review their results will be discussed if relevant to the social incompetence of children with ADHD. If SST was part of a multimodal treatment, but the specific effects of the SST could be examined (as in the study by Abikoff et al., 2004), the study was included in the present review.

3. Results

No review articles on SST in children with ADHD were found. Six intervention studies were selected, which are summarized in Table 1. All studies used a controlled design, gave a detailed description of the population and

Table 1
SST outcome studies for children with ADHD

Design	Participants *N*	Inclusion criteria	Treatment condition	Treatment outcome	Treatment outcome measures
Abikoff et al., 2004, random assignment	103: 34: methylphenidate (mph) 34: mph+MPT8* 35: mph.+peer activities age: 7–9;9 years *Multi Psychosocial Treatment	ADHD diagnosis positive reaction to mph	1 year weekly, 2nd year monthly mph only mph+MPT+SST mph+MPT+peer activities	effective for all 3 treatment groups effects maintain 1 year posttest no additive effect of psychosocial treatments	SSRS: parent and child form TOPS observations
Tutty et al., 2003, random assignment	100: 75 male–25 female 34: ADHD-C 25: ADHD-I: 41: active control age: 5–12 years mean age: 9;3 (S.D. 1;9)	DSM IV: ADHD DuPaul's ADHD rating scale parent and teacher ratings	8 weeks: SST parents sessions control condition is standard care: medication management by telephone	SST effective for ADHD parent ratings improvement parental discipline strategies Posttest and 3 months follow-up: no effect for teacher ratings, no differences between DHD-I and AHDH-C	DuPaul's child attention profile DuPaul's ADHD Rating scale
Antshel and Remer, 2003, stratified: gender, education, comorbidity before randomization	120: 90 male–30 female 59: ADHD-I 61: ADHD-C 53: comorbid ODD mean age: 9;6 (S.D. 1;1)	DSM IV: ADHD CBCI:>1 S.D. Attention scale	8 weeks:SST 3 parent sessions control condition: w.l.	significant effect for treatment groups: SSTS-assertion skills parent and child form sign more effect for ADHD-I posttest and 3 months follow-up: covarying ODD: sign. group effect: parent SSRS assertion, cooperation, responsibility child SSRS: self-control, empathy	CBCL, DICA-RP, SSRS
Miranda and Presentacion, 2000, stratified randomization unclear	32: 25 boys –7 girls 16 : ADHD 16:ADHD/ODD 8 ADHD+8 ADHD/ODD: Stop and Think 8 ADHD + 8 ADHD/ODD Stop and Think +anger control Age: 9–12 years	>15 Abb. Connors RS Parents >16 DSM III parents interview IQ>80 No psychosis, no gross neurological, sensory or motor impairment >7 aggression Iowa Scale	18 sessions SST/CBT: "Stop and Think" "anger control"	Posttest and follow up 2 months: sign. effects for both treatments Parents reported less: antisocial behavior, school problems, psychopathological disorder, internalization problems Teachers reported less: learning problems, antisocial behavior, more: school adjustment, self-control In general: effect for ADHD superior to ADHD/ODD Treatment differences: combined program is superior: Antisocial behavior, social adjustment in the ADHD + aggression group	Hyperactivity questionnaire scale of behavior problems EPS Abb. Connors Rating Scale IOWA Connors TRS problems inventory school IPE hyperactivity, aggression, self-control Rating Scale social skills assessment: teacher form

				In the single treatment condition anxiety increased In the combined treatment anxiety decreased.	
Pfiffner and McBurnett, 1997, randomization within gender	27: 19 male–8 female	extreme scores: CLAM and SNAP	for 8 weeks:	SST-only and SST + PM	SSRS: Parent and Teacher form
	9: SST	T-score >60 CBCL Attention	SST-only	both effective; no superiority: increase in appropriate soc. skills	test of social skill knowledge,
	9: SST + Parent Mediation	DSM-III-R: ADHD and UADD	SST + parent training	decrease in parents problem-behavior score (post and follow up)	CLAM, SNAP-R, CBCL, TRF
	9: waiting list	disturbed peer relations	controls: w.l.	increase in social skill knowledge (post test)	consumer satisfaction questionnaire
	age: 8–10 years			SST-PM: improvement Teacher Social skills measure SST-only: improvement Teacher rated problem behavior score Improvement in soc. skills knowledge 3 months follow-up: decrease in problem behavior score was maintained	
Frankel et al., 1997, assignment unclear, child and parent treatment both manualized	73: 37 male–12 female	peer problems/	SST for 12 week	treatment group sign better than w.l.:	SSRS: attention and self-control
	mixed groups: 47: ADHD	problems making friends ADHD (using Methylph.)	12 parent sessions control condition: w.l.	parent SSRS: self-control, assertion teacher: aggression, withdrawal only for no-ADHD	PEI teacher form
	26: no ADHD 24: ADHD/ODD	ODD based on DSM-III-R ADHD clinic parent interview		no group × diagnosis interaction effect no interaction effect for comorbid ODD	
	age: 6, 11–12, 11 years			no follow-up	

Methylph. = methylphenidate, MPT = multimodal psychosocial treatment, SST = social skills training, /CBT = cognitive behavior therapy, w.l. = waiting list, ADHD = attention-deficit/hyperactivity disorder, ADHD-I = inattentive type, ADHD-C = type, ADD/H: attention deficit disorder with hyperactivity, UADD = undifferentiated attention deficit disorder, ODD = oppositional defiant disorder, SSRS (Social Skills Rating Scale; Gresham & Elliott, 1990), TOPS (teachers taxonomy of problem situations, Dodge, McClaskey, and Feldman, 1985), DuPaul's ADHD Rating scale for parents and teachers/Child Attention Profile [CAP] (DuPaul, 1990), CBCL (Child Behavior Check-List; Achenbach, 1991a; Attention = attention scale), Teacher Rating Form (Achenbach, 1991b), DICA-RP (Diagnostic Interview for Children and Adolescents, revised for parents; Reich, 2000), test of social skill knowledge (Pfiffner & McBurnett, 1997), CLAM (Swanson, 1992), SNAP-R (Swanson, 1992), Consumer Satisfaction Questionnaire (Pfiffner & McBurnett, 1997), Stop and Think (Kendall, Padover, & Zupan, 1980), anger control (Braswell and Bloomquist, 1991), Abbreviated Connors Rating Scale and Connors Abbreviated Symptom Questionnaire (Connors, 1975), DSM-III-R (American Psychological Association, 1987), Wechsler Intelligence Scale for Children (Wechsler, 1980), Iowa Connors Teachers Rating Scale (Loney and Milich, 1982), Hyperactivity Questionnaire (based on the DSM III R-criteria, APA, 1987), Scale of Behavioral Problems (EPC; Navarro, Piero, Llacer, & Silva., 1993), Problems Inventory in the School (IPE; Miranda, Martorell, Llancer, Peiro, & Silva, 1993), Self-Control Rating Scale (Kendall & Wilcox, 1979), Social Skills Assessment Teacher Form (adapted from Goldstein, 1988), ADHD Clinic Parent Interview (Barkley, 1991), PEI (Pupil evaluation Inventory; Pekarik, Prinz, Liebert, Weintraub, & Neil, 1976).

