



# Learning How to Make Friends for Chinese Adolescents with Autism Spectrum Disorder: A Randomized Controlled Trial of the Hong Kong Chinese Version of the *PEERS*<sup>®</sup> Intervention

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## Abstract

This study examined the treatment efficacy of PEERS<sup>®</sup> (Program for the Education and Enrichment of Relational Skills) among Chinese adolescents with autism spectrum disorder (ASD) in Hong Kong. The original PEERS<sup>®</sup> manual was translated into Chinese, and cultural adjustments were made according to a survey among 209 local adolescents in the general population. 72 high-functioning adolescents with ASD were randomly assigned to a treatment or waitlist control group. The 14-week parent-assisted training significantly improved social skills knowledge and social functioning, and also reduced autistic mannerisms. Treatment outcomes were maintained for 3 months after training and replicated in the control group after delayed treatment. The present study represents one of the few randomized controlled trials on PEERS<sup>®</sup> conducted outside North America.

**Keywords** Autism · Social skills · PEERS · Intervention · Chinese · Adolescents

Friendship—a relationship of mutual affection between individuals—is important to a child’s development (Berndt 2002; Hartup and Stevens 1999; Laursen and Mooney 2005). High-quality friendships enhance the psychosocial functioning of a child by providing him or her with emotional security, intimacy, companionship, and greater self-worth (Rubin et al. 2004). Children without friends are at risk of

loneliness, stress, negative affect, and concomitant developmental psychopathologies (Whitehouse et al. 2009).

Autism spectrum disorder (ASD) is a developmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts, and the presence of restricted, repetitive patterns of behavior, interests, or activities, according to the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5; American Psychiatric Association 2013). With such deficits in social functioning, children with ASD typically have poor peer relationships regardless of cognitive ability, and social problems may often worsen when they enter adolescence. Teenagers with ASD are reported to experience greater loneliness, have poorer friendship quality, have lower social network status, and display higher levels of depressive symptoms than their typically developing peers (Lasgaard et al. 2010; Locke et al. 2010; Whitehouse et al. 2009).

Moreover, adolescents with ASD are more prone to becoming victims of bullying in schools, especially in the general education setting (Schroeder et al. 2014). They experience higher rates of perceived physical, verbal, and relational forms of bullying relative to the general population (Cappadocia et al. 2012; Humphrey and Hebron 2015; Maiano et al. 2016; Sterzing et al. 2012), as well as higher

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SAHK is a non-profit charitable organization in Hong Kong which dedicatedly provides a wide range of rehabilitation services for persons with disabilities.

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rates of victimization than peers with other special educational needs (Humphrey and Symes 2010; Rowley et al. 2012; Zeedyk et al. 2014).

What are the risk factors for victimization among adolescents with ASD? Prior studies have indicated that social exclusion, peer marginalization, and the number of friendships are significant predictors of victimization within the ASD population (Cappadocia et al. 2012; Humphrey and Hebron 2015; Sofronoff et al. 2011). Moreover, social skills and conversational ability also correlate significantly with victimization among adolescents with ASD (Sterzing et al. 2012). Conversational ability refers to a range of verbal and nonverbal skills, including clear speech, appropriate gestures and expressions, as well as responsiveness to questions and changes in topic. Even for those high-functioning adolescents that possess average to above average cognitive abilities and some level of conversational ability, the noticeable weaknesses in their conversational and social skills may still place them at higher risk for victimization (Sterzing et al. 2012).

These findings underscore the importance of providing social skills training for adolescents with ASD, especially those in general education, that focus on conversational skills, social etiquette, and friendship development. One such intervention program that targets high-functioning adolescents with ASD is the Program for the Education and Enrichment of Relational Skills (PEERS®) developed at the University of California, Los Angeles (Laugeson and Frankel 2010). This is a parent-assisted, manualized social skills training program that addresses crucial areas of social functioning for adolescents, including reciprocal conversational skills, choosing appropriate friends, the appropriate use of humor, peer entry skills, organizing and hosting get-togethers, handling teasing and bullying, changing a bad reputation, and handling disagreements and rumors. Psychoeducation and cognitive-behavioral therapy techniques are employed to help adolescents develop ecologically valid skills for making and maintaining friendships.

Empirical evidence is accumulating on the effects of PEERS® on enhancing the social functioning of adolescents with ASD. Results from randomized controlled trials (RCTs) have shown improved knowledge of social skills, improved social responsiveness, increased frequency of peer interactions, decreased social anxiety, and reduced autistic mannerisms in treatment groups after intervention compared with control groups (Laugeson et al. 2012, 2009; Laugeson and Park 2014; Schohl et al. 2014; Van Hecke et al. 2015; Yoo et al. 2014). Improvements were maintained at long-term follow-ups 1–5 years after treatment (Mandelberg et al. 2014). Moreover, parents of the participants in the PEERS® treatment group also reported increased parental self-efficacy, suggesting the beneficial effects of the intervention program on family outcomes (Karst et al. 2015).

Nevertheless, the treatment efficacy of the PEERS® for ASD populations beyond North America awaits further investigation.

Research suggests that cultural aspects can influence the feasibility and effects of psychological interventions, and adaptations according to cultural differences may be necessary before implementation (Hall et al. 2016; Hwang 2006). Unfortunately, psychological interventions in general are rarely evaluated outside North America and Europe (Arnberg et al. 2013). In a systematic review of RCTs of social skills group interventions for children and adolescents with ASD, Jonsson et al. (2016) identified 15 eligible RCTs published between 1990 and 2014. Only 1 out of the 15 studies was conducted in a non-Western context (Yoo et al. 2014), while the majority of the studies were completed in North America (DeRosier et al. 2011; Frankel et al. 2010; Koenig et al. 2010; Koning et al. 2013; Laugeson et al. 2009; Lerner and Mikami 2012; Lopata et al. 2010; Schohl et al. 2014; Solomon et al. 2004; Thomeer et al. 2012; White et al. 2013), and the rest in either Europe (Baghdadli et al. 2013; Begeer et al. 2011) or Australia (Beaumont and Sofronoff 2008). The included population in most of these studies was predominantly Caucasian. Hence, the generalizability of the treatment effects of social skills group interventions to children and adolescents with ASD in non-Western societies remains to be explored.

One underlying cultural difference between the East and the West that may potentially affect the generalizability of treatment outcomes is that of parent–child interactions and parenting styles. For instance, in Chinese culture, methods of control in parenting are commonly used, including monitoring, physical punishment, and shaming, while parental involvement is often characterized by heightened intrusiveness (Xia et al. 2015). In many of the parent-assisted social skills training programs, high-quality parental social coaching is pivotal to the success of the intervention. Adolescents' receptivity to parental social coaching often depends on the parenting emotional climate and the quality of the coaching (Gregson et al. 2016). Specifically, parental constructive advice during parent–adolescent discussions on peer problems predicts increases in prosocial behavior among adolescents, whereas parental intrusive advice predicts decreases in prosocial behavior (Poulin et al. 2012). Moreover, a warm, nonhostile parenting emotional climate fosters adolescents' openness to parental input and brings about constructive communication over peer issues (Darling et al. 2008, 2009). As such, would these parent-assisted interventions—with strong emphasis on parental social coaching—be feasible in cultures where parental intrusiveness is generally perceived as high (Xia et al. 2015)?

