

Mental health and neurodevelopmental disorders in Turner Syndrome:  
New approaches to psycho-social management

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Jeanne Stéphanie Camille Wolstencroft  
16089056

Doctor of Philosophy (PhD)  
University College London

## Declaration

I, Jeanne Stephanie Camille Wolstencroft confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Some of the content in this thesis is based on work published or submitted for peer review. When content have been taken from my published work, this has been indicated at the beginning of the relevant chapter. The inclusion of the content of papers in chapter form adheres to University regulations (<https://www.ucl.ac.uk/academic-manual/chapters/chapter-5-research-degrees-framework>, p18, Section 5.1.2)

Jeanne Wolstencroft

## Publications arising from this thesis

### Chapter 1:

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### Chapter 4:

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### Chapter 6:

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## Abstract

Turner Syndrome (45,X; TS) is one of the most common sex chromosome aneuploidies. It is associated with physical morbidities affecting nearly every body system, but there has been little research into the psychological wellbeing of girls, adolescents and young women with TS (Chapter 1). We conducted a large online mental health survey with TS participants aged 4 to 25. This showed they had elevated rates of mental health disorder and social skills difficulties compared to typically developing females (Chapter 2). 33% of participants met criteria for at least one DSM-5 mental health diagnosis. Of these, 23% met criteria for an autism spectrum disorder, 11% had anxiety disorders and 13% had an attention deficit hyperactivity disorder.

Nearly two-thirds (59%) had autistic-like social communication difficulties of clinical significance. We hypothesized that those social communication difficulties could be improved with a social skills intervention. First, we reviewed the published evidence for the effectiveness of appropriate treatment procedures. A subsequent meta-analysis identified PEERS as the best evidenced intervention (Chapter 3 and 4). Second, we conducted semi-structured interviews with young women with TS and their parents to assess the feasibility and acceptability of piloting PEERS. TS is rare and participants resided across the British Isles, therefore PEERS was not considered to be feasible in its original weekly face-to-face format (Chapter 5). Accordingly, the protocol was adapted to incorporate a novel online component which substituted for face-to-face meetings. This modification proved to be feasible and it was acceptable to families. Parents reported that their daughters had shown significant improvements in their social knowledge and performance after the two month intervention period. This improvement was sustained during a three month follow-up (Chapter 6).

## Impact Statement

This thesis has two main outputs. (1) The results of our survey of mental health and neurodevelopmental disorders could have an important impact on the clinical management of young women with Turner Syndrome (TS). (2) We developed a novel online approach to social skills training. This approach constitutes a methodological innovation in treatment delivery that has the potential to facilitate access to psychological treatment for a wide range of disorders associated with impaired social communication.

The current literature on TS is heavily biased towards medical and physical health research, despite evidence for pervasive social skills difficulties. This thesis aimed to redress this imbalance by conducting the largest survey to date of mental health and neurodevelopmental disorders in TS. Our findings dispelled a number of misconceptions about children with TS. Recent TS clinical care guidelines stated that women with TS were affected by “psychological difficulties”, rather than diagnosable “psychopathologies”. Our research found high rates of neurodevelopmental disorder in childhood and high rates of mental health problems in late adolescence. By taking a developmental perspective we were also able to establish that conditions such as attention deficit hyperactivity disorder had a developmental trajectory, with difficulties resolving without intervention. One quarter of participants met criteria for an autism spectrum disorder. This has implications for the clinical management of this population. Parents and clinicians may be reassured to know that presenting difficulties with hyperactivity, impulsivity and inattention are restricted to childhood.

The social deficits of the syndrome have a substantial impact on functioning and wellbeing across the lifespan. We aimed to pilot a social skills training intervention (PEERS) developed for children with autism in order to improve social competence. Pre-pilot interviews indicated that traditional weekly face-to-face treatment sessions caused too much disruption to family life, and created a barrier to engaging with treatment. In response to this feedback we developed a novel model of treatment delivery involving the use of online meeting rooms. Our pilot study demonstrated that this online-first approach was both feasible and acceptable to families. The success of the pilot acts as a proof of principle study to researchers wishing to broaden the access to psychological interventions of this type and deliver psychological treatment in a more cost-effective manner.

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## **List of abbreviations**

ADHD – Attention Deficit Hyperactivity Disorder

ASD – Autism Spectrum Disorder

BAI – Beck’s Anxiety Inventory

BDI – Beck Depression Inventory

CAP - Child and Adolescent Perception Measure

CASS – Contextual Assessment of Social Skills

CDI – Children's Depression Inventory

CFT - Children's Friendship Training

CMFVB – Cambridge Mindreading Face-Voice Battery for Children

DANVA - Diagnostic analysis of Nonverbal Accuracy

DICA - Diagnostic Interview for Children and Adolescents

FPS – Faux Pas Stories task

GSSI – Group Social Skills Intervention

IAQ – Intervention Acceptability Questionnaire

IFMT – Incidental Face Memory Task

LS – Loneliness Scale

MFQ – Mood and Feelings Questionnaire–Short Form

OCD – Obsessive Compulsive Disorder

P – Parent

PBL – Problem Behaviour Log

PEERS – Programme for Education and Enrichment of Relational Skills

PEI – Pupil Evaluation Inventory

PHSC – Piers-Harris Self-concept

PIM – Peer Interaction Measure

PIP – Peer Interaction Paradigm

PTSD – Post Traumatic Stress Disorder

QSQ – PEERS Quality of Socialisation Questionnaire

RSE – Rosenberg Self-Esteem Scale

SAS – Social Aptitude Scale

SAS-R – Social Anxiety Scale for Children–Revised

SASI - Schedules for the Assessment of Social Intelligence

SCI – Social Competence Inventory

SCID - Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders

SCP – Social Competence with Peers  
SDQ – Strengths and Difficulties Questionnaire  
SE-OE – Self-efficacy and outcome expectancy  
SIS – Social Interactions Survey  
SPP – Self-Perception Profile for Children  
SRS – Social Responsiveness Scale  
SSToM - Social Skills and Theory of Mind  
SST-R – Revised Version of the Strange Stories Task  
SWS – Spence Social Worries Scale  
T – Teacher  
TASSK – Test of Adolescent Social Skills Knowledge  
TOM – Theory of Mind Inventory  
TS – Turner Syndrome  
Tx – Treatment group  
WAIS – Wechsler Adult Intelligence Scale  
WLC – Waitlist Control  
YP – Young Person

Mental health and neurodevelopmental disorders in Turner Syndrome:  
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## Chapter 1 Introduction to Turner Syndrome

*This chapter includes some work that has been published in Current Opinions in Psychiatry: Wolstencroft, J., & Skuse, D. (2019). Social skills and relationships in Turner syndrome. Current Opinion in Psychiatry, 32(2), 85-91.*

### 1. Genetics and diagnosis

Turner Syndrome (45,X; TS) was first described clinically in 1938 by Henry Turner in 1938. Some 20 years later the genetic basis for the disorder was discovered. TS is caused by the partial or complete loss of one X chromosome in females. In approximately 70% of cases the chromosomal loss is caused by paternal non-disjunction, in these cases only the maternal X chromosome is inherited (Mathur et al., 1991). The complete loss of one X chromosome (monosomy) is found in approximately 45% of patients (Wolff, Van Dyke, & Powell, 2010; Table 1.1). The other 55% of patients have partial losses of the X chromosome including structural chromosomal abnormalities or mosaicisms (e.g. two or more genetically different cell lines are present; Gravholt, Andersen, Conway, Dekkers, Geffner, Klein, Lin, Young, et al., 2017; Wolff et al., 2010; Table 1.1).

Karyotype	%	Description
45, X	40-50	Monosomy
45,X/46,XX	15-25	Mosaicism
45,X/47,XXX 45,X/46,XX/47,XXX	3	Mosaicism with "Triple X"
45,X/46,XY 46,XX, del(p22.3) 46,X,r(X)/46,XX	10-12	Mixed gonadal dysgenesis Deletion Xp22.3 Ring X chromosome
46,X i(Xq) 46,X, idic(Xp)	10	Isochromosome Xq Isodicentric Xp
X-autosome translocation Unbalanced translocation	Rare	Various

**Table 1.1: Type and frequency of chromosome abnormalities in Turner Syndrome.**

Adapted from Gravholt et al., 2017. See Appendix 1 for illustrations of the complex structural rearrangements.

TS is one of the most common sex chromosome aneuploidies, with an incidence of 1 in 2,500 female births (Jacobs et al., 1997). The rates of TS are substantially higher in pregnancies that do not reach full term. More than 99% of TS conceptuses are spontaneously lost before 28 weeks (Wolff et al., 2010). It is not known why approximately the remainder survive to term. It has been hypothesized to be linked to an undetected "cryptic mosaicism" for a cell line of a second sex chromosome (Held et al., 1992; Hook & Warburton, 2014; Wolff et al., 2010), but this has not been conclusively demonstrated.

It is not known exactly which genes on the X chromosome are linked to the TS phenotype, but it is known that the majority of genes associated with the physical phenotypes are located on Xp (Xp11.2-p22; Zinn et al., 1998) and that haplo-insufficiency of the SHOX gene (Xp22.33) leads to short stature (Rao et al., 1997).

Approximately 25% of women with TS are diagnosed at birth, presenting with obvious clinical features (Lee & Conway, 2014). Another 25% are diagnosed in childhood, presenting with short stature (Elsheikh, Dunger, Conway, & Wass, 2002; Lee & Conway, 2014). 50% present to services as teenagers with primary amenorrhoea (Stochholm, Juul, Juel, Naeraa, & Højbjerg Gravholt, 2006). Only a small proportion is diagnosed in adulthood.

Diagnosis of TS is usually confirmed post-natally through karyotype testing, fluorescent in-situ hybridisation testing or chromosomal microarrays. In-utero testing for TS is performed using amniocentesis or chorionic villous sampling as part of routine clinical care for older mothers. New non-invasive pre-natal testing techniques, which screen for TS have been developed using circulating cell-free DNA. This new method has been offered clinically since 2013 to women with abnormal sonograms (e.g. cystic hygromas; Bianchi et al., 2013) and has now become part of routine antenatal care (Bianchi, 2019). In this changing landscape, it is more important than ever to have clear and detailed prognostic information available for parents and genetic counsellors, so that informed decisions can be made.

## 2. Physical health and intellectual functioning

TS is associated with a variety of morbidities affecting nearly every bodily system, including skeletal abnormalities such as short stature, dysmorphic features (e.g. ptosis, webbed neck, low-set posteriorly rotated ears, wide chest, strabismus, pigmented naevi etc.), hearing difficulties, infertility, cardiac abnormalities, diabetes and thyroid problems. These difficulties have been well characterized in the literature (see Gravholt et al., 2017 for the most recent review) and require clinical monitoring across the lifespan. Children with TS typically take daily injections of growth hormone for 5.5 to 7.5 years to achieve gains in height of 5 to 8 cm (Gravholt et al., 2017). Most young women with TS need oestrogen hormone replacement therapy to induce puberty. The initial introduction of oestrogen at approximately 13 years is carefully balanced with the growth hormone therapy in order to preserve growth potential (Gravholt et al., 2017).

In terms of cognitive development, the majority of women with TS attain average or above average IQ scores, however approximately 10% have intellectual disabilities (Gravholt et al., 2017). In X-monosomy verbal intelligence is normal, but there are associated deficits in visuo-spatial intelligence (Pennington et al., 1985; Ross, Zinn, & McCauley, 2000; Swillen et al., 1993). Ring chromosome

anomalies are often associated with intellectual disability (Kubota et al., 2002; Kuntsi, Skuse, Elgar, Morris, & Turner, 2000).

Language abilities are preserved, but females with TS are reported to find language tasks demanding executive function or spatial language skills more challenging (Inozemtseva, Matute, Zarabozo, & Ramírez-Dueñas, 2002; Temple, 2002). Young women with TS perform poorly on visuo-spatial and perceptual-motor tasks (Buchanan, Pavlovic, & Rovet, 1998; Cornoldi, Marconi, & Vecchi, 2001). These difficulties may manifest themselves as difficulties with driving, navigating and judging distances (Elsheikh et al., 2002; Ostberg & Conway, 2003). These challenges may also contribute to difficulties with mathematics (Gravholt et al., 2017). There is some evidence to support motor function difficulties in both general and specific motor skills (El-Mansoury, Barrenäs, Bryman, Hanson, & Landin-Wilhelmsen, 2009; Nijhuis-van der Sanden, Eling, & Otten, 2003).

In regards to executive function, deficits have been reported in planning, inhibiting, working memory, task-switching and processing speed (Hong, Kent, & Kesler, 2009). Executive function impairments have been found to be independent of visuo-spatial deficits (Green et al., 2015).

### 3. Mental health

There has been little research into the psychological wellbeing of children and adolescents with TS (Chadwick, Smyth, & Liao, 2014). Most (91%) of the published research is focused on physical health (Sandberg et al., 2019). Only 9% discussed psychological functioning, and most studies evaluate quality of life (Sandberg et al., 2019). It is difficult to conclude which factors affect quality of life in women with TS, because studies have used different methodologies (Reis, de Assumpção, Guerra-Junior, & de Lemos-Marini, 2018). The most recent longitudinal study found quality of life deteriorated between childhood and adulthood, and was poorer in those with a late diagnosis (i.e. after puberty) and in those with hearing impairments (Krantz, Landin-Wilhelmsen, Trimpou, Bryman, & Wide, 2019).

#### Emotional disorders

##### *Anxiety disorders*

In adulthood, TS is associated with increased rates of anxiety. One study reported that up to 11% of adult participants met criteria for a current anxiety disorder and lifetime prevalence was 15% (Cardoso et al., 2004; Table 1.2).

Studies that have examined the prevalence of anxiety disorders in children and young people have reported contradictory results. Many rely on self-report (Table 1.2). Methodological differences include assessment tools of varied sensitivity and potential response biases. McCauley et al. (2001) compared parental reports of anxiety with their daughters' self-report. On parental report there

were no differences between typical controls and girls with TS. The daughters reported fewer anxiety symptoms than healthy controls, but they also had very high scores on the assessment's "lie" scale, which suggests that their accounts were potentially unreliable (McCauley et al., 2001).

There is little research evidence about the prevalence of other types of anxiety disorders such as Obsessive Compulsive Disorder (OCD) or specific phobias (Table 1.2). There are anecdotal accounts of OCD-tendencies, checking behaviours and specific phobias.

### *Depression*

TS has been linked to depression in adulthood, with up to 44% of participants meeting criteria across the lifespan (Cardoso et al., 2004). Reports of depressive symptoms are difficult to interpret in childhood and adolescence. In one study, children and adolescents report high rates of depression (Rickert, Hased, Hendon, & Cunniff, 1996) and in another they report relatively few depressive symptoms compared to typically developing controls (Kiliç, Ergür, & Öcal, 2005). Our experience is that children and adolescents with TS find it difficult to report on the depressive symptoms they experience. They tend to be emotionally immature and emotional self-awareness emerges in later adolescence. There are few published reports of depressive symptomatology provided by parents. But parental reports may be unreliable, as parents may not be able to report accurately on the subjective emotional experiences of their daughters.

In TS, emotional disorders such as anxiety and depression emerge in adolescence and may persist into adulthood, but there is little longitudinal evidence on this trajectory.

### **Neurodevelopmental disorders**

#### *Attention deficit hyperactivity disorder (ADHD)*

Attention deficit hyperactivity disorder (ADHD) is estimated to affect between 10 and 14% of children with TS (McCauley et al., 2001; Russell et al., 2006). However, ADHD traits may affect a larger proportion of children, with estimates of up to 51% (Russell et al., 2015). ADHD can be classified into three subtypes based on the clustering of symptoms; (1) inattentive, (2) hyperactive/impulsive or (3) combined (American Psychiatric Association & DSM-5 Task Force, 2013). Russell et al. (2006) estimated that of those with ADHD, 25% met criteria for the combined type, 33.3% for the predominantly inattentive type and 41.7% for the predominantly hyperactive/impulsive type. There is anecdotal evidence that symptoms of hyperactivity resolve developmentally in adolescence (Skuse, 2009) but nothing is known about the persistence of the symptoms into adulthood.

### *Autism spectrum disorders (ASD)*

There is evidence for higher rates of autism spectrum disorder (ASD) in children with TS compared to typically developing females from a large-scale study conducted in 1999 by Creswell and Skuse. This study conducted psychiatric interviews with parents. A subsequent study of autistic symptomatology with self-report measures found no differences between young women with TS and healthy controls (Lepage, Lortie, Deal, & Théoret, 2014). The current clinical care guidelines conclude that the evidence for increased rates of ASD is “controversial” (Gravholt et al., 2017). Few studies of TS related psychopathology have included assessments of neurodevelopmental conditions.

