

A randomized controlled trial to examine the effects of the Tackling Teenage psychosexual training program for adolescents with autism spectrum disorder

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Background: Previous research underscores the importance of psychosexual guidance for adolescents with autism spectrum disorder (ASD). Such guidance is provided in the Tackling Teenage Training (TTT) program, in which adolescents with ASD receive psycho-education and practice communicative skills regarding topics related to puberty, sexuality, and intimate relationships. This randomized controlled trial investigated the effects of the TTT program on (a) cognitive outcomes (i.e. psychosexual knowledge, and insight in interpersonal boundaries) and (b) behavioral outcomes (i.e. skills needed for romantic relationships and problematic sexual behavior). **Methods:** A total of 189 cognitively able adolescents with ASD, aged 12–18 years old, were randomized to an intervention condition ($n = 95$) or a waiting-list control condition ($n = 94$). We assessed outcomes using self-reported as well as parent-reported questionnaires at baseline (T1), posttreatment (T2; after 6 months), and follow-up (T3; after 12 months). **Results:** Linear mixed model analyses showed significant treatment effects for psychosexual knowledge and adequate insight in boundaries, both posttreatment and at follow-up. All adolescents increased significantly over time in their social responsiveness and decreased their problematic sexual behavior, irrespectively of condition. The TTT program was most effective for younger adolescents with ASD; following the TTT program resulted in higher psychosexual knowledge, and higher social functioning for these adolescents. **Conclusions:** The results of this study indicate that the TTT program is effective as a psycho-educational program to provide adolescents with ASD with the knowledge and insight they need to prepare themselves for a healthy psychosexual development. Further research is needed to investigate how this increased knowledge and insight can subsequently ameliorate improvements in romantic skills and prevent the development of problematic sexual behavior and victimization. **Keywords:** Adolescence; autism spectrum disorders; sexual behavior; intervention; randomized controlled trial design.

Introduction

Adolescence is a transition phase in life in which psychosexual development accelerates (Santrock, 2005), which offers several challenges for adolescents with autism spectrum disorder (ASD). In the past, it was thought that people with ASD did not have a desire for relationships and that they were asexual (Konstantareas & Lunskey, 1997). We now know that most adolescents with ASD do have an interest in social relationships and sexuality, and that they have psychosexual needs and want to engage in sexual behavior (Hénault, 2006; Stokes & Kaur, 2005). However, deficits in social cognition and communication can make understanding, developing and maintaining close interpersonal relationships difficult for people with ASD (American Psychiatric Association, 2013; Byers & Nichols, 2014; Mehzabin & Stokes, 2011). For instance, adolescents with ASD report few intimate and sexual experiences and more unfulfilled desires and sexual

frustration (Coskun, Karakoc, Kircelli, & Mukaddes, 2009; Gougeon, 2010; Murrie, Warren, Kristiansson, & Dietz, 2002; Stokes & Kaur, 2005; Stokes, Newton, & Kaur, 2007). Difficulties in psychosexual functioning of adolescents with ASD are not limited to problems with normative sexual behavior, but they can also lead to problematic sexual behavior, for example touching others inappropriately, stalking, public masturbation or even sexual delinquency (Chan & Saluja, 2011; Griffin-Shelley, 2010; Realmuto & Ruble, 1999; Stokes et al., 2007; Sullivan & Caterino, 2008). In addition, because adolescents with ASD often have a propensity for repetitive and stereotyped behavior and often experience hyper- or hyposensitivity, they are at a higher risk to develop sexual preoccupations or paraphilias, such as fetishism or exhibitionism (Fernandes et al., 2016; Ray, Marks, & Bray-Garretson, 2004). Furthermore, difficulties with understanding the intentions of other people and the desire to be socially accepted can put adolescents with ASD at a higher risk to become a victim of sexual coercion, sexual bullying, and sexual abuse (Brown-Lavoie, Viecili, & Weiss, 2014; Edelson, 2009; Mandell, Walrath, Manteuffel,

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Sgro, & Pinto-Martin, 2005). Consequently, there is a well understood and described importance for standardized evidence-based psychosexual guidance and training programs especially designed for adolescents with ASD (Dewinter, Vermeiren, Vanwesenbeeck, & Nieuwenhuizen, 2013; Ginevra, Nota, & Stokes, 2016; Koller, 2000; Nichols & Blakeley-Smith, 2009), but so far such training programs, and research on the effects of these programs, have been scarce (Sevlever, Roth, & Gillis, 2013).

An individual training program has been developed targeting a positive psychosexual development in adolescents with ASD: the Tackling Teenage Training (TTT) program (Boudesteijn, Van der Vegt, Visser, Tick, & Maras, 2012). A first systematic evaluation among 30 adolescents with ASD on the effects of the TTT program on psychosexual knowledge showed that adolescents with ASD had increased knowledge of puberty and psychosexual topics after following the training program (Dekker et al., 2014). However, it is known that adolescents' knowledge develops rapidly on several domains during adolescence (Sanrock, 2005; Shattuck et al., 2012), underlining the importance of further investigating the effects of the TTT program in a randomized controlled trial (RCT).