Notably, only one study thus far has examined the efficacy of the PEERS® intervention in an Asian culture. Based on a RCT, Yoo et al. (2014) reported that the intervention was

efficacious among youths with ASD in South Korea after modest cultural adjustments were made. The Korean version of the PEERS® program significantly improved social communication and interaction (SCI), social skills knowledge, and interpersonal relationships, and also reduced depressive symptoms among high-functioning teens with ASD aged 12–18 (Yoo et al. 2014). This is one of the very few cross-cultural validation trials on an evidence-based intervention for adolescents with ASD in the existing literature (Reichow et al. 2013), and the only published study to date that has attempted to examine the treatment outcomes of PEERS® in an Asian culture. More research is certainly needed to establish the evidence for the treatment efficacy of PEERS® for adolescents with ASD from other cultural backgrounds.

In the present study, we conducted a RCT to investigate the feasibility and treatment efficacy of a Hong Kong Chinese version of PEERS® on improving social skills among Chinese adolescents with ASD. Specifically, we aimed to identify the adaptations required prior to the implementation of the training in a context culturally different from Western societies and to examine the treatment outcomes of this parent-assisted intervention among Hong Kong Chinese adolescents. Given the resemblances in terms of cultural values and parenting practices between Hong Kong and other Chinese societies (e.g., in mainland China and Taiwan; Lin and Ho 2009; Yau and Smetana 2003), it is possible that results obtained in this study may be externally valid for other Chinese-based cultures, although this is beyond the scope of our study.

Furthermore, as the generalization of skills across settings has often been overlooked and inadequately reported in past research on social skills group interventions (Jonsson et al. 2016; Rao et al. 2008), we included measures from teachers and peers to evaluate the adolescents' social functioning in school in order to explore whether and to what extent the acquired social skills were enacted in everyday life.

Our research questions were as follows: (1) Is the Hong Kong Chinese version of the PEERS® intervention applicable and feasible for Chinese adolescents with ASD? What are the modifications needed for cultural adaptation? (2) Is the Hong Kong Chinese version of PEERS® efficacious in improving social skills and the quality of social interaction for adolescents with ASD in the local context?

## Method

### Translation and Adaptation of the PEERS® Treatment Manual

The original English version of the PEERS® Treatment Manual (Laugeson and Frankel 2010) was translated into traditional Chinese by the first author and the research team

who were qualified PEERS® certified providers (i.e., they had received the PEERS® Certified Training at the UCLA PEERS® Clinic). The guiding principles of each training session and all the instructions were expressed in Standard Chinese (i.e., the written form of Chinese), while the conversational scripts in the role-plays were translated into Cantonese-Chinese (i.e., the spoken dialect used in Hong Kong) to facilitate the delivery of the lessons. The translated version was then reviewed by 20 healthcare professionals in Hong Kong, including educational psychologists, speech therapists, occupational therapists, and social workers. Content areas that required modifications due to cultural differences were identified. For instance, some of the identifiable peer groups originally listed (e.g., goths, emos) were not commonly found in Hong Kong schools.

To better adapt the treatment manual to the local context, 209 adolescents (166 boys and 43 girls) aged 12–15 were recruited from two secondary schools to complete an 8-item survey based on issues identified as being more culturally sensitive. These areas included common conversation topics with peers, area of interests/hobbies, locations and means of making friends, commonly used social media platforms, identifiable peer groups/crowds inside and outside school, extracurricular activities joined in school and in the community, locations of get-togethers, and activities for get-togethers. In the survey, students were either asked to select options from a given list (e.g., commonly used social media platforms) or to nominate answers themselves (e.g., common conversational topics among peers). The most popular responses on each of these items were documented. Amendments were made to the classification of common peer groups (parent session 3 and teen session 4) and sources of friendship from school/community activities (parent session 4) based on the results of the student survey (Supplementary Table 1). Other modifications to the treatment manual based on cultural considerations are listed in Supplementary Table 1. Apart from these changes, the overall structure and components of each training session were maintained.

### Recruitment and Screening of Participants

Potential participants were recruited from the community through advertisements in the mass media or by referral from school social workers and healthcare professionals working in hospitals. Teen participants were included based on the following criteria: (1) aged 11–15, currently studying in Grade 7 to Grade 9; (2) with a clinical diagnosis of ASD; (3) experiencing social difficulties as reported by parents in a structured intake interview; (4) showed moderate to severe deficits in social interactions based on the Autism Diagnostic Observation Schedule (ADOS) conducted during intake assessment; (5) demonstrated verbal fluency with a verbal IQ at or above 70 based on a standardized IQ test during intake

assessment; (6) showed strong motivation to participate in the intervention; (7) without a diagnosis of hearing, visual, or physical impairments that might hinder participation in activities; (8) without a diagnosed history of major mental illnesses or other diagnosed medical conditions that might affect participation in the intervention. Written consent and oral assent were obtained from all parents and adolescents prior to the screening procedures.

Adolescents' eligibility to participate in the study was initially assessed through telephone interviews with the parents, based on a phone-screening script translated from the original treatment manual (Laugeson and Frankel 2010). Face-to-face intake interviews were further conducted with the teens using an interview checklist (Laugeson and Frankel 2010) to assess their cognitive and social functioning, along with their motivation to participate in the treatment. The teens' willingness to participate in the group intervention should be considered carefully in the intake interviews, to ensure that they were not pressurized by parents to join the treatment. Including families of which teens were reluctant to engage might often lead to poor group cohesion and higher rates of attrition (Laugeson and Frankel 2010). In addition, each potential participant was individually tested on their IQ and social communication using the Wechsler Intelligence Scale for Children—Fourth Edition (Hong Kong) (WISC-IV[HK]; Wechsler 2010) and the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al. 2012), respectively. To corroborate diagnoses of high-functioning ASD among the participants, they must have attained scores of 70 or above in the Verbal Comprehension domain on the WISC-IV(HK) and comparison scores of 5 or above on the ADOS-2 indicating moderate to severe deficits in social interactions. Those who failed to meet the inclusion criteria were excluded from the study. All interviews and assessments were conducted in Cantonese-Chinese by qualified professionals on the research team.