It is likely that the barriers to diagnosis experienced by women with TS are similar to those experienced by women with ASD without intellectual disabilities. There is an increasing amount of evidence to suggest that women with ASD are being under-diagnosed because of gender biases in the assessment process; as ASD is seen as a disorder that predominantly affects males (Loomes, Hull, & Mandy, 2017).

### *Other disorders*

#### *Conduct disorders*

To our knowledge, no studies have examined or reported on the presence of conduct disorders in Turner Syndrome. This is likely to be because it has never been considered a concern.

#### *Psychosis and schizophrenia*

There are a few case-reports of psychosis or schizophrenia in young women with TS (Backes, Christian, & Agarwal, 2017; Catinari, Vass, & Heresco-Levy, 2006; Pestana, Silva, Ferreira, Duarte, & Loureiro, 2018; Wustmann & Preuss, 2009). At present there is insufficient evidence to conclude whether the incidence of psychosis and/or schizophrenia are higher in TS than would be expected in population samples.

#### *Personality disorders*

Approximately 5% of adults with TS taking part in an adult study of mental health were reported to have a current personality disorder (Cardoso et al., 2004). There is no other research in this area.

#### *Eating disorders*

A study of mental health in adults with TS found that 6% of participants were affected by eating disorders during their lifetime (Cardoso et al., 2004). There is also no other research in this area.

Paper	Age	N	Assessment	Informant	Finding
<b>Anxiety</b>					
<b>Cardoso et al., 2004</b>	16-61	100	Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (fourth edition) (SCID I & II)	Self-report	11% current diagnoses: <ul style="list-style-type: none"> <li>- 4% panic disorder</li> <li>- 2% social phobia</li> <li>- 2% generalised anxiety disorder</li> <li>- 2% specific phobia</li> <li>- 1% anxiety not otherwise specified</li> </ul> 15% past diagnoses
<b>Hong et al., 2011</b>	3-12	39	Revised Children's Manifest Anxiety Scale, Second edition	Self-report	No significant differences compared to healthy controls
<b>Kilic et al., 2005</b>	9-17	11	State-trait anxiety	Self-report	Significantly more anxiety symptoms than healthy controls
<b>Lesniak-Karpiak et al., 2003</b>	6-22	69	Revised Children's Manifest Anxiety Scale	Self-report	No significant differences compared to healthy controls
			Social Phobia and Anxiety Inventory for Children	Self-report	No significant differences compared to healthy controls
<b>McCauley et al., 2001</b>	13-18	122	Revised Children's Manifest Anxiety Scale	Self-report	Significantly less anxiety symptoms than healthy control group, but TS Lie scores high (suggestive of inaccurate self-report)
			Children's Manifest Anxiety Scale	Parent	No significant differences compared to healthy controls
<b>Schmidt et al., 2006</b>	16-61	100	Social anxiety scale	Self-report	Significantly more social anxiety symptoms than healthy controls
<b>Depression</b>					
<b>Cardoso et al., 2004</b>	16-61	100*	Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, fourth edition		11% current diagnoses: <ul style="list-style-type: none"> <li>- 5% major depression</li> <li>- 5% minor depression</li> <li>- 1 dysthymia</li> </ul> 44% past diagnoses
<b>Kilic et al., 2005</b>	9-17	11	Children's depression inventory	Self-report	No significant difference compared to healthy controls
<b>McCauley et al., 2001</b>	13-18	122	Children's Depression Inventory scores	Parent and self-report	Self-report: Significantly less depression symptoms compared to healthy controls

					Parent report: No significant differences
<b>Rickert et al., 1996</b>	12-19	140	Reynolds Adolescent Depression Scale	Self-report	Moderate levels of depression with 20% endorsing severe depressive symptomatology
<b>Schmidt et al., 2006</b>	16-61	100	Center for Epidemiologic Studies Depression Scale	Self-report	Significantly more depressive symptoms than healthy controls
<b>ADHD</b>					
<b>Green et al., 2015</b>	5-12	49	Behaviour Assessment System for Children, Second Edition	Parent	51% in at risk range for ADHD associated behaviours
			NEuroPSYchological	Parent	
<b>McCauley et al., 2001</b>	13-18	96	Diagnostic Interview for Children and Adolescents (ADHD module)	Parent	10% ADHD
<b>Russell et al., 2006</b>	7-16	50	Diagnostic interview for children and adolescents	Parent	
			Conners' revised	Parent and Teacher	24% ADHD
<b>ASD</b>					
<b>Creswell and Skuse, 1999</b>	2-16	150	Bishop's Communication List	Parent	3% ASD
			Autism Diagnostic Interview	Parent	
<b>Hong et al., 2011</b>	3-12	36	Social Responsiveness Scale	Parent	Significantly higher ratings than healthy controls
<b>Lepage et al., 2014</b>	M=24	15	Empathy Quotient Autism Spectrum Quotient	Self-report Self-report	No significant differences No significant differences
<b>Other</b>					
<b>Cardoso et al., 2004</b>	16-61	100	Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition	Self-report	Personality disorder: - 5% current Substance dependence: - 3% past diagnoses Eating disorder: - 0% current - 6% past diagnoses

**Table 1.2: Summary table of mental health research in TS**

\* Hormone replacement therapy discontinued at the time of administration of the assessment

## Evaluating the mental health and neurodevelopmental disorders evidence base

Compared to the body of research associated with physical health, mental health research in TS has been minimal. Our own clinical observations from attending TS clinics and the UK TSSS support society meetings for the last 5 years suggest that the psychological difficulties of young women with TS are not being addressed. In our experience the psychological aspects of TS are often perceived to be of more importance to families than physical health concerns after they reach school age, as they have a more noticeable impact on day-to-day life.

Only two large-scale studies of mental health in childhood and adulthood in TS have been conducted (Cardoso et al., 2004; McCauley et al., 2001). Both studies examined a range of psychiatric disorders, but neither study assessed neurodevelopmental disorders. Neglecting to assess these alongside other mental health disorders may lead to diagnostic over-shadowing. Diagnostic over-shadowing can lead to diagnoses being misattributed when the symptoms of different disorders overlap. This is particularly pertinent during childhood and adolescence, where symptoms of a mental health disorder could be explained by atypical neurodevelopment. For example, anxiety in social situations could be interpreted as an anxiety disorder, when a more comprehensive evaluation would reveal it to be one of the symptoms of an ASD. A more comprehensive and systematic approach to mental health evaluation is needed.

When completing standardised mental health questionnaires, adolescents and young women with TS minimised their symptoms. In recent patient-centred research, parents of children, adolescents and adults with TS were asked about their research priorities. The same questions were posed to women with TS over the age of 18. The women with TS regarded psychological research to be of less importance than their parents did (Sandberg et al., 2019). The systematic use of multiple-informants (e.g. self-report, parent report, observer/teacher report) is critical to our understanding of emotional disorders in TS.

### 4. Social Skills and friendships

Parents often report their daughters to have social interaction difficulties (Table 1.3). We contrasted the parental report and self-report of social skills and friendships.

#### Parental accounts of social ability

To date, most studies that have assessed social competence have used the parent-report Child Behaviour Checklist's (i.e. social withdrawal and social problem scales/constructs; Achenbach, 1991; Table 1.3). These difficulties have been found to be significantly worse in young girls with TS when compared to typically developing controls (McCauley, Ross, Kushner, & Cutler, 1995; Rovet, 1993; Rovet & Ireland, 1994; Swillen et al., 1993). At one time it was thought that short stature was a



major contributory factor to social difference (Rovet & Ireland, 1994). But social skills difficulties were subsequently found to be greater when compared to controls with short stature (McCauley, Ito, & Kay, 1986; McCauley et al., 1995; Skuse, Percy, & Stevensen, 1994).

Previous research has failed to reach a consensus about the age of onset of social interaction difficulties. One study indicated that social differences were present from a very young age (Hong, Dunkin, & Reiss, 2011; age 3-12 years), and another found no association between age and social ability (Rovet & Ireland, 1994; age 7-13). There is agreement that by adolescence the social difficulties have become more pronounced (McCauley et al., 2001; age 13-18). There is a tendency for social withdrawal in early adolescence (Wide Boman, Möllet, & Albertsson-Wikland, 1998), which may be a coping strategy (Lesniak-Karpiak, Mazzocco, & Ross, 2003).

### Self-report on social ability

Young person self-reports of their social competence have been difficult to interpret. They appear contradictory. For example, Suzigan and colleagues (2011) found that young women with TS obtained comparable scores to their sisters on a *structured* social skills questionnaire, yet they described more experiences of social difficulties than their sisters during subsequent *qualitative* face-to-face interviews. Self-reports did not match their mothers' descriptions, which highlighted social difficulties. Whilst superficially contradictory, these discrepancies shed light on the nature of the social deficit. Young women with TS are able to correctly identify the appropriate social behaviours on a structured questionnaire (Suzigan, De Paiva e Silva, Guerra-Junior, Marini, & Maciel-Guerra, 2011), which is indicative of good *social knowledge*. The inconsistencies between their self-report questionnaire and their interviews are suggestive of a social desirability response bias. Prior research noted that adolescents with TS minimised their social skills difficulties and reported less *social performance* difficulties compared to parental reports (Lagrou et al., 1998). It has also been previously documented that young people with social skills difficulties (such as ASD), tend to report their "desired" social performance as opposed to their "actual" social performance (Bauminger & Kasari, 2000).

It is possible that the inconsistencies between the parental and youth reports of social ability arise from a conflation between *social knowledge* and *social performance*: one may simultaneously have a good knowledge of social etiquette, and a poor ability to perform social skills. The inconsistencies could also be explained by the social desirability phenomenon. At present very little qualitative research has been conducted on children, adolescents and women with TS's perceptions of their own social ability. Research is needed to explore the social experiences of children, adolescents and young women with TS throughout development in order to understand the nature of the social interaction difficulty.

Additionally, the quality of social interaction has rarely been examined through behavioural observations, and has never been assessed with typically developing peers as informants. Reports on social ability from age-matched peers would provide more ecologically valid information on the child's social performance. New socio-metric techniques which map social group networks may be useful with schoolchildren (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011b). Sociometric mapping used in conjunction with in-depth parental and self-report would provide an invaluable insight into the social ability of children and adolescents with TS.

Study	Age	N	Comparison group	Social competence measures	Findings
<b>Childhood and Adolescence</b>					
McCauley et al., 1986	9-17	17	Girls of short stature and normal karyotype, general population norms	Friendship Questionnaire, Chumship Checklist, Child Behaviour Checklist	Lower social competence
McCauley et al., 1987	9-17	17	Girls of short stature and normal karyotype	Affective Discrimination Task	Less accurate at inferring facial affect
Rovet 1993	6-16	67	Male and female children of normal stature, general population norms	Child Behaviour Checklist	Lower social competence
Swillen et al., 1993	4-20	50	General population norms	Child Behaviour Checklist	Lower social competence
Rovet et al., 1994	7-13	103	Girls of normal stature	Child Behaviour Checklist	Lower social competence
Skuse et al., 1994	3-19	274	Girls of short stature and normal karyotype	Child Behaviour Checklist	Lower social competence
McCauley et al., 1995	7-14	97	Girls of normal stature, general population norms	Child Behaviour Checklist	Lower social competence
McCauley et al 2001	13-18	122	Schoolgirls with normal karyotype	Child Behaviour Checklist	Lower social competence
Hong et al., 2011	3-12	42	Population norms, opportunity sample of age-matched peers	Social Responsiveness Scale	Difficulties in all domains except social motivation
Lepage et al., 2013	5-12	40	Population norms, opportunity sample of age-matched peers	Social Responsiveness Scale	Difficulties in all domains except social motivation
<b>Adults</b>					
Aran et al., 1992	19-41	48	Control data from general population	Questionnaires	Fewer married
Okada 1994	20-34	20	Women with growth hormone deficiency, general population data	Questionnaires	Fewer married

Pavlidis et al., 1995	19-56	80	General population norms	Derogatis Sexual Functioning Inventory	Fewer married
Boman et al., 2001	18-59	63	General population data	Semi-structure Interview on Social Functioning	Fewer co-habiting, more social isolation
Boman et al., 2004	18-59	63	-	Semi-structure Interview on Social Functioning	Close friendships reported in childhood (73%) and adulthood (87%) Partner relationships reported by 29%
Carel et al., 2006	18-31	566	-	Social Adjustment (self-report) Sexual Experience	No norms for social adjustment scale 33% no lifetime sexual experience
Jez et al., 2018	18-53	176	-	Questionnaires	
<b>Childhood to adulthood</b>					
Nielsen 1977	7-39	44	Women with short stature, amenorrhea but normal karyotype	Interviews	Fewer had partners Higher age of first sexual experience
Lesniak-Karpiak et al., 2003	7-22	29	Fragile X, healthy controls	Role-plays Social Phobia and Anxiety Inventory Child Behaviour Checklist	Fewer facial movements than fragile X or comparison group Lower social competence compared to controls
Sutton et al., 2005	7-59	97	-	Semi-structured Interview	32% Married, 15% Divorced 6 had children (5 adopted, 1 IVF)
Schmidt et al., 2006	16-61	100	Women with premature ovarian failure, healthy controls	Social Anxiety Scale Shyness Scale	More social anxiety and shyness than healthy controls, but not POF
Suzigan et al., 2011	15-35	52	Sisters	Semi-structured Interview Del-Prette Social Skills Inventory	Parents reported more social difficulties compared to siblings Women with TS reported more social skills difficulties than siblings during interviews, but not on the SSI

**Table 1.3: Studies measuring social competence in Turner Syndrome**

## Friendships and romantic relationships

Studies of adult women with TS have shown that as many as 70% reported having had a best friend in childhood and 78% reported having a close friend, other than a family member, in adulthood (Boman, Bryman, Halling, & Möller, 2001). Nevertheless, women with TS reported more social isolation than population controls (Amundson, Boman, Barrenäs, Bryman, & Landin-Wilhelmsen, 2010; Boman et al., 2001).

Women with TS are less likely to have a partner than their peers (Rolstad, Möller, Bryman, & Boman, 2007) and are less likely to be married (Aran et al., 1992; Downey, Ehrhardt, Gruen, Bell, & Morishima, 1989; Holl, Kunze, Etzrodt, Teller, & Heinze, 1994; Nielsen, Nyborg, & Dahl, 1977). Stable relationships are established later than average (Aran et al., 1992; Nielsen et al., 1977; Pavlidis, McCauley, & Sybert, 1995). The proportion of women with TS who have married is variable from country to country. For example in Scandinavia 16% are married, 25% are married in Poland and 32% are married in America (Boman et al., 2001; Jez et al., 2018; Sutton et al., 2005). There is little evidence on the stability of these relationships as of yet; a study conducted in 2005 by Sutton et al found that 15% of young women with TS were divorced (Sutton et al., 2005).

The sexual debut is also reported to occur later than average, with reports of less sexual activity (Downey et al., 1989; Nielsen et al., 1977; Pavlidis et al., 1995; Rolstad et al., 2007). Although sexual dysfunction has been noted, women “unanimously” reported being satisfied with their sex lives and their relationships (Rolstad et al., 2007). Infertility may have an impact on how women with TS interact with their partners in intimate relationships, with some women fearing rejection after disclosing details of their condition to their partner (Sutton et al., 2005). One small-scale study suggested that sexual orientation was hetero-normative (Hettmer, Hoepffner, Keller, & Brähler, 1995), but in view of the societal changes in sexual attitudes (Mercer et al., 2013), this merits re-examination.

## Aetiology of social skills difficulties

The origin of the social skills difficulties has been linked to physical factors, such as stigmata, hearing difficulties, endocrine differences and socio-cognitive factors.

### *Physical differences*

Much of the initial psychological wellbeing research in TS focused on the impact of physical characteristics of the syndrome on wellbeing. Many studies explored the link between short stature, hormone replacement therapy (growth hormone and oestrogen), self-esteem and quality of life.

Early research hypothesized that physical differences such as short stature and delayed puberty were the source of the social interaction difficulties (Lagrou et al., 1998; Rovet & Ireland, 1994; Sutton et al., 2005). Their underlying assumption was that physical differences were the cause of stigma and social exclusion. The impact of oestrogen hormone replacement therapy was thought to enhance self-esteem and social ability, but this has not been conclusively demonstrated (Ross et al., 2002; Ross, Feuille, Kushner, Roeltgen, & Cutler, 1997; Ross et al., 2004). Short stature is now thought to be just one of many factors contributing to social difference (Hong & Reiss, 2012).