Table 2
Type of interventions in SST outcome studies for children with ADHD

	Didactic methods	Skills	Cognition	Emotion	Parents/Teachers
Abikoff et al., 2004*	modeling	basic social skills	problem solving		reinforcement strategies
	role-play	getting along with others			daily school report card
	video-interaction analysis	conversation skills			
Active control		no social skills training Tasks and play with peers			
Tutty et al., 2003	modeling	listening skills	anger management	expression of	psycho-education
	group feedback and discussion	friendship skills	self control	feelings	video demonstration
	role-play video demonstration homework		self esteem		supporting friendship
Antshel and Remer, 2003	instruction	sharing	perspective taking	recognizing anger	psycho education about: course methods skills
	modeling	assertiveness	problem solving	controlling anger	homework support
	role-play	giving and receiving compliments			
	coaching	give and receive complaints			
	homework	accepting negative consequences			
Miranda and Presentacion, 2000, **	discussion	self-instruction skills'	problem solving	recognizing own feelings	
	modeling	relaxation techniques	reflecting on consequences	recognizing feelings of others	
	behavioral contingencies		recognizing thoughts	identification of anger cues	
	psycho-education	calming self statements	identification of thoughts of others	anger control	
	role-play				
Pfiffner and McBurnett, 1997	instruction	playing together getting along skills	problem solving	recognizing emotions psycho education about:	
	symbolic and in vivo modeling	accepting consequences		dealing with feelings	course content
	role-play	assertiveness		dealing with anger	type of skills
	rehearsal	handling provocation			reinforcement techniques
Frankel et al., 1997	behavior rehearsal	conversation techniques			evaluation of child's homework
	coaching	playing together/getting along			psycho-education about: course skills
	homework	giving compliments and criticism			

applied interventions according to a treatment manual. Five studies reported positive treatment effects for the SST. In the Abikoff et al. (2004) study positive outcomes were attributed to methylphenidate and not to the SST. None of the efficacy studies were replicated either by an independent research team or by the same investigators. Thus,

Table 2 (*continued*)

	Didactic methods	Skills	Cognition	Emotion	Parents/Teachers
	reinforcement: verbal and token	negotiating and persuasion skills			reinforcement techniques supporting play dates
		change activities supporting play dates handling teasing handling confrontations with adults coaching play of others handling unjustified criticism			

*Abikoff et al. (2004): adaptations of Getting Along With Others; Teaching Social Effectiveness to Children Program (Jackson, Jackson, & Monroe, 1983), ACCEPTS Program (Walker et al., 1983).

**Miranda and Presentacion (2000): Stop and Think program (Kendall et al., 1980); adaptation of anger control techniques (Braswell & Bloomquist, 1991).

none of these interventions can be classified as "well established" (Task Force on Promotion and Dissemination of Psychological Procedures, 1995). The aforementioned interventions can also not claim to be "probably efficacious" for various reasons. In two studies (Frankel, Myatt, Cantwell, & Feinberg, 1997; Miranda & Presentacion, 2000), it is not clear whether participants were randomly assigned. Three SSTs were tested in studies that used a waiting list control condition (Antshel & Remer, 2003; Frankel et al., 1997; Pfiffner & McBurnett, 1997) and no active control condition. In the study by Tutty, Gephart, and Wurzbacher (2003) specific social outcome indices are absent. So from this study it cannot be concluded if the SST is efficacious in improving social competence. Therefore, the SSTs all carry an "experimental" status. Before we turn to an analysis of the treatment contents there are some issues to address. The studies reported in this review are difficult to compare, as they not only differ in treatment content and treatment intensity, but also in research focus. Abikoff et al. investigated the additive effects of psychosocial treatments (including SST) to methylphenidate and found equally positive effects in all conditions. These positive effects were attributed to the common factor: methylphenidate. Tutty et al. compared the SST results of different subtypes of ADHD and found no differences in efficacy between children with ADHD-I (predominantly inattentive type) and ADHD-C (combined type). Antshel and Remer made similar comparisons and added a group of children with comorbid ODD. They found that children with ADHD-I profited more from the SST than children with ADHD-C. Moreover, for children with comorbid ODD results were less positive than for children with ADHD without comorbidity. Also in the study of Frankel et al. treatment-outcome was compared for children with ADHD and ADHD/ODD. As no interaction effect between group and diagnosis was found, the authors concluded that all participants improved as a result of the treatment. Miranda and Presentacion aimed to examine the additive effect of an anger control intervention for children with ADHD and comorbid ODD. They compared two active treatments, SST only and SST plus anger control treatment. Both treatments were effective, but the combination treatment was more effective for children with ADHD/ODD. In the Pfiffner and McBurnett study, the focus was on the additive effect of a parent training and it was found that the SST only and the SST plus parent training yielded similar positive results.

It can be concluded that in four studies (Antshel & Remer, 2003; Frankel et al., 1997; Miranda & Presentacion, 2000; Pfiffner & McBurnett, 1997), SST improved aspects of social functioning in children with ADHD. The SSTs in these four efficacy studies have an experimental empirical status. Considering the need for well-established SST for children with ADHD much can be gained by adapting research designs (randomization, active control conditions and relevant outcome measures) and replication of promising studies. Next to that, impact of SSTs can improve by combining the most effective treatment components. In the next paragraph we will analyze the SSTs and deduct what components are shared and possibly related to positive social outcomes.