## Participants

Ninety-two adolescents were assessed for eligibility at the intake, and 72 of them met the inclusion criteria. Reasons for exclusion are listed in Fig. 1. Eligible teens along with their parents, teachers, and peers participated in the current study. At baseline, adolescent participants were between 11 and 15 years of age (mean = 13.51,  $SD = 0.97$ ). 79% of them were male ( $n = 57$ ) and 21% were female ( $n = 15$ ), and they were all native Cantonese-speaking Chinese adolescents studying at local secondary schools in Hong Kong. All of them had a previous diagnosis of autistic disorder ( $n = 36$ ), Asperger's disorder ( $n = 10$ ), or pervasive developmental disorder-not otherwise specified (PDD-NOS;  $n = 26$ ), and also met the criteria for ASD in DSM-5 based on the intake interview and assessment. Parents completed a short

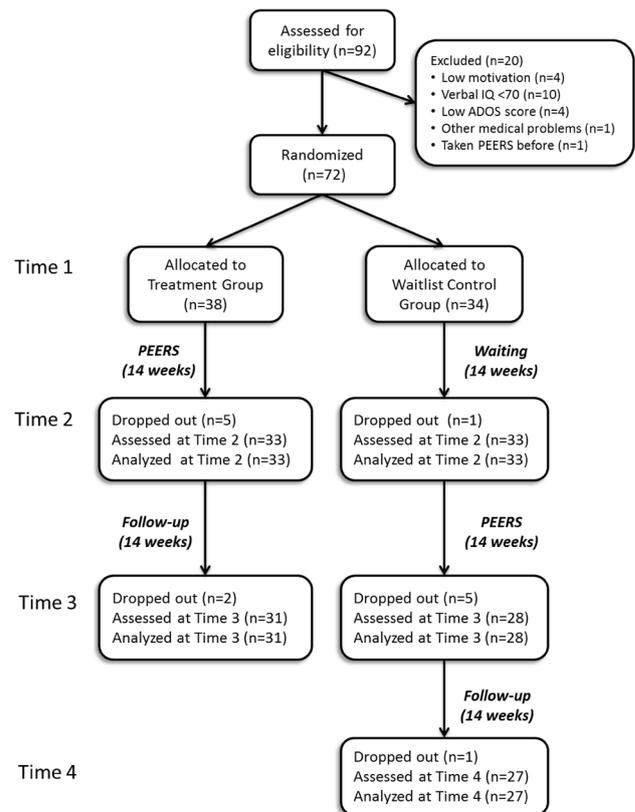


Fig. 1 CONSORT flow diagram

demographic questionnaire to report their own education level (1 = *completed primary school*, 2 = *completed secondary school*, 3 = *bachelor's degree*, 4 = *master's degree or above*). Self-reports revealed that almost all parents (mothers, 100%; fathers, 99%) had completed at least secondary school education and about half had received tertiary-level education (mothers 49%; fathers, 67%).

The adolescent participants and their parents were randomly assigned to a treatment group (TX;  $n = 38$ ) or a waitlist control group (CG;  $n = 34$ ). The treatment group received 14 weeks of the PEERS® intervention immediately following a baseline assessment at Time 1, while the waitlist control group received the same intervention after a 14-week waiting period. Participants were recruited over a 12-month period, and there were 4 cohorts in total. For each cohort, participants in the treatment group were assessed at baseline (Time 1), immediately after the 14-week intervention (Time 2), and at a follow-up assessment 14 weeks after the end of the training (Time 3). Participants in the waitlist control group were assessed at baseline (Time 1), after 14 weeks of waiting (Time 2), immediately after the 14-week intervention (Time 3), and again at the follow-up 14 weeks after treatment ended (Time 4). The study design is shown in Fig. 1. At each of the assessment times, parents and

adolescents were asked to complete questionnaires. Moreover, assessment measures were mailed to teachers and peers at school who were nominated by the adolescent participants and blinded to the group assignment of the participants.

### **PEERS® Intervention**

Training was conducted in small groups of approximately ten participants. The program consisted of 14 sessions, 90 min each, delivered once a week on weekends at community service centers. Parents and teens attended concurrent sessions held in separate rooms conducted by PEERS® certified providers, who had been trained by the program developer and were licensed social workers, speech therapists, and occupational therapists by profession. Each group was led by 2 group leaders, and there were altogether 18 group leaders involved in the whole study. In addition, behavioral coaches assisted the group leaders in running the teen groups. The coaches were all undergraduate students majoring in Psychology who were trained and supervised by the group leaders throughout the intervention. The coaches were responsible for assisting with role-play demonstrations, providing performance feedback to adolescents during behavioral rehearsals, and monitoring the treatment fidelity of the intervention.

The training program included 14 topics of instruction based on the common social difficulties among adolescents with ASD and the core social skills needed for making and keeping friends (Supplementary Table 2). Each teen session began with a review of the homework assignment from the previous week and allowed time for troubleshooting problems encountered in completing the behavioral assignment. This was followed by a didactic lesson on the weekly topic, where the adolescents were instructed on the rules of social etiquette derived from ecologically valid social skills. To facilitate a better understanding of the social rules, behavioral coaches and group leaders modeled both the appropriate and inappropriate behaviors in role-play demonstrations. Role-playing was usually followed by questioning to enhance perspective-taking and social cognition. Adolescents were then encouraged to rehearse the behaviors in structured socialization activities, during which performance feedback was provided by the group leaders and coaches. Towards the end of each session, behavioral homework was assigned for the coming week, the teens reunited with their parents, and the details for carrying out the assignment were further negotiated between the teens and their parents.

For the parent group, more time was allocated to homework review, during which parents shared their experiences and difficulties in providing social coaching and assisting their teens in the weekly socialization homework. They were then given an overview of the didactic lesson using a parent handout. Based on anecdotal evidence from our pilot study

that Chinese parents are typically not as competent in providing social coaching to their teens as are parents in Western societies, role-playing and behavioral rehearsal exercises were included in the Chinese manual to provide parents with more practice in their coaching skills under the guidance of group leaders. Another added feature was the use of handouts in the teen group. Handouts with important key words and social rules were distributed to the adolescents at the end of each session to facilitate review during the week and minimize note taking during the didactic lesson. Detailed procedures and the content of the PEERS® intervention are described in Laugeson et al. (2012). Supplementary Table 2 provides an overview of the treatment sessions.

### **Feasibility Measures**

The feasibility of this intervention was assessed by looking at the weekly attendance of the teens and parents, their homework completion rates, and the overall treatment completion rate. For those who failed to complete the training, interviews were conducted over the phone to record their reasons for attrition. Moreover, anecdotal evidence was collected from both the parents and teen participants at the end of the intervention to solicit their feedbacks towards the training program.

### **Outcomes Measures**

#### **Test of Adolescent Social Skills Knowledge (TASSK)**

This measure consists of 26 items derived from the 13 didactic lessons in PEERS® to assess the specific social skills knowledge taught during the intervention (Laugeson and Frankel 2010). Adolescents were asked to read sentence stems and choose the best answer from two options to complete the sentence in each item. Each correct answer was awarded one point. Higher scores on this task reflected better knowledge of social etiquette, and the maximum possible score was 26. Previous studies on the PEERS® intervention have shown that the TASSK is sensitive to treatment effects (Laugeson et al. 2012; Schohl et al. 2014; Yoo et al. 2014). Laugeson et al. (2009) reported a coefficient alpha of 0.56 for this measure, and they asserted that this level of internal consistency was acceptable given the wide domain of questions in the scale. Similarly low coefficient alpha was reported by Schohl et al. (2014), and they explained that the questions were not expected to cohere with one another, as they were derived from the 13 didactic lessons in the intervention. In this study, the items were translated into Chinese and back-translated into English by two different bilingual translators. The original English version and the back-translated version were compared, and discrepancies were noted and corrected by the research team. This measure was

completed by the adolescents at all time points to assess both immediate and delayed treatment outcomes. We obtained a Cronbach's alpha of 0.50 based on the current sample. The reliability of this measure was thus similar to those reported in previous studies (Laugeson et al. 2012, 2009; Mandelberg et al. 2014; Schohl et al. 2014).