In later life, the premature loss of hearing has also been noted to have a significant impact on social function (Bergamaschi et al., 2008; Hong et al., 2009; Hultcrantz & Sylvén, 1997). Unsurprisingly, hearing difficulties may affect one's ability to follow and engage with conversations. The relationship between hearing difficulties and social ability has never been examined.

### *Socio-cognitive differences*

Children and adolescents with TS score within the normal range in tests of full scale IQ. There is an imbalance in their subscale scores. They typically score within the normal range in the verbal domain, but below average in the performance domain on visuo-spatial and visuo-motor tasks (McCauley, Kay, Ito, & Treder, 1987; Nijhuis-van der Sanden, Eling, & Otten, 2003). Difficulties with executive function in the domains of attention, working memory, cognitive flexibility, processing speed and abstract reasoning are also noted (Buchanan et al., 1998; Hong et al., 2009; Lepage, Dunkin, Hong, & Reiss, 2011; Romans, Stefanatos, Roeltgen, Kushner, & Ross, 1998).

Individuals with TS have social cognition deficits that include specific difficulties in recognising faces, emotions and direction of eye gaze, as well as theory of mind. They have more difficulty in recognising faces presented to them previously in experimental paradigms than controls (Reiss et al., 1993; Romans et al., 1998; Ross, Feuille, Kushner, Roeltgen, & Cutler, 1997). It is unclear whether these difficulties reflect impaired configural processing (Anaki, Zadikov Mor, Gepstein, & Hochberg, 2016; Lawrence, Kuntsi, Coleman, Campbell, & Skuse, 2003; Mazzola et al., 2006).

Emotion recognition in TS is significantly impaired, especially in recognising fearful and angry faces (Good et al., 2003; Lawrence, Kuntsi, et al., 2003; Mazzola et al., 2006; Morel et al., 2018; Romans et al., 1998). Eye-tracking studies of this phenomenon also showed that individuals with TS attended more to mouth regions, to the neglect of eye regions during these tasks in comparison to controls (Mazzola et al., 2006). The mouth-attention bias was the most pronounced when the women were presented with fearful faces (Mazzola et al., 2006). These differences in emotion recognition are independent of deficits in visuo-spatial processing, global face recognition or performance IQ (Hong et al., 2009; Lawrence, Kuntsi, et al., 2003; Lepage, Dunkin, Hong, & Reiss, 2013).

Women with TS have also been shown to be worse at detecting eye gaze direction than controls (Elgar, Campbell, & Skuse, 2002). This effect was maintained both for egocentric gazes, where the stimuli's gaze is directed at the viewer/participant, and allocentric gazes, where the stimuli in the picture's gaze is directed at something or someone in the background (Elgar et al., 2002).

Women with TS have difficulty in the capacity known as Theory of Mind (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). For instance, it has been shown that they do not accurately attribute mental states to images in the "Mind in the eyes task" (Lawrence et al., 2003).

Many of these features are reminiscent of difficulties experienced by people with an ASD. On a measure of autistic symptomatology, the Social Responsiveness Scale, on average young women with TS score in the clinical range (Hong et al., 2011; Lepage et al., 2013).

#### Social skills: Need for intervention

To date, social skills interventions have never been trialled in the TS population. We hypothesized that socialisation difficulties in TS could be managed in the same way that social interaction difficulties in children with ASD are managed, as they share similar characteristics in terms of social communication and socio-cognitive difficulties. We hypothesized that a social skills training intervention developed for children with autism could help ameliorate their problems in social functioning. Recently published TS clinical care guidelines (Gravholt et al., 2017) support this hypothesis and recommend piloting the Programme for the Education and Enrichment of Relational Skills (PEERS; Laugeson & Frankel, 2011). The manualised treatment programme requires parents and young people to attend 14 weekly lessons (Laugeson & Frankel, 2011). The efficacy of the programme is well supported by randomised control trials and meta-analyses of social skills interventions (Gantman, Kapp, Orenski, & Laugeson, 2012; Laugeson, Frankel, Mogil, & Dillon, 2009; Schohl et al., 2014; Wolstencroft et al., 2018). The success of PEERS with young women with TS will depend on a comprehensive understanding of their experiences and expectations of socialisation.

#### 5. PhD aims

This PhD aimed to address gaps in the evidence base and clinical care. Our two main aims were to:

1. **Strengthen the evidence base for the characteristics of associated mental health problems and neurodevelopmental disorders in TS:** We aimed to systematically evaluate the mental health and neurodevelopmental disorders of girls and women with TS aged 4 to 25 with standardised measures of ascertainment. We conducted the largest and most comprehensive study of children and adolescent mental health in TS (Chapter 2).

2. **Take a new approach to managing the social interaction difficulties of young women with**

**Turner Syndrome:** We piloted the PEERS intervention with the aim of ameliorating the social interaction difficulties experienced by young women with TS. The current best practice in developing and evaluating interventions is based on the Medical Research Council framework (Craig et al., 2008). It involves four steps:

*i. Identify and develop theory:* We reviewed the social skills theory literature and developed a theory-driven assessment framework (Chapter 3).

*ii. Identify the evidence base:* We reviewed the social skills intervention literature to confirm whether PEERS was the most appropriate social skills programme to pilot with young women with TS (Chapter 4).

*iii. Evaluate feasibility:* We conducted semi-structured interviews with young women with TS and their parents to understand their experiences of socialisation and whether the young women are interested in taking part in a social skills programme (Chapter 5). We gained insights from aforementioned interviews on how and when to intervene appropriately and identified barriers to taking part (Chapter 5).

*iv. Pilot and evaluation:* We piloted PEERS and assessed its efficacy and acceptability to families using our theoretical framework (Chapter 6 & 7).



## **Chapter 2 Mental health and neurodevelopmental disorders survey**

### **1. Rationale**

Only 9% of the published research in TS is focused on psychological functioning in TS, despite evidence from patient-centred research which indicates that psychosocial research is viewed as a research priority by women with TS and their families (Sandberg et al., 2019).

We recognised a need for a systematic evaluation of mental health disorders in young women with TS, which takes into account developmental changes. This study aimed to comprehensively evaluate the psychopathology and neurodevelopmental disorders of children, adolescents and young women with TS from the ages of 4 to 25. To this end, we used a short behavioural screening questionnaire and an online psychiatric interview for which normative are available from the 1999, 2004 and 2018 UK national studies of mental health in children and young people (Emerson & Hatton, 2007; Ford, Goodman, & Meltzer, 2003; Green, McGinnity, Meltzer, Ford, & Goodman, 2004; Heiervang et al., 2007). A supplementary measure of autistic symptomatology was then used to examine the nature of the social interaction deficit in more detail.

### **2. Methods**

#### **Participants**

Children, adolescents and young women with Turner Syndrome aged 4 to 25 and their parents were recruited to take part in the SOAR Study (SOcial skills And Relationships in Turner Syndrome) from the UK Turner Syndrome Support Society and specialist NHS clinics at University College London Hospital and Great Ormond Street Hospital. Families were also recruited from the IMAGINE ID cohort study (Intellectual Disability: assessing the IMpAct of Genetics on NEurodevelopment). A subset of families also consented for their daughter's classroom teacher to take part in the study. A diagnosis of Turner Syndrome was confirmed by obtaining genetic reports or clinic letters.

#### **Procedure**

Parents and young people above the age of 12 were invited to complete psychometric questionnaires online or in pen and paper form. If consent was obtained, teachers were contacted to complete psychometric questionnaires after the parent and young person questionnaires were received. Ethical approval for the study SOAR study was obtained through the University College London Committee and the NHS REC West London GTAC (UCL REC: 11837/001; IRAS: 219817).

IMAGINE ID ethical approval was obtained from the London Queen Square Research Ethics Committee (IRAS: 153245; Appendix II).

## Measures

*Strengths and Difficulties Questionnaire (SDQ)*: The SDQ is a well-validated behavioural screening questionnaire (Goodman, Lamping, & Ploubidis, 2010). The SDQ includes scales that measure emotional symptoms, conduct problems, hyperactivity/impulsivity and inattention difficulties, peer relationship problems and prosocial behaviour. The first four scales are combined to create a total difficulties score. An additional impact scale measures the impact of this composite score on daily life. It has been validated for use in children aged 4–17 in UK national studies of psychological adjustment, and a new form for 18+ years old has recently been developed. The SDQ national study dataset is available for download from UK Data Service (Office for National Statistics [ONS], Ford, & Goodman, 2004). Norms were available for participants aged 4 to 17 (Table 2.1). It was completed online by the adolescents, parents and teachers (Table 2.1).

*Development and Wellbeing Assessment (DAWBA)*: The DAWBA was used to collect information on the child's behavioural adjustment and mental health. The DAWBA has been used both in UK national and international surveys (Emerson & Hatton, 2007; Ford, Goodman, & Meltzer, 2003; Green, McGinnity, Meltzer, Ford, & Goodman, 2004; Heiervang et al., 2007). Using the same protocol as the UK national studies, the DAWBA data was reviewed by a psychiatrist in accordance with the ICD-10/DSM-V diagnostic criteria. Comparison data is available for population controls aged 5 to 19 years old. The DAWBA was completed online by parents (Table 2.1).

*Social Responsiveness Scale, second edition (SRS-2)*: The SRS-2 measures the severity of autistic symptomatology. It has convergent validity with ASD diagnostic instruments including the ADOS and ADI-R (Bölte, Westerwald, Holtmann, Freitag, & Poustka, 2011; Constantino & Gruber, 2012). The SRS-2 subscales measure Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviour. Raw scores are converted into T-scores normed for age and sex. Total T-scores in the mild range are indicative of clinically significant deficits in reciprocal social behaviour that have a mild to moderate impact on everyday social interactions. T-scores in the moderate range are indicative of substantial deficits in everyday social interaction and typically associated with ASD of moderate severity. T-scores in the severe range are strongly associated with a clinical diagnosis of an ASD. Norms are available for the SRS-2 from age 4 to 79 years old. The SRS-2 was completed online by parents and teachers (Table 2.1).

*Health Questionnaire (HQ):* The questionnaire was developed by the UCLH Turner Syndrome Life Course Project to record information about physical health, health care, education, social life, physical activity and relationships (Cameron- Pimblett, La Rosa, King, Davies, & Conway, 2017). The self-report version of the questionnaire was completed by TS participants aged 12 and over with the assistance of their parents. Parents completed the questionnaire on behalf of their daughters for children aged 11 and under (Table 2.1).

*Indices of Multiple Deprivation (IMD):* Socio-economic status was ascertained through postcode data using the IMD (ONS, 2015). IMD scores combine information from seven domains to produce a relative measure of deprivation. The domains take into account income, employment, education, health, crime, barriers to housing and services, and the living environment. IMD scores are ranked and organised into deciles; the first decile includes the most deprived postcodes and the tenth decile includes the least deprived postcodes. IMD scores are available for England and Scotland.

Assessment	Parents	Young People (aged 12+)	Teachers	Norms available for age
DAWBA	✓	-	-	5 to 19 years
SDQ	✓	✓	✓	4 to 17 years
SRS-2	✓	✓	✓	4 years and up
HQ	✓	or	✓	-

**Table 2.1: Assessment schedule**

### 3. Results

#### Sample

177 families consented to take part; this included 159 parents, 87 young people and 33 teachers.

47% of families were recruited through NHS specialist TS clinics (n=83), 43% of families were recruited from the TSSS (n=77) and 10% were referred through the Imagine ID study (n=17).

Enthusiasm to take part in the study was high; during the specialist TS NHS clinic recruitment phase 70% of families approached signed up to the study (83/118).

90% of recruited parents completed one or more assessments. Of these 82% completed the DAWBA, 79% completed the SDQ and 85% completed the SRS-2. 93% of young people completed one or more of the questionnaires. The Health questionnaire was completed by the parent or the young person for 67% of participating families. 33 teachers returned the completed SDQ and SRS-2. Five teacher SRS-2 questionnaires were excluded due to missing answers.

## Participant characteristics

Participants had a wide range of TS karyotypes. The available karyotypes were genetically representative of the TS population (Table 2.2). We were not able to verify the karyotype reports of 23 participants recruited from the TSSS. Data from participants with unconfirmed karyotypes were included in the final analysis as there were no significant differences compared to the whole sample on the total score for the SDQ and SRS-2 and the “any diagnosis” variable on the DAWBA.

<b>Karyotype</b>	<b>n</b>	<b>%</b>
<b>Monosomy 45,X</b>	66	37.5
<b>Mosaic</b>	38	21.6
<i>Mosaic (undisclosed)</i>	3	1.7
<i>Mosaic 45,X / 46,XX</i>	18	10.2
<i>Mosaic 45,X / 46,XY</i>	8	4.5
<i>Mosaic 45,X / 47,XXX</i>	5	2.8
<i>Mosaic 45,X / 46, XX / 47,XXX</i>	4	2.3
<b>Ring</b>	14	8
<b>Isochromosome</b>	13	7.4
<b>Isodicentric</b>	10	5.7
<b>Partial X deletion</b>	8	4.5
<b>Pseudo-dicentric</b>	2	1.1
<b>Translocation</b>	1	0.6
<b>Unconfirmed*</b>	23	13.6

**Table 2.2: Karyotypes of recruited participants**

N=177. \*Participants recruited from UK Turner Syndrome Support Society: original genetics report not available.

The average age of participants was 13.8 years (SD=6.1; see Table 2.3 for distribution). On average oestrogen replacement therapy started at age 13 (SD=1.95) and menarche started at age 14.76 (SD=2.58). 10.4% of participants had a severe hearing impairment and 4.2% had a severe visual impairment.

<b>Age (years)</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>
<b>Frequency (n)</b>	7	11	10	10	5	9	8	7	7	7	9	14	12	14	6	7	6	7	3	2	7	9

**Table 2.3 Distribution of participant ages (years) at recruitment**

43.8% of parents rated their children as having some learning difficulties (n=98). Language expression and comprehension was rated to be better than their peers for 31.6%, average for 46.9% and behind their peers for 21.4% of participants. For the children of school age (N=94) 93% attended a mainstream school, of these 42% received educational support and 3% were in a special unit. 7% of participants attended a special needs school.

The socio-economic status of the participants was skewed towards the least deprived IMD scores (deciles 1-5=39%; deciles 6-10=61%; Table 2.3).

	Most deprived					Least deprived				
Decile	1	2	3	4	5	6	7	8	9	10
Frequency	5	16	16	13	11	18	14	19	17	28

**Table 2.4: IMD distribution**

N=157 (21 postcodes outside of England and Wales e.g. Ireland, Northern Island, Jersey, Isle of Wight, Isle of Man, Orkney and USA).

#### SDQ: Behavioural adjustment

##### *Comparisons to typically developing peers and multi-informant responses*

The SDQ norms allow for comparison of the TS group to population norms for children aged 4 to 17. We also compared the SDQ scores by informant, as we hypothesized that the TS group would report less difficulties than the parent and teacher groups.

The parent group rated their daughters as having “slightly raised” difficulties overall on the SDQ, particularly in regards to the emotional difficulties and peer relationships scales. The difficulties were rated as having a “very high” impact on their daughter’s everyday lives (Table 2.4).

The TS group rated themselves as performing as well as their peers (i.e. typically developing children) on all the scales except for the emotional difficulties scale, where they rated themselves to have a “slightly raised” level of difficulty. The difficulties were rated as having a “slightly raised” impact on their everyday life (Table 2.4).

The teacher group rated the girls with TS as performing in the “close to average” range for all the domains, except for the peer relationship scale, where they rated their students to have a “slightly raised” level of difficulty. The difficulties were rated to have a “slightly raised” impact on their student’s everyday life.

The parent and self-report scores were broadly aligned. Parents highlighted more peer relationships difficulties than their daughters did. Parents also rated the emotional and behavioural adjustment of their daughter to have a more severe impact on everyday life than their daughters did.

The TS and teacher groups reported the least difficulties. The teacher scores highlighted that the peer relationship difficulties were also present in the school environment.