The aims of this study were first to evaluate the effects of the TTT program for adolescents with ASD on cognitive outcomes (i.e. psychosexual knowledge and insight in interpersonal boundaries) and second to investigate the effect of the TTT program on behavioral outcomes (i.e. social skills needed for romantic relationships and problematic sexual behavior). Based on the previous results, we hypothesized that the TTT program could improve psychosexual knowledge and insight in interpersonal boundaries. However, from general sexuality research, we know that having psychosexual knowledge may not be sufficient for positive sexual functioning (Byers, Nichols, Voyer, & Reilly, 2013) and that a low correlation has been found between knowledge and behavior (Winn, Roker, & Coleman, 1995). In general, the ability to develop skilled performance of complex domains of behavior tends to develop more directly through experience rather than through the acquisition of knowledge (Hambrick & Meinz, 2011). Therefore, in this study, we explored whether a gain in cognitive outcomes could additionally cascade into actual behavior changes, because knowledge and insight might be necessary requirements to portray subsequent changes in social behavior.

Methods

Participants and procedure

Participants were 189 boys and girls with ASD recruited between January 2012 and March 2014. All participants were between 12 and 18 years old, had a total score of 51 or above on the Social Responsiveness Scale (SRS, see measures;

Constantino & Gruber, 2002; Roeyers, Thys, Druart, De Schryver, & Schittekatte, 2011) and an intelligence quotient (IQ) score in the normal range (full IQ \geq 85). In addition, all participants were previously diagnosed with ASD following DSM-IV criteria by a licensed psychiatrist or psychologist, and for this study ASD severity was further determined using the Autism Diagnostic Observation Schedule-2, (ADOS-2; De Bildt & De Jonge, 2008; Lord et al., 2012). However, meeting the ADOS cut-off was not considered a prerequisite for participation, given that the sensitivity of the ADOS for detecting PDD-NOS or high-functioning ASD, especially in females, is not optimal (Lai et al., 2011). Participants were recruited for this study through referrals from professionals working with adolescents with ASD, either at Yulius, a large expert mental health care institution in the South-West of The Netherlands, in schools for special education or through open application. After the application, with permission of the parents and the adolescents, information about the study was sent to their home address together with the consent forms, and parents were asked to fill out the SRS. We used a total score of 51 or above on the SRS, because this is the preferred cut-off point based on research among clinical referrals and children from the Dutch general population (Roeyers et al., 2011). With the SRS, it is possible to also identify children with less severe forms of ASD, such as Pervasive Developmental Disorder Not Otherwise Specified, in addition to the more classic or severe forms, such as Autistic Disorder (Constantino & Gruber, 2002). Written informed consent was obtained from all adolescents and their parents. Full IQ was taken from the medical file of the adolescent and used if the assessment was not older than 2 years old, and if a valid and reliable instrument was used (i.e. WISC or WAIS). In most cases ($n = 123$), no or no recent IQ measurement was available, and IQ was assessed using the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999). For descriptive purposes, the ADOS-2 (De Bildt & De Jonge, 2008; Lord et al., 2012) was administered in all adolescents at baseline to get an indication of ASD severity in the current sample, using the calibrated severity scores. The ADOS-2 has four modules, each designed to be administered to different individuals according to their level of expressive language. In this study, module 4 was used based on the age as well as the language abilities of the participating adolescents.

Adolescents that portrayed offensive sexual behavior (i.e. law-violating behavior) were not eligible for this study. Because the professionals that referred subjects to this study were familiar with the design of the study (explained in information sessions), and the possibility that an adolescent would be placed on a waiting list for 1 year, their clinical judgment excluded adolescents with too severe, offensive law-violating levels of sexual problems or inappropriate sexual behaviors.

This study was approved by the medical ethical commission of the Erasmus Medical Center, Rotterdam (MEC-2013-040) and registered in the Dutch Trial Register (NTR2860). A further detailed description of the design of this study is provided in Visser et al. (2015).

Participating adolescents and their parents filled out questionnaires at three time points: at baseline (T1), posttreatment (T2; after 6 months) and follow-up (T3; after 12 months). We used both self-reported and parent-reported questionnaires, in order to reflect both the perception of the adolescent with ASD itself and his or her parents. Adolescents were randomly assigned to the intervention condition ($n = 95$) or the control condition ($n = 94$) after completion of T1. Adolescents in the intervention condition started the TTT program shortly after randomization and the adolescents in the control condition were placed on a waiting list for the duration of the study (1 year).

Intervention

The TTT program is a psychosexual intervention aimed at adolescents with ASD aged 12–18 years old with a full IQ of 85

or higher (Visser et al., 2015). The TTT program consists of a manual for the professional and a workbook for the adolescent (Boudesteijn et al., 2012). The manual for the professional contains a detailed protocol that guides the professional per session with a description of the exercises. The workbook for the adolescent contains texts, exercises and illustrations. Each week, the discussed session is added to the workbook of the adolescent, creating an extensive reference guide for the adolescent over the course of the training program. Furthermore, parents are weekly informed by mail on the progress of the training by the professional, via structured contact reports. The contact reports consist of information on the topic of the session (i.e. psycho-education), the take-home assignment of the child, and particularities (i.e. strengths and difficulties of the child) during the specific session. This involvement of parents is built in to stimulate communication about delicate subjects between the adolescents with ASD and their parents, and to enhance generalization of learned knowledge, insight and skills to other contexts outside the setting of the training.