### Quality of Play Questionnaire (QPQ)

The QPQ was adapted from Frankel and Mintz (2011) and included in the original treatment manual as QPQ-P (parent) and QPQ-A (adolescent; Laugeson and Frankel 2010). Parents and adolescents were asked to complete the questionnaire independently. There are 12 items in the questionnaire, 2 of which assess the frequency of get-togethers—both hosted by the teen and to which the teen was invited—over the previous month, and the remaining 10 items gauge the level of conflict during the last hosted get-together. Items on the Conflict Scale, for instance, include “They/We criticized or teased each other”. Parents and teens rated how true each statement was on a 4-point rating scale (0–3). Ratings for the 10 items were summed to determine the total conflict score. Higher scores on the Conflict Scale indicated more conflict observed during the last get-together. Cronbach's alpha for the Conflict Scale was 0.87 (Laugeson et al. 2012). A similar level of internal consistency ( $\alpha = 0.72$ ) was found for the Conflict Scale in the current study. For the frequency of get-togethers, we reported the total number of get-togethers by adding up the hosted and invited scores. The QPQ has been used in prior studies to test the effectiveness of social skills training (Laugeson et al. 2014, 2012; Schohl et al. 2014; Yoo et al. 2014). It was translated into Chinese, back-translated into English, and reviewed, according to the same procedures as described for the TASSK.

### Social Responsiveness Scale, Second Edition (SRS-2)

The Social Responsiveness Scale, Second Edition (SRS-2)—School-Age Form (Hong Kong Chinese version) used in this study was an author-reviewed research translation provided by Western Psychological Service. It is a 65-item questionnaire that measures the severity of social impairments associated with ASD in natural social situations and encompasses social awareness, social cognition, social motivation and communication, and autistic mannerisms (Constantino and Gruber 2012). Each item is rated on a scale from “0” (*never true*) to “3” (*almost always true*). The total raw score provides an index of the severity of social deficits for those on the autism spectrum, with higher scores indicating more severe social impairments. Parents and teachers in this study were asked to complete the SRS-2 based on their observations of their child/student over the previous 6 months. In addition to the total raw score, we also

examined the two DSM-5-compatible subscale scores for SCI and Restricted Interests and Repetitive Behavior (RRB) to measure changes in symptom severity in response to the intervention over time. Excellent internal consistency has been reported for the SRS-2 ( $\alpha = 0.97$ ; Constantino and Gruber 2012), and it has been shown to be sensitive to changes in social functioning among children with ASD (Laugeson et al. 2014; Schohl et al. 2014; Van Hecke et al. 2015; Yoo et al. 2014). Cronbach's alpha for the SRS-2 in this study was 0.90.

### Adaptive Behavior Assessment System, Second Edition (ABAS-II)

The Chinese version of the Adaptive Behavior Assessment System, Second Edition (ABAS-II; Harrison and Oakland 2008) is an assessment of general adaptive behavior in daily functioning. We were mainly interested in whether the PEERS® intervention might affect the adolescents' daily coping in terms of communication, social interactions, and emotion regulation. The current study used the raw scores of three subscales of the ABAS-II—Communication, Social, and Self-Direction—as outcome measures of the treatment. Parents were asked to complete the ABAS-II Parent Form (for children ages 6–17) by rating on a scale of 0–3 how often their child performed a behavior independently when the behavior was needed. Higher scores represented better adaptive functioning in the skill area. Sample items for each of the skill areas include the following: “Ends conversation appropriately” (Communication); “Laughs in response to funny comments or jokes” (Social); “Controls temper when disagreeing with friends” (Self-Direction). The internal reliabilities reported for ages 11–15 on the parent-rating form ranged from 0.94 to 0.97 for Communication, 0.95–0.97 for Social, and 0.93–0.97 for Self-Direction (Harrison and Oakland 2008). For the current sample, the reliability coefficients for the subscales of Communication, Social, and Self-Direction were 0.91, 0.91, and 0.94, respectively.

### Adolescent Social Behavior Scale (ASBS)

To obtain peer evaluations of the adolescents' social behaviors over the course of our study, we used the peer-rating form from the ASBS (Hung 2000). The ASBS is a screening tool for assessing adolescents' adaptive and non-adaptive social behaviors in school. It was developed in Taiwan based on a representative sample of 384 students from Grade 6 to Grade 9 across 12 schools. There are 60 items that measure adaptive behaviors, including group-related skills, communication skills, reciprocation, conflict-solving, and self-efficacy, and 53 items that measure non-adaptive behaviors, such as aggression, hyperactivity, withdrawal, anxiety, and interpersonal maladjustments. Peers nominated by our

participants were asked to complete the rating form by indicating on a 5-point scale (1–5) how often the adolescent displayed the particular social behavior in school. Higher scores on the adaptive scale and lower scores on the non-adaptive scale both indicated better adaptive functioning in school. According to Hung (2000), internal reliabilities for the subscales on the peer-rating form were good ( $\alpha=0.84\text{--}0.94$ ), and test–retest reliabilities were acceptable ( $r=0.56\text{--}0.78$ ). Internal consistencies for the adaptive and non-adaptive scales were both 0.96 based on our sample.

## Statistical Analyses

Statistical analyses were performed with the IBM SPSS Statistics 23. The pattern of missing data was examined using Little's test of missing completely at random (MCAR) for multivariate data (Little 1988). Demographic and baseline variables at Time 1 were compared between the treatment and waitlist control groups using independent samples *t* tests. Immediate training effects at Time 2 were analyzed using analyses of covariance (ANCOVAs). Repeated-measures analyses of variance (ANOVAs) were conducted separately on the treatment and control groups to examine maintenance of training effects over time. Statistical significance was defined as  $p < .05$ .

## Results

### Feasibility Assessment

Of the 72 adolescent participants who initially joined the study at Time 1, 66 completed the assessment at Time 2 (TX=33; CG=33), 59 completed the assessment at Time 3 (TX=31; CG=28), and 27 adolescents in the control group eventually completed the Time 4 assessment (Fig. 1). Similar attrition rates were observed for the treatment (18.4%) and control groups (17.6%) at Time 3. The reasons for attrition included scheduling issues, busy timetable, diminishing motivation, and being the only girl in the group. The mean treatment completion rates for the adolescents and their parents in each training condition are summarized in Supplementary Table 3.

Among those adolescents who completed the intervention (TX=33; CG=28), 95% had attended at least 11 out of the 14 training sessions ( $n=58$ ), and the mean number of sessions attended was 12.8 ( $SD=1.26$ ). At least one pre-identified parent of each adolescent attended the weekly parent group (mother only=71%; father only=9%; both parents=20%), and the mean number of sessions attended by parents was 12.7 ( $SD=1.81$ ). The overall homework completion rate was about 60%, with differential completion rates observed for the different types of behavioral

assignment: 100% for in-group phone call, 60–70% for calling a non-group member, 50–60% for socialization tasks such as entering and exiting conversations, and approximately 50% for hosting get-togethers. The weekly homework assignments are listed in Supplementary Table 2.

