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Enhancing social outcomes in autistic youth: Assessing the impact of PEERS® booster sessions

Laura Maria Fatta^{a,b,*}, Dora Bianchi^b, Elizabeth A. Laugeson^c, Elina Veytsman^c,
Giovanna Romano^d, Fiorenzo Laghi^b, Maria Luisa Scattoni^a

^a Research Coordination and Support Service, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy

^b Department of Developmental and Social Psychology, Sapienza University of Rome, Via dei Marsi 78, 00185 Rome, Italy

^c University of California, Los Angeles, United States

^d Ministry of Health, Rome, Italy

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ABSTRACT

Background: The Program for the Education and Enrichment of Relational Skills (PEERS®) is a social skills training program for autistic adolescents and those facing social challenges. Its efficacy has been established worldwide, including in Italy. Although booster interventions are a potentially valuable strategy to maintain improvements over time, there is currently no research on the efficacy of providing booster sessions of PEERS® following the traditional treatment.

Aims: This study aims to evaluate the efficacy of PEERS® Booster sessions in a sample who had previously participated in a traditional PEERS® Adolescent program.

Methods and procedures: A longitudinal non-randomized study was conducted involving 21 autistic adolescents, divided into the treatment group undergoing PEERS® Booster sessions and the control group without it.

Outcomes and results: The study evaluated the primary outcomes (social abilities) and secondary outcomes (co-occurrences, executive functions) at two-time points (pre- and post-treatment). No significant differences were found between groups on baseline measures and primary outcomes. However, there were significant group differences between pre- and post-treatment on primary outcomes (social awareness and social communication) and secondary outcomes (externalizing problems).

Conclusions and implications: The efficacy of the PEERS® Booster Sessions shows promise and clinical implications were also discussed.

What this paper adds?

The evaluation of booster interventions is a scientifically significant field of interest, as booster programs have the potential to sustain gains over time, especially considering that social skills training (SST) programs typically have a limited time range. This study provides the first evidence supporting the implementation of a shortened, maintenance program using PEERS® within a sample that completed the traditional PEERS® for Adolescents program. Results suggest the promising efficacy of PEERS® Booster sessions across social functioning and emotional-behavioral outcomes, specifically in social awareness, social communication, and externalizing problems. However, the results should be compared with findings from other similar studies to

* Corresponding author at: Research Coordination and Support Service, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy.
E-mail address: laura.fatta@iss.it (L.M. Fatta).

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confirm the observed outcomes. Nonetheless, an intensive, shortened training of PEERS® represents a promising intervention option in various contexts, including for families in disadvantaged conditions, though this requires further investigation.

Data availability

Data will be made available on request.

1. Introduction

Autism Spectrum Disorder (ASD) is a heterogeneous and highly heritable neurodevelopmental disorder defined by two diagnostic criteria: difficulties in reciprocal social communication, and restricted, repetitive patterns of behaviors, interests, or activities (APA, 2013). Social competence is a multidimensional construct including specific verbal and nonverbal behaviors that lead to positive social interactions. Social competencies could be operationalized into two clusters: social knowledge and performance (Gresham, 1997). Difficulties in social knowledge refer to a lack of awareness of how to perform prosocial behaviors, while a deficit in social performance is linked with the difficulties of generalizing social interactions in daily life. Difficulties in navigating social interactions in neurotypical network relationships are common for autistic people, impacting friendships, romantic relationships, and workplace participation (Laugeson & Ellingsen, 2014). Noteworthy, better social skills correlate with higher self-efficacy and quality of life, which are protective factors against psychiatric co-occurring conditions (Mazurek, 2014). Social skills training (SST) targeting autistic adolescents and young adults is recommended in worldwide guidelines (National Institute for Health and Care Excellence [NICE], 2013; Italian National Institute of Health [ISS], 2023), and has established moderate (Gates, Kang, & Lerner, 2017) and large (Wolstencroft et al., 2018) effect sizes. The duration of SST programs typically varies, ranging from 5 weeks [MAX/Skillstreaming model] (Lopata, Thomeer, Rodgers, Donnelly, & Booth, 2020) to 20 weeks [START model] (Ko, Miller, & Vernon, 2018). Despite the recognized need for comprehensive ASD treatments that are adaptable to diverse formats and settings (Odom, Boyd, Hall, & Hume, 2014), there is a paucity of evidence regarding shorter versions of SST programs. While accelerated versions of traditional programs have been explored to some extent (e.g. Lopata et al., 2019; Marchica & D'Amico, 2016), research on SST booster programs for autistic individuals aimed at reinforcing skills acquired through conventional methods is lacking.

Booster sessions are additional sessions provided weeks or months after the conclusion of the traditional formal intervention, during which the main content of the intervention is reviewed. Based on cognitive-behavioral theory, booster interventions operate cognitively by enhancing the retention and memory of intervention concepts, and behaviorally by providing social reinforcement (Lochman et al., 2014). These aspects could play an especially important role for autistic adolescents, given the fact that the maintenance of skill acquisition over time is one of the critical issues found in intervention models for autistic individuals (Kasari & Locke, 2011). Moreover, these interventions are shortened and show promise in addressing common barriers that interfere with the accessibility of SST programs, such as the challenges faced by families in disadvantaged conditions in accessing clinical services and evidence-based interventions.

Randomized controlled trials (RCT) of booster interventions have been explored for children with behavioral problems. For example, Lochman and colleagues' (2014) study on a child-oriented booster abbreviated preventive intervention for Coping Power has been conducted, but conclusive results regarding efficacy are still elusive.

To our knowledge in the SST field for autism, the MAX/Skillstreaming model has been adapted from the traditional version to an accelerated format, specifically for school settings (Lopata et al., 2019) or summer camps (Thomeer et al., 2012). Additionally, an accelerated version of the *Program for the Education and Enrichment of Relational Skills* (PEERS®) for Adolescents has been evaluated. However, neither of these investigations included booster sessions in addition to the traditional programs.