Table 2 summarizes components of the SSTs that are evaluated in the studies reviewed above. The SSTs of Antshel and Remer (2003), Tutty et al. (2003), Miranda and Presentacion (2000), and Pfiffner and McBurnett (1997) contain a variety of interventions encompassing behavioral (i.e., social skills training), and cognitive behavioral elements (i.e., problem solving, recognizing and dealing with emotions). The SST of Frankel et al. (1997) and Abikoff et al. (2004) both contain mainly behavioral techniques. Frankel et al. found skills training efficacious for all participants, i.e.,

children with and without ADHD and children with and without comorbid ODD. This finding is contrary to the outcome of the studies of Miranda and Presentacion and of Ansthel and Remer. These studies found differential effects of the SST for ADHD-subgroups and comorbidity (see Table 1.).

Parents were involved in all reviewed SSTs, except in the study of Miranda and Presentacion. Parent programs contained psycho-education and information about the children's treatment. Two parent programs also focused on stimulating friendships with peers. Only Pfiffner and McBurnett (1997) explicitly evaluated the efficacy of parent interventions. They reported limited additive effects (more positive effects on some teacher ratings) (see Table 1.). Apart from marking a daily report card (Abikoff et al., 2004) teachers were not involved in the SSTs of this review.

In conclusion, four efficacy studies (Antshel & Remer, 2003; Frankel et al., 1997; Miranda & Presentacion, 2000; Pfiffner & McBurnett, 1997) found positive effects of SST for children with ADHD, and these interventions have an experimental empirical status. The SST in three studies (Antshel & Remer, 2003; Miranda & Presentacion, 2000; Pfiffner & McBurnett, 1997), was a multi-component program. The behavioral intervention (skills training) of the Frankel et al. (1997) study also yielded positive, yet undifferentiated, results in a mixed diagnosis population. From this review we cannot deduct what the necessary components are of effective SSTs for children with ADHD. This knowledge is, however, crucial for the development of "well-established" treatments (Kazdin, 2000). Mechanisms of change are based upon a theory about the causes of the problem and/or the way problems are maintained. Therefore, in the next paragraph, we will relate the SST components (see Table 2) to their conceptual base.

4. Conceptual basis of SST components

Social problems can be viewed as the result of inadequate performance on developmental social tasks such as "interacting with peers." This inadequate performance can be labeled as "socially incompetent" (Dodge, 1985; Gresham, 1986). According to the social skills deficit model a socially incompetent child lacks the appropriate skills to perform adequately on a given social task. From a treatment perspective this implies that a socially incompetent child needs a social skills training. Within the skills approach, a distinction has been made between acquisition deficits and performance deficits (Gresham, 1997). Children with an acquisition deficit lack particular skills in their behavioral repertoire. Children with a performance deficit possess adequate skills but fail to apply them in specific social situations.

The social skills deficit model covers the behavioral part of social incompetence. There is, however, also a wide range of cognitive and emotional factors that determine social responding (see Spence, 2003). The cognitive approach to social incompetence focuses on maladaptive and irrational thought processes underlying incompetent social behavior. Errors in different phases of social information processing (e.g., encoding of cues, interpretation, response generation and selection, and evaluation of the response) have been linked to social incompetent and inappropriate behavior (Crick & Dodge, 1994). For example, aggressive boys have been found more likely to attribute hostile intentions to a neutral actor (Orobio-de-Castro, Veerman, Koops, Bosch, & Monshouwer, 2002) and are more confident to respond with an aggressive action than nonaggressive boys. Kendall and Morris (1991) argue that it is important to differentiate between cognitive deficencies (such as the failure to activate planned and systematic thinking, typical for children with ADHD) and cognitive distortions (e.g., hostile attribution of intent described above for aggressive children). Examples of cognitive interventions are "problem solving" interventions based on the work of Spivack and Shure (1974), the "problem solving" theory of D'Zurilla and Goldfried (1971), and the self-control and stress inoculation approaches which originated from the work of Meichenbaum (1977).

The question is how these conceptualizations of social problems are related to conceptualizations of the social problems of children with ADHD. Starting with the social skills deficit model, this model does not seem to fit the extensive variation in clinical symptoms in the ADHD population. Wheeler and Carlson (1994) suggested that children with ADHD are well able to perform social skills, but fail to do so in specific situations. Their performance deficits result from a range of affective factors, cognitive deficits, or from competing/interfering problem behaviors such as inattention and impulsivity. Thus, the social skills deficit model is too limited to represent the social problems in children with ADHD and, consequently, the skills training approach also well.

Cognitive factors may play an important role in understanding social inadequate and inappropriate behavior. However, little is known about the cognitions involved in social incompetence in ADHD. Matthys, Cuperus, and Van

Engeland (1999) investigated social information processing variables in children with ADHD and found that they encoded fewer cues in social situations and generated fewer responses to video-cued social situations compared to normal children. The children with ADHD and comorbid ODD/CD tended to select more aggressive responses than normal controls and were also more confident that they would be successful in performing this anticipated aggressive reaction. Whalen and Henker (1985) found ADHD children to perform as well as normal controls when they had to evaluate the effectiveness of solutions for hypothetical social problems. However, the children with ADHD performed less effectively when they had to generate their own solutions. Melnick and Hinshaw (1996) found that the social goals of ADHD and normal boys differ, in that the ADHD boys, particularly those with high levels of aggression, tended to seek domination and 'trouble-making' to a greater extent than normal control boys. It appears that children with ADHD make specific cognitive errors in various stages of social information processing calling for cognitively based therapeutic approaches to their social problems.