Anecdotal reports from parents and teens revealed practical difficulties in organizing or hosting get-togethers at home due to limited free time and crowded living spaces. Nonetheless, the participants acknowledged that the homework assignments served to motivate the teens to experiment with different social skills in real life. They also indicated that the parent and teen groups provided a platform for them to discuss their social situations openly. Topics that were considered most useful were conversational skills, handling teasing and embarrassing feedback, and handling bad reputations.

### Demographic and Baseline Variables

Demographic and baseline variables collected at Time 1 for both treatment and waitlist control groups are presented in Table 1. Only those participants who had completed Time 1 and Time 2 assessments were included in the analyses and reported in Table 1. Independent samples *t* tests showed no significant differences in the demographic profile and baseline measures of all variables except for the total number of get-togethers reported by teens and the conflict level at get-togethers reported by parents on the QPQ (Table 1). The adolescents in the control group reported having more get-togethers, and their parents indicated higher levels of conflict at get-togethers relative to the treatment group at Time 1.

Little's test (1988) was conducted to examine the pattern of missing data. Results indicated that there were no patterns in the missing data and the missing values were not related to any variables under study (i.e., missing completely at random; Time 2:  $\chi^2(9)=7.97$ ,  $p=.54$ ; Time 3:  $\chi^2(9)=10.65$ ,  $p=.30$ ; Time 4:  $\chi^2(18)=497$ ,  $p=1.00$ ). Listwise deletion was subsequently employed in all statistical analyses. Participants with completed parent-report and self-report data at Time 2 were included in the analyses of immediate training effects (TX=33; CG=33), while those with completed parent- and self-report data at Time 3 (TX=31) and Time 4 (CG=27) were included in the analyses of the maintenance of training benefits. Data of the attrited participants were not included in the analyses at the respective time points (Fig. 1). The return rates of the teacher-report and peer-report questionnaires at Time 2 were 33.3% ( $n=22$ ) and 27.3% ( $n=18$ ), respectively.

### Immediate Training Effects at Time 2

ANCOVAs were performed on all outcome variables. In each analysis, the Time 2 score was entered as the dependent variable, the training condition (treatment vs control) as the

**Table 1** Mean demographic and baseline variables for treatment and waitlist control groups

Variable	Treatment group ( <i>n</i> = 33)		Waitlist control ( <i>n</i> = 33)		<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>	
Age (years)	13.42	0.94	13.55	1.00	.59
Sex (% male)	84.85		72.73		.24
Mother's education level	2.56	0.98	2.48	0.57	.70
Father's education level	2.82	1.01	2.63	0.61	.36
IQ					
Full scale	100.85	18.81	102.21	14.69	.74
Verbal	96.36	18.72	94.70	17.77	.71
ADOS					
Total	9.67	3.07	9.97	4.97	.77
Social affect	8.06	3.07	8.88	4.23	.37
Restricted, repetitive behavior	1.61	1.48	1.09	1.38	.15
Adolescent self-report measures					
TASSK	14.27	3.01	15.06	3.32	.32
QPQ-A					
Total get-togethers	0.95	1.79	2.56	4.10	.04
Conflict	5.15	4.43	4.73	3.32	.66
Parent report measures					
ABAS					
Communication	50.34	10.86	51.15	10.27	.76
Social	43.41	10.33	46.00	11.12	.33
Self-direction	51.16	9.95	52.33	12.79	.68
SRS					
Total	103.91	28.13	102.18	27.62	.80
Social communication and interaction	84.24	19.52	83.70	21.44	.91
Restricted, repetitive behavior	20.52	8.05	18.42	6.94	.26
QPQ-P					
Total get-togethers	2.21	3.03	1.21	1.43	.09
Conflict	4.33	3.18	6.30	3.75	.03
Teacher report measures <sup>a</sup>					
SRS					
Total	92.90	25.38	98.45	25.45	.56
Peer report measures <sup>b</sup>					
ASBS					
Adaptive behaviors	195.07	43.70	176.00	31.03	.20
Non-adaptive behaviors	114.53	37.29	119.38	23.52	.69

*ADOS* Autism Diagnostic Observation Schedule, *TASSK* test of adolescent social skills knowledge, *QPQ* Quality of Play Questionnaire, *ABAS* Adaptive Behavior Assessment System, *SRS* Social Responsiveness Scale

<sup>a</sup>N's are 21 for treatment group and 11 for waitlist control group

<sup>b</sup>N's are 15 for treatment group and 13 for waitlist control group

independent variable, and the Time 1 score as the covariate. The results of the analyses are summarized in Table 2. To control for multiple hypothesis testing, the false discovery rate (Benjamini and Hochberg 1995) was considered, and adjusted *p* values are reported in Table 2.

Significant improvements in social skills knowledge and social functioning with medium to large effect sizes (i.e.,  $\eta_p^2 > .09$  for medium effects,  $\eta_p^2 > .25$  for large effects;

Cohen 1988; Miles and Shevlin 2001) were found after 14-weeks of the PEERS® training. Among the adolescent self-report measures, the mean score of the TASSK, which measured knowledge of social skills, was significantly higher in the treatment group than in the control group at Time 2, after controlling for baseline scores ( $F[1,63] = 36.04$ , adjusted  $p < .001$ ,  $\eta_p^2 = .36$ ). The mean total score on the SRS-2 as reported by parents was significantly lower in the

**Table 2** Results of ANCOVA comparing outcome variables at Time 2 after controlling for Time 1 scores

Variable	Treatment group ( <i>n</i> = 33)				Waitlist control ( <i>n</i> = 33)				<i>F</i>	<i>p</i>	Adjusted <i>p</i>	Effect size ( $\eta_p^2$ )
	Time 1		Time 2		Time 1		Time 2					
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>				
Adolescent self-report measures												
TASSK	14.27	3.01	19.39	3.51	15.06	3.32	15.24	3.01	36.04***	<.001	<.001	.36
QPQ-A												
Total get-togethers	0.95	1.79	1.71	2.10	2.56	4.10	2.15	3.00	0.06	.82	.82	.00
Conflict	5.15	4.43	2.24	2.84	4.73	3.32	3.32	2.93	3.93*	.05	.12	.06
Parent report measures												
ABAS												
Communication	50.34	10.86	57.77	8.77	51.15	10.27	55.27	10.52	2.27	.14	.22	.04
Social	43.41	10.33	47.74	9.15	46.00	11.12	46.24	11.97	2.62	.11	.20	.04
Self-direction	51.16	9.95	55.77	9.99	52.33	12.79	52.15	13.73	4.36*	.04	.11	.07
SRS												
Total	103.91	28.13	87.00	25.31	102.18	27.62	100.58	26.84	9.19**	.004	.01	.13
SCI	84.24	19.52	70.47	20.41	83.70	21.44	82.64	20.69	10.34**	.002	.01	.23
RRB	20.52	8.05	15.34	6.38	18.42	6.94	17.88	6.99	9.05**	.004	.01	.13
QPQ-P												
Total get-togethers	2.21	3.03	1.27	1.62	1.21	1.43	0.91	1.44	0.49	.49	.53	.01
Conflict	4.33	3.18	4.56	3.74	6.30	3.75	5.52	3.28	0.72	.40	.51	.01
Teacher report measures <sup>a</sup>												
SRS												
Total	92.90	25.38	91.73	22.39	98.45	25.45	82.29	32.10	2.35	.14	.22	.11
Peer report measures <sup>b</sup>												
ASBS												
Adaptive behaviors	195.07	43.70	207.00	34.68	176.00	31.03	212.18	33.86	1.28	.28	.39	.08
Non-adaptive behaviors	114.53	37.29	99.86	39.05	119.38	23.52	103.09	29.61	0.58	.46	.53	.04