The TTT program consists of 18 individual sessions that cover the following topics: discussing puberty, appearances, first impressions, physical and emotional developments in adolescence, friendships, falling in love and dating, sexuality and sex (e.g. sexual orientation, masturbation, and intercourse), pregnancy, setting and respecting boundaries and safe internet use. The professional and adolescent discuss one session per week, in which one topic is discussed and exercises are practiced in a structured manner in approximately 45 min. The training program consists of a total of 112 exercises (e.g. knowledge and insight quizzes and role plays with the professional). At the end of each session, the adolescent receives a take-home assignment in which the topic of that session can be practiced outside of the context of the training, for instance a small interview with one of the primary caregivers on the topic of the session, stating your own boundaries to someone that crosses them, and arranging a get-together with a friend.

The TTT program can be used for two purposes: (a) for intervention purposes, because problems in psychosexual functioning have already occurred, or (b) for prevention purposes, to prepare adolescents with ASD for a healthy psychosexual development. Because of the ethical concerns of potentially placing adolescents with obvious problems in psychosexual functioning on a waiting list for 1 year (i.e. 50% chance of receiving the control condition), the focus of this study is on the preventive psycho-educational effects of the TTT program.

The TTT program was provided by professionals who had a bachelor's or master's degree in psychology or social services and who had at least 3 years of working experience with people with ASD. All professionals took a 2-day train-the-trainer course and participated in interdisciplinary meetings every 3 months to discuss questions and case reports with other professionals and the developers of the training program. A total of 11 professionals provided the TTT program in this study.

Fidelity was investigated by looking at protocol adherence by the professionals providing the training program and looking at received sexual guidance during the study. Protocol adherence was monitored by means of standardized short evaluation forms that the professionals filled out after each training session. Two measures were used to measure protocol adherence: the number of exercises skipped and number of exercises adjusted by the professional in the whole training program. In addition to checking protocol adherence for the adolescents in the intervention condition, we also investigated whether the adolescents in the control condition did not receive a sexual education intervention. At T2 and T3, we have asked all adolescents and their parents if and by whom they have received sexual education (i.e. from parents, teachers, or in a special intervention) in the last 6 months, in order to be able to control for this in the main analyses in case it turned out to be of influence on the outcomes.

Outcome measures

Cognitive outcomes. A psychosexual knowledge test for adolescents (Dekker et al., 2014) was used consisting of 37 questions (see online Appendix S1 for an overview of the questions). Scores were summed with one point for each correct response, ranging the total scores from 0 to 37. In addition, as a second measure of psychosexual knowledge, parents were questioned regarding their estimation of the knowledge of their child using a scale with 10 questions regarding psychosexual knowledge (example items: 'My child understands the difference between friendship and dating', 'My child has knowledge of the physical changes that occur during puberty'). Items were scored on a 3-point scale with 'Not at all true'; 'Somewhat or Sometimes true' and 'Definitely or Often true'. Mean scores for this scale ranged from 0 to 2 (higher scores indicating higher abilities) and the internal consistency of this scale in the current population was good ($\alpha = .89$).

To investigate whether the TTT program increased insight in interpersonal boundaries, we created a scale that includes both the ability of the adolescent to recognize and indicate their own as well as other people's boundaries with seven items for parents (example items: 'My child is able to recognize another person's boundaries regarding intimate contact', and 'My child is able to set his/her boundaries regarding intimate contact'). Items were scored on a 3-point scale with 'Not at all true'; 'Somewhat or Sometimes true' and 'Definitely or Often true'. Mean scores for this scale ranged from 0 to 2 (higher scores indicating higher abilities) and the internal consistency of this scale in the current population was good ($\alpha = .86$).

Behavioral outcomes. The SRS (Constantino & Gruber, 2002) was administered to assess potential changes in the social functioning of the adolescents. The SRS is a 65-item questionnaire that covers the various dimensions of interpersonal behavior, communication, as well as repetitive/stereotypic behaviors that are characteristic of ASD. The SRS provides a dimensional measure of autistic traits, with higher scores on the SRS reflecting a greater degree of social impairment. The SRS has been shown to be sensitive to changes in social functioning among children with ASD (Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012; Wood et al., 2009). In addition, we measured self-perceived romantic relational skills of the adolescents with a scale existing of three items (example item: 'When I am in love with someone, I do not know what to do'). Items were scored on a 3-point scale with 'Not at all true'; 'Somewhat or Sometimes true' and 'Definitely or Often true'. Adolescents only received a score on this scale if they have had romantic experiences, therefore the sample for this scale was lower than the other scales. Mean scores for this scale ranged from 0 to 2 (higher scores indicating higher abilities) and the internal consistency of this scale was acceptable ($\alpha = .78$).

We used the Sex Problems scale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001; Verhulst & van der Ende, 2013) to determine changes in psychosexual problems. This scale consists of five items regarding sexual problems, thinking of sex too much, playing with own genitals in public, playing with own genitals too much and the desire to be from the other gender, that are rated by parents on a 3-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true; Achenbach & Rescorla, 2001; Letourneau, Schoenwald, & Sheidow, 2004). Furthermore, similar to Ginevra et al. (2016), we constructed a self-report and a parent-reported scale measuring specific ASD-related inappropriate sexual behavior (see Appendix S2 for the items in these scales). Items were again scored on a 3-point scale with 'Not at all true'; 'Somewhat or Sometimes true' and 'Definitely or Often true'. Mean scores for these scales ranged from 0 to 1 (higher scores indicating more inappropriate sexual behavior).