<b>SDQ Age 4 -17 M(SD) / Severity</b>	<b>Parent N=114</b>	<b>TS self-report N=33</b>	<b>Teacher N=30</b>
<b>Total Score</b>	16.12 (6.95) Slightly raised	12.94 (6.61) Close to average	10.33 (4.93) Close to average
<b>Emotional</b>	4.05 (2.81) Slightly raised	4.94 (2.65) Slightly raised	2.63 (1.81) Close to average
<b>Conduct</b>	2.14 (1.98) Close to average	1.55 (1.56) Close to average	0.87 (1.17) Close to average
<b>Hyperactivity/Impulsivity &amp; Inattention</b>	5.88 (2.99) Close to average	4.00 (2.31) Close to average	4.13 (2.97) Close to average
<b>Peer</b>	4.05 (2.49) Slightly raised	2.45 (1.94) Close to average	2.70 (2.31) Slightly raised
<b>Prosocial</b>	7.66 (2.32) Close to average	8.39 (1.66) Close to average	7.60 (1.87) Close to average
<b>Impact</b>	3.21 (2.84) Very high <sup>1</sup>	1.0 (1.44) Slightly raised <sup>2</sup>	1.25 (1.32) Slightly raised <sup>3</sup>

**Table 2.5: SDQ scores by informant**

<sup>1</sup>N=113; <sup>2</sup>N=21; <sup>3</sup>N=28. The SDQ ratings indicate the level of severity of the difficulties in comparison to population norms for children aged 4 to 17 (subset of sample, N=114). Where young people had completed self-report questionnaires, parent reports were available in each case. The questionnaires completed by the young people and teachers are a subset of those completed by the parents. 5 cases overlap between the self-report and teacher report.

#### *Developmental trajectory of peer interaction and hyperactivity/impulsivity and inattention*

In order to understand the developmental trajectory of behavioural adjustment the SDQ subscales were correlated with age (Table 2.5). We hypothesized that peer abilities would not be associated with age, but that hyperactivity/impulsivity and inattention difficulties would be negatively correlated with age.

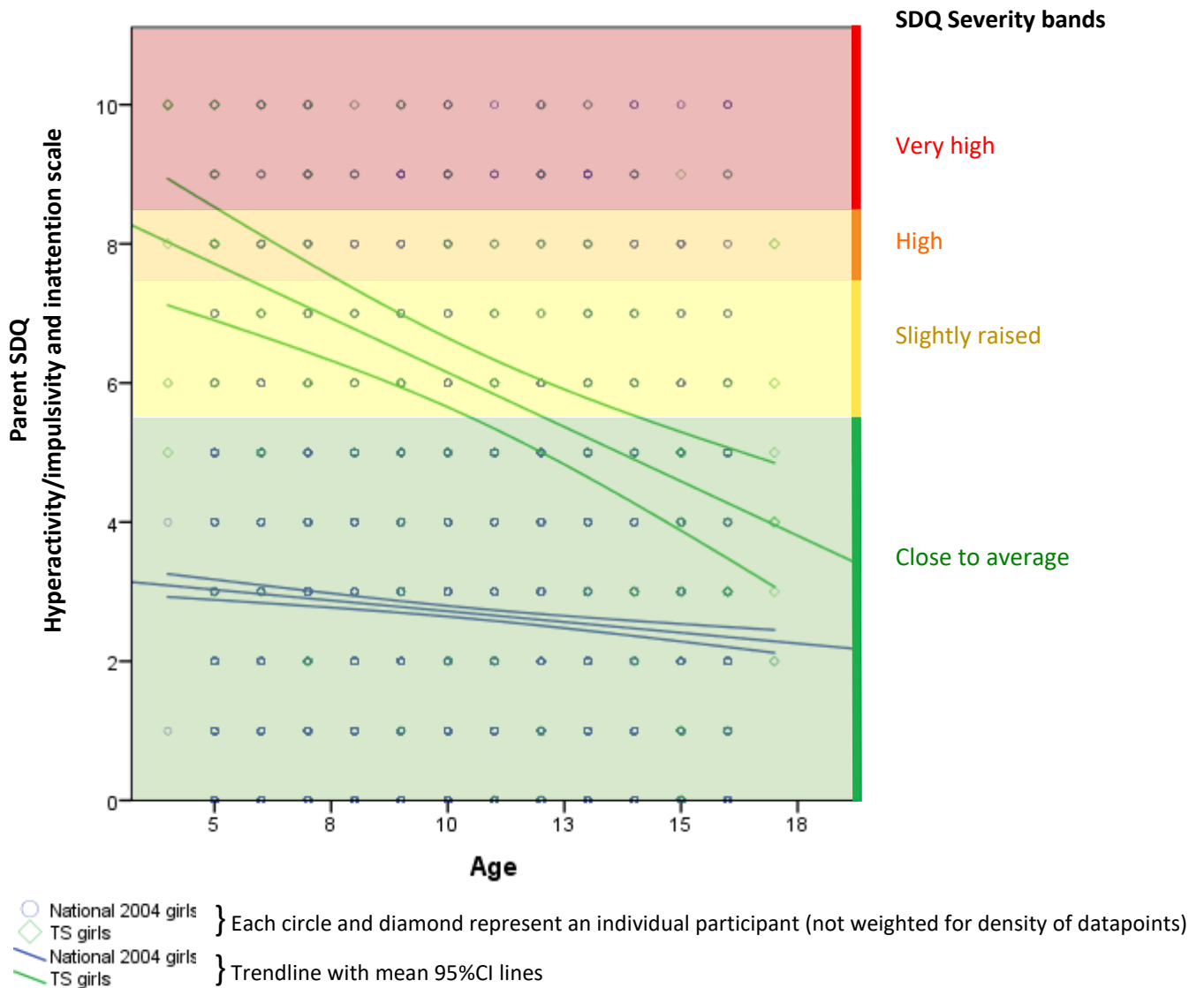
There was no significant association between parent SDQ scores and age on the total score, emotional difficulties or peer difficulties subscales. There was a positive association between age and prosocial ability ( $r=0.23$ ;  $p=0.02$ ), as well as a negative association between age and conduct ( $r=-0.19$ ;  $p=0.04$ ), and hyperactivity/impulsivity and inattention ( $r=-0.43$ ;  $p=0.000$ ). Only the negative association between age and hyperactivity/impulsivity and inattention subscale remained significant after corrections for multiple testing ( $p<0.0001$ ).

Parent SDQ	Total score	Emotional	Conduct*	Hyperactivity/Impulsivity & Inattention	Peer	Prosocial*
<b>r</b>	-0.16	0.15	-0.19	-0.43	0.04	0.23
<b>p</b>	0.92	0.10	0.04	0.000	0.69	0.02

**Table 2.6: Parent SDQ correlations with age**

Pearson correlations for parent reported SDQ scores by age. \*Spearman’s rho correlation used due to significant outliers. Bonferroni new alpha = 0.008. N=114

A graphical representation of the symptoms of hyperactivity/impulsivity and inattention in childhood for young women with TS and typically developing girls suggest a developmental change in the TS group (Figure 2.1). In the TS group the average SDQ scores for hyperactivity/impulsivity and inattention were in the “high” range from ages 4 to 6, in the “slightly raised” range from age 6 to 12 and in the “close to average” range from ages 12 to 18. The average scores for the population norm sample were higher for participants in childhood than those in adolescence, but remained within the “close to average” range throughout.



**Figure 2.1: Comparison of developmental trajectory of SDQ hyperactivity/impulsivity and inattention parent-report scores for children with TS and girls in the UK national study**

National UK girls data from 2004 data release (n=3866); TS group (n=114)

DAWBA: Mental health and neurodevelopmental disorders

The prevalence of mental health and neurodevelopmental disorders was assessed using the DAWBA parental interview. We hypothesized that children with TS would experience more mental health difficulties and would be affected by more neurodevelopmental disorders than their typically developing female peers.

On the DAWBA questionnaire 34% of participants met criteria for a disorder, which is more than double the proportion of girls in the national survey meeting criteria for a disorder. The relative risk



of having a disorder is 2.64 times greater in children with TS compared to typically developing girls (Table 2.6).

13% of the girls in our sample met criteria for an anxiety disorder and 1% for depression. The developmental trajectory of anxiety disorders in the TS group revealed a reduction in separation anxiety disorders in the older age group and a gradual increase in generalised anxiety disorders in the older age groups (Table 2.6). The prevalence of depression was lower than in typically developing females and only present in the late teenage years in the TS group (Table 2.6). None of the participants met criteria for a behavioural disorder.

The proportion of participants meeting criteria for neurodevelopmental disorders was substantially higher than would be expected compared to female population norms. In the TS group 13% met criteria for ADHD, of these 11% met criteria for the combined subtype and 2% met criteria for the hyperactive subtype.

23% of participants also met criteria for an ASD. This is equivalent to a 57.5 fold increased relative risk of meeting criteria for an ASD compared to typically developing girls. Similar to the national study females, the prevalence of ASD was stable across age groups in TS (Table 2.6).

Mental health disorder prevalence (%)	TD girls				TS girls				Relative Risk
	5 to 10	11 to 16	17 to 19	All ages	5 to 10 n=44	11 to 16 n=42	17 to 19 n=14	All ages n=100	
<b>Any disorder</b>	6.6	14.4	23.9	<b>12.9</b>	36.4	33.3	28.6	<b>34</b>	<b>2.64</b>
<b>Emotional disorders</b>	3.6	10.9	22.4	<b>10</b>	9.1	16.7	14.3	<b>13</b>	<b>1.3</b>
<b>Anxiety disorders</b>	3.4	9.7	20.3	<b>9.1</b>	9.1	16.7	14.3	<b>13</b>	<b>1.4</b>
Separation anxiety disorder	1.1	0.4	-	<b>0.6</b>	2.3	2.4	-	<b>2</b>	<b>3.33</b>
Generalised anxiety disorder	0.2	2.2	4.6	<b>1.8</b>	2.3	9.5	14.3	<b>7</b>	<b>3.88</b>
Obsessive compulsive disorder	0.1	0.6	0.7	<b>0.4</b>	-	2.4	-	<b>1</b>	<b>2.5</b>
Specific phobia	0.9	1.0	0.9	<b>0.9</b>	4.5	2.4	-	<b>3</b>	<b>3.33</b>
Social phobia	0.2	1.3	2.6	<b>1.1</b>	2.3	2.4	-	<b>2</b>	<b>1.82</b>
<b>Depressive disorders</b>	0.2	3.8	6.5	<b>2.8</b>	-	-	7.1	<b>1</b>	<b>0.36</b>
Major depressive episode	0.1	2.8	4.7	<b>2</b>	-	-	7.1	<b>1</b>	<b>0.5</b>
<b>Hyperactivity disorders</b>	0.8	0.7	-	<b>0.6</b>	15.9	11.9	7.1	<b>13<sup>1</sup></b>	<b>21.6</b>
<b>Other less common disorders</b>	1.0	2.0	2.2	<b>1.6</b>	22.7	23.8	28.6	<b>24</b>	<b>15</b>
Autism Spectrum Disorder (ASD)	0.4	0.7	0.0	<b>0.4</b>	22.7	23.8	21.4	<b>23</b>	<b>57.5</b>
Eating disorders	0.1	1.0	1.6	<b>0.7</b>	-	-	7.1	<b>1</b>	<b>1.43</b>
Tics/other less common disorders	0.6	0.4	0.8	<b>0.6</b>	2.3	2.4	-	<b>2</b>	<b>3.33</b>

**Table 2.7: DAWBA diagnoses prevalence by age for national girls sample and girls with TS**

5 – 19 years for comparison to national sample N=100

<sup>1</sup> All ADHD: 11 combined subtype, 2 hyperactive/impulsive subtype.

Positive results reported only. See Appendix III for comprehensive table of disorders.

## DAWBA: Social ability

The DAWBA autism module contains questions about friendships. We hypothesized that children, adolescents and young women with TS would have less friends than their peers, and that they would have difficulties both in making and keeping friends.

Children, adolescents and young women with TS had more difficulties making friends than keeping friends. 71% of parents of a child with TS rated their daughter as finding it harder than average to make friends, in the general population study the comparable figure was 9.1%. 55.7% of parents of a child with TS rated their daughter as finding it harder than average to keep friends, compared to 5% reported by the parents of typically developing girls. 17% of participants in the TS group were reported by parents to have no friends that they fairly often spent time with, whereas only 1.2% of typically developing girls had no friends. 83% of the TS group had between one and four friends, whereas 83% of the typically developing girls had between two and nine friends (Table 2.7).

<b>How easy does your daughter find it to make friends?</b>					
	<b>Harder than average</b>		<b>About average</b>	<b>Easier than average</b>	
<b>TS girls</b>	71.6%		20.5%	8%	
<b>TD girls</b>	9.1%		35.1%	55.8%	
<b>How easy does your daughter find it to keep friends?</b>					
	<b>Harder than average</b>		<b>About average</b>	<b>Easier than average</b>	
<b>TS girls</b>	55.7%		40.9%	3.4%	
<b>TD girls</b>	5%		35.7%	59.3%	
<b>How many friends does she fairly often spend time with?</b>					
	<b>None</b>	<b>One</b>	<b>Two to four</b>	<b>Five to nine</b>	<b>Ten or more</b>
<b>TS girls</b>	17%	18.2%	64.8%	-	-
<b>TD girls</b>	1.2%	4.2%	43%	40.3%	11%

**Table 2.8: DAWBA friendship questions (TS n=88; TD girls n=3,798)**

## SRS-2: Autistic symptomatology

The SRS-2 measures autistic symptomatology. We hypothesized that the social interaction difficulties of children, adolescents and young women with TS would be comparable to those experienced by children, adolescents and young women with autism. Based on previous research we hypothesized that the subscale scores would reveal that social motivation is preserved (Hong et al., 2011). We hypothesized that the autistic symptomatology would be pervasive across environments and would be reported by both parent and teacher informants.

Analysis of the parent SRS-2 responses showed that only 41% of participants scored in the “normal” range. 33.6% scored in the “mild” and “moderate” ranges and 25.4% scored in the “severe” range. Scores in this range are strongly associated with clinical diagnoses of an ASD. This is equivalent to a 42.3 fold increased relative risk of experiencing severe autistic symptomatology in TS compared to typically developing girls (SRS-2 population norms). Taken together this suggests that 59% of participants experience difficulties with social interaction, which are likely to interfere with their everyday functioning (Table 2.8).

Parent and teacher ratings were aligned, particularly in regards to the “normal” and “severe” ratings (Table 2.8).

SRS-2 Total score	Normal	Mild	Moderate	Severe
<b>TD population* Parent report</b>	84.1%	9.2%	6.1%	0.6%
<b>Parent (n=122)</b>	41%	16.4%	17.2%	25.4%
<b>Teacher (n=26)</b>	42.3%	26.9%	7.7%	23.1%

**Table 2.9: Distribution of SRS-2 total scores by severity ratings**

\*From SRS-2 norms

The average subscale scores revealed that parents tended to rate participants as having higher rates of autistic symptomatology than teachers (Table 2.9). However, both rated the participants as being the most impaired in the domain of restricted interests and repetitive behaviours, where they scored in the “moderate” severity rating band (Table 2.9).

<b>SRS-2 Scales M (SD)</b>	<b>Parent Severity Rating (n=122)</b>	<b>Teacher Severity Rating (n=26)</b>
<b>Social Awareness</b>	Mild 61.8 (13.83)	Normal 58.88 (13.94)
<b>Social Cognition</b>	Mild 62.89 (16.02)	Normal 58.04 (13.73)
<b>Social Communication</b>	Mild 63.5 (14.69)	Mild 61 (12.67)
<b>Social Motivation</b>	Mild 61.93 (13.9)	Normal 59.12 (12.24)
<b>Restricted Interests and Repetitive Behaviour</b>	Moderate 66.11 (15.56)	Moderate 67.92 (21.72)
<b>TOTAL SCORE</b>	Mild 65.04 (14.92)	Mild 62.38 (13.94)

**Table 2.10: SRS-2 subscale scores by severity rating**

A subset of teachers completed the SRS-2. All the teacher SRS-2 responses overlap with the parent responses.

#### 4. Discussion

Girls with TS have higher rates of psychiatric and social skills difficulties than the general population. A third of participants met criteria for a mental health disorder and there were high rates of neurodevelopmental disorders.

#### High rates of ASD and social interaction difficulties of an autistic type

Most participants experienced some degree of social interaction difficulty, with 71% parents reporting that their daughter had difficulties making friends and that their daughters had fewer friends than typically developing female peers. These difficulties are likely to arise from an early age, as no association between age and the SDQ peer interaction difficulties scale was detected.

There is converging evidence from the DAWBA and the SRS-2 that approximately one in five girls had an ASD. This is equivalent to a 42.3 fold increased relative risk of experiencing severe autistic

symptomatology and a 57.5 fold increased relative risk of meeting criteria for an ASD in TS compared to typically developing girls.