TASSK test of adolescent social skills knowledge, QPQ Quality of Play Questionnaire, ABAS Adaptive Behavior Assessment System, SRS Social Responsiveness Scale, SCI social communication and interaction, RRB restricted and repetitive behaviors, ASBS Adolescent Social Behavior Scale

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

<sup>a</sup>N's are 15 for treatment group and 7 for waitlist control group

<sup>b</sup>N's are 7 for treatment group and 11 for waitlist control group

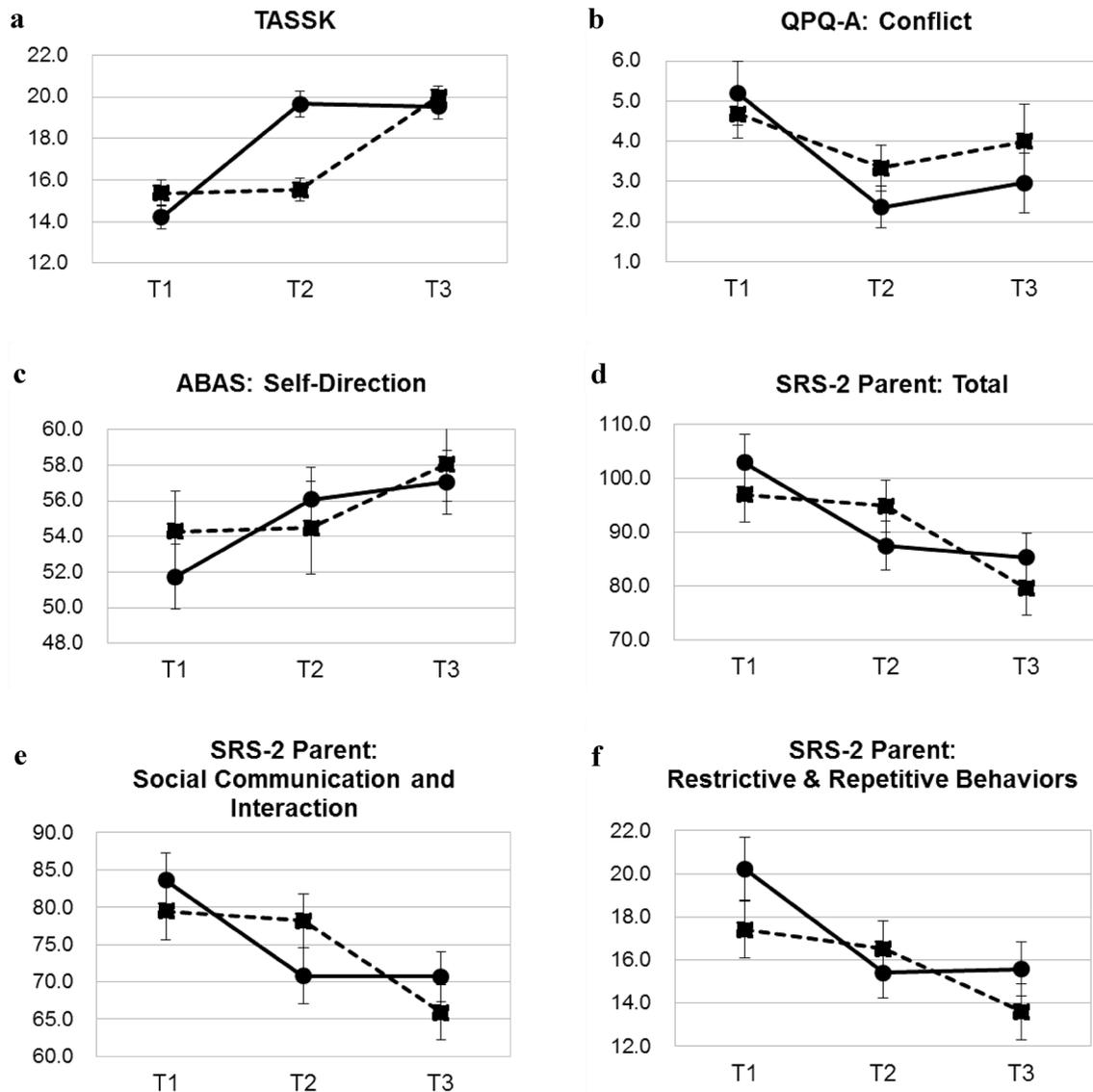
treatment group than in the control group at Time 2, after controlling for the Time 1 results ( $F[1,63]=9.19$ , adjusted  $p=.01$ ,  $\eta_p^2=.13$ ). Note that a lower score on the SRS-2 indicates better performance in social functioning. Analogous results were obtained for the two subscales of the SRS-2, showing significantly better social communications and interactions ( $F[1,63]=10.34$ , adjusted  $p=.01$ ,  $\eta_p^2=.23$ ) and fewer restricted and repetitive behaviors ( $F[1,63]=9.05$ , adjusted  $p=.01$ ,  $\eta_p^2=.13$ ) in the treatment group compared to the control group at Time 2.

The mean score of the Self-Direction subscale of the ABAS was also revealed to be higher in the treatment group at Time 2, although the group differences between treatment and control groups failed to reach statistical significance after adjusting for the false discovery rate in multiple hypothesis testing ( $F[1,63]=4.36$ ,  $p=.04$ , adjusted

$p=.11$ ,  $\eta_p^2=.07$ ). Similarly, the teens in the treatment group reported lower level of conflict during get-togethers than the control group at Time 2 after controlling for Time 1, but the difference failed to reach statistical significance ( $F[1,63]=3.93$ ,  $p=.05$ , adjusted  $p=.12$ ,  $\eta_p^2=.06$ ). Both teacher-report and peer-report measures did not show any statistically significant differences between the two groups at Time 2 based on the ANCOVA results (adjusted  $ps > .22$ ).