The internal consistency of these scales was low (parent-reported: $\alpha = .56$; self-reported: $\alpha = .54$).

Statistical analyses

Preliminary analyses. Baseline characteristics were calculated for adolescents in both conditions. For more in-depth information of the severity of problematic sexual behavior of our study population, we calculated the percentages of this behavior (i.e. sexual problems measured by the CBCL and inappropriate sexual behavior). By means of binominal tests, we calculated whether the reported percentages of sexual problems in the current sample differed from the two norm samples used in the ASEBA manual (Achenbach & Rescorla, 2001).

We investigated the potential influence of fidelity, by looking at protocol adherence and received sexual education during the study. We also checked whether the time between T1 and T2 and between T2 and T3 differed between the two conditions. In case any of these factors turned out to be of influence on the outcome measures, or differed significantly between the groups, we controlled for these factors in the main analyses.

Main analyses. To investigate the effects of the TTT program on the cognitive and behavioral outcomes, we used linear mixed models (LMM) from the SPSS 19.0 statistical software package (SPSS; Nie, Bent, & Hull, 1975). LMMs are advantageous compared to repeated measures ANOVA in that they accommodate missing time points, utilizing all available data, and therefore can be considered truly intent-to-treat models (Hox, 2010). We thus used data from all 189 adolescents that had complete baseline data. Time (with three levels: baseline, effect, and follow-up) was set as a repeated variable, and condition (with two levels: intervention and control) was added to the models as a factor. We used an unstructured covariance matrix to allow all covariances (both slopes and intercepts were fixed). The interactions between condition and time directly tested whether there was a significant difference between the two conditions over time. To determine the magnitude of the effects, we calculated partial eta-squared for all interaction effects. With significant interactions, we looked at the estimates of fixed effects for T2 and T3 in order to determine the time of onset of treatment effects, and we calculated the effect size by means of Cohen's d separate at T2 and T3 (Durlak, 2009).

Finally, to evaluate the potential moderating influence of gender and age on the outcomes, we performed two additional sets of analyses, each including one of these factors in a three-way interaction with time and condition in the LMMs. When age or gender showed to be a significant moderator, we performed stratified analyses in order to clarify for which subgroups the TTT program was most effective. For age, we stratified the groups into the three stadia of adolescent development: early (cases aged between 12 and 14 years old), middle (between 14 and 16 years old) and late adolescence (between 16 and 18 years old; Santrock, 2005).

Results

Participant flow and baseline characteristics

Figure 1 provides the CONSORT Study Flow Chart of this study, illustrating participant movement throughout the study. From the 189 participants that were randomized and completed the baseline measurement (T1), 163 adolescents (86%) participated posttreatment (T2) and 158 (84%) participated

at follow-up (T3). Because parents were given the choice to participate separately in addition to their child, 182 parents participated at baseline (T1), 146 parents (80%) participated posttreatment (T2), and 143 parents (79%) participated at follow-up (T3). In total, 15% of the participants ($n = 28$; intervention condition $n = 14$; control condition $n = 14$) dropped out of the study, due to personal circumstances (e.g. lack of motivation of the adolescent or parents, changes in the family context; $n = 20$) or practical reasons (e.g. moving to a different location, changing schools; $n = 8$). All 83 adolescents that completed the TTT program followed all 18 sessions in the training program. The average time between T1 and T2 was significantly longer for adolescents in the intervention condition ($M = 0.64$, $SD = 0.18$) than for adolescents in the control condition ($M = 0.57$, $SD = 0.11$), $t(133.56) = 3.15$, $p < .01$, Cohen's $d = .47$, we therefore controlled for time between T1 and T2 in the main analyses. No significant difference was found between the two conditions on the average time between T2 and T3 (intervention condition: $M = 0.57$, $SD = 0.13$; control condition: $M = 0.56$, $SD = 0.14$), $t(159) = 0.47$, $p = .64$, Cohen's $d = .07$.

The characteristics of the 189 participating adolescents are presented in Table 1. Regarding problematic sexual behavior in the current population we found that, compared to the nonreferred norm sample used in the ASEBA Manual (Achenbach & Rescorla, 2001), the percentages of all reported sexual problems in the current sample were higher for both boys and girls. Compared to the referred norm sample, differences were found for boys on two reported sexual problems: Parents of boys in the current sample more often reported that their son 'plays with his own sex parts too much' and 'thinks about sex too much'. The reported inappropriate sexual behavior varied from 7.7% (for parent-reported inappropriate masturbation) to 51.1% (for parent-reported inappropriate questions/remarks; see Appendix S2 for an overview of the percentages of problematic sexual behaviors).

Fidelity

The TTT program consists of a total of 112 exercises. On average, per adolescent, six mandatory exercises (range: 0–56; 5.3%) in the training program were skipped by the professional and on average, eight exercises (range: 0–82; 7.2%) were adjusted to the need of the adolescents. Protocol adherence (i.e. skipping or adjusting) had no influence on any of the outcome measures. And even though a percentage of the adolescents (8.6% from parents and 27.2% in school) and their parents (23.6% from parents and 21.1% in school) in the control condition reported to have received sexual education between T1 and T2 and T2 and T3, this did not influence the results.