PEERS® is distinguished as one of the most rigorously validated evidence-based, parent-assisted, group social skills training programs (Laugeson, Frankel, Mogil, & Dillon, 2009). The traditional PEERS® format consists of weekly 90-minute sessions, with concurrent parent and teen sessions administered in a small group format (8–10 participants) for a total of 14-weeks. The program aims to teach skills related to making and keeping friendships and handling peer conflict and rejection. The lessons focus on the following social skills: (1) trading information, (2) conversational skills, (3) electronic communication, (4) choosing appropriate friends, (5) appropriate use of humor, (6) peer entry strategies, (7) peer exiting strategies, (8) get-togethers, (9) good sportsmanship, (10) handling teasing, (11) handling physical bullying and changing bad reputation, (12) handling disagreements, and (13) handling cyberbullying and rumors and gossip.

Currently, the traditional PEERS® for Adolescents program (Laugeson & Frankel, 2010) includes over thirty RCT studies and one meta-analysis (Zheng, Kim, Salzman, Ankenman, & Bent, 2021). The meta-analysis on PEERS® for Adolescents provided evidence for the efficacy of the program in autistic youth with large effect sizes in the content knowledge (social knowledge), small to large effect sizes in the frequency of get-togethers with peers (social performance), and moderate to large effect sizes in overall social skills (Zheng et al., 2021). The maintenance and durability of treatment gains following the traditional PEERS® program were examined in a short-term follow-up (14-weeks; Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012) and a long-term follow-up study (1–5 years; Mandelberg, Frankel, Cunningham, Gorospe, & Laugeson, 2014). Laugeson et al. (2012) found that at a 14-week follow-up, maintenance of treatment gains in social knowledge, overall social skills, and social engagement remained with additional improvements in reduced externalizing behaviors and in overall social skills according to independent ratings from teachers unaffiliated with the program. Mandelberg et al. (2014) also found significant maintenance of treatment effects at a 1–5-year follow-up in all domains,

including overall social skills, social responsiveness, social engagement, and social knowledge.

PEERS® has also been adapted in different countries with minimal changes, obtaining similar findings compared to the original context (US). Cross-cultural validation trials have been conducted in East Asia (Yamada et al., 2020; Yoo et al., 2014; Shum et al., 2019), Canada (Marchica & D'Amico, 2016), Israel (Rabin, Israel-Yaacov, Laugeson, Mor-Snir, & Golan, 2018), and Europe, including the Netherlands (Idris et al., 2022), Poland (Platos, Wojaczek, & Laugeson, 2022), and a recently Italy (Fatta et al., 2024).

While booster SST interventions for autism, including PEERS®, have not been thoroughly evaluated, PEERS® has indeed been explored in an accelerated fashion both the US and other international contexts. In the Canadian adaptation, the traditional format was modified to include twice-weekly meetings for 7 weeks (Marchica & D'Amico, 2016). Another study compared the efficacy of the traditional 14-week PEERS® for Adolescents vs. the accelerated version (Matthews et al., 2020), which was held twice weekly for 7 weeks. Marchica & D'Amico (2016) observed significant overall improvements in social skills and the conflict measure (a proxy of social performance), with greater improvements at the follow-up assessment (7 weeks following treatment) compared to the post-intervention. Matthews et al. (2020) also reported enhancements in overall social skills and social knowledge in the accelerated PEERS® format. However, when comparing the traditional version to the accelerated version, no statistically significant differences were found. It is worth noting that both studies enrolled participants who had not previously attended any other social skills training program, including PEERS®. In other words, the results contribute to establishing the efficacy of the accelerated format of PEERS® but do not provide insights into whether it could be beneficial to sustain social skills already acquired by providing booster sessions in an accelerated fashion.

Thus, although PEERS® for Adolescents appears to work well in long-term follow-up assessments of autistic youth, demonstrating the sustained efficacy of the program, there is currently no available evidence about the efficacy and added benefits of “booster sessions” in autistic adolescents who have previously attended PEERS® training.

Clinical experience suggests that both parents and teens who have completed the traditional PEERS® for Adolescents program may require additional opportunities to practice the skills they have acquired. Acceptability measures from parents indicate that they are satisfied with the intervention and feel confident in their social coaching skills to support their children. However, at the same time, they also ask for more time to practice (e.g. platos et al., 2022). It is possible that for both teens and parents, the 14-week duration of the traditional PEERS® program may be perceived as a relatively short time to fully develop confidence in applying these strategies.

The present research aims to evaluate whether attending four two-hour PEERS® booster sessions, following the completion of the traditional PEERS® for Adolescent program, can contribute to maintaining previously achieved results in a sample of Italian autistic youth. The program was implemented via telemedicine for 21 autistic Italian adolescents, utilizing a longitudinal non-randomized design. Specifically, we evaluated the program's efficacy on primary and secondary outcomes by comparing the Treatment Group (TG) who attended PEERS® Booster sessions with the Control Group (CG), who did not participate in PEERS® Booster sessions. We hypothesized that there would be significant improvements at post-treatment in primary outcomes (RQ1), including overall social skills, social knowledge, and social performance, as well as secondary outcomes (RQ2), encompassing co-occurring psychiatric conditions (depression, emotional and behavioral issues), and executive functioning. These improvements were anticipated specifically for the TG and not for the CG.

2. Materials and methods

2.1. Design

This study aims to assess the clinical efficacy of “PEERS® Booster sessions”, as a short and intensive maintenance program designed to reinforce and enhance the durability of the social skills acquired in the traditional version of PEERS® within a sample of autistic youth. The design was a longitudinal non-randomized study where participants were recruited to take part in PEERS® Booster sessions six months after having completed the traditional PEERS®.

Participants were divided into TG and CG groups, based on their motivation to receive PEERS® Booster sessions in an accelerated fashion. However, both groups had previously completed the traditional 14-week PEERS® for Adolescents program.

Baseline data were collected before pre-treatment assessment, as part of the previous RCT study in which adolescents had participated (Fatta et al., 2024). Primary and secondary outcomes data was collected for both TG and CG at the 3-month follow-up in the traditional PEERS® program and was then included in the present study as the pre-treatment assessment (T0) of the PEERS® Booster sessions. Post-intervention data (T1) was collected at post-treatment for PEERS® Booster sessions for TG and as a second baseline for CG, who did not attend the Booster program. The present study adhered to the principles of the Declaration of Helsinki or comparable standards. The research and its procedures received ethical approval by Scientific and Ethics Committee of Department of Developmental and Social Psychology, Sapienza, University of Rome (Date: 09.25.2020/ No. 871). Informed consent was obtained from all participants included in the study.