### Maintenance of Training Effects at 14-Week Follow-Up Assessment

Figure 2 shows the mean scores of the treatment outcomes over time. Repeated-measures ANOVAs were conducted separately on the treatment and control groups, with time entered as the within-subject factor, to compare training



**Fig. 2** Mean scores and standard errors of outcomes variables for treatment group (solid line) and waitlist control group (dotted line) at Time 1, Time 2, and Time 3. **a** Test of adolescent social skills knowledge (TASSK); **b** Conflict score on the Quality of Play Questionnaire completed by adolescents (QPQ-A); **c** Self-Direction subscale

score on the Adaptive Behavior Assessment System (ABAS); **d** Total raw score on the Social Responsiveness Scale completed by parents (SRS-2); **e** Social Communication and Interaction subscale score on the Social Responsiveness Scale; **f** Restrictive and Repetitive Behaviors subscale score on the Social Responsiveness Scale

effects at several time points (Time 1–Time 4; refer to study design in Fig. 1). The main effects of time and the post hoc comparisons between the scores at different time points for the treatment and control groups are presented in Tables 3 and 4, respectively. All  $p$  values for the pairwise comparisons were adjusted for multiple comparisons using the Bonferroni method. Improvements over time were denoted by positive difference scores on the TASSK and ABAS and negative difference scores on the SRS-2 and QPQ (Conflict).

Training effects observed in the treatment group were maintained for all treatment outcomes at the 14-week post-intervention follow-up except for self-reported

improvements in conflict levels at get-togethers (Table 3). More specifically, follow-up assessment scores at Time 3 were significantly improved when compared to the pretest at Time 1 for all treatment outcomes ( $ps < .02$ ), except for the measure of conflict level on the QPQ-A ( $p = .06$ ). All Time 2 scores were significantly different from the pretest scores ( $ps < .03$ ), but no significant differences were found between the Time 2 and Time 3 scores.

Comparable results were observed for the waitlist control group. The training effects on social skills knowledge and social responsiveness were maintained over time for a period of 14-weeks after the intervention (Table 4). The

**Table 3** Maintenance of training effects for the treatment group ( $n=31$ ): main effects of time using repeated measures ANOVA, and post hoc tests for mean differences between pretest (T1), immediate post-test (T2), and follow-up assessment (T3)

	Main effects of time			T2–T1			T3–T2			T3–T1		
	<i>F</i>	<i>p</i>	$\eta_p^2$	Mean	<i>SE</i>	<i>p</i>	Mean	<i>SE</i>	<i>p</i>	Mean	<i>SE</i>	<i>p</i>
Adolescent self-report measures												
TASSK	43.39***	<.001	.59	5.42***	0.76	<.001	–0.10	0.46	1.00	5.32***	0.74	<.001
QPQ-A												
Conflict	7.98**	.001	.21	–2.84**	0.68	.001	0.61	0.63	1.00	–2.23	0.90	.06
Parent report measures												
ABAS												
Self-direction	6.97**	.002	.19	4.33*	1.52	.02	1.00	1.33	1.00	5.33*	1.69	.01
SRS												
Total	8.55**	.001	.22	–15.48**	4.45	.005	–2.16	4.34	1.00	–17.65**	5.14	.005
SCI	9.12***	<.001	.23	–12.81**	3.48	.003	–0.13	3.25	1.00	–12.94**	3.70	.004
RRB	10.30***	<.001	.26	–4.81**	1.22	.001	0.16	0.97	1.00	–4.65**	1.39	.007

TASSK test of adolescent social skills knowledge, QPQ-A Quality of Play Questionnaire (Adolescent), ABAS Adaptive Behavior Assessment System, SRS Social Responsiveness Scale, SCI social communication and interaction, RRB restricted and repetitive behaviors

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

**Table 4** Maintenance of training effects for the waitlist control group ( $n=27$ ): main effects of time using repeated measures ANOVA, and post hoc tests for mean differences between baseline (T1), immediate pre-test (T2), immediate post-test (T3), and follow-up assessment (T4)

	Main effects of time			T2–T1			T3–T2			T4–T3			T4–T2		
	<i>F</i>	<i>p</i>	$\eta_p^2$	Mean	<i>SE</i>	<i>p</i>	Mean	<i>SE</i>	<i>p</i>	Mean	<i>SE</i>	<i>p</i>	Mean	<i>SE</i>	<i>p</i>
Adolescent self-report measures															
TASSK	27.08***	<.001	.53	0.24	0.54	1.00	4.64***	0.62	<.001	–0.24	0.57	1.00	4.40***	0.87	<.001
QPQ-A															
Conflict	1.78	.16	.07	–1.14	0.60	.43	0.78	1.12	1.00	–1.48	1.07	1.00	–0.70	0.85	1.00
Parent report measures															
ABAS															
Self-direction	5.55**	.002	.18	–0.54	1.66	1.00	3.89	1.51	.10	1.62	1.47	1.00	5.50**	1.39	.003
SRS															
Total	11.46***	<.001	.31	–2.58	3.60	1.00	–15.85**	3.38	.001	2.73	2.81	1.00	–13.12*	4.41	.04
SCI	11.70***	<.001	.32	–1.50	2.91	1.00	–12.73***	2.63	<.001	2.00	2.13	1.00	–10.73*	3.40	.03
RRB	6.56**	.001	.21	–1.12	0.89	1.00	–3.04*	0.96	.02	0.77	0.98	1.00	–2.27	1.26	.50

TASSK test of adolescent social skills knowledge, QPQ-A Quality of Play Questionnaire (Adolescent), ABAS Adaptive Behavior Assessment System, SRS Social Responsiveness Scale, SCI social communication and interaction, RRB restricted and repetitive behaviors

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

follow-up assessment scores for the waitlist control group at Time 4 were significantly better than the immediate pretest scores at Time 2 for the TASSK, the Self-Direction subscale of the ABAS, and the social communication and interaction subscale on the SRS-2. For the RRB subscale of the SRS-2, a significant training effect was observed immediately after the intervention at Time 3, but this effect failed to maintain significance at Time 4. The main effect of time was not significant for the self-reported improvements in conflict levels at get-togethers. To summarize, the results of the maintenance of training

benefits seen in the treatment group were replicated in the waitlist control group.

## Discussion

This study explored the feasibility and treatment efficacy of using the Hong Kong Chinese version of PEERS® among adolescents with ASD in Hong Kong, China. Our study is among the very few RCTs conducted in a non-Western society to examine the effects of social skills group interventions

and possibly the second study thus far to establish evidence for PEERS® based on a population outside North America and Europe. It is also noteworthy that the large sample size reported here was remarkable for an RCT on ASD treatment outcomes for individuals aged 6–21 (Reichow et al. 2013).

The results from the present study suggest that PEERS®, as a parent-assisted social skills training program, may be efficacious in enhancing the social skills knowledge and social communication among high-functioning Chinese adolescents diagnosed with ASD. More specifically, knowledge of social etiquette as indicated on the TASSK and social functioning as indicated on the SRS-2 were both significantly improved after training, while restricted and repetitive behaviors were reduced. Training effects were maintained for at least 14 weeks after the intervention had ended, and these results were replicated in the waitlist control group after receiving delayed treatment.