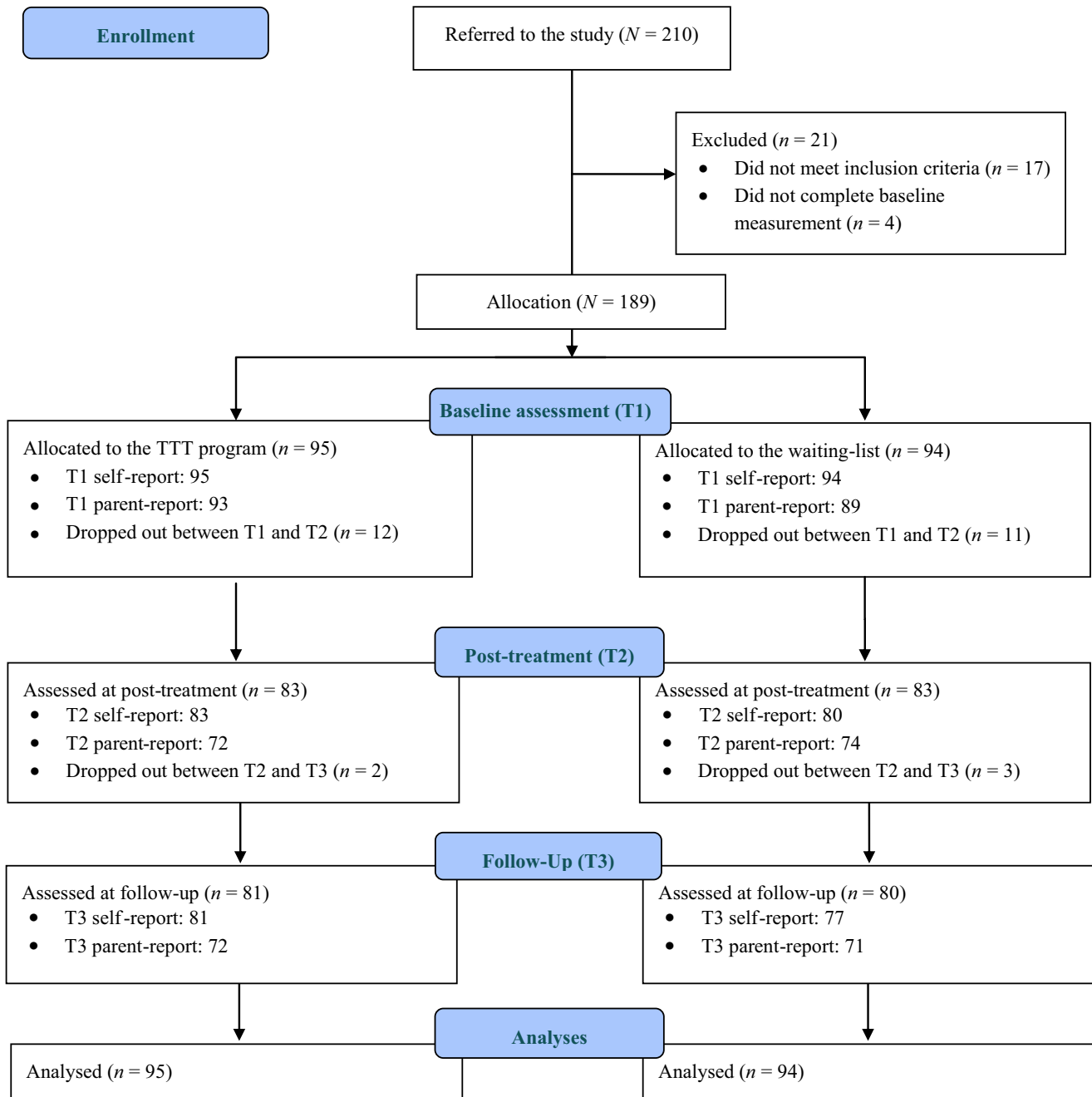


Figure 1 CONSORT study flow chart [Colour figure can be viewed at wileyonlinelibrary.com]

Effects of the TTT program

Descriptive information on the outcome measures is summarized in Table 2 and the results of the statistical analyses comparing the two conditions, controlling for time between T1 and T2, over the three time points are displayed in Table 3.

Cognitive outcomes. Compared to adolescents in the control condition, adolescents in the intervention condition demonstrated a significantly greater increase in psychosexual knowledge, as measured using the psychosexual knowledge test, $F(2, 161.62) = 13.51$, $p < .01$, $\eta^2 = .14$, as well as when using the parent-reported scale, $F(2, 146.53) = 9.36$, $p < .01$, $\eta^2 = .11$.

More specifically, following the TTT program resulted in a significant increase in the psychosexual knowledge at T2 [$t(164.27) = -2.56$, $p < .01$, Cohen's $d = -.40$] and at T3 [$t(154.76) = -2.67$, $p < .01$, Cohen's $d = -.42$]. Also, parent-reported knowledge of their child increased significantly more in the intervention condition than in the control condition at T2 [$t(152.46) = -3.91$, $p < .01$, Cohen's $d = -.63$] but not at T3 [$t(137.23) = -0.42$, $p = .67$, Cohen's $d = -.07$].