2.1.1. Participants

Participants were recruited from a previous RCT study aimed to evaluate the efficacy of the traditional version of the PEERS® program in Italy in a clinical sample of autistic adolescents [$N = 37$; 29.7% ($n = 11$) females based on biological sex], aged 12–18 years (Fatta et al., 2024)

For the present study, as suggested in other PEERS® studies (Laugeson et al., 2009, 2012), the inclusion criteria were: (a) confirmed diagnosis of ASD - level 1, (b) fluency in the Italian language (both adolescents and parents), (c) social difficulties as reported by adolescents and parents, (d) motivation to participate, (e) no attendance at other social skills training programs in the past 12 months,

except for traditional version of PEERS®, (f) absence of neurological issues (i.e. epilepsy), neurosensory deficits (i.e. visual or auditory), and genetic syndromes (i.e. Down Syndrome, Fragile X Syndrome, sclerosis tuberosa), (g) absence of co-existing psychiatric disorders (i.e. schizophrenia, psychotic disorders, bipolar disorders) or co-occurring severe behavioral problems, and (h) absence of an intellectual disability. Confirmation of ASD diagnosis was made by the clinical staff of the local health services (Child Psychiatry Units) according to the criteria provided in the DSM-5 (APA, 2013), and supported by the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al., 2012). If necessary, the clinicians who made the diagnosis were contacted, to confirm the inclusion criteria and collect further data about the participant's verbal and total IQ. Verbal abilities were assessed with the Verbal Comprehension Index of the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV; Wechsler, 2004; Orsini, Pezzuti, & Picone, 2012), and IQ level was computed by the Total Score of WISC-IV. Only participants with a verbal comprehension score ≥ 80 and an IQ total score ≥ 70 were included in the study. Parents self-assessed autistic traits using the Autism Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Ruta, Mazzone, Mazzone, Wheelwright, & Baron-Cohen, 2012). Socioeconomic status (SES) was calculated by the Hollingshead Four Factor Index of Socioeconomic Status, which includes parents' biological sex, education level, employment, and marital status, live context, and allows defining four categories, as follows: very low SES (0), low SES (10 to 35), medium SES (40 to 65), and high SES (more than 70; Bellina et al., 2020).

Out of the original sample of 37 participants, 21 youth were included in the present uncontrolled study, exclusively based on their motivation to receive additional sessions of PEERS®, and consequently, to participate in PEERS® Booster sessions. Group allocation depended on the youth's motivation to attend the booster program, without randomization. The sample consisted of Caucasian adolescents with a clinical diagnosis of ASD level 1 (APA, 2013) ($M_{\text{age}}=17.3$; $SD_{\text{age}}=1.8$; age range=13.9–20.6), with 72% males ($n = 15$) and 28% females ($n = 6$) based on biological sex. The average age of participants was also calculated separately for the TG ($n = 10$; $M_{\text{age}}=17.0$; $SD_{\text{age}}=2.2$; age range=13.9–20.6) with 20.0% ($n = 2$) females based on biological sex, and the CG ($n = 11$; $M_{\text{age}}=17.7$; $SD_{\text{age}}=1.4$; age range=15.9–19.7) with 36.4% ($n = 4$) females based on biological sex. Participants were from various regions with 13 (61.9%) residing in central Italy, and 8 (38.1%) in northern Italy. Their places of residence included urban areas ($n = 10$, 47.6%), towns ($n = 6$, 28.6%), suburbs ($n = 3$, 14.3%), and rural areas ($n = 2$, 9.5%). Four participants (19.0%) reported having another family member (within three generations) with a diagnosis of ASD; in five cases (23.8%), at least one parent exhibited subthreshold autistic traits. In one case (4.8%), the adolescent was adopted, and the information could not be ascertained. Finally, three participants (14.3%) were prescribed medication for internalizing or externalizing problems.

Data was collected from both parents and teens. SES, IQ, and ADOS-2 scores were extracted from the dataset of the previous RCT study (Fatta et al., 2024). Those scores were analyzed before the pre-treatment assessment to evaluate baseline differences between TG and CG. At T0, scores of primary and secondary outcomes were analyzed to verify differences between the two groups. Finally, data analysis at T1 aimed to evaluate the efficacy of PEERS® Booster sessions. However, some questionnaires on primary and secondary outcomes were missing data depending on the informant. Nevertheless, each participant had at least one informant who had completed the measures. Out of 21 participants, 19 parents (90.4%) and 18 adolescents (85.7%) returned the questionnaires (TG: parents 9/10, 90%, adolescents 10/10, 100%; CG: parents 10/11, 90.9%, adolescents 8/11, 72.7%).

Procedures for participant screening, allocation, and research implementation are summarized in Fig. 1.

2.2. Procedure

Linguistic and cultural adaptations of the PEERS® curriculum to an Italian context were approved by the developer of PEERS® (Dr. Elizabeth Laugeson) and summarized in a previous RCT with efficacy results reported (Fatta et al., 2024).

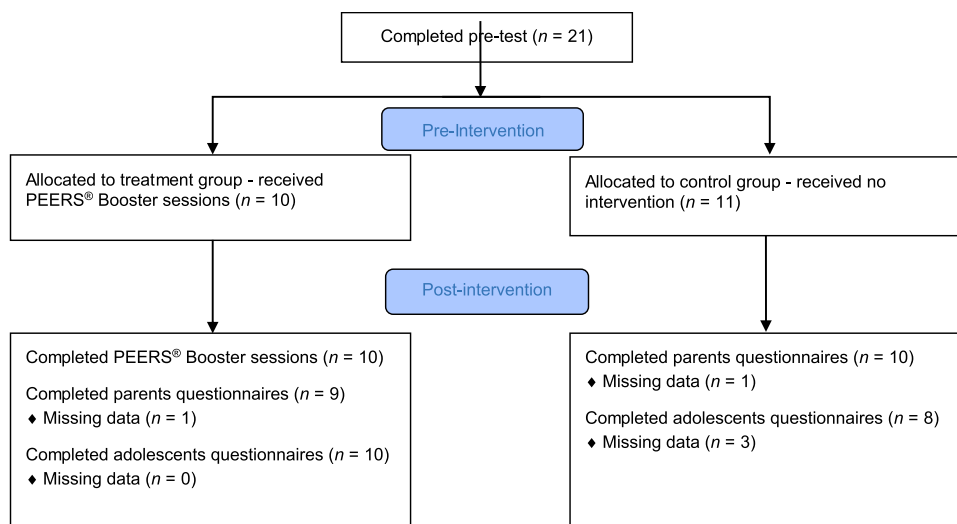


Fig. 1. Diagram flowchart.