Most participants (59%) were reported to have mild to moderate autistic traits, which had a clinically significant impact on their day-to-day social interaction. On the SRS-2 participants gained their highest scores on the “repetitive and restricted interests” subscale. The SRS-2 subscale score profile is consistent with previous research using the SRS-1 on a smaller sample of girls with TS (Hong et al., 2011). These findings suggest most children, adolescents and young women with TS experience social interaction difficulty of an autistic type. These findings also support an association between TS and ASD, which had previously been considered controversial.

#### **ADHD and the developmental trajectory of hyperactivity/impulsivity and inattention**

ADHD is known to be associated with TS in childhood, with anecdotal evidence of the hyperactivity resolving in adolescence (Skuse, 2009). We found that 85% of the TS group that met criteria for ADHD had the combined subtype and 15% had the hyperactive/impulsive type. This is not consistent with previous research which reported that 25% met criteria for the combined type, 33.3% for the predominantly inattentive type and 41.7% for the hyperactive/impulsive type (Russell et al., 2006). It is not known whether the differences in estimates are the result of methodological differences. Russell and colleagues (2006) assessed ADHD in TS using a parent interview conducted by clinicians called the Diagnostic Interview for Children and Adolescents over the phone and the Conners’ rating scales with parent and teacher informants. They also assessed a narrower age range of girls with TS (7-16 years old).

Our developmental perspective, assessing ADHD from childhood to adolescence revealed that difficulties with hyperactivity/impulsivity and inattention that were preponderant in the younger age groups were no longer of concern by late adolescence. Most children with idiopathic ADHD experience chronic difficulties, but a proportion will no longer meet criteria for the disorder by adolescence (Faraone, Biederman, & Mick, 2006). There may be a characteristic developmental trajectory of idiopathic ADHD in girls between childhood and adolescence (Sasser, Kalvin, & Bierman, 2016), but it has not been thoroughly investigated. Recent evidence suggests that in girls symptoms of inattention persist, whereas symptoms of hyperactivity and impulsivity lessen with age (Franke et al., 2018; Hinshaw, Owens, Sami, & Fargeon, 2006; Murray et al., 2019). In TS, ADHD traits declined from middle childhood to adolescence. Targeted interventions to help with inattention/hyperactivity and impulsivity concerns in the early years and throughout childhood at school are advised, as they may help improve educational attainment.

## Emotional disorders

The prevalence of depression was lower than in the national study was and only present in the late teenage years in the TS group (relative risk 0.35). This is consistent with previous reports of low rates of depression in childhood and adolescence in TS (Kiliç et al., 2005; McCauley et al., 2001; Rickert et al., 1996). The rates of anxiety were higher in the TS group compared to the national study sample. The prevalence of generalised anxiety disorders appeared to be increased in adolescents (Table 2.6).

## 5. Strengths and limitations

To our knowledge this study has collected the largest mental health and neurodevelopmental dataset on children and young people with TS from the ages of 4 to 25 years. Previous studies focused exclusively on adolescents aged 13 to 18 years (McCauley et al., 2001; n=122), and women aged 16 to 61 years (Cardoso et al., 2006; n=100). These studies did not discuss developmental trends in mental health or neurodevelopmental characteristics of TS.

We compared the behavioural adjustment and psychological wellbeing of young women with TS to “typically developing girls” using population norms. Recruiting our own control group could have potentially permitted closer matching to the participants in terms of socio-economic status and intellectual ability.

There appears to be a characteristic developmental trajectory for hyperactivity/impulsivity and inattention symptoms, which peaks in middle childhood and resolves by adolescence. These findings need to be replicated in longitudinal research. Further insights on developmental trajectories would help guide the timing of intervention.

The DAWBA is not a clinical diagnostic assessment. Formal psychiatric diagnoses require face-to-face clinical interviews and observations. Ideally they should acquire information from multiple informants (e.g. parents, teachers and the young person themselves). Additionally, our study was limited to parental reports of mental and neurodevelopmental disorders, due to concerns about the validity of self-report of children and adolescents with TS. Future studies will need to understand why there are discrepancies between parent and self-reports of emotional state and behaviours.

This study, like all studies of rare genetic disorders, may be affected by an ascertainment bias. Families needed to be engaged with their clinical services or the UK support society to find out about the study. It is also possible that the study adverts attracted more families who have children experiencing psychological difficulties than those without difficulties.



## 6. Conclusion

Taking a systematic approach to assessing psychopathology has revealed high rates of social skills difficulties, mental health disorders (anxiety disorders) and neurodevelopmental disorders (ASD and ADHD). The use of the same assessment tools from the ages of 4 to 25 years has provided useful prognostic information on psychopathology in TS and its developmental trajectory. Difficulties with inattention, impulsivity and hyperactivity appeared to be restricted to childhood. However, the high rates of generalised anxiety disorder are likely to persist into adulthood without appropriate intervention. Difficulties with reciprocal social interaction and autism emerged at a young age and are also likely to be sustained throughout the lifespan. Given the overlap in symptomatology between TS and ASD, social skills interventions developed for children with ASD may prove to be an apt choice for treatment.

## Chapter 3 Identifying and developing theory: Evidence base for social skills interventions

### 1. Rationale

Children with TS experience higher levels of social interaction difficulties than their typically developing female peers and one in five are likely to meet criteria for an ASD diagnosis. The social interaction difficulties are comparable to those experienced by children with autism (Chapter 2). Therefore we decided to explore treatment approaches that have been successful with autistic children. The TS clinical care guidelines also recommend piloting a programme which was originally developed for young people with autism called PEERS (Laugeson & Frankel, 2011). The Medical Research Council have created guidelines to pilot and evaluate complex interventions. The first step of the framework recommends identifying relevant theory and developing a theoretical understanding of the likely process of change (Craig et al., 2008). In order to follow these guidelines we conducted preliminary research on social competence theory and group social skills interventions.

### 2. Social competence theory

#### Definitional issues

“Social competence” is a multi-faceted and complex construct, and owing to this, remains poorly defined. Most definitions emphasize that it is an outcome that can be judged as successful or appropriate, in relation to the social context (Cavell, 1990; Nangle, Grover, Holleb, Cassano, & Fales, 2010; Rubin & Rose-Krasnor, 1992). *Social competence* is often used interchangeably with *social skills*, however, social skills are more accurately described as behaviours that are performed in social situations (McFall, 1982). For example, the successful performance of social skills such as conversations and initiating social contact may lead to social competencies such as friendship. The distinction between social skills and social competence is important because a deficit in social competence is not always the result of a deficit in social skills. For example, a child that possesses the skills to behave in a socially adept manner, but fails to use these skills (perhaps out of shyness), is said to have a social skills performance deficit. Whereas a child that does not have the social skill in their behavioural repertoire, is said to have a social acquisition deficit (Gresham, 1997). To assess social competence comprehensively, it is important to also assess for acquisition and performance deficits.

Interestingly, much of the intervention and assessment literature also chooses to refer to social skills rather than social competence. Systematic reviews of the social skills assessment literature have noted discrepancies in how different assessment tools define social skills (Cordier et al., 2015;

Crowe, Beauchamp, Catroppa, & Anderson, 2011; Matson & Wilkins, 2009). Most assessment tools assess social skills in relation to interpersonal contact, as well as reciprocal verbal and non-verbal interactions. But some tools also assess areas that are not typically considered social skills, such as school readiness, self-esteem and adaptive behaviour (Matson & Wilkins, 2009). This suggests that not all social skills assessment tools are capturing the same phenomena.

In the absence of a definitional consensus a variety of social competence models have emerged. Early models of social competence developed in the 1970s to 1980s describe social competence as a process, discussing social competence as a sequence of events. The models use slightly different terminology, but conceptualise social competence as an exercise in receiving social cues, analysing the cues and responding to the cues (e.g. McFall's Reformulated Model of Social Skills, (McFall, 1982); Social Information Processing Model; (Dodge, Murphy, & Buchsbaum, 1984); Behavioural-Analytic Model, (Goldfried & D'Zurilla, 1969); Social Information Processing Model, (Crick & Dodge, 1994)).

Later models such as the Social Competence Prism (Rose-Krasnor & Rose-Krasnor, 1997), the Model of Social Competence (Elliott & Gresham, 1987) or the Socio-Cognitive Integration of Aptitudes model (SOCIAL) (Beauchamp & Anderson, 2010) begin to parse out the different emotional, cognitive and environmental factors influencing social competence (see Figure 3.1). Most of these new models use constructs such as *linguistics*, *cognitive function*, *emotional function*, *skill ability*, *motivation* and the *environment* to define social competence. These building blocks are organised differently, depending on the author's views of which component is the most critical for social skills, which may in turn be influenced by the client group the author has experience of working with. For example Rose-Krasnor's social competence prism model emphasizes the importance of social motivation, which is aligned with her research on shyness and social withdrawal and isolation (Fredstrom et al., 2012; Rose-Krasnor & Rose-Krasnor, 1997). Whereas Gresham and Elliott's (1987) model of social competence emphasizes adaptive behaviour, which reflects their research with children with intellectual disabilities. The Beauchamp and Anderson's SOCIAL model emphasizes cognitive function as well as neuronal brain development, which again, is consistent with their research on social development in children with brain injury (Anderson & Beauchamp, 2012; Anderson et al., 2013; Beauchamp & Anderson, 2010).

### Social skills interventions

Social skills interventions can be used individually, in dyads or in groups. Here we discuss social skills training in groups, as it is the most common form of delivery. Group social skills interventions (GSSIs) have been used with different populations including children with oppositional behaviour, ADHD or

anxiety, and adults with schizophrenia. In the last 15 years there has been a sharp increase in the number of social skills interventions being developed or adapted for children with ASD (Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012; Reichow & Volkmar, 2010; Volkmar, Lord, Bailey, Schultz, & Klin, 2004). The teaching strategy, delivery, intensity and content of GSSIs can vary significantly. Manualised GSSIs typically include behavioural modelling of a specific social skill, practicing the skill through role-play and individualised feedback on performance. The interventions can also vary by teaching strategy, for example most interventions include a lesson about a specific social skill and are referred to as “didactic”. However, some interventions do not make use of structured teaching sessions, focusing instead on eliciting social skills through play; these are called “performance” interventions (Kaat & Lecavalier, 2014). The delivery of the intervention can also be highly variable, with some programmes requiring parent, peer or teacher involvement. The duration and intensity of treatment can also vary significantly, with some programmes requiring 12 or more 90min sessions on a weekly basis and others requiring attendance at intensive summer camps. The content of individual GSSI programmes appear to target different domains of social behaviour, however a detailed examination of GSSI teaching syllabuses has been limited, as few manualised intervention programmes have been published. It has been hypothesized that intervention-specific factors such as treatment duration, teaching strategy (e.g. didactic or performance) and parental involvement may moderate the outcome of GSSIs (McMahon, Lerner, & Britton, 2013; Reichow, Barton, Boyd, & Hume, 2012).

The empirical evaluation of GSSI has been mixed (Beelmann, Pfungsten, & Lösel, 1994; Schneider & Byrne, 1989). Both parents and children report high personal satisfaction with GSSIs (Gates, Kang, & Lerner, 2017; McMahon et al., 2013). Yet despite their popularity, many reviews have concluded that there is not sufficient evidence to make a judgement on efficacy, often citing weak study methodology as a reason for their inconclusive judgements (Cappadocia & Weiss, 2011; Ferraioli & Harris, 2011; McMahon et al., 2013; Rao, Beidel, & Murray, 2008; Reichow & Volkmar, 2010; White, Keonig, & Scahill, 2007).

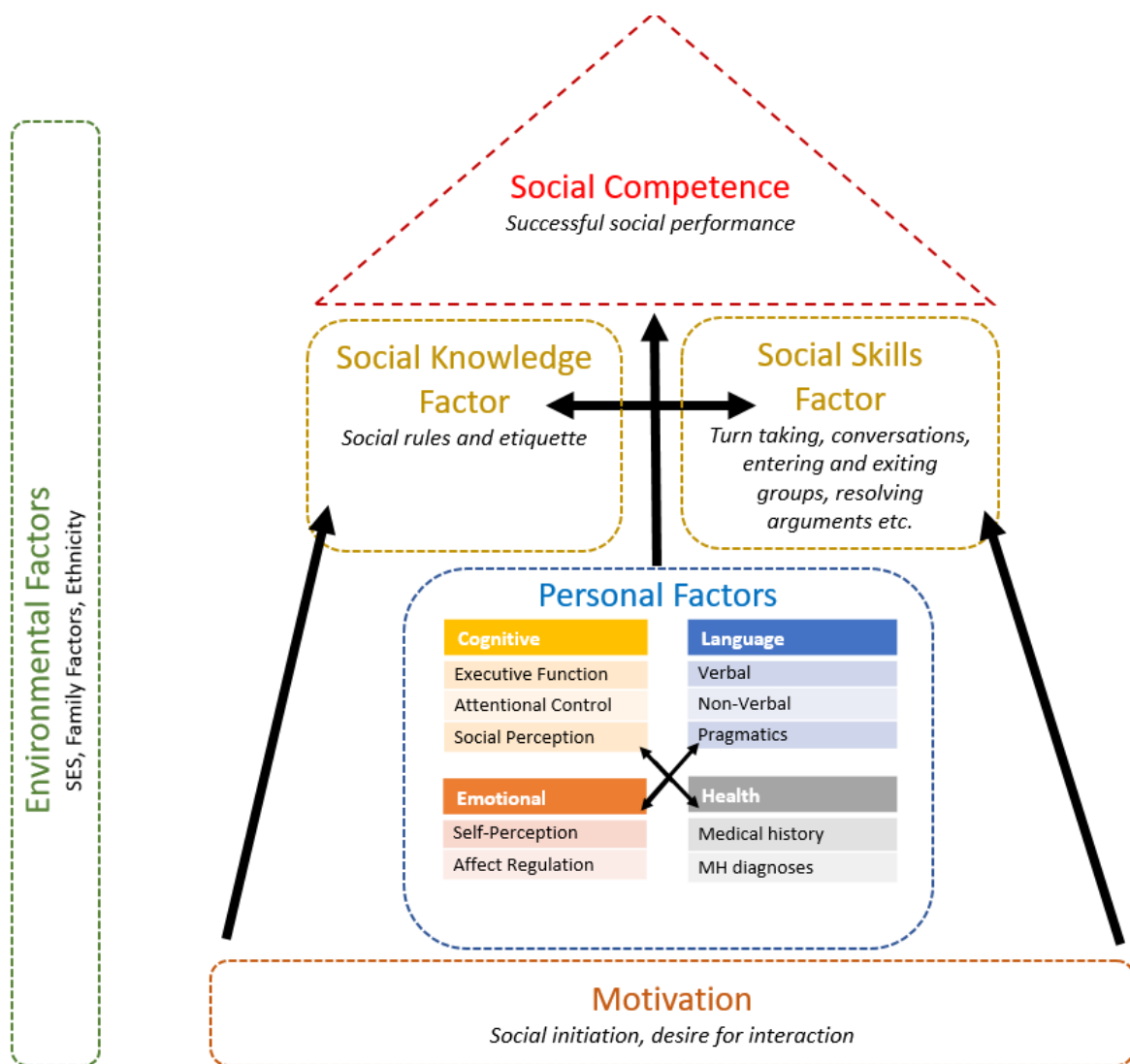
Given the diversity of interventions and definitional ambiguity of social skills and social competence it is unsurprising that social skills training intervention reviews have been unable to make a judgement on treatment efficacy. We hypothesize that previous evaluations of GSSIs efficacy have been inconclusive due to the definitional ambiguity of social skills and social competence. In order to reduce the definitional ambiguity and evaluate intervention outcomes more effectively we have developed a new “social competence assessment framework” against which to benchmark efficacy.

## Social competence assessment framework

The “social competence assessment framework” was developed to examine all of the building blocks of social competence individually. It was developed through discussions between the student and the senior investigators on this project. The model aims to integrate all of the domains of social competence found in previous theoretical models. The advantage of this comprehensive model is that it can capture the subtle difference between diverse social skills training programmes and social competence assessment tools.

The model includes six key building blocks called factors. These include: social motivation, personal factors, social knowledge, social skills, social competence and the environment.

Social motivation is posited as the underlying force driving individuals to achieve social competence. The personal and environmental factors influence the development of social knowledge, social skills and social competence (see Figure 3.1).