Regarding insight in interpersonal boundaries, a significant treatment effect was found on the parent-reported scale measuring adequate boundaries, $F(2, 141.77) = 2.92$, $p = .05$, $\eta^2 = .04$. Following the TTT program resulted in significantly more increase

Table 1 Baseline descriptives ($N = 189$)

	Intervention condition $n = 95$	Control condition $n = 94$
Demographics		
Gender (male), n (%)	73 (77.7)	79 (84.0)
Age (in years), $M \pm SD$ (range)	14.4 \pm 1.74 (12.1–18.8)	14.5 \pm 1.74 (12.0–18.5)
Full intelligence quotient, $M \pm SD$ (range)	106 \pm 11.78 (86–140)	105 \pm 13.13 (85–143)
SRS total score, $M \pm SD$ (range)	97 \pm 24.92 (52–153)	95 \pm 22.87 (52–158)
ADOS-2 calibrated severity score	6.3 \pm 2.09 (1–10)	6.1 \pm 2.03 (1–9)
ADOS-G classification		
No classification (%)	7 (7.3)	9 (9.6)
Autism spectrum disorder (%)	43 (44.8)	36 (38.3)
Autism (%)	44 (45.8)	44 (46.8)
CBCL externalizing problems, $M \pm SD$ (range)	15.1 \pm 10.1 (0–55)	16.5 \pm 10.1 (0–43)
CBCL internalizing problems, $M \pm SD$ (range)	19.7 \pm 9.7 (4–45)	18.0 \pm 8.7 (3–39)

M , mean; SD , standard deviation; SRS, Social Responsiveness Scale; CBCL, Child Behavior Checklist; ADOS, Autism Diagnostic Observation Schedule.

Table 2 Descriptives on outcome measures for both conditions

	Condition	T1			T2			T3		
		M	SD	N	M	SD	n	M	SD	n
Cognitive outcomes										
Psychosexual knowledge test	Intervention	25.71	7.71	93	32.09	4.28	82	32.70	4.30	80
	Control	26.43	7.88	93	28.79	6.95	80	30.81	5.38	77
Parent-reported psychosexual knowledge of the child	Intervention	1.45	0.42	93	1.79	0.30	73	1.86	0.18	73
	Control	1.56	0.41	87	1.67	0.34	72	1.76	0.28	71
Parent-reported adequate boundaries	Intervention	0.93	0.51	91	1.25	0.39	72	1.34	0.50	73
	Control	0.92	0.49	87	1.11	0.47	72	1.19	0.43	71
Behavioral outcomes										
SRS total score	Intervention	97.46	24.92	95	84.44	24.66	73	78.49	26.90	70
	Control	95.18	22.88	92	86.24	21.93	72	83.42	23.47	73
Self-reported romantic relational skills	Intervention	0.94	0.63	70	1.03	0.59	65	1.08	0.60	67
	Control	1.12	0.60	79	1.05	0.56	69	1.08	0.51	65
CBCL sex problems scale	Intervention	0.65	1.13	92	0.34	0.69	73	0.40	0.95	67
	Control	0.97	1.58	89	0.58	1.21	71	0.56	0.31	72
Self-reported inappropriate sexual behavior	Intervention	0.12	0.24	95	0.08	0.16	83	0.12	0.22	81
	Control	0.10	0.20	93	0.10	0.19	80	0.11	0.23	77
Parent-reported inappropriate sexual behavior	Intervention	0.34	0.27	93	0.25	0.22	72	0.22	0.22	73
	Control	0.34	0.28	87	0.28	0.32	72	0.28	0.25	71

M , mean; SD , standard deviation; SRS, Social Responsiveness Scale; CBCL, Child Behavior Checklist.

in parent-reported insight in adequate boundaries for adolescents in the intervention condition than adolescents in the control condition at T2 [$t(147.49) = -2.40$, $p = .02$, Cohen's $d = -.40$] but not at T3 [$t(133.19) = -0.71$, $p = .48$, Cohen's $d = -.12$].

Behavioral outcomes. A significant main effect for time was found on the SRS total score, $F(2, 154.24) = 21.70$, $p < .01$, $\eta^2 = .22$, indicating that adolescents in both conditions significantly increased their social functioning over time, irrespectively of condition. Significant main effects for time were also found on the Sex Problems scale of the CBCL, $F(2, 152.95) = 11.05$, $p < .01$, $\eta^2 = .13$, and on the parent-reported inappropriate sexual behavior scale, $F(2, 150.05) = 13.13$, $p < .01$, $\eta^2 = .15$, indicating decreased problematic sexual behavior in all participating adolescents, irrespectively of

condition. No significant treatment effects were found on the SRS total score, the self-reported romantic relational skills scale, the Sex Problems scale of the CBCL, nor on the self-reported and parent-reported inappropriate sexual behavior scale.