In the traditional PEERS® for Adolescents program, sessions are structured as follows: (a) homework review (where problems with the application of skills are addressed, individual goals are tailored, and social rules from the previous session are briefly reviewed (30 min); (b) didactic instruction (or psychoeducation) using the Socratic method with role-playing demonstrations are conducted, including perspective-taking questions (30 min); (c) practice exercises involving a behavioral coach or another participant (behavioral rehearsal), often including a recreational activity (20 min); (d) homework assignments for upcoming week (e) check out with parents (10 min). This structured approach ensures comprehensive coverage of the program contents and provides opportunities for participants to practice and apply the acquired social skills.

For the present study, the research team developed a revised version of the original Italian PEERS® manual to include PEERS® Booster sessions and guidelines for therapists on how to address common issues in the session. In order to reduce the number of sessions, the 13 traditional sessions were condensed into 4 sessions of two hours in duration for 4 weeks. A summary of the session modifications is highlighted in Table 1.

The structure of the PEERS® Booster sessions included: (a) a welcoming introduction to the didactic lesson, during which teens were encouraged to recall the main rules from the previous session (with the exception of the first session; 5 min); (b) role-playing demonstrations and perspective-taking questions (10 min); (c) didactic instruction (or psychoeducation) utilizing the Socratic method (10 min); (d) behavioral rehearsal exercises (15 min). Additionally, the fourth session included an award ceremony.

Due to time constraints and based on feedback provided by both teens and parents in the social validity questionnaire delivered in the Italian RCT study (Fatta et al., 2024), the following contents were omitted: handling teasing, handling physical bullying, changing bad reputation, handling cyberbullying, and handling rumors and gossip. This selection was made to streamline the program while considering the practical input from participants and their families. Other details about the contents are available in Table 1.

In the traditional PEERS® for Adolescents program, parents receive training to serve as social coaches for their teens to modulate social performance in real-life situations through prompting and feedback. However, parents did not actively participate in the PEERS® Booster program as it was assumed that once they had learned the coaching strategies, they could support their teens' efforts to use the skills when required.

The training was conducted online for four weeks from June to July 2022, utilizing a traditional webinar platform. Each participant received information about how to use the platform, common group rules, and what to expect from the booster intervention.

The clinical team was composed of one psychotherapist and one licensed clinical psychologist, both experienced in working with autistic youth, who served as group leaders, and two trainees in developmental psychology, who served as behavioral coaches. The treatment team had prior experience with the traditional PEERS® for Adolescents program and received intensive 3-day training from the principal investigator who is a PEERS® Certified Provider.

Fidelity was ensured through supervision by the PEERS® Certified Provider, who viewed 50% of the session recordings, to verify that the session implementation was aligned with the treatment manual. Additionally, after each session, a team briefing was conducted to monitor the application of strategies in behavior rehearsals, and adherence to the protocol during sessions.

2.3. Measures

2.3.1. Primary outcomes measures

The *Social Responsiveness Scale* (SRS; Constantino & Gruber, 2005) is a 65-item parent-report questionnaire for evaluating features of autism in children and adolescents aged 4 to 18 years. Higher scores indicate greater autistic traits. Parents were administered the measure at pre- and post-intervention to assess their teen's overall social competence. The SRS consists of five scales: Social Awareness (SA), Social Cognition (SC), Social Communication (SCo), Social Motivation (SM), and Restricted Interests/Repetitive Behaviors (RI RB). Data were transformed into T-scores using the validated Italian version, demonstrating robust psychometric properties and

Table 1

Comparison of Traditional PEERS® and PEERS® Booster sessions content.

Didactic lesson	Traditional PEERS® session number	PEERS® Booster session number	Excluded content from PEERS® Booster sessions
Trading information	1	1	
Conversational skills	2	1	
Electronic communication	3	2	
Choosing appropriate friends	4	1	
Appropriate use of humor	5	2	
Peer entry strategies	6	3	
Peer exiting strategies	7	3	
Get-togethers	8	4	
Good sportsmanship	9	3	
Handling teasing	10		X
Handling physical bullying	11		X
Changing bad reputation	11	4	
Handling disagreements	12	4	
Handling cyberbullying	13		X
Handling rumors and gossip	13		X
Graduation /where to go from here	14		X

high consistency ($\alpha > .90$; Zuddas, Di Martino, Delitala, Anchisi, & Melis, 2010). In the recent Italian PEERS® adaptation study, internal consistency of the SRS was found to be satisfactory ($\alpha = .89$; Fatta et al., 2024).

Quality of Socialization Questionnaire-Revised (QSQ-R; Laugeson & Frankel, 2010) is an adolescent- and parent-report questionnaire designed to assess an individual's ability to establish and maintain friendships in natural settings based on the frequency of social interactions. It was used as a social performance measure comprised of two dimensions: The Social Initiative Scale, which evaluates the number of get-togethers hosted by the adolescent, and the number of people who accepted the invitation, and the Social Reciprocity Scale, which assesses the number of get-togethers the adolescent attended as a guest, and the number of people who invited them. The questionnaire lacks a specified age range and normative reference samples. Back-translation and cultural adaptation were carried out in a prior Italian study (Fatta et al., 2024). Both parents and adolescents completed the measure separately before and after the intervention, and raw scores were used to calculate scores on the two scales. We treated the dimensions as distinct outcomes, and no composite scale score was reported. Due to this approach and the limited number of items, Cronbach's alpha was not computed.