Emotional factors play a crucial role in social interactions. Emotional deregulation is hypothesized to be responsible for the disruption of the smoothness of the ongoing stream of social interactions, reciprocity, and cooperation (Whalen & Henker, 1992). Barkley has introduced a model that conceptualizes ADHD as a deficit in behavioral inhibition, leading to dysfunction in executive neuropsychological abilities such as emotion-regulation. The executive system may have evolved to support social activities such as reciprocal exchange and altruism, imitation and vicarious learning, self-sufficiency and innovation, and social self-defense (Barkley, 2001). High and low levels of emotional expressivity can be associated with reactive and effortful control. The latter two are key concepts in developmental psychopathology theories. Reactive control is thought to have a biological basis and is an aspect of temperament. The development of effortful control is linked to the development of conscience and empathy and to psychopathology and maladjustment (e.g., ADHD) (Eisenberg, Fabes, Guthrie, & Reiser, 2000; Kochanska, 1997; Kochanska, Murray, & Harlan, 2000; Krueger, Caspi, Moffitt, White, & Stouthamer Loeber, 1996; White et al., 1994). Effortful control, self-control and emotion regulation are therefore conceptually closely related to theories about social dysfunction in ADHD, and to the key mechanisms in stress-inoculation training, problem solving and self-regulation interventions.

In conclusion, cognitive behavioral interventions (problem solving, emotion regulation, and self control) are linked by theory and empirical evidence to the specific social inadequacies accompanying ADHD.

5. Candidate mediators

In this paragraph we will discuss what processes possibly mediate therapeutic change in SST. Technically, a potential mediator has to be measured during treatment, must correlate with treatment choice and has a main or interactive effect on the outcome (see Kraemer, Wilson, Fairburn, & Agras, 2002). Mediators should be measured during the course of SST or should reflect change in the target behavior during the period of intervention. In none of the reviewed studies an analysis of mediating mechanisms was performed. Therefore, we will analyze the components of SSTs that were found to be effective in this review to detect potential mediators.

5.1. Improved social cognitive skills mediate improved peer relations

The main focus of all SSTs is improving social behavior through the training of social skills. The skills training is part of all SSTs in the present review. Children with ADHD may not profit from skills training in the way other socially incompetent children do. In children with ADHD, the social problems not merely result from lack of social and problem-solving skills, but rather from a failure to perform those social skills when needed (Wheeler & Carlson, 1994). This performance failure may be caused by emotional deregulations and the inability to control boisterous and aggressive behavior. Support for this notion comes from the finding that SST was more effective for the ADHD-I group than for the ADHD-C group (Antshel & Remer, 2003). The ADHD-I group (with its key symptom inattention) is thought to suffer from skill knowledge deficits rather than from performance deficits (Wheeler & Carlson, 1994) but their social behavior is not determined by hyperactivity and lack of emotional control. So this subgroup could profit more from skills-interventions than the ADHD-C group. The hypothesis that the underlying mechanism of social problems in all children with ADHD is a lack of skills (i.e., social skills, problem solving skills) needs specification.

Theory and empirical data—Bierman and Welsh (2000) conceptualize social competence as an organizational construct that reflects the child's capacity to integrate behavioral, cognitive, and affective skills to adapt flexibly to

diverse social situations. The rationale of SST is that improved social competence will result from learning more adequate social behavior. This behavior in return will be reinforced by the positive reactions of peers, leading to an increase in socially adapted behavior. However, this response-reinforcement cycle can be expected to take time and persistence and both might be a problem for children with ADHD. Children are not likely to provide contingent positive reinforcements to each other. For children with ADHD it has been found that reinforcements for desired behavior need to be applied immediately and explicitly in order to be effective. Moreover, it is quite possible that the supposed reinforcement mechanism is counteracted by the so called "wake effect" (Taylor, 1994). This effect refers to the finding that it may take a year or longer for children to undo a bad reputation and it might take a long time before socially adequate behavior is met with positive peer reactions. Overall, the social skills-deficit theory for social incompetence seems to have little in common with recent theories and knowledge about ADHD. Self-control in general and the control of aggression specifically (key mechanism in the stress-inoculation, problem solving and self-regulation interventions) are conceptually more clearly related to theories about social dysfunction in ADHD (see paragraph on conceptual basis of SST and social problem of ADHD) than the social skills-deficiency theory.

5.2. Effective parenting mediates socially competent behavior

Another potential mediator of SST outcome is the style parents use to discipline their children. In five of the seven intervention studies in this review some form of parental involvement was stimulated. Antshel and Remer (2003) included three parent sessions in which parents were provided with information about their child's SST and were instructed in guiding their child's homework completion. In the Frankel et al. (1997) study SST was combined with 12 parent sessions. In these sessions, parents were educated about ADHD and the contents of the SST of their children and they were taught contingency-management techniques to influence their child's behaviour at home. Reinforcement strategies were also part of the interventions in the Abikoff et al. (2004) study. Only in the Tutty et al. (2003) study parents were encouraged directly to stimulate friendships. In none of the studies reviewed was the possible additional value of the parental involvement assessed. Only Pfiffner and McBurnett (1997) investigated the additive value of parental programs by comparing a SST-child-only with a SST-plus-Parent-Mediated-Generalization-program. They found no differences in efficacy between the two programs. In fact the results were slightly more positive for the SST-child-only group (see also Barkley et al., 2000). Hinshaw et al. (2000) undertook a hypothesis-driven approach to mediator analyses in the MTA-study, positing that improvement in parenting style during the course of active child-intervention would mediate improvement in social skills and school-related externalizing behavior. Negative and ineffective discipline and positive parenting factors showed significant improvements as a function of MTA-treatments. The effects of the combined medication and behavioral treatment were positive for (teacher-reported) social skills and were mediated by reductions in negative and ineffective parenting (Hinshaw et al., 2000). The empirical evidence that parental disciplinary style and reinforcement strategies are working mechanisms in SST is lacking, but in a more comprehensive intervention program (for MTA treatments, see MTA, 1999) parental discipline style was mediating the positive effects on social behavior.

Theory and empirical data—The main reason to involve parents in SST is to stimulate parents to assist and encourage the child to practice the newly learned skills outside the therapy room. The rationale is that parents can provide direct and on-the-spot reinforcements for adaptive social behavior (Barton, Brulle, & Repp, 1986) and consequently, more socially adaptive behavior will mediate peer acceptance. Therefore, the hypothesized mediating mechanism is that enhanced parental effectiveness in contingency management of socially adaptive behavior will ultimately lead to an improvement in social contact with peers. However, it might be that the quality of the parent–child relationship itself serves as a ground for the child's social relationships with others. Interactions between parents and children with ADHD are influenced by the child's disruptive behavior. Negative parent–child interactions have been found predictive of conduct problems in school and society (Anderson, Hinshaw, & Simmel, 1994).