**Figure 3.1: Social competence assessment model**

The personal factors are grouped into four inter-related personal domains; the cognitive, emotional, language and health domains. The cognitive domain includes processes such as executive function, attentional control, social knowledge and social perception. The emotional domain includes processes like self-perception and affect regulation. The language domain includes verbal, non-verbal and semantic language abilities. The health domain includes physical and mental health. Although the emotional and cognitive domains have been separated, there is overlap between the two domains, especially in regards to affect regulation and social problem solving. All four personal domains are in a constant interplay with each other (Table 3.1). The appropriate interaction of motivation, personal factors, social skills and social knowledge gives rise to social competence.

<b>Social competence framework: Personal factors</b>		
<b>Motivation</b>		Initiating social interaction Social engagement
<b>Social knowledge</b>		Knowledge of social rules and cues Knowledge of content taught in intervention
<b>Communication</b>	Verbal communication	Tone of voice Volume Rate of speech Clarity of speech Latency of response
	Non-verbal communication	Eye contact Facial expression Posture Social distance Gesture
	Pragmatics	Literal use and understanding of language
<b>Cognitive</b>	Executive function	Working memory Cognitive flexibility Planning Strategic behaviour Social problem-solving
	Attentional control	Selective and sustained attention Response inhibition Self-monitoring Self-regulation
	Social perception	Social attention and awareness Face emotion perception Theory of mind Perspective taking
<b>Emotional</b>	Self-perception	Self-esteem Recognising own emotions
	Affect	Controlling negative emotions Managing anxiety Being gracious when feeling strong emotions (good loser/winner)

**Table 3.1: Social competence framework personal factors descriptors**

### 3. Identifying the evidence base: Systematic review of group social skills interventions using a novel framework

#### Rationale

Our preliminary review of social competence theory revealed that there was a substantial amount of heterogeneity in the conceptualisation of social skills and social competence. We also discovered that the evidence for GSSI training programmes is mixed. We hypothesized that previous evaluations of GSSIs efficacy had been inconclusive due to the definitional ambiguity of social skills and social competence, resulting from a misalignment between the theory, the treatment programmes and the assessment tools definitions of social competence. In order to reduce the definitional ambiguity a systematic review of GSSI was conducted using our newly developed social competence assessment framework. Our objective was to identify and evaluate the evidence base to GSSI in a systematic way. Specifically, we aimed to (1) examine the areas of the framework targeted by GSSI and compared them to those assessed by social skills instruments and (2) provide insights into the methodological rigour of the GSSI evidence base.

#### Methods

##### *Search strategy*

Electronic searches were conducted on the Medline, CINAHL, PsycInfo and Embase in December 2016 using MeSH key terms “social skills” and “group interventions”, as well as filters for age and language (see Appendix IV for full search strategy). Two independent coders rated the article abstracts at the screening stage against the inclusion criteria (Box 3.1). The reasons for exclusion were recorded. The reference lists of review articles from the electronic search were screened to identify additional studies.

Two independent coders rated the full articles at the eligibility stage. At both the screening and eligibility stages disagreements between raters were resolved through discussion, and when a consensus could not be reached, a third rater was consulted. Only the third reviewer was blind to the article authors, institutions or publication journal.



### **Box 3.1: Inclusion criteria**

**Studies:** Peer reviewed, Any study design; Intervention and assessments conducted in English

**Participants:** Any client group (ASD, schizophrenia, social anxiety, generalised anxiety disorder, ADHD etc.); Age range of participants 6-25 years

**Intervention:** Delivered by professionals; Replicable (eg. manualised); Multi-modal social skills training interventions (intervention not to be a sub-component of an intervention focusing on something else or combined with another type of training); Two or more participants in a treatment group

**Outcome measures:** Must include social skills outcome measures

### *Data extraction*

Data was extracted on the study design; the intervention and the outcome measures for all studies retained in the eligibility phase using a bespoke excel spreadsheet extraction form. Further analysis was conducted on a subset of studies which employed a randomised control (RCT) design with a waitlist or delayed treatment control group.

### *Risk of bias analysis*

Studies employing an RCT design were assessed for risk of bias by two independent coders. The Cochrane Collaboration tool RoB v2 was used to assess bias for sequence generation, allocation concealment, baseline measurements, blinding of participants and personnel, blinding of outcome assessments, addressing incomplete outcomes, selective reporting and other biases (Higgins, 2016) .

### *Social competence assessment framework*

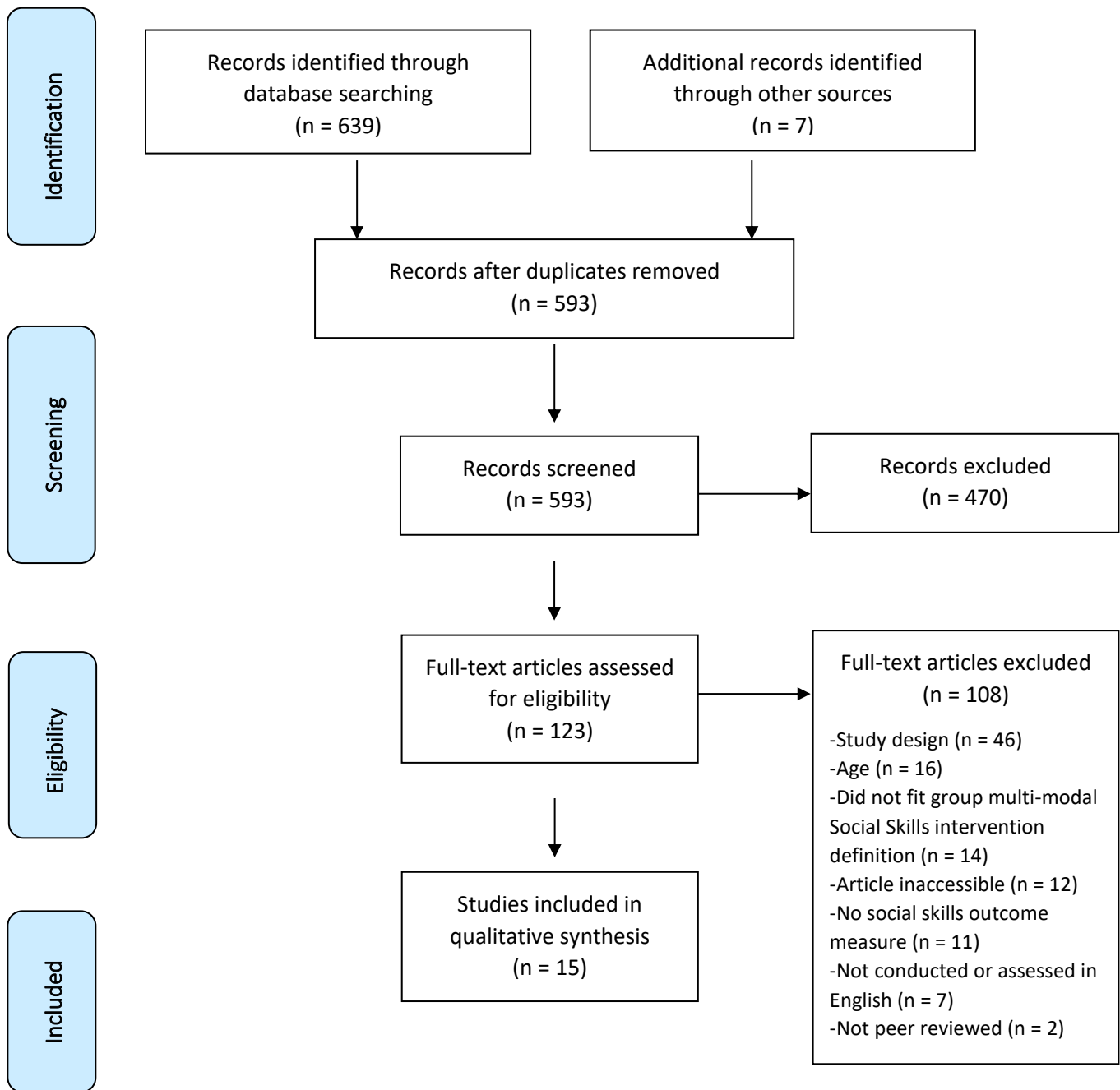
The social competence assessment framework (see Table 3.1 for detailed description of personal factors) was used to rate the domains of social competence used in the intervention and the outcome measures by two independent raters. The outcome measures were rated individually, and then a summary composite variable of all the measures used in each study was created.

Disagreements were resolved through discussion. The consensus ratings obtained for the interventions and those obtained for the outcome measures were then compared.

## Results

### *Search results*

The electronic search returned 611 articles after duplicates were removed. Additional articles were identified through correspondence with authors and by screening the reference lists of review articles picked up in the initial screening search. Studies were excluded if they didn't fit the inclusion criteria or didn't fit this review's definition of group social skills interventions (Figure 3.2). The screening process reduced the number of eligible articles to 123, which were fully assessed for eligibility. Finally, 15 RCT studies that met criteria for eligibility were retained for qualitative synthesis.



**Figure 3.2: Prisma flow diagram**

### *Study characteristics*

*Participant characteristics:* The majority of studies were focused on children with ASD (+/- co-morbidities). Studies looking at different populations (e.g. schizophrenia, anxiety etc.) were captured in the literature search, but they were subsequently excluded as they did not use social competence outcome measures.

Most studies used comprehensive screening batteries to confirm the eligibility of their participants. The most common screens included mental health diagnoses and co-morbidities (confirmed by study assessments or medical notes), medication history, IQ tests, information on schooling and demographics (ethnicity, SES, parental education and income). Some studies excluded participants based on their intellectual functioning (largely verbal IQ) or behavioural difficulties. Overall participants' health was fairly well characterised, but socio-economic status was captured less systematically. Some studies also used adaptive behaviour assessments and only one study (Solomon, Goodlin-Jones, & Anders, 2004) required participants to pass a social-cognitive task to be included in the study.

*Intervention characteristics:* The search showed that a very diverse range of interventions were used (Table 3.2). There were more didactic interventions than performance interventions, but there is a substantial overlap between the two practices, therefore the distinction must be interpreted cautiously.

Most interventions ran one session a week for 6 to 16 weeks, but some interventions were more intensive, running biweekly or every weekday. The majority of the interventions ran concurrent parent groups, two included peer confederates to facilitate the sessions.

Article Intervention	Intervention	Age (M)	N	Number of sessions	Features	Performance or Didactic
Corbett (2016)	SENSE Theatre	11.27	30	240 min/ 10 sessions (summer camp model)	Peer-assisted	Performance
De Rosier (2004)	S.S.GRIN	8.6	415	60 min/ 8 sessions	-	Didactic
Dolan (2016)	PEERS	13.41	58	90 min / 14 weekly sessions	Parent group	Didactic
Frankel (2010)	CFT	8.53	66	60 min/ 12 weekly sessions	Parent group	Didactic
Gantman (2012)	PEERS	20.4	17	90 min/ 14 weekly sessions	Parent group	Didactic
Koenig (2010)	Not named - manual developed	9.2	44	75 min/ 16 weekly sessions	Peer tutors	Performance
Koning (2013)	Not named - manual developed	11.07	15	120 min/ 15 weekly sessions	Parent handout	Didactic
Laugeson (2009)	PEERS	14.6	32	90 min/ 16 weekly sessions	Parent group	Didactic
Laugeson (2015)	PEERS Young Adults	21.39	22	90 min/ 12 weekly sessions	Parent group	Didactic
Lopata (2010)	Adapted Skillstreaming	9.47	36	350 min /daily sessions for 5 weeks	Parent group	Didactic
Schohl (2014)	PEERS	13.65	58	90mins/ 14 weekly sessions	Parent group	Didactic
Solomon (2004)	The Social Adjustment Enhancement Curriculum	9	18	90 min/ 20 weekly sessions	Parent group	Didactic
Thomeer (2012)	Adapted Skillstreaming	9.31	35	350 min /daily sessions for 5 weeks	Parent group	Didactic
Thomeer (2016)	summerMAX	9.15	57	350 min /daily sessions for 5 weeks	Parent group	Didactic
Waugh (2015)	SSToM CFT	9	49	SSToM: Not disclosed CFT: 60min/ 10 weekly sessions	Parent group	Didactic

**Table 3.2: Participant and intervention characteristics**

*Informants and outcome measures:* A variety of different outcome tools were used (Table 3.3). The most popular outcome measures used with parents and teachers were the SRS and SSRS. Parents and children were frequently asked to complete satisfaction or feedback questionnaires. The most common socio-cognitive tasks that participants were asked to complete were theory of mind tasks such as the Diagnostic Analysis of Nonverbal Accuracy (DANVA), reading mind in the eyes task or strange stories task. Peers, who were sometimes participants in the study were only asked to complete sociometric assessments. Most studies did not use an optimal combination of informants; only six out of 15 studies used parents, the child (questionnaire or task) and an observer (teacher, observer or peer).

Article Intervention	Parent	Self-report	Task	Teacher	Staff/Observation	Peer
<b>Corbett (2016)</b> <b>SENSE Theatre</b>	- SRS - ABAS	-	- NEPSY - IFMT	-	- PIP	-
<b>De Rosier (2004)</b> <b>S.S.GRIN</b>	-	- SIS - SE-OE - SAS-R - SPP - MFQ	-	-	-	- Sociometrics
<b>Dolan (2016)</b> <b>PEERS</b>	-	- TASSK	-	-	- CASS	-
<b>Frankel (2010)</b> <b>CFT</b>	- QPQ - SSRS	- LS - PHSC	-	- PEI	-	-
<b>Gantman (2012)</b> <b>PEERS</b>	- SSRS - SRS - EQ - QSQ	- SELSA - QSQ - TYASSK	-	-	-	-
<b>Koenig (2010)</b> <b>Not named - manual developed</b>	- CGIS - SCI - Parent Satisfaction Survey	-	-	-	-	-
<b>Koning (2013)</b> <b>Not named - manual developed</b>	- VABS-2 - SRS	- Social knowledge	- CAP	-	- PIM	-
<b>Laugeson (2009)</b> <b>PEERS</b>	- SSRS - QPQ	- QPQ - TASSK - FQS	-	- SSRS	-	-

<b>Laugeson (2015)</b>	- SRS	- TYASSK	-	-	-	-
<b>PEERS Young Adults</b>	- SSRS - QSQ - EQ	- QSQ				
<b>Lopata (2010)</b>	- ASC	-	- DANVA-2	-	-	-
<b>Adapted</b>	- SRS		- SKA			
<b>Skillstreaming</b>	- BASC-PRS - Satisfaction Survey		- CMFVB			
<b>Schohl (2014)</b>	- QSQ	- TASSK	-	- SRS	-	-
<b>PEERS</b>	- SRS - SSRS	- QSQ - FQS - SIAS		- SSRS		
<b>Solomon (2004)</b>	- BDI*	- CDI	- DANVA-2	-	-	-
<b>The Social</b>	- PBL		- TOPS			
<b>Adjustment</b>			- SST			
<b>Enhancement</b>			- FPS			
<b>Curriculum</b>						
<b>Thomeer (2012)</b>	- ASC	-	- DANVA-2	-	-	-
<b>Adapted</b>	- SRS		- SKA			
<b>Skillstreaming</b>	- BASC-PRS - Satisfaction Survey					
<b>Thomeer (2016)</b>	- ASC	- CASL	-	-	-	-
<b>summerMAX</b>	- SRS - BASC-2-PRS - Satisfaction Survey	- Satisfaction Survey				
<b>Waugh (2015)</b>	- SRS	-	- SST-R - TOM	-	-	-

**Table 3.3: Outcome measures**

\*Assessing parents



**Interventions-** CFT: Children’s Friendship Training; PEERS: Programme for the Education and Enrichment of Relational Skills; SENSE theatre: SENSE theatre; SSToM: Social Skills and Theory of Mind.