Test of Adolescent Social Skills Knowledge - Revised (TASSK-R; Laugeson et al., 2012) is a 30-item adolescent-report questionnaire designed to evaluate social knowledge related to the skills taught in PEERS®, with higher scores indicating greater social knowledge. In line with the objectives of the current study and session modifications, we have recalculated the total score by excluding non-discriminative items and those related to handling teasing, physical bullying, cyberbullying, rumors, and gossip, starting from the raw score. Normative reference samples and cut-off thresholds are unavailable. Previous studies have reported reliability coefficients around $\alpha = .56$ in most cases (es. Laugeson et al., 2009, 2012). The questionnaire covers a wide range of social domains (with two items corresponding to each session), and the low correlation between items has been considered sufficient (Shum et al., 2019). However, in the present research, the reliability was not calculated in line with other studies (Dolan et al., 2016). Back-translation and cultural adaptation were previously conducted (Fatta et al., 2024), and in the current study, TASSK-R was administered to adolescents before and after the intervention.

2.3.2. Secondary outcomes measures

Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) is a widely used checklist for assessing developmental psychopathology, with higher scores indicating more severe symptoms. It evaluates various dimensions, including Syndrome Scales, Internalizing, Externalizing, Total Problems, and DSM-Oriented Scales. The CBCL was administered to parents and youth before and after the intervention, and only Internalizing, Externalizing, and Total score dimensions were analyzed. Raw scores were converted into standardized T-scores using references from an Italian normative group that demonstrated excellent consistency for parents (internalizing problems $\alpha = .83$; externalizing problems $\alpha = .85$; total problems $\alpha = .91$; Frigerio et al., 2004). Internal consistency of these scales was also ascertained in the Italian PEERS® adaptation study, revealing satisfactory reliability both for parents (internalizing problems $\alpha = .87$; externalizing problems $\alpha = .91$; total problems $\alpha = .95$), and adolescents (internalizing problems $\alpha = .90$; externalizing problems $\alpha = .78$; total problems $\alpha = .93$; (Fatta et al., 2024).

Children's Depression Inventory - Second Edition (CDI-2; Kovacs, 2010) is a 28-item self-report questionnaire designed to detect depressive symptoms in children and adolescents aged 7 to 17 years. Higher scores indicate more severe symptoms. It provides a Total Score as well as two dimensions: Emotional Problems and Functional Problems. Adolescents completed the measure before and after the intervention. The raw scores were transformed into standardized T-scores using the Italian version, where validity (concurrent, convergent, and discriminating) has been confirmed (Camuffo & Cerutti, 2018). The measure revealed acceptable reliability in the Italian PEERS® adaptation study (total score $\alpha = .86$; Emotional Problems $\alpha = .81$; and Functional Problems $\alpha = .69$; (Fatta et al., 2024).

Behavior Rating Inventory of Executive Function - Second Edition (BRIEF-2; Gioia, Isquith, Guy, & Kenworthy, 2015) is a parent-report questionnaire designed to assess executive functioning in children aged 5 to 18 years. The measure comprises 63 items organized into nine scales, which are combined to derive three indices: Behavioral Regulation Index (BRI), Emotional Regulation Index (ERI), and Cognitive Regulation Index (CRI). Additionally, a Global Executive Composite Score (GEC) can be calculated by summing the scores of the three indices. Higher scores indicate a higher level of deficits in executive functions. Standardized T-scores were analyzed using the Italian normative scores, with reliability scores ranging from .72 to .97 (Marano, Innocenzi, & D'Amico, 2016). Additionally, the internal consistency observed in the Italian PEERS® adaptation data was excellent (BRI $\alpha = .83$; ERI $\alpha = .90$; CRI $\alpha = .95$; GEC $\alpha = .96$; (Fatta et al., 2024).

2.4. Data analysis

The Statistical Package for Social Sciences software (IBM® SPSS) version 27.0 was used for statistical analyses. Statistical significance was defined at the conventional level of $p < .05$.

Preliminarily, bivariate Pearson correlations among the key variables at T0 have been computed for the overall sample and are reported in Table 1 in the Supplementary Materials.

Independent-samples *t*-tests were performed entering the groups (TG vs. CG) as the independent variable, and the baseline continuous measures of teens' age, IQ score (WISC-IV), autism symptom severity (ADOS-2), SES, as well as primary outcome measures (SRS, TASSK-R), as dependent variables. A Chi-square test was conducted to assess differences in demographic characteristics across the two groups.

The treatment efficacy was investigated using a repeated measures factorial analysis of variance (ANOVA), comparing the primary and secondary outcomes between the two groups (TG vs. CG; between-subjects factor) at two different time points (T0 vs. T1; within-subjects factor). When significant Group*Time interaction effects were found, paired-samples *t*-tests were conducted to interpret the

direction of the interaction. Only for the variables that violated assumptions of normality, the ANOVAs were replaced by Wilcoxon's test (i.e. QSQ-R).

2.5. Results

2.5.1. Differences between the treatment and control groups at baseline

The comparison between TG vs. CG regarding demographic variables showed no differences in biological sex ($\chi^2 = .69, p = .80$; Cramer's $v = .04$), geographical areas (North, Central, South Italy) ($\chi^2 = 2.65, p = .10$; Cramer's $v = .35$), places of residence (urban, towns, suburbs, rural) ($\chi^2 = .28, p = .96$; Cramer's $v = .11$), and medication use ($\chi^2 = .28, p = .59$; Cramer's $v = .12$). In addition to disclosing family history of autism, parents completed the AQ questionnaire to better investigate their own autistic traits. The comparison between groups revealed no significant differences in parents' AQ scores ($\chi^2 = 5.98, p = .11$; Cramer's $v = .53$).

The independent-samples *t*-tests revealed no statistically significant differences between groups in baseline measures (i.e. age, IQ, ADOS-2, SES) or primary outcomes (TASSK-R, SRS Total Score; see Table 2).

2.5.2. Differences between T0 and T1 in the treatment group vs. control group

Table 3 summarizes the means and standard deviations for the two groups across time points, presenting the Group*Time interaction effects and the estimated effect sizes.