Negative child–parent interactions are observed already in preschool children with ADHD (Cohen, Sullivan, Minde, Novak, & Keens, 1983; DuPaul, McGoey, Eckert, & VanBrakle, 2001). With increasing age, degree of conflict in parent–child interactions lessens, but conflicts remain into later childhood (Barkley, Karlsson, & Pollard, 1985; Mash & Johnston, 1982) and adolescence (Barkley, Anastopoulos, Guevremont, & Fletcher, 1992; Barkley, Fischer, Edelbrock, & Smallish, 1991; Edwards, Barkley, Laneri, Fletcher, & Metevia, 2001). Presence of comorbid ODD is associated with the highest levels of interaction conflicts between parents and their affected children and adolescents (Barkley et al., 1991, 1992; Edwards et al., 2001; Johnston, 1996). The social exchanges of children with

ADHD are characterized by coercive patterns. Children with ADHD seem to "force" others by their disruptive and intense behavior into negative social exchanges. It has been demonstrated that the primary direction of effects within this interaction is from child to parent rather than the reverse (Fischer, 1990; Mash & Johnston, 1990). The same phenomenon has been observed in interactions with teachers and with peers (Whalen, Henker, & Dotemoto, 1980). Hinshaw, Zupan, Simmel, Nigg, and Melnick (1997) investigated the predictive influence of maternal parenting beliefs on sociometric ratings for children with ADHD. They found that authoritative maternal beliefs were predictive of positive peer regard. Authoritative beliefs involve clear, firm structuring and limit setting in the presence of warmth and responsiveness (Maccoby & Martin, 1983). In early attachment models sensitivity and responsiveness of parents/care givers are perceived as precursors of models of interpersonal relationships (Sroufe, 1986). Hinshaw and Melnick (1995) proclaim beneficial effects of authoritative parenting on the child's development of emotion regulation abilities. Thus, parenting style might be an important mediator in social outcomes in ADHD (see Hinshaw et al., 1997).

Obviously, parenting style encompasses more than parental effectiveness in reinforcing socially adapted behavior and supervising homework assignments. More comprehensive therapeutic approaches to ameliorate the quality of parent–child relationship might be more effective in influencing the social behavior of the child with ADHD.

5.3. Medication effects mediate socially adaptive behavior

The most powerful mediator of treatment outcome within the social realm might well be stimulant medication, as stimulant treatment reduces negative social behaviors (Hinshaw, Henker, Whalen, Erhardt, & Dunnington, 1989; Klein et al., 1997; Whalen, Henker, Collins, McAuliffe. & Vaux, 1979). These negative social behaviors can be directly related to the core symptoms of ADHD (Greene et al., 1996). Omnibus findings indicate that psychosocial treatments work for children and adolescents with externalizing disorders, but for ADHD, the preponderance of evidence points to the superiority of pharmacologic over psychosocial treatments, at least in terms of immediate reduction of core symptoms (Hinshaw, Klein, & Abikoff, 2002; MTA Cooperative Group, 1999). By administering stimulant medication the negative, talkative and generally excessive behavior of children is positively influenced. In return positive effects on directive and negative behavior of parents have been documented (Barkley & Cunningham, 1979; Barkley, Cunningham, & Karlsson, 1983; Danforth, Barkley, & Stokes, 1991; Humphries, Kinsbourne, & Swanson, 1978).

In the recent study by Abikoff et al. (2004), included in this review, 103 children with ADHD were assigned to three treatment conditions: methylphenidate alone, methylphenidate plus multimodal psychosocial treatment including SST, and methylphenidate plus multimodal psychosocial treatment in which the SST was replaced by an attention control treatment. Children in all treatment conditions improved over time on parent and teacher ratings of social functioning. There were no advantages for the group that received combined psychosocial treatment including SST and methylphenidate. These results are in line with the overall conclusions of the MTA-study (MTA Cooperative group, 1999). Both the Abikoff et al. study and the MTA-study showed a robust impact of methylphenidate condition, while intensive behavioral psychosocial treatment, including SST, did not add towards this effect. However, when the combined treatment methylphenidate-behavioral treatment was compared to intensive behavioral treatment alone, the combined treatment proved superior on teacher-rated social skills and parent–child relations (MTA Cooperative group, 1999) and on measures of good sportsmanship and peer negative nominations (Pelham et al., 2000). In the Abikoff et al. study there was a robust impact of methylphenidate in reducing negative social interactions, including negative interactions initiated by the treated children and those directed towards them. Children with ADHD and comparison children did not differ significantly on rates of positive social behavior at any point. Also, Whalen and Henker (1985) found that children with ADHD were similar to their peers with regard to the frequency of positive behavior such as cooperative play and positive verbal exchanges. Abikoff et al. suggest that measures of positive social behavior do not reflect social impairment of children with ADHD, because they do not lack positive social skills but excessively express disruptive behavior. In a study by Whalen et al. (1987), twenty-five boys with ADHD received a placebo or methylphenidate. In this study an improvement of the child's social status within his peer group was found. The improvement was medication-dose responsive. However, it was reported that improvements did not normalize peer appraisals.

Hinshaw et al. (1989) found that methylphenidate was effective in reducing noncompliance and physical and verbal aggression for boys with ADHD, but found no increases in neutral and positive social behavior. Smith et al.

(1998) assessed the social behaviors of 49 adolescents with ADHD during a Summer Treatment Program combining methylphenidate and psychosocial treatment. Multiple domains of social behavior were assessed within a psychosocial program containing classroom and study activities, therapeutic recreation, job periods and social skills and problem-solving training. After two weeks, methylphenidate was added to this comprehensive treatment program. Overall, there was a statistically significant positive effect of the medication on all social outcome measures over and above the initial improvements on social behavior as a result of the two weeks Summer Treatment Program.

In general, stimulant medication has been shown to improve the social behavior of children with ADHD in numerous short-term investigations (Hinshaw et al., 1989). It remains unclear, however, whether the positive effects measured on questionnaires and behavioral observations are reflected in enhanced peer acceptance and in better quality friendships. Moreover, it is not known whether improvements remain stable over time and what the effects on social behavior are when medication is terminated and core symptoms return.