**Parent Outcome measures-** ABAS: Adaptive Behaviour Assessment Schedule; ASC: Adapted Skillstreaming Checklist; BASC- PRS: Behaviour Assessment System for Children - Parent Rating Scales; CAP: Child and Adolescent Perception Measure; BDI: Beck Depression Inventory; CASL: Comprehensive Assessment of Spoken Language; CASS: Contextual Assessment of Social Skills; CDI: Children's Depression Inventory; CGIS: Clinical Global Impressions Scale; CMFVB: Cambridge Mindreading Face-Voice Battery for Children; DANVA: Diagnostic Analysis of Nonverbal Accuracy; EQ: Empathy Quotient; LS: Loneliness Scale; MFQ: Mood and Feelings Questionnaire–Short Form; NEPSY: NEuroPSYchological Assessment; IFMT: Incidental Face Memory Task; PEI: Pupil Evaluation Inventory; PHSC: Piers-Harris Self-concept; PIM: Peer Interaction Measure; QSQ: Quality of Socialisation Questionnaire; QPQ: Quality of Play Questionnaire; SAS-R: Social Anxiety Scale for Children–Revised; SCI: Social Competence Inventory; SE-OE: Self-Efficacy and Outcome Expectancy; SELSA: Social and Emotional Loneliness Scale for Adults; SIAS: Social Interaction Anxiety Scale; SIS: Social Interactions Survey; PIP: Peer Interaction Paradigm; SKA: Skillstreaming Knowledge Assessment; SPP: Self-Perception Profile for Children; SRS: Social Responsiveness Scale; SSRS: Social Skills Rating Scale; SST: Strange Stories Task; SST-R: Revised Version of the Strange Stories Task; TASSK: Test of Adolescent Social Skills Knowledge; TOPS: Test Of Problem Solving; TOM: Theory of Mind Inventory; TYASSK: Test of Young Adult Social Skills Knowledge; VABS: Vineland Adaptive Behaviour System

### *Quality Assessment: Risk of bias analysis*

One study (Vaughn et al., 2015) scored high risk in all of the bias criteria except for selective outcome reporting and as such, will be discussed separately to all the other studies. It obtained high risk ratings in the sequence generation and allocation concealment criteria, as the study design was pseudo-randomised (Table 3.4). At baseline there were significant differences on one of the primary outcome measures between the two treatment groups and the delayed control group, which led to a high risk rating on baseline measurements criterion. The incomplete outcome criterion was also marked as high risk as there was attrition and participant exclusions.

All of the other studies obtained a low risk or unclear rating for the sequence generation and allocation concealment criteria. The ratings criteria were rated as unclear when the studies did not explicitly state their method of randomisation or that an individual who was not involved in the study was responsible for the randomisation process (Appendix V).

One study obtained a high risk rating on the baseline measurement criterion (Corbett et al., 2016) as there were some significant differences between the control and intervention group for some of the outcome measures. Two studies obtained an unclear rating on this criterion; Solomon and colleagues (2004) reported the baseline measures for the control and intervention group, but did not conduct significance testing; the Thormeier and colleagues (2012) outcome measures were “adjusted” at baseline before significance testing. All the other studies obtained a low risk rating on this criterion.

The blinding of participants, personnel and outcome assessors was high risk for all of the studies. A few studies employed observation outcome measures where the coders were blind to the participants’ group status, but these were always used in conjunction with outcome measures where the assessors were not blind.

The incomplete outcome data category was rated high risk for 8 out of 14 studies, which reflects participant attrition from the waitlist control or the intervention group. One study was rated as unclear (Solomon et al., 2004) as the data was incomplete for one of the measures in the control group. All the other studies were rated low risk for this criterion.

The selective outcome reporting category was rated low risk in all studies, but one (DeRosier, 2004), where the reporting on outcome measures was unclear.

No other sources of bias were detected.

RCTS	Sequence Generation	Allocation Concealment	Baseline measurements	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective outcome reporting
Corbett (2016)	Low risk	Low risk	High risk	High risk	High risk	High risk	Low risk
De Rosier (2004)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Unclear
Dolan (2016)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Frankel (2010)	Low risk	Unclear	Low risk	High risk	High risk	High risk	Low risk
Gantman (2012)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Koenig (2010)	Low risk	Low risk	Low risk	High risk	High risk	Low risk	Low risk
Koning (2013)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Laugeson (2009)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Laugeson (2015)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Lopata (2010)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Schohl (2014)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Solomon (2004)	Unclear	Unclear	Unclear	High risk	High risk	Unclear	Low risk
Thomeer (2012)	Unclear	Unclear	Unclear	High risk	High risk	Low risk	Low risk
Thomeer (2016)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Waugh (2015)	High Risk	High Risk	High risk	High risk	High risk	High risk	Low risk

**Table 3.4: Risk of bias summary**

### *Social competence assessment framework analysis*

The present analysis is focused on the motivation, social knowledge and the other personal factors (communication, cognitive and emotional) domains of the framework. The environmental factors and health factors of participants will not be discussed as part of the model as they have been described in detail in the participants' characteristics section (p50).

*Outcome measures:* Every outcome measure was individually rated using the assessment framework (See Appendix VI). Table 3.5 presents summary ratings for the combination of outcome measures used in each study.

*Intervention programmes:* The social competence assessment framework analysis shows that the interventions focus on different areas of social competence (Table 3.5). None of the interventions included explicit teaching in all domains of the social competence model. All of the trials taught social rules and knowledge, pragmatics and executive skills. There were discrepancies in all of the other framework domains. All but one study taught about social perception. Most interventions taught about affect regulation (75%) and promoted social motivation (62%). 68% of studies did not teach participants explicitly about verbal communication and 38% were not taught about the non-verbal areas of communication. Many of the interventions also did not explicitly teach participants about attentional control (81%) or self-perception (69%).

*Comparing outcome measures and intervention programmes:* There were a number of discrepancies between the intervention and the outcome measures coverage of social competence domain areas. In 36% of cases there was a discrepancy; in 15% the intervention taught skills in a domain, that were not assessed by an outcome measure; whereas in the remaining 21% the reverse was true with an outcome measure assessing a domain, which was not taught in the intervention. Seven studies included outcome measures that assessed every area of the social competence taught in their intervention, of these five assessed all the social competence factor domains.

Article	Motivation		Social rules & knowledge		Communication						Cognitive						Emotional			
	Intervention	Assessment	Intervention	Assessment	Verbal		Non-verbal		Pragmatics		Executive		Attentional		Perception		Self-perception		Affect	
					Intervention	Assessment	Intervention	Assessment	Intervention	Assessment	Intervention	Assessment	Intervention	Assessment	Intervention	Assessment	Intervention	Assessment	Intervention	Assessment
Corbett (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
De Rosier (2004)	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y	N
Dolan (2016)	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	N	Y	N	N	N	Y	Y
Frankel (2010)	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Gantman (2012)	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Koenig (2010)	N	Y	Y	N	N	N	N	N	Y	N	Y	Y	N	N	N	Y	N	N	Y	Y
Koning (2013)	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y
Laugeson (2009)	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Y
Laugeson (2015)	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y
Lopata (2010)	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y
Schohl (2014)	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Solomon (2004)	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y
Thomeer (2012)	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y
Thomeer (2016)	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y
Waugh (2015) CFT	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N
SSToM	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N

**Table 3.5: Social competence assessment framework model analysis**

## 4. Discussion

### Study characteristics

The studies included in this review used a variety of informants and types of assessment. The most popular type of outcome measure used was the questionnaire, undoubtedly because of the ease of administration. The most popular social skills outcome measures used were the SRS and the SSRS. Our findings suggest that in many studies, the current use of instrument and informant type was not optimised to capture changes in social skill acquisition or performance. This is consistent with previous systematic reviews of social skills interventions.

### Quality assessment

The risk of bias was assessed in 15 RCT studies included in the systematic search. The most consistent source of bias in the studies was the blinding of participants, personnel and outcome assessors. Due to the nature of the intervention the study personnel and participants cannot be blinded, but future studies could reduce the bias of outcome assessors by using blind assessors in conjunction with parent and self-report.

Dropout and attrition was a problem that affected many studies. Although this is not always feasible, it would be helpful for studies to report more comprehensively on the baseline characteristics of participants that dropped out and report the reason for dropout. This would help determine if some baseline characteristics are predictors of dropout.

### Social competence assessment framework model analysis

Prior to this analysis, no attempts to assess the syllabi of social skills interventions or the content of social skills outcome measures have been documented in the literature. The most striking finding from the assessment framework analysis is that the interventions target different domains of the social competence. All of the interventions focused on teaching social knowledge (rules and etiquette), concentrating their teaching on pragmatics, executive function and social perception. Most of the interventions did not cover domains such as verbal communication, non-verbal communication and attentional control. The majority of the studies included participant screening for verbal IQ and behavioural difficulties, which indicates that a good mastery of verbal language and attention were pre-requisites.

In the social competence assessment framework, motivation is posited as the driving force behind social interaction, so it is interesting that a third of studies did not explicitly teach social initiation. However, motivation may again be a pre-requisite for participation that is captured at the initial

screening stage. Intuitively, it seems that higher levels of motivation should be linked to better outcomes. Future research is needed to understand if motivation is a moderating factor in the success of social skills interventions.

Whilst almost all interventions taught about social perception, only a third of the studies taught about self-perception. This is intriguing not only because social perception and self-perception are interlinked domains (the acquisition of perception skills such as theory of mind and empathy are reliant on some ability to perceive one's own emotions). But also because it shows a theoretical divide between the interventions, with some focusing heavily on self-perception and others not touching upon it at all. This suggests that some interventions are based on the theoretical foundations that self-insight and awareness are critical to developing social skills, whereas others do not. For example, the PEERS intervention teaches social perception rather than self-perception and is associated with improvements in social performance. Therefore, explicitly teaching self-perception may not be essential to improving social competence. Improvements in social competence may still be observed because social- and self- perceptions are intrinsically linked, so targeting social perception indirectly improves self-perception. Alternatively, this may be because the core feature of social skills training is to teach participants how to use social scripts, which can be mastered on a superficial and practical level without necessitating a deeper emotional connection. This is akin to "camouflage", a coping strategy adopted by many people with ASDs to help them to "fit in". Camouflaging typically entails masking social deficits by suppressing behaviours that might be perceived by peers as unacceptable or attempting to perform social behaviours that are deemed more acceptable (Attwood, 2007; Willey, 1999). This might involve performing a range of non-verbal cues such as making eye contact during conversations and imitating facial expressions and gestures or following learnt social scripts such as using pre-prepared jokes or comments (Lai & Baron-Cohen, 2015). Recent research suggests that females are better at camouflaging than males (Dean, Harwood, & Kasari, 2016; Lai et al., 2016). At present too few females have taken part in social skills training to determine whether there are sex differences. Perhaps males would benefit more from social skills training than females because they need support in learning how to camouflage. Or it may be that social skills training interventions are more effective with females because they are better equipped to learn how to camouflage, but conversely this advantage may not leave them with much to improve on during social skills training.

The choice of outcome measure was not always well matched to the domains of social competence targeted by the interventions. For example, part of the de Rosier (2004) study intervention is

focused on communication (verbal, non-verbal and pragmatics), yet these are not explicitly assessed, which means that improvements in this area may have been missed.

Analysis with the social competence assessment framework has shown that the RCTs employing didactic social skills training interventions share some core features, which include teaching pragmatics, executive control and social perception. However, there were also some subtle, but important differences in the domains of social competence targeted by different interventions. As there are discrepancies between social skills training interventions and the outcome measures it is imperative that researchers implementing social skills training choose appropriate outcome measures to capture change.

This analysis provides two explanations for the mixed evidence base for the efficacy of social skills interventions. The first is the misalignment between the content of the outcome measures and the interventions, as the appropriate measures were not always used to capture change. The second is the meta-analytic approach. Previous meta-analyses have combined outcomes measures as if they were assessing the same constructs, which is not the case. Meta-analyses are commonly criticised for attempting to combine studies that are too heterogeneous. This criticism is often referred to as the “apples and oranges argument”; combining studies evaluating apples and oranges is only appropriate if you are attempting to estimate the effect of their shared properties as fruit (Cortina, 2003).

## 5. Conclusion

The definitional ambiguity surrounding social skills and social competence may be obscuring the evaluation of social competence. A theory-driven multi-dimensional approach to social skills and social competence is order to pierce through the haze. A more granular approach to evaluating the efficacy of GSSI is needed.

The quality of GSSI study methodology also requires improvement. This study highlighted two areas of high risk for bias including the blinding of outcome assessors and incomplete outcome data reporting. These biases could be improved by using multiple informants, specifically “blinded” external observers and reporting on the characteristics of patients who dropout of programmes. It is essential to create a targeted multi-informant assessment battery to comprehensively evaluate social knowledge and social performance.





## **Chapter 4 Identifying and evaluating the evidence base: Meta-analysis of group social skills interventions using the SRS and SSRS**

*This chapter includes some work that has been published in the Journal of Autism and Developmental Disorders: Wolstencroft, J., Robinson, L., Srinivasan, R., Kerry, E., Mandy, W., & Skuse, D. (2018). A systematic review of group social skills interventions, and meta-analysis of outcomes, for children with high functioning ASD. Journal of Autism and Developmental Disorders, 48(7), 2293-2307.*

### **1. Rationale**

In Chapter 3 we concluded that the evaluation of GSSI studies was likely to have been hindered by theoretical ambiguity and poor methodological rigour of GSSI studies and meta-analyses evaluating GSSI.

Previous GSSI reviews have assumed that diverse social skills outcome measures reflect the same underlying constructs, hence they have assumed that it is legitimate to combine the scores of a wide range of different tools for the purpose of outcome analysis. We conducted an additional systematic review and meta-analysis, which took an approach of high internal validity by focusing exclusively on GSSI employing two of the most common social competence assessment tools. This methodology was adopted to reduce the variability between studies due to assessment measures.

In Chapter 3 we established that the most commonly used outcome measures are the Social Responsiveness Scale (SRS) and the Social Skills Rating System (SSRS) (Kaat & Lecavalier, 2014; McMahon et al., 2013). They are both norm-referenced questionnaires that can be completed in 15-20 minutes. Both assessments predominantly focus on social performance. The SRS was designed to measure autistic traits quantitatively and the instrument has convergent validity with other ASD diagnostic tools (Constantino & Gruber, 2012). The SSRS was designed to provide a comprehensive picture of social behaviour rather than specific ASD traits (Gresham & Elliott, 1990). The SRS subscales comprise Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviour (RRB). The SSRS subscales examine Social Skills (including Cooperation, Assertion, Self-control, Responsibility) and Problem Behaviours (including Externalising Behaviours, Internalising Behaviours and Hyperactivity). We aimed to evaluate the degree to which change in SRS and/or SSRS scores is mediated by a GSSI.

There has been no published systematic review of the GSSI teaching syllabus content (Koenig et al., 2009). Few manualised intervention programmes have been published, but it is thought that intervention-specific factors such as treatment duration, intensity, teaching strategy (e.g. didactic or

performance) and parental involvement may moderate programme success (Reichow et al., 2012; McMahon et al., 2013). We aimed to evaluate whether intervention-specific factors such as intervention type, parental involvement, method of delivery, or duration have a moderating impact on social competence, by means of moderation analysis.

## 2. Methods

### Systematic review

This study used the same search strategy, data extraction and risk of bias procedures as described above in Chapter 3.3. However, the inclusion criteria applied to the study selection procedure was more stringent to increase internal validity (Box 4.1).

#### **Box 4.1: Inclusion criteria**

*Studies:* Peer reviewed, Randomised Controlled trial with delayed treatment group;  
Intervention and assessments conducted in English

*Participants:* Diagnosis of ASD; Age range of participants 6-25 years; IQ scores >70 (eg. no intellectual disability)

*Intervention:* Delivered by professionals; Replicable (eg. manualised); Multi-modal social skills training interventions (intervention not to be a sub-component of an intervention focusing on something else or combined with another type of training); Two or more participants in a treatment group

*Outcome measures:* Must include the SRS or SSRS as a social skills outcome measure.

### Meta-analysis

Following this initial selection the choice of parental outcome measure was examined. Studies that used the SRS and/or SSRS were retained for the meta-analysis (Valentine, Pigott, & Rothstein, 2010).

#### *Data Analysis*

Statistical analysis was conducted using STATA 14. The standardized mean difference (SMD) and 95% confidence interval for each outcome measure were used as a summary statistics. The post-treatment measures of the treatment and delayed control groups were compared. The SMD was interpreted as a small effect size for values of 0.20-0.50, moderate for values of 0.50-0.80, large for values of 0.80-1.30 and very large for values above 1.30 (Cohen, 1988).

The random-effects model was used as heterogeneity was suspected in the data. Heterogeneity was assessed using the Higgins heterogeneity  $I^2$  statistic in order to assess whether all studies were evaluating the same underlying effect. The degree of heterogeneity was considered low for values of

25%, moderate for values of 50% and high for values of 75% (Higgins et al., 2003). Statistically significant heterogeneity was assumed when  $p < 0.05$ .

A series of meta-regressions were planned to examine the moderating effects of intervention characteristics on outcomes. The predictors included parent involvement, teaching strategy, intervention duration and intensity.

Publication bias was assessed using funnel plots with Egger's test, and the trim and fill method (Egger, Smith, Schneider, & Minder, 1997).