In terms of the primary outcomes, a significant time effect with a moderate effect size was observed for parent-reported SRS Social Awareness, indicating significant changes between T0 and T1. The corresponding paired-samples *t*-test comparisons revealed a significant decrease in mean scores for SRS Social Awareness at T1 solely within the TG, $t(8) = 2.46, p = .039$. In contrast, while mean scores decreased in the CG, $t(9) = 1.49, p = .168$, this reduction was not statistically significant. This suggests a potential reduction in autistic traits specifically within the TG following PEERS® Booster sessions.

Furthermore, a significant Group*Time interaction effect with a moderate effect size was observed for parent-reported SRS Social Communication. Paired-samples *t*-test comparisons showed that the SRS Social Communication mean scores significantly decreased at T1 only for the TG, $t(8) = 2.33, p = .048$. In contrast, such a decrease was not observed in the CG, $t(9) = -.87, p = .407$, where conversely mean scores increased, although not to a statistically significant threshold, suggesting a reduction of autistic traits in the TG following PEERS® Booster sessions.

The statistical analyses of parent-reported SRS Social Cognition did not yield significant results, but indicated a trend to significance ($p = .058$), with the same pattern of mean score direction as described for Social Communication.

Regarding the secondary outcomes, a significant Group*Time interaction effect, with a small effect size, was observed for parent-reported CBCL externalizing problems. Subsequent paired-samples *t*-test comparisons indicated that the mean scores significantly decreased at T1 for the TG $t(8) = 4.17, p = .003$, but not for the CG, $t(9) = .27, p = .792$, indicating a reduction of behavioral externalizing problems attributable to the intervention. Notably, no significant effects were found in adolescent-reported secondary outcomes (i.e. CDI-2) and other parent reports (i.e. BRIEF-2).

When comparing T0 vs. T1 scores on the QSQ-R variables, using a Wilcoxon's test, a significant result was observed in the Social Initiative Scale, only in the CG (parent version: T0-T1 differences in TG, $z = -1.44, p = .150$; in CG, $z = -2.29, p = .022$; adolescent version: T0-T1 differences in TG, $z = -.93, p = .354$; in CG, $z = -.57, p = .572$). These results indicate a significant decrease in the get-togethers hosted in the CG, per parent report ($M_{pre} = 9.36, SD_{pre} = 6.58; M_{post} = 4.90, SD_{post} = 4.68$) but not according to adolescent reports. However, no statistically significant differences emerged in the Social Reciprocity Scale across time, as rated by parents (T0-T1 differences in TG, $z = 1.19, p = .233$; in CG, $z = -.46, p = .644$) and adolescents (T0-T1 differences in TG, $z = -1.12, p = .261$; in CG, $z = -.84, p = .399$). This indicates an absence of changes in the number of get-togethers to which participants were invited, per both adolescent and parent reports.

Table 2

Baseline differences in individual characteristics and primary outcomes between groups.

Variable	TG (n = 10)			CG (n = 11)			t (df)/ χ^2	p	
	M (SD)	range		M (SD)	range				
		Min	Max		Min	Max			
Age (y)	17.00(2.23)	13.90	20.60	17.71(1.43)	15.90	19.70	-.87(19)	.39	
Biological sex (%F)	20,0			36,4			.69	.41	
WISC-IV	Total IQ*	111.33(12.32)	94	128	103.67(14.79)	73	120	1.05(13)	.31
	Verbal IQ	110.60(15.44)	86	132	116.18(20.21)	82	140	-.71(19)	.49
ADOS-2 Mod.3	Total**	9.13(3.04)	6	14	9.50(3.51)	5	14	-.21(12)	.83
SES***		40.35(14.62)	16	21.0	62.0	21	23	64,5	.20
<i>Primary Outcomes</i>									
SRS-P	Total	80.90(19.10)	51	106	66.55(11.36)	58	94	2.07(14)	.57
TASSK-R		25.40(2.84)	19	26	26.00(1.61)	23	27	-.60(19)	.55

* Data available WISC-IV Total Score for 15 (6 for TG and 9 for CG) (4 evaluations above 3 years; 2 use the other version of Wechsler's scale)

** Data available ADOS-2 Mod.3 Total score for 14 (8 for TG and 6 for CG) (1 have ADOS-2 module 4; 3 have ADOS-G; 3 evaluations above 3 years).

*** Calculated with Hollingshead Four Factor Index of Socioeconomic Status (Bellina et al., 2020).

Table 3

Descriptive statistics and ANOVAs comparing pre-intervention (T0) vs. post-intervention/second pre-test (T1) between groups.

Variable		TG (n = 10)		CG (n = 11)		F (df)	η^2_p
Primary Outcome		Pre-Test M (ds)	Post-test M (ds)	Pre-Test M (ds)	Post-Test M (ds)		
SRS-P	SA	65.78(15.36)	57.11(18.02)	61.60(12.55)	58.30(12.26)	87(1, 17)**	.39
	SC	71.33(15.53)	67.00(15.02)	63.20(9.76)	65.60(8.26)	.34(1,17)	.02
	SCo	77.33(17.93)	70.67(16.13)	69.90(12.05)	72.00(13.94)	1.51(1,17)*	.08
	SM	74.44(13.89)	72.78(16.32)	58.30(12.46)	60.40(15.78)	.01(1,17)	.00
	MA						
	RIRB	78.44(21.62)	74.33(13.89)	67.80(9.58)	68.40(12.91)	.35(1,17)	.02
	Tot	79.11(19.34)	73.89(16.64)	68.10(10.67)	69.50(12.36)	1.08(1,17)	.06
TASSK-R		17.00(1.50)	16.80(1.47)	17.00(1.07)	17.63(9.92)	1.76(1,16)	.02
Secondary Outcome							
CBCL-P	Int. Pr.	60.78(8.72)	58.67(8.86)	60.20(6.60)	63.40(5.82)	.13(1,17)	.01
	Ext. Pr.	53.78(8.84)	47.11(7.10)	50.10(7.08)	49.50(5.52)	6.83(1,17)*	.23
	Tot. Pr.	58.00(8.54)	55.00(9.53)	56.20(5.45)	58.20(4.78)	.11(1,17)	.01
CBCL-Y	Int. Pr.	53.20(15.38)	55.40(16.20)	55.13(12.38)	55.13(12.62)	.42(1,16)	.03
	Ext. Pr.	45.40(9.43)	45.90(5.45)	47.63(9.23)	48.88(7.14)	.36(1,16)	.02
	Tot. Pr.	53.00(12.17)	51.10(12.87)	55.91(10.10)	58.09(8.97)	2.81(1,19)	.13
CDI-2	Total	44.50(6.64)	46.40(8.62)	48.13(10.45)	49.50(5.66)	.53(1,16)	.03
BRIEF-2	GEC	60.80(15.43)	62.22(14.53)	54.90(6.10)	56.30(5.91)	.52(1,17)	.03

SRS-P (Parents). SA: Social Awareness; SC: Social Cognition; SCo: Social Communication; SM: Social Motivation; RIRB: Restricted Interests and Repetitive Behaviors.