Theory and empirical data—Genetic and neurological factors play an important role in the etiology of ADHD (Barkley, 2003). Neuropsychological theories of ADHD aim to describe functional brain deficits that underlie symptomatic behavior. These theories guide investigations of etiology as they provide links between behavior, cognitive processes and mechanisms, and neural systems (Zametkin & Rapoport, 1987). Neuropsychological theories of ADHD focus on executive functions and behavioral inhibition located in the frontal lobes of the brain. Neuropsychological tests of frontal lobe dysfunction are in general inconclusive about the cognitive and behavioral sequelae, except for what Nigg (2001, 2003) called "executive inhibition" and "motor inhibition." Barkley's (1997b) "behavioral inhibition" model of ADHD assumes that deficits in executive neuropsychological abilities (working memory, self-regulation of affect, motivation, and arousal) underlie behavioral deficits and disruptions in socializing. A link is assumed between executive functions and self-control (i.e., self-regulation and goal-directed behavior). Barkley (1997a) and colleagues (Barkley, DuPaul, & McMurray, 1990) propose that children with ADHD lack self-control and have a problem with regulating their emotions. There is some evidence that individuals who are either very high or very low in emotional expressivity are likely to be perceived by others as socially unskilled (Gottman, Katz, & Hooven, 1997; Halberstadt, Denham, & Dunsmore, 2001).

Self-regulation is also a key concept in the study of temperament in children. Regulatory processes such as approach, avoidance, and attention serve to modulate the reactivity of the individual (Rothbart & Derryberry, 1981). Reactivity represents a core feature in temperament modeling (Shiner, 1998). Nigg et al. (2002) found support for a relation between effortful control (a temperamental control system, Rothbart and Ahadi, 1994) and inattention–disorganization (ADHD symptoms). Nigg, Goldsmith, and Sachek (2004) stated in a recent review article on the relationship between child temperament and ADHD, that existing evidence consistently suggests that effortful control is a primary temperament domain involved in vulnerability to ADHD. The hypothesized neural substrate of effortful control is the same anterior prefrontal cortical region implicated in executive control and in ADHD (Barkley, 1997a). Effortful control is observed to develop in the second through fourth year of life (Rothbart & Ahadi, 1994). The development of effortful control is theoretically interesting, as it has been linked to the development of social behavior. The concepts of emotional regulation (inhibition theory, Barkley et al., 1990) and effortful control (temperament theory, Kohnstamm, Bates, & Rothbart, 1989) therefore appear closely related. Both concepts provide a framework for understanding social problems in children with ADHD. Both concepts assume a neurological basis and offer a way to explain psychopharmacological effects on social behavior in ADHD.

6. Candidate moderators

We have discussed processes, which may be involved in therapeutic change in SST interventions. In this paragraph we now will focus on factors (moderators) that influence treatment outcome. A moderator occurs prior to randomization and is a variable that alters the magnitude or even direction of the relationship between two other variables. If a baseline variable is differentially associated with treatment response across conditions, it serves as a moderator. A moderator can identify subpopulations with possibly different causal mechanisms or different courses of illness. Moderators can provide information to guide future restructuring of diagnostic classification and indications for treatment (see Hinshaw et al., 2002). In the SST-outcome literature we have reviewed, four potential moderators have been noted: ADHD-subtype, comorbid disorders, gender and age. These will be discussed in the following paragraphs.

6.1. Subtypes

Since the ADHD population is marked by a large variation in clinical symptoms, attempts to create more homogenous subgroups have resulted in three ADHD subtypes consolidated in the DSM-IV (APA, 1994): ADHD predominantly inattentive type (ADHD-I); the hyperactive and impulsive children without gross inattention (ADHD-H-I) and the combined ADHD type (ADHD-C). Social skills deficits are expected to vary across these subtypes. Antshel and Remer (2003) compared the effects of SST in diagnostically homogeneous and heterogeneous ADHD groups comprising children with ADHD-I and ADHD-C. Their preliminary results indicated that differences in clinical symptoms (I: inattention-only versus C: hyperactivity, impulsivity and inattention combined) moderated treatment outcome. The authors hypothesized that children with ADHD-I would benefit more from SST as they are less driven by oppositional defiant behavior, emotional regulation difficulties and performance deficits. Their results showed that children with ADHD-I indeed demonstrated a greater improvement on a measure of assertion than children with ADHD-C at post-treatment and follow-up assessments. In the study of Tutty et al. (2003), no differential treatment effects were found between ADHD-I and ADHD-C. However, as mentioned before, this study did not report results on social outcome measures and is therefore of limited value to this review.

Wheeler and Carlson (1994) suggested that children with ADHD-C merely show social performance deficits, whereas children with ADHD-I show deficits in both social performance and social knowledge. A child suffers from acquisition deficits when it lacks particular social skills in its behavioral repertoire. It suffers from performance deficits if it can perform the skill, but fails to do so in specific situations. As discussed above, performance deficits may result from a range of affective factors, cognitive deficits or distortions, or from competing/interfering problem behaviors. Inattention and impulsivity are such interfering problem behaviors that are presumed to mediate social knowledge deficits and performance deficits (Nelson and Hayes, 1979, as cited in Gresham, 1988). Maedgen and Carlson (2000) found that children with ADHD-C were less popular than normal controls, whilst children with ADHD-I were not. Parents of children with ADHD-I, however, rated the social performance of their children as more deviant compared to the ratings of children with ADHD-C. The ADHD-I children did not differ from normal controls on indices of emotional regulation and their behavior might therefore be less disruptive.

This would be in line with Barkley's (1997a) hypothesis that children with ADHD-I are not characterized by an inhibitory deficit. Based on these results, their social functioning appears more characterized by passivity and inadequate social knowledge (acquisition deficit) than regulatory deficits such as aggression. Recently, Santosh and Mijovic (2004) assembled seven aspects that cover social impairment and social interaction in a group of children and adolescents with the diagnosis Hyperkinetic Disorder (the ICD-10 diagnosis of ADHD). By conducting a factor analysis, two subtypes of social impairment could be distinguished. One subtype, 'Relationship difficulty,' was characterized by significant difficulties of the child relating to his family members and adults. This factor was associated with conduct disorders, affective symptoms and environmental stressors. The second subtype, 'Social communication difficulty,' was associated with speech and language problems, repetitive behavior and developmental difficulties, e.g., social communication difficulties commonly seen in autistic spectrum disorders. Santosh and Mijovic propose a resemblance between their 'Relationship Difficulty'-subtype and the social skill performance deficit in the Gresham model (1988) (see paragraph "conceptual models of SST"). The social communication difficulty resembles the acquisition/skills deficit in Gresham's model.