These results were largely comparable to previous studies on PEERS®, in which improvements in the knowledge of social skills and social responsiveness and reductions in autistic mannerisms were also observed (Laugeson et al. 2009, 2012; Laugeson and Park 2014; Schohl et al. 2014; Van Hecke et al. 2015; Yoo et al. 2014). Moreover, the maintenance of treatment gains at the 14-week follow-up assessment corroborated the results of other similar studies with respect to the durability of treatment outcomes (Laugeson et al. 2012; Yoo et al. 2014). Most treatment gains were reportedly maintained for a period of at least 3 months after the intervention had concluded. This extension of post-treatment effects might be attributed to the enhanced parental skills and parental involvement in providing social coaching to their teenagers, which continued after completion of the training.

Nonetheless, the frequency of get-togethers did not increase significantly over the course of intervention. This finding was different from the results of PEERS® studies conducted in North America (Laugeson et al. 2012, 2009; Schohl et al. 2014) but comparable to that observed in a South Korean population (Yoo et al. 2014). Like their Korean counterparts, adolescents in Hong Kong are faced with immense pressure to achieve academically in a highly competitive educational environment (Huan et al. 2008). They often devote large amounts of time to studying, and many attend private cram schools after school and on weekends. In addition, their schedules are typically occupied with various extra-curricular activities (e.g., sports practices, learning musical instruments). It was common to receive feedback from parents and teens during the intervention that they were unable to organize or host get-togethers because of busy schedules among themselves as well as among their peers.

Furthermore, our participants also reported practical difficulties in hosting get-togethers at home, due to the relatively

small living spaces typically found in Hong Kong. This comment aligned with the teen survey results, indicating that local teenagers preferred to hang out with their friends rather than having get-togethers at home. In view of this situation, the Hong Kong Chinese version of the PEERS® manual incorporated social rules on holding non-home-based get-togethers. However, parents still found it hard to encourage their teens to arrange social gatherings, and they would not be able to report on the level of conflict if those gatherings were held outside home. The homework completion rate for get-togethers was hence only about 50% in our study, which was similar to the rate of less than 45% observed in the Korean sample (Yoo et al. 2014).

Apart from the social rules for non-home-based get-togethers, another adaptation implemented was the addition of role-playing and behavioral rehearsals for the parent group to promote parents' competence in delivering social coaching. The quality of the parental coaching often predicts adolescents' receptivity to it (Gregson et al. 2016). Child-rearing practices indigenous to the Chinese culture, such as high levels of monitoring and control, a strong emphasis on respect for authority, and the disapproval of reciprocal parent–child communication, all seem counterintuitive to high-quality social coaching. In the present study, Chinese parents in the group training were explicitly taught how to coach their teens in the weekly socialization tasks via modeling and practice. Participants generally found these exercises useful in equipping them for their roles as social coaches.

We attempted to examine the generalization of treatment gains in social skills across settings by inviting additional third parties—teachers and peers—who were not actively involved in the intervention to evaluate the social functioning of our adolescent participants in schools. Teachers and peers were nominated by the adolescents, but they were blinded to the experimental conditions and group assignment of the participants to avoid bias. However, neither the teacher-report nor the peer-report measures revealed significant differences between the treatment and control groups. We suspect that the low return rate (33.3% for teachers and 27.3% for peers) might have affected the results as a consequence of reduced statistical power. Indeed, comparably poor response rates from teachers have also been reported in similar studies (Laugeson et al. 2009, 2012). In spite of repeated efforts to remind teachers and fellow peers to return the rating forms in the current study, response rates were still far from satisfactory. This remained one of the major limitations of this study.

To explore whether the non-significant results based on the teacher- and peer-reports were simply due to insufficient sample size or a lack of robustness of intervention outcomes beyond the treatment groups, future research should work on improving the response rates of third party assessments in order to obtain a more accurate estimate of the extent of skill

generalization across settings. One suggestion is to provide online forms for teachers and peers to complete—instead of asking them to mail back the questionnaires to the researchers—to minimize the hassle for the informants. Moreover, researchers may also consider incorporating direct observation of participants in naturalistic social interactions by blinded observers in future studies of PEERS®. This may supplement the results obtained from indirect measures, as well as circumvent the problem of low return rate of teacher- and peer-reports.

During the intervention, we tried to ensure high treatment fidelity by providing detailed lesson plans for the group leaders and behavioral coaches, and the actual delivery of the lessons was primarily guided by scripts written in the manual. In addition, members of the research team met regularly with the group leaders and conducted site visits to observe the intervention. Unfortunately, quantitative data on treatment integrity was not collected in this study. In spite of our greatest effort to ensure procedural integrity, the lack of quantifiable measures on implementation fidelity might pose some threats to the internal validity of the intervention study. Treatment integrity is an important indicator of the trustworthiness of the efficacy shown in a feasibility study, as it reflects the methodological rigor and the adherence of the actual treatment to what is originally intended. As such, the results here should be interpreted with caution. That said, we did include a number of quantitative feasibility measures to indicate dosage of treatment (e.g., attendance and treatment completion rates) and the fidelity of teen and parent behaviors during the intervention (e.g., homework completion rates and get-together reports). Nevertheless, we suggest that this issue should be carefully dealt with in future studies, possibly by asking the teen and parent participants to fill out a simple checklist at the end of each training session to indicate the completion of activities and the attainment of session goals.

The present study adds to the meager literature on evidence-based social skills group interventions for individuals with ASD beyond Western populations and represents one of the very few RCTs on PEERS® conducted outside North America. The results from this study support the feasibility and treatment efficacy of the PEERS® intervention in improving social skills among Hong Kong Chinese adolescents with ASD, after some modifications to adapt for cultural differences. Our findings provide evidence for the generalizability of the treatment effects of PEERS® to different cultures across the globe.

Up till now, there are very few, if any, culturally adapted evidence-based social skills training available for adolescents with ASD in a Chinese society. The adapted Hong Kong Chinese version of the PEERS® intervention is certainly one of a kind. Despite the unique Hong Kong context upon which this study was based, there remains a strong

possibility that the findings here may also be valid for the high-functioning ASD populations in other Chinese societies, such as metropolitan areas in mainland China and Taiwan, as cultural values and parenting practices are rather similar among these places (Lin and Ho 2009; Yau and Smetana 2003). On the other hand, given the special linguistic features of the Hong Kong PEERS manual—conversational scripts transcribed in Cantonese—and content specifically adapted to the local teen culture, we believe that the use of this manual would be most appropriate among Hong Kong adolescents with ASD. The external validity of the current feasibility study for other Chinese-based cultures or even other Asian cultures warrants further investigation in future studies.

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**Author Contributions** KKS conceived the study, participated in its design, performed the statistical analysis, interpreted the data, and drafted the manuscript; WKC and LMOL participated in the design and coordination of the study, and performed the measurement; EAL participated in the design of the study and helped to draft the manuscript; WSW participated in the coordination of the study and performed the measurement; LSKL conceived the study, and participated in its design and coordination. All authors read and approved the final manuscript.

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## Compliance with Ethical Standards

**Conflict of interest** K. K.-M. Shum and W. K. Cho declare that they have no conflict of interest. L. M. O. Lam, W. S. Wong, and L. S. K. Law are current employees of SAHK. E. A. Laugeson is the director of the UCLA PEERS® Clinic, and author of the original PEERS® Manual.

**Ethical Approval** All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

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

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