BRIEF-2 GEC: Global Executive Composite.

CBCL: P (Parents); Y (Youth); Int. Pr. (Internalizing problems) Ext. Pr. (Externalizing problems), Total Pr. (Total problems).

Note: *** $p < .001$; ** $p < .01$; * $p < .05$. Benchmarks for effect size interpretation correspond to Cohen's $\eta^2_p \geq .01$. Small effect; $\geq .06$. Intermediate effect; $\geq .14$. Large effect (Cohen, 1988).

3. Discussion

PEERS® is a structured international program with worldwide validation, adaptable for delivery in telehealth, hybrid formats, and in-person settings. Evidence from PEERS® for Adolescents has supported the validity of telemedicine delivery (e.g. Estabillo et al., 2022), demonstrating that there were no significant differences in efficacy based on delivery mode. In addition, preliminary evidence suggests the efficacy of a 7-week delivery format (Marchica & D'Amico, 2016; Matthews et al., 2020), indicating that an accelerated version of PEERS® could be considered for implementation. Furthermore, prior follow-up studies on the traditional PEERS® for Adolescents program have demonstrated the maintenance of achievements over both short and long-term follow-up (Laugeson et al., 2012; Mandelberg et al., 2014). However, to the best of our knowledge, there is currently no evidence assessing whether a brief and intensive training, conducted following the traditional PEERS® program, contributes to the enhancement and maintenance of previously achieved results. Therefore, this study represents the initial evidence endorsing the utilization of a shortened maintenance program using PEERS® within a sample that has undergone the traditional PEERS® for Adolescents program.

This research aimed to investigate and assess the clinical efficacy of PEERS® Booster program, comparing a treatment group (TG) that participated in the PEERS® Booster sessions, with a control group (CG) that refrained from the additional sessions, on primary outcomes (RQ1) and secondary outcomes (RQ2). The program was provided over telehealth once a week for four consecutive weeks. A longitudinal non-randomized study was conducted using the same sample of autistic youth who had previously attended the traditional PEERS® program in Italy (Fatta et al., 2024), based on their motivation to receive PEERS® Booster sessions in an accelerated fashion. The primary outcomes of overall social skills, social knowledge, and social performance, as well as secondary outcomes of emotional and behavioral problems, executive functions, and depressive symptoms, were evaluated. Baseline data (T0) were extracted from the original validation study of the Italian version of PEERS® (Fatta et al., 2024). Post-intervention data for the TG and second baseline for the CG (T1) were collected after four weeks of TG participation in the PEERS® Booster program.

In the present study, no differences in baseline data were found between the TG and CG. Regarding primary outcomes (RQ1), the results indicated positive changes in parent-reported SRS Social Awareness and SRS Social Communication following the PEERS® Booster program. Social Awareness exhibited consistently reduced mean scores in both groups, but this decrease was significant only in the TG, indicating additional improvement following the PEERS® Booster program. On the other hand, Social Communication showed a divergent pattern, with a mean scores reduction observed only in the TG, while in CG the mean scores increased from T0 to T1, albeit not at a statistically significant level. These findings suggest that booster sessions may have additional benefits for teen's social awareness and expressive social communication, enhancing participants' understanding of social signals, as well as fostering reciprocal social behavior in various social situations and contexts. In a study exploring accelerated PEERS®, Matthews et al. (2020) reported a comparable result between pre-and post-intervention, though only reporting the SRS Total Score. Notably, difficulties in social communication, social cognition, and understanding of social stimuli constituted the three clusters of social challenges in autistic teens without cognitive impairment (Laugeson & Ellingsen, 2014). This finding on social communication represents an encouraging goal. Additionally, the Group*Time interaction in SRS Social Cognition scores revealed a trend toward significance, with opposite directions in mean scores changes between groups. The TG exhibited enhanced social cognition abilities from T0 to T1, while

the CG showed a decrease, suggesting that the TG may have experienced additional improvement in the theory of mind processes and empathizing abilities following the booster sessions. It is crucial to verify in future studies whether PEERS® Booster sessions could support improvements in social cognition. The extensive use of role-play videos and perspective-taking questions in a short timeframe may support improvements and have particular effects in the social cognition domain. Therefore, these results are likely attributed to the efficacy of the training coupled with the potential for greater growth among TG, driven by their motivation to enhance social skills, leading them to attend booster sessions.

With regard to the QSQ-R, no significant results were observed in the TG. Conversely, the CG showed a significant decrease in hosted get-togethers, as reported by parents (but not by adolescents), indicating possible maintenance of gains for the TG and not for the CG. It is likely that parents of the TG group, who did not attend the training, focused on their adolescents' ongoing attempts to organize get-togethers with other peers. Conversely, adolescents attending booster sessions held higher expectations regarding the support that could be provided by additional sessions for the successful organization of hosted get-togethers with peers. Without the support of booster sessions, the CG appeared to struggle in organizing get-togethers with friends. In contrast, the TG appeared to maintain the same level of social engagement following treatment, despite not significantly increasing their encounters with friends. However, as in previous studies (e.g. Yamada et al., 2020), the QSQ-R displayed a non-normal distribution, and it was not possible to conduct comparisons with multivariate modeling to control for other potentially relevant covariates (e.g. social awareness, social communication).