Few, if any, studies have specifically addressed subtype as an independent variable in intervention research (Pfiffner & McBurnett, 1997). According to Gresham, Sugai, and Horner (2001) most SST studies deliver a treatment with an almost complete disregard for the types of social skills deficits children may have. They conclude that most research fails to acknowledge whether children actually need to be taught the skills which are offered to them in standardized SST (Forness, Kavale, & Walker, 1999; Zaragoza, Vaughn, & McIntosh, 1991). It might well be that treatment specificity will enhance treatment effects for subtypes of ADHD.

6.2. Comorbidity

Few SST outcome studies treat comorbidity as an independent variable. However, some studies in the present review have defined comorbid disorders in the assessment phase (Frankel et al., 1997; Miranda & Presentacion, 2000;

Pfiffner & McBurnett, 1997). This reflects the authors' expectation that comorbidity may have an impact on the treatment results and therefore should be controlled for. Antshel and Remer (2003) found less proof of efficacy for children with comorbid ODD. Similar findings have been reported by DuPaul and Eckert (1994), Kavale and Forness (1996), Kolko et al. (1990), and Landau, Milich, and Diener (1998).

Presence of comorbid disruptive behavior disorders (Hinshaw, 1987) and internalizing disorders (Biederman et al., 1991; MTA Cooperative Group, 1999) has been well established in ADHD. The combination of ADHD with ODD appears to result in the highest levels of conflict, parental stress, and child behavioral problems within the ADHD population (Barkley et al., 1991, 1992). It is a matter of debate whether this is merely an additive effect of two separate childhood disorders or whether ADHD+ODD/CD represents a unique clinical population with a specific social profile (Jensen, Martin, & Cantwell, 1997). To answer this question, studies are needed which compare ADHD-only, with ADHD+comorbidity and the comorbid disorders without ADHD and controls. Matthys et al. (1999) conducted a study of this type investigating the Social Information Processing model of Dodge, Pettit, McClaskey, and Brown (1986). As stated above, they did find specific differences in cognitive aspects of social information processing between comorbid groups. Frankel and Feinberg (2002) also reported differential results in their study of social impairment of children with ADHD and ODD. Diagnoses of ADHD and ODD were both associated with decreased resistance to provocation from peers. However, children diagnosed with ODD tended to score lower on the "Respectful" subscale (subscale of the Self-control scale of the SSRS, Gresham and Elliott, in Frankel & Feinberg, 2002) as disrespectful behavior towards adults is a hallmark of ODD. For children with ADHD, the "Disruption" subscale score (subscale of the Aggression scale of the PEI) (Peccary, Prinz, Liebert, Weintraub, and Neale, 1976, in Frankel & Feinberg, 2002) was elevated, as expected, since disruptive behavior is a hallmark of ADHD.

The MTA study, unique for its large sample of children with ADHD, examined whether children with ADHD+ANX (anxiety), ADHD+ODD/CD, ADHD+ANX+ODD/CD and ADHD-only would show different clinical psychosocial profiles. Significant differences were established between the ADHD+ANX and ADHD+ODD/CD for parent-rated social skills (SSRS) (Jensen et al., 2001) at baseline. The social skills in the AHDH+ODD/CD group were rated at a lower level. More over an additive effect of comorbidity ADHD+ANX+ODD/CD was found for parent rated SSRS social skills. As for the moderating effect of comorbidity Jensen et al. found that the behavioral treatment exerted more effect (reflected in a higher rating from teachers for SSRS social skills) for the ADHD+ANX group.

Green, Gilchrist, Burton, and Cox (2000) distinguished different pathways to social dysfunction in ADHD. Oppositional behavior was a significant correlate of social dysfunction at school, in spare-time problems, problems with parents, and problems with peers. Anxiety emerged as a significant correlate of difficulties in peer interactions (spare-time activities, spare-time problems, activities with peers, and problems with peers).

In summary, ample evidence underscores the differences between children with ADHD and children with ADHD-ODD/CD and with comorbid anxiety. Differences are found in social cognitive functioning, in the nature of the disruptive behaviour, in the nature of the social skills deficits, and in the pathways leading to social problems. Comorbidity can therefore be considered a potentially strong treatment moderator.

6.3. Gender

In general, more boys than girls suffer from ADHD with a ratio of roughly 3:1 (Barkley, 2003). Research has shown that there are very few differences in the social profiles of boys and girls with ADHD. The only exception was that boys exhibited greater social impairment at school compared to girls with ADHD. Girls as well as boys appeared to have more severe symptoms when ADHD was accompanied by comorbidity (Greene et al., 2001). Girls may be more handicapped than boys in the social domain, because hyperactive and impulsive behavior is considered more deviant for girls than for boys (Carlson, Tamm, & Gaub, 1997). In two studies in the present review the girls were divided equally over the treatment groups (Antshel and Remer, 2003; Pfiffner & McBurnett, 1997). This suggests that it was expected that girls would react differently to the SST than boys. However, none of the reviewed studies elaborated on this assumption nor were gender differences reported in treatment results.

Nangle, Erdley, Carpenter, and Newman (2002) criticized social skills researchers for not paying enough attention to differences between boys and girls. Girls and boys do differ in the way they show aggression in social contexts. Boys show overt forms of aggression such as hitting and pushing, which are not commonly displayed by girls (Crick, 1996; Crick, Bigbee, & Howes, 1996). More indirect forms of violence are characteristic of girls (Björkqvist, Lagerspetz, &

Kaukian, 1992; Crick, 1995). These differences suggest that gender may be a powerful moderator of SST efficacy. However, as stated before, there is little evidence to support this assumption. Moreover, in the MTA study, gender was tested as a putative moderator, but was not associated with outcome in any of the four treatment conditions (Owens et al., 2003).