Moderators of outcome

Cognitive outcomes. The effect of the TTT program on psychosexual knowledge was moderated by age, shown in the three-way interaction on the adolescent psychosexual knowledge test, $F(5, 170.62) = 10.95$, $p < .01$, $\eta^2 = .24$, and the three-way interaction on the parent-reported psychosexual knowledge scale, $F(5, 163.74) = 3.63$, $p < .01$, $\eta^2 = .10$. Stratified LMM showed that on the psychosexual knowledge test following the TTT program was associated with more knowledge gain for the early adolescents, $F(2, 79.53) = 10.42$, $p < .01$, $\eta^2 = .21$ and the middle

Table 3 Linear mixed models outcome measures ($N = 189$)

	<i>F</i>	Numerator <i>df</i>	Denominator <i>df</i>	<i>p</i>
Cognitive outcomes				
Psychosexual knowledge test				
Time	88.55	2	161.63	.00**
Condition	2.55	1	166.32	.05
Condition × time	13.51	2	161.62	.00**
Parent-reported sexual knowledge of the child				
Time	52.87	2	146.53	.00**
Condition	1.00	1	156.65	.32
Condition × time	9.36	2	146.53	.00**
Parent-reported adequate boundaries				
Time	46.83	2	141.76	.00**
Condition	3.29	1	152.46	.07
Condition × time	2.92	2	141.77	.05*
Behavioral outcomes				
SRS total score				
Time	21.70	2	154.24	.00**
Condition	0.16	1	161.06	.69
Condition × time	1.18	2	154.25	.31
Self-reported romantic relational skills				
Time	0.45	2	129.26	.64
Condition	0.44	1	140.56	.51
Condition × time	0.54	2	129.25	.59
CBCL sex problems scale				
Time	11.05	2	152.95	.00**
Condition	1.58	1	163.78	.21
Condition × time	0.27	2	152.95	.73
Self-reported inappropriate sexual behavior				
Time	1.02	2	160.27	.67
Condition	0.40	1	164.44	.53
Condition × time	0.53	2	160.27	.59
Parent-reported inappropriate sexual behavior				
Time	13.17	2	150.05	.00**
Condition	0.50	1	158.31	.48
Condition × time	1.20	2	150.05	.30

SRS, Social Responsiveness Scale; CBCL, Child Behavior Checklist.

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

adolescents, $F(2, 47.10) = 4.57$, $p = .02$, $\eta^2 = .17$, but not for the older adolescents, $F(2, 31.58) = 0.87$, $p = .43$, $\eta^2 = .05$. The same results were found for the early adolescents, $F(2, 73.22) = 10.08$, $p < .01$, $\eta^2 = .22$, the middle adolescents, $F(2, 42.04) = 5.46$, $p < .01$, $\eta^2 = .21$, and the older adolescents, $F(2, 26.36) = 1.97$, $p = .16$, $\eta^2 = .13$, on the parent-reported psychosexual knowledge scale. No moderation effects were found for gender. The three-way interaction with age and the three-way interaction with gender for insight in interpersonal boundaries showed that neither of these factors were significant moderators.

Behavioral outcomes. A significant moderation effect was found on the SRS for age, with a significant three-way interaction on the SRS total score, $F(5, 162.78) = 2.80$, $p = .01$, $\eta^2 = .08$. Stratified LMM for the early adolescents, $F(2, 75.00) = 3.15$, $p = .05$, $\eta^2 = .08$, the middle adolescents, $F(2, 45.56) = 2.36$, $p = .11$, $\eta^2 = .09$, and the late adolescents, $F(2, 29.08) = 1.07$, $p = .36$, $\eta^2 < .07$, showed that younger adolescents with ASD significantly increased their social functioning after following the

TTT program. Gender did not moderate the effects on the SRS and no significant moderation effects were found for age and gender on the other behavioral outcomes.

Discussion

In this study, we used a RCT design with an intervention condition and a waiting-list control condition to investigate the effects of a psychosexual training program for adolescents with ASD; the TTT program (Boudesteijn et al., 2012). Regarding the cognitive outcomes, the results showed that, after following the TTT program, adolescents with ASD in the intervention condition had more knowledge of psychosexual themes, indicated by scores on a knowledge test as well as a parent-reported questionnaire, compared to adolescents in the control condition. Especially younger adolescents with ASD benefited more from the TTT program than older adolescents, which is partly in line with other studies that showed that psychosexual knowledge increases the most between the age of 11 and 14 (Winn et al., 1995), but it also shows that younger adolescents

with ASD are able to profit more from psychosexual training. This indicates that the TTT program is an effective way to increase psychosexual knowledge in teens with ASD. In addition, parents of adolescents with ASD in the intervention condition reported their children to have more insight in interpersonal boundaries, more specifically being more capable of recognizing and indicating their own as well as other people's boundaries in social and intimate situations.

Regarding the behavioral outcomes, we found that parents of younger adolescents with ASD reported significantly improved social functioning after following the TTT program. However, in this study we did not find evidence that the TTT program improved skills needed for romantic relationships or reduced problematic sexual behavior. Several possible explanations exist for the lack of results in these outcome domains. First, the focus of TTT program is not primarily on improving skills. Deficits in the social reciprocity skills are core problem of ASD (American Psychiatric Association, 2013) and increasing social and relational skills requires extensive group coaching (Matson, Matson, & Rivet, 2007; White, Keonig, & Scahill, 2007). The majority of the exercises in the TTT program is focused on checking knowledge and, because the training is individualized, adolescents are not provided with the chance to practice skills with peers during the training program. Second, the limited results on the behavioral outcomes might be due to the methodological limitations in the measures that were used, such as measurement errors and insufficient validity of the used questionnaires. Third, the follow-up of 6 months might not be long enough for the adolescents with ASD to transfer their knowledge and insight into an actual behavioral change (i.e. improved skills; Hambrick & Meinz, 2011), and more long-term follow-up is required to investigate how these adolescents will develop in the long run.