Adolescent-reported social knowledge, measured by the TASSK-R, designed to align with the specific knowledge taught in the training, did not differ significantly between groups. Results may be better understood as the maintenance of skills acquired following the traditional version of PEERS® for Adolescents, despite mean scores decreasing in both groups after booster sessions. This interpretation aligns with a prior PEERS® study that found no significant differences in TASSK-R between the TG and CG when comparing traditional vs. accelerated PEERS® (Matthews et al., 2020). However, it is essential to note that the evidence pertains to the accelerated versions of PEERS® administered to samples with no prior program participation. In the current study, the lack of significant results in this area may be attributed to the short timeframe between the conclusion of traditional PEERS® and the start of PEERS® Booster sessions. Future studies should consider larger sample size, increasing statistical power, and more extended time intervals (e.g. beyond 6 months) from traditional PEERS®, to explore changes in this measure over time.

In terms of secondary outcomes, a significant result was observed in the CBCL externalizing problems domain, where the treatment had a significant effect in reducing parent-reported symptoms within the TG but not in the CG. Specifically, the TG had a significant decrease in externalizing problems, including aggressive and oppositional behaviors following booster sessions. This pattern aligns with previous findings of the Italian PEERS® validation (Fatta et al., 2024), an accelerated version of PEERS® (Marchica & D'Amico, 2016), and a short-term follow-up study (Laugeson et al., 2012), indicating consistency in the positive impact of the treatment on reducing externalizing behaviors. Externalizing behaviors pose a significant challenge for autistic individuals and their families and are closely linked to emotion regulation abilities. Greater emotion regulation and better social competencies are predictive of fewer externalizing problems (Berkovits, Eisenhower, & Blacher, 2017). In this study, the emotional regulation index did not reach statistical significance, in contrast to a prior Italian study (Fatta et al., 2024). Nevertheless, poor emotion regulation may underlie externalizing behavioral manifestations along an emotional reactivity continuum (Mazefsky & White, 2014), negatively impacting an individual's quality of life and inclusion in the community. Presumably, the results may be better understood as the maintenance of emotion regulation skills acquired following the traditional version of PEERS® for Adolescents. In this context, the goal of emotional regulation was achieved but not further enhanced, contributing to the observed reduction in externalizing problems after booster sessions. This reduction in externalizing problems could also be sustained by improvements in social abilities over time, creating a positive cycle.

In summary, the intensive PEERS® Booster program has been found to be effective in enhancing and maintaining achievements in primary outcomes, including social awareness and communication skills (SRS Social Awareness Scale, SRS Social Communication Scale). Findings suggest that the experimental group improved in their social competencies even more, while the control group, which did not participate in PEERS® Booster program, experienced a decline in some of the gains acquired in traditional PEERS®. Furthermore, this intensive shortened training has demonstrated efficacy in addressing externalizing emotional-behavioral problems (CBCL - Externalizing Problems Scale). These findings are consistent with previous short and long-term follow-up studies (Laugeson et al., 2012; Mandelberg et al., 2014) as well as studies investigating the accelerated versions of PEERS® (Marchica & D'Amico, 2016; Matthews et al., 2020). Overall, the evidence shows promise of the PEERS® Booster program in improving various aspects of social functioning and emotional-behavioral outcomes. However, future studies should assess its long-term efficacy to verify if the gains have been maintained over time.

4. Conclusions

This study provides initial evidence endorsing the utilization of a shortened, maintenance program using PEERS® within a sample that has undergone the traditional PEERS® for Adolescents program. However, it is essential to acknowledge several limitations.

First, the small sample size reduces the statistical power, making it challenging to detect a large number of findings. Nevertheless, given the limited sample size, these results likely reflect a credible representation of reality. In future studies involving the booster program, significant trends, such as those related to social cognition, should be further explored in larger and randomized samples. Furthermore, this study exclusively included Caucasian participants and did not account for gender differences due to the limited representation of females, both based on biological sex and gender identity. This limitation restricts the generalizability of the results and their applicability to clinical practice. Although prior evidence in PEERS® (McVey et al., 2017), does not support the gender-related effects of the intervention, addressing these limitations for future research is crucial. This can be achieved by recruiting

representative samples from various cultural/ethnic backgrounds and including participants who identify as females to examine potential cultural and gender influences.

Second, in this study, participant recruitment started from another previous study. Group allocation relied on the youth's motivation to attend the booster program, without randomization, introducing a potential selection bias. Although the current sample was derived from an original sample that was assessed for motivation as an inclusion criterion for enrollment in the RCT study (Fatta et al., 2024), those participating in the PEERS® Booster sessions were likely more motivated than the control group. This factor could have influenced the study's results and should be considered when interpreting the findings.

Third, it is worth highlighting that our findings could not be considered equivalent to an accelerated version of PEERS®, involving adolescents who had never participated in PEERS®, or traditional follow-up studies. This specific context restricts our ability to make direct comparisons with results from other similar studies and identify any critical points of departure.

Fourth, questionnaire data from teachers were not collected and qualitative measures were not employed due to the challenges associated with implementing them in a telehealth mode of delivery. Consequently, as the results relied on measures where the evaluators were not blinded to the treatment and were self-reported, there is a substantial potential risk of bias in our findings. These limitations emphasize the need for cautious interpretation of the results and the implementation of "unbiased" (e.g. third party) measures in future research.

Fifth, the effects of PEERS® Booster sessions on parental and familial well-being outcomes, as well as their relationship with teen outcomes, remains unexplored. This knowledge gap impedes our understanding of how the program may affect parents who did not participate directly and the role of parental and familial variables as potential mediators in teen outcomes.

In the present study, economic resources and feasibility were not evaluated and should be investigated in future studies. Nevertheless, the potential cost saving associated with delivering a short-term evidence-based intervention, after completion of regular intervention could be substantial in terms of cost-effectiveness. Therefore, these findings appear to support the potential feasibility of the PEERS® Booster program, representing a promising intervention option for families in disadvantaged conditions (e.g. rural contexts, limited access to specialized services, and low-income countries), where economic and logistical barriers may hinder access to longer interventions.

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Data availability

Data will be made available on request.

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Conflicts of interest

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ridd.2024.104698](https://doi.org/10.1016/j.ridd.2024.104698).

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