6.4. Age

Surprisingly little is known about age as a potential moderator in SST. Major age-related contextual factors that could be considered in social skills interventions include normative changes in socially appropriate behaviors, growth in cognitive capacities, and increasing rigidity in peer perceptions (Bierman & Montminy, 1993). Routinely referring to chronological age, as social skills researchers often do, makes little sense without also attending to the developmental level of the children (Nangle et al., 2002). In a meta-analysis of social intervention studies, Beelman et al. (1994) indeed found an interaction effect between age and general intervention characteristics such as mono-modal and multi-modal approaches. For children with ADHD, this information is currently not available. In the studies selected for this review, results are reported for primary school-aged children, mostly in the range of 8–12 years without any further differentiation, not even when the age range is as wide as 7 years, e.g., in the Tutty et al. (2003) study. Although it has been argued that specific early intervention efforts are needed for specific groups (Hudley, 1994; Hudley & Graham, 1993; Lochman, Coie, Underwood, & Terry, 1993; Middleton & Cartledge, 1995) to date there is little empirical knowledge to decide what approach is suitable for what age.

In summary, it seems clear that ADHD subtype and comorbidity are robust moderators that need to be systematically included in SST-research programs in order to assess their influence on treatment efficacy. Studies that do not distinguish between subtypes of ADHD and comorbid disorders may lack effectiveness because their interventions are not matched to the specific needs of the children. Gender and age might be important moderators but empirical data are sparse.

7. Discussion

In this review SST-intervention studies were evaluated for their efficacy in influencing social competence in children with ADHD. In four studies positive effects were found (Antshel & Remer, 2003; Frankel et al., 1997; Miranda & Presentacion, 2000; Pfiffner & McBurnett, 1997) and all four SSTs were found to have an experimental empirical status. A "well-established" intervention for the serious and persistent social problems in children with ADHD is not available and the development of such an intervention is sorely needed. In line with Kazdin's recommendations for improving treatments (see Kazdin, 2000), we analyzed SST efficacy studies in order to detect what SST components might be working mechanisms and what factors moderate the outcomes of SST.

Generally, SST is based on the social skills deficit model in which social problems with peers are conceptualized as either a lack of adequate skills in the child's behavioral repertoire or as a failure to apply skills adequately in specific social situations (Gresham, 1997). The social problems of children with ADHD cannot fully be understood as the result of a lack of social skills. They are associated with a wide range of cognitive and emotional deficiencies, including cognitive distortions in social information processing (Matthys et al., 1999), executive dysfunctions (Barkley, 2001) and emotional deregulations (Whalen & Henker, 1992). Therefore, cognitive behavioral interventions (i.e., problem solving, self-control, emotion regulation) are conceptually better linked to the social problems of children with ADHD than purely behavioral interventions.

After describing the SST components, we analyzed these components for their hypothesized mediator status and identified three potential candidates: increase in social skills, more effective parenting, and medication-induced reduction of key symptoms. It was found that the empirical and theoretical basis for the first candidate mediator was weak. Improvement in social skills appears not to be the mechanism of change, at least not for the majority of children with ADHD. ADHD covers a wide variation of symptom complexes and underlying mechanisms of social dysfunction can be expected to vary as well. The second candidate mediator, more "effective" parenting, is not supported by evidence from SST effect studies. However, in a mediator analysis of a comprehensive intervention program (MTA-study, see Hinshaw et al., 2000) negative and ineffective parental discipline were mediated changes in social skills. Possibly the scope of parent programs accompanying SST was too limited (the focus is to support the children's treatment) to significantly add to the effects of the child's SST. The empirical support for the third candidate mediator,

medication-induced reduction of key symptoms, however, seems strong (Abikoff et al., 2004; MTA cooperative group, 1999). The key symptoms of ADHD are held responsible for the failure to perform adequate social skills (Greene et al., 1996). Stimulant medication might influence social behavior indirectly by improving self-control and emotion regulation. This proposed mediating mechanism is consistent with the inhibition theory of Barkley (1997a). This theory provides a link between behavioral concepts (impulsivity, hyperactivity and aggression), neuropsychological concepts (attention and inhibition) and neurobiological systems on which stimulant medication is supposed to operate. However, this theory might not be comprehensive. Denney (2001) found that environmental features and task parameters cause variation in medication response. He argues that although biological variables represent important predisposing causes of disorder, they do not preclude the operation of contributory environmental influences that mediate intra- and inter-individual variations in symptom severity. Denney suggests that we therefore need a diathesis–stress conception of the ADHD syndrome. It will be crucial for such a theory to encompass explanations about the workings of stimulant medication.

Next to the question what ingredients in SST are most promising mediators for therapeutic change, we looked for factors that seemed to moderate these changes. Four potential moderator variables were discussed: subtype, comorbid disorders, gender and age. Distinguishing subtypes of ADHD proved to be a fruitful endeavor. Treatment effects differed between ADHD subtypes (Antshel & Remer, 2003) and research conducted by Wheeler and Carlson (1994) and Maedgen and Carlson (2000) has shown that different subtypes exhibit different social problem profiles. Comorbid disorders proved to be a factor of major influence on SST outcomes (Antshel & Remer, 2003). Especially, ODD is considered a comorbid condition that complicates intervention efforts (DuPaul & Eckert, 1994; Kavale & Forness, 1996; Kolko et al., 1990). The fact that in the study of Frankel et al. (1997) no moderating effect of comorbidity was found may be the result of the limited, mostly skills orientated, treatment content. However, this hypothesis needs further examination.

The next generation of social interventions needs to contain treatment components that are based upon theory and empirical evidence about ADHD. Research designs specifically need to address issues concerning subtypes and comorbidity. The studies of Miranda and Presentacion (2000) and Antshel and Remer (2003) provide illustrative examples as both studies report differential treatment effects for various symptoms complexes. Future research needs to further attend specifically to the factors gender and age because, the impact of these potential moderators might be considerable (Nangle et al., 2002) but have hardly been studied. Effective SSTs need replication in a design with active control conditions.

By summarizing and integrating a large body of knowledge about social functioning of children with this behavioral disorder, we hope to have cleared the path towards the development of well established SST for children with ADHD.

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