Interestingly, we found an improvement over time regarding almost all behavioral aspects of the psychosexual development of adolescents with ASD, irrespectively of whether the adolescents had followed the TTT program or not. It should be noted that this can partly be explained by retest effects, such as regression to the mean (Barnett, van der Pols, & Dobson, 2005), but it might also provide us with information on the natural development of adolescents with ASD over the course of 1 year. Further long-term research is needed to investigate whether adolescents with ASD can indeed improve aspects of their psychosexual development during adolescence and how their psychosexual functioning is further developed when they are adults.

Clinical considerations and limitations

This study was the first RCT on a psychosexual training program for adolescents with ASD, and

some limitations that need to be addressed in future studies can be identified. First, we relied upon questionnaire data and we did not use observational measures to directly observe changes in skills and behavior, such as the Contextual Assessment of Social Skills (Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011), due to funding and time constraints and because a direct observational measure focusing on relational and intimate behavioral skills was not available at the time we started this study. Also, while using both self-reported and parent-reported questionnaires can be seen a strength of this study, it is known from research in the general population that the correlation between the different informant reports is generally low (De Los Reyes & Kazdin, 2005; Duhig, Renk, Epstein, & Phares, 2000; Jensen et al., 1999; Renk & Phares, 2004). In this study, agreement between self-report and parent-report was found, finding consistency between the reports on the significant and the nonsignificant results. However, the previous reported difficulties adolescents with ASD have with reporting about their feelings and emotions (Mazefsky, Kao, & Oswald, 2011) underscore the importance of further investigating informant discrepancies between self-reported and parent-reported psychosexual functioning of adolescents with ASD. Second, in this study, we did not find that the TTT program worked as an effective intervention program to decrease problematic sexual behavior of adolescents with ASD. Given the possibility to be randomized to the control condition and placed on a waiting list for 1 year, it was not possible to include adolescents that already portrayed severe problems in psychosexual functioning. The results show that even though the occurrence of reported sexual problems in the current sample of cognitively able adolescents with ASD was higher than those of teens from the general population, they were comparable to teens referred for professional help for behavioral, emotional, or social problems. Therefore, this study investigated the effects of the TTT program as a preventive psycho-educational program rather than as a treatment program for sexual problems that already existed.

The results also show that, over the course of the research project, the reported problematic sexual behavior decreased in all adolescents with ASD. Thus, we found no evidence to support the reported concerns some parents of adolescents with ASD might have that talking about sexuality to their child will increase the problems the adolescents have, because they will wrongly interpret the information (Ballan, 2012; Nichols & Blakeley-Smith, 2009; Tissot, 2009). This study thereby contributes to the growing number of publications promoting the discussion of psychosexual topics with adolescents with ASD (Koller, 2000; Nichols & Blakeley-Smith, 2009).

Conclusions and future directions

The results of this study indicate that the TTT program is effective as a psycho-educational program to provide adolescents with ASD with the knowledge and insight needed to be prepared for a healthy psychosexual development. Furthermore, the TTT program was most effective for younger adolescents with ASD, finding a higher gain in psychosexual knowledge and an increase in parent-reported social functioning for adolescents between 12 and 14 years old, which leads to the recommendation to offer the TTT program in early adolescence.

Increasing psychosexual knowledge and the recognition of their own boundaries may decrease the risk of becoming a victim of sexual coercion, sexual bullying, or sexual abuse. Increasing knowledge and insight might therefore be an important first step toward reducing the risk of vulnerability of adolescents with ASD in the future. However, in this study sample, we did not find treatment effects regarding inappropriate sexual behavior and sexual problems. Thus, the effectiveness of the TTT program as a behavioral intervention for adolescents that already portray higher levels of problematic sexual behavior remains to be investigated. In addition, further research is warranted on how the effect of increased knowledge and insight of adolescents with ASD can lead to a satisfactory relational and sexual life in adulthood and prevent the development of problematic sexual behavior. Because a close relationship exists between sexual satisfaction and overall well-being of people with and without ASD (Byers & Nichols, 2014), future research should also

examine the long-term effects of psychosexual guidance on the overall well-being and quality of life of people with ASD.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. The psychosexual knowledge test.

Appendix S2. Percentages of problematic sexual behavior.

Appendix S3. Consort checklist.

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Key points

- Adolescents with autism spectrum disorder (ASD) run several risks in their psychosexual development, yet evidence-based psychosexual guidance/training programs designed for this population are scarce.
- The Tackling Teenage Training (TTT) program – a standardized program targeting a positive psychosexual development in adolescents with ASD – showed to be an effective psycho-educational program, increasing psychosexual knowledge and insight in interpersonal boundaries in adolescents with ASD.
- The TTT program was most effective for younger adolescents with ASD, indicating it is recommended to offer the TTT program in early adolescence.
- Further research is needed to investigate how increased knowledge and insight can subsequently ameliorate improvements in romantic skills and prevent the development of problematic sexual behaviors and victimization.

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