### 3. Results

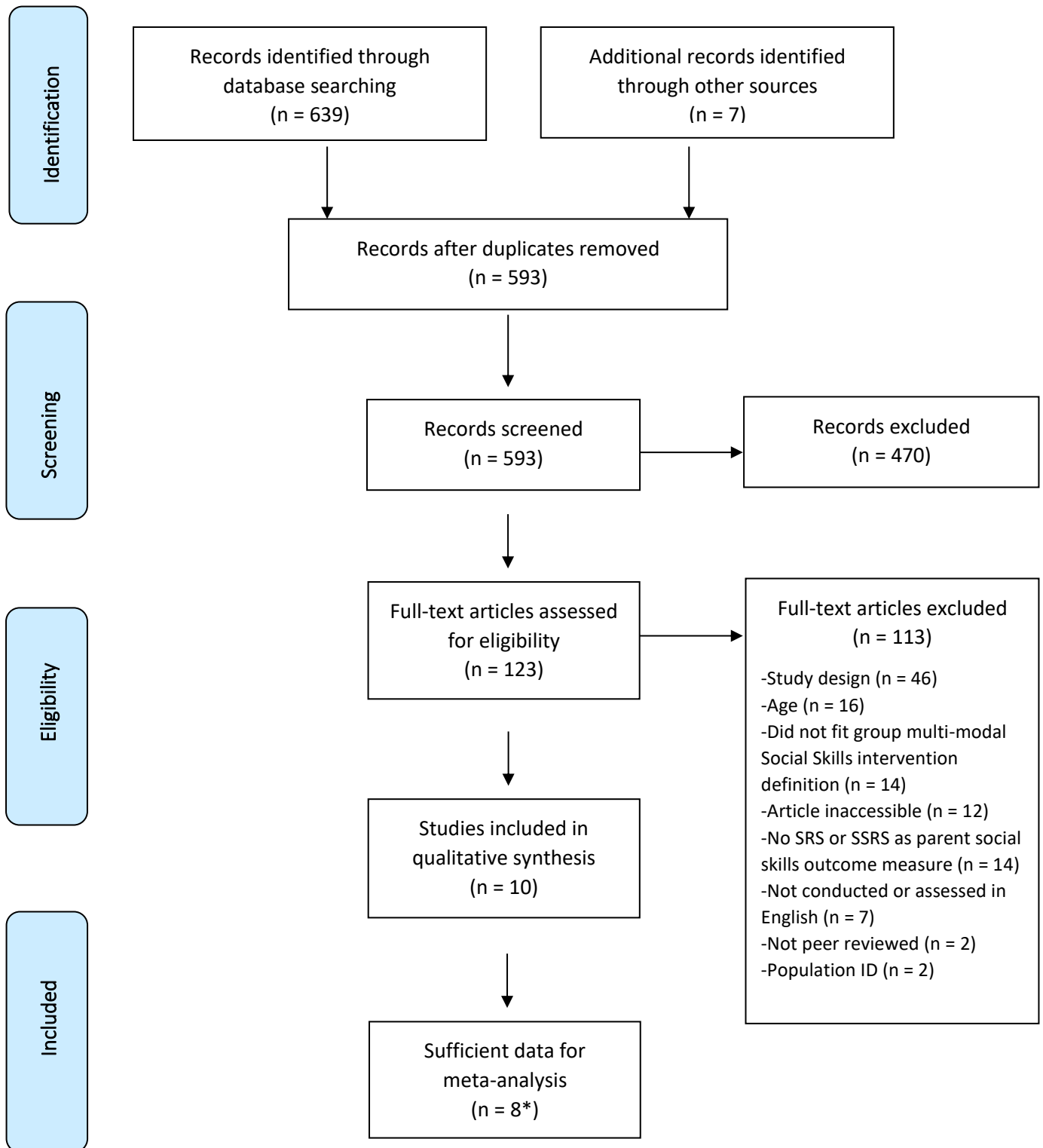
#### Study selection

##### *Systematic review*

The electronic search returned 593 articles after duplicates were removed. Additional articles were identified through correspondence with authors and by screening reference lists of review articles picked up in the initial screening search. Studies were excluded if they did not fit the inclusion criteria or did not fit this review's definition of group social skills interventions (Figure 4.1). The screening process reduced the number of eligible articles to 123 that were fully assessed for eligibility. Ten studies that met criteria for eligibility were retained for qualitative synthesis.

##### *Meta-analysis*

The use of outcome measures was assessed in the 10 studies retained for qualitative synthesis. The authors were contacted for unpublished total and subscale scores. Following this correspondence there were sufficient data to conduct meta-analyses on eight studies using the SRS and/or SSRS.



**Figure 4.1: Prisma flow diagram (studies using SRS or SSRS)**

\*Eight studies used the SRS (n=5), the SSRS (n=1) or both (n=2).

## Qualitative synthesis

### *Intervention characteristics*

Five different types of intervention programmes were used, including established protocols such as PEERS, Children's Friendship Training, summerMAX and SENSE Theatre; as well as a less-well known manualised Cognitive Behavioural Therapy (CBT) social skills programme that remain unnamed as of yet. The programmes varied by teaching strategy, parent assistance, duration and intensity. All but one of the programmes (SENSE Theatre) took a didactic teaching approach. All GSSIs ran children groups, the majority of interventions also ran parallel parent groups. The summerMAX and the SENSE Theatre programmes ran intense summer-camp style interventions where participants were required to attend 4-5 hours of training five days a week for 2 to 5 weeks. The other programmes were less intensive and ran for 60-90 minute sessions once a week for 10-16 weeks (Table 4.1).

The syllabus covered in GSSIs was also varied, each GSSI focused on teaching different domains of social competence such as social knowledge, social communication, social cognition and social emotions. All the GSSIs contained some instruction about social rules and social cues. In terms of social communication, all the GSSIs taught about the use of pragmatic language skills (e.g. literal use and understanding of language). Apart from the PEERS programme, all GSSI also focused on non-verbal skills such as eye contact, facial expression, posture and social distance. All of the GSSIs taught some cognitive social skills including problem solving, cognitive flexibility, social perception and/or perspective taking. In terms of emotional social skills, the summerMAX programme explicitly focused on self-perception (e.g. understanding one's emotions), whereas the SENSE theatre and PEERS programme focused on affect regulation (e.g. how to be a good sport, controlling emotional impulses or anxiety).

Article	Intervention	M age	N	Number of sessions	Teaching Strategy	Additional input	Parent
<b>Corbett (2016)</b>	SENSE Theatre	11.27	30	240 min/ 10 sessions	Performance	Peer assisted	- SRS - ABAS
<b>Gantman (2012)</b>	PEERS Young Adults	20.4	17	90 min/ 14 sessions	Didactic	Parent group	- SSRS - SRS - EQ - QSQ
<b>Koning (2013)</b>	Not named - manual developed	11.07	15	120 min/ 15 sessions	Didactic	Parent handout	- VABS-2 - SRS
<b>Laugeson (2009)</b>	PEERS	14.6	33	90 min/ 12 sessions	Didactic	Parent group	- SSRS - QPQ
<b>Laugeson (2015)</b>	PEERS Young Adults	21.39*	22	90 min/ 16 sessions	Didactic	Parent group	- SRS - SSRS - QSQ - EQ
<b>Lopata (2010)</b>	Adapted Skillstreaming	9.47	36	350 min/ 5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS - BASC-2-PRS - Satisfaction Survey
<b>Schohl (2014)</b>	PEERS	13.65	58	90mins/ 14 sessions	Didactic	Parent group	- QSQ - SRS - SSRS
<b>Thomeer (2012)</b>	Adapted Skillstreaming	9.31	35	350 min/ 5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS - BASC-2-PRS - Satisfaction Survey
<b>Thomeer (2016)</b>	summerMAX	9.15	57	350 min/ 5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS-2 - BASC-2-PRS - Satisfaction Survey

Waugh (2015)	SSToM CFT	9	49	SSToM: Not disclosed CFT: 60min/ 10 weekly sessions	Didactic Didactic	Parent group Parent group	- SRS-2
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**Table 4.1: Intervention characteristics and assessments**

**Outcome measures-** ABAS: Adaptive Behaviour Assessment Schedule; ASC: Adapted Skillstreaming Checklist; BASC-2-PRS: Behaviour Assessment System for Children - Parent Rating Scales, Second Edition; BASC- 2-TRS: Behaviour Assessment System for Children - Teacher Rating Scales, Second Edition; CASL: Comprehensive Assessment of Spoken Language; CASP: Child and Adolescent Social Perception measure; CGIS: Clinical Global Impressions Scale; EQ: Empathy Quotient; DANVA-2: Diagnostic Analysis of Nonverbal Accuracy2; FQS: Friendship Qualities Scale; NEPSY: Developmental Neuropsychological Assessment; QSQ: Quality of Socialisation Questionnaire; QPQ: Quality of Play Questionnaire; SCI: Social Competence Inventory; SELSA: Social and Emotional Loneliness Scale for Adults; SIAS: Social Interaction Anxiety Scale; SKA: Skillstreaming Knowledge Assessment; SRS: Social Responsiveness Scale; SSI: Social Skills Inventory; SSRS: Social Skills Rating Scale; TASSK: Test of Adolescent Social Skills Knowledge; TYASSK: Test of Young Adult Social Skills Knowledge; VABS: Vineland Adaptive Behaviour System.



*Quality assessment: Risk of bias*

A “risk of bias” analysis was conducted on all of the RCTs including the parent SRS and/or SSRS as outcome measures (Table 4.2). The risk of bias results are the same as those found in Table 3.3, but includes only 10 studies. In line with the results discussed in Chapter 3, the Waugh 2015 study was excluded from the meta-analysis as it obtained a high number of “high risk” ratings and there were baseline discrepancies in the SRS scores.

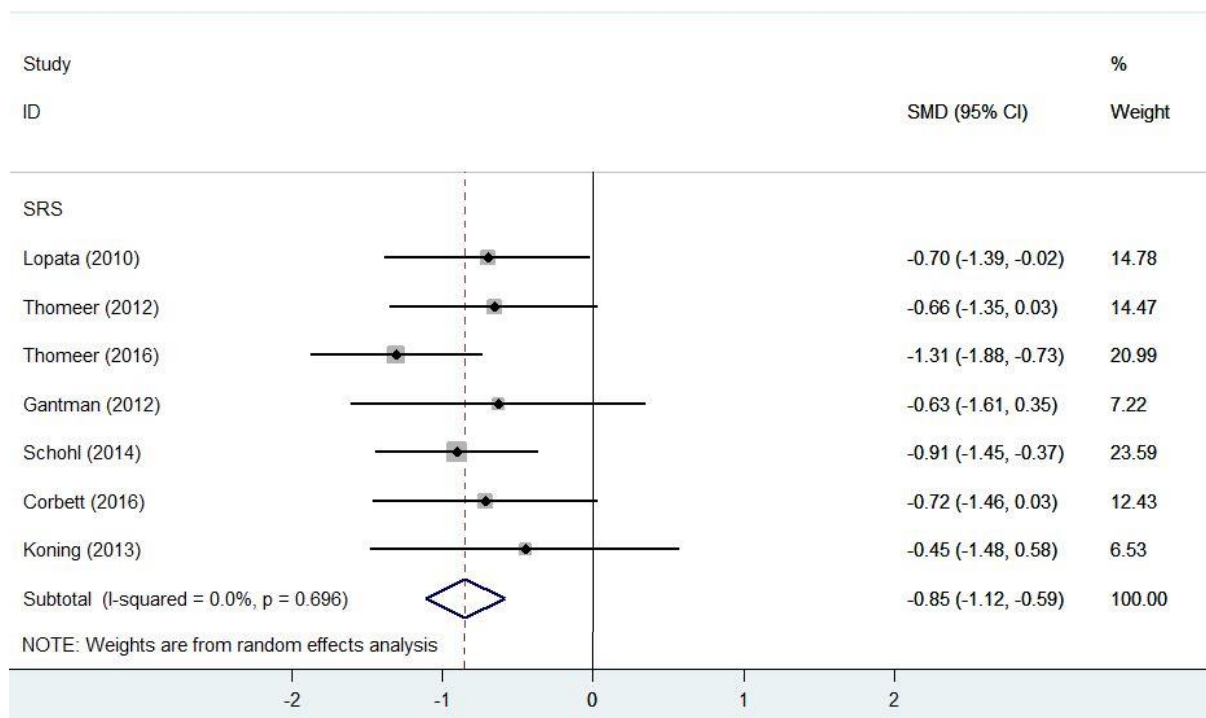
RCTS	Sequence Generation	Allocation Concealment	Baseline measurements	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective outcome reporting
Corbett (2016)	Low risk	Low risk	High risk	High risk	High risk	High risk	Low risk
Gantman (2012)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Koning (2013)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Laugeson (2009)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Laugeson (2015)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Lopata (2010)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Schohl (2014)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Thomeer (2012)	Unclear	Unclear	Unclear	High risk	High risk	Low risk	Low risk
Thomeer (2016)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Waugh (2015)	High Risk	High Risk	High risk	High risk	High risk	High risk	Low risk

**Table 4.2: Risk of bias summary**

## Meta-analysis

### *Social Responsiveness Scale (SRS)*

A comparison of the treatment group's post-interventions scores and the control group's post-intervention scores showed that participants who received a group social skills intervention obtained better outcomes than the control group, as shown by a reduction in their SRS total scores (SMD= -0.85, 95% CI [-1.12,-0.59], Z= 6.35, p=0.000; Figure 4.2; Table 4.3). This is a significant (P<0.0001) and large effect size. There were insufficient studies to conduct a meta-regression (Thompson & Higgins, 2002).



**Figure 4.2: Forest plot of SRS total scores**

Study	n		SRS	SSRS	SSRS
	Tx	WLC	Total score SMD (95% CI)	Social Skills SMD (95% CI)	Problem Behaviours SMD (95% CI)
Corbett (2016)	17	13	-0.72 (-1.46, 0.03)	-	-
Koning (2013)	7	8	-0.45 (-1.48, 0.58)	-	-
Lopata (2010)	18	17	-0.7 (-1.39, -0.02)	-	-
Thomeer (2012)	17	17	-0.66 (-1.35, 0.03)	-	-
Thomeer (2016)	28	29	-1.31 (-1.88, -0.73)	-	-
Gantman (2012)	9	8	-0.63 (-1.61, 0.35)	0.47 (-0.50, 1.44)	-0.11 (-1.06, 0.84)
Schohl (2014)	29	29	-0.91 (-1.45, -0.37)	0.45 (-0.07, 0.97)	-0.35 (-0.36, 0.17)
Laugeson (2009)	17	16	-	0.83 (0.12, 1.54)	-1.15(-1.89, -0.41)
<b>Total</b>			<b>-0.85 (-1.12, -0.59)**</b>	<b>0.56 (0.18, 0.95)*</b>	<b>-0.55 (-1.13, 0.03)</b>

**Table 4.3: Meta-analysis summary table**

\* P<0.05

\*\* P<0.0001

Tx: treatment

WLC: waitlist control

Participants who received a group social skills intervention also made greater improvements than the control group on all of the SRS subscales, as shown by a decrease in their scores (Table 4.4). The effect sizes for the social awareness (SMD= -0.57, 95% CI [-0.87,-0.28], Z= 3.78, p= 0.000), social cognition (SMD = -0.53, 95% CI [-0.98,-0.09], Z= 2.34, p= 0.019) and social motivation subscales (SMD= -0.55, 95% CI [-1.02,-0.07], Z= 2.27, p= 0.023) were moderate. The effect sizes on the social communication (SMD= -0.89, 95% CI [-1.2,-0.59], Z= 5.71, p= 0.000) and ritualised and repetitive behaviours subscales (SMD= -0.9, 95% CI [-1.23,-0.57], Z=5.4, p=0.000) were large. The effect sizes obtained on all subscales were significant (p<0.05).

SRS		n		Total Score	Social Awareness	Social Cognition	Social Communication	Social Motivation	Restricted Interests and Repetitive Behaviour
Study	Intervention	Tx	WLC	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)
<b>Corbett (2016)</b>	SENSE Theatre	17	13	-0.72 (-1.46, 0.03)	-0.26 (-0.99, 0.46)	-0.6 (-1.34, 0.14)	-0.89 (-1.65, -0.13)	-0.24 (-0.96, 0.49)	-0.49 (-1.22, 0.25)
<b>Koning (2013)</b>	CBT social skills	7	8	-0.45 (-1.48, 0.58)	-0.45 (-1.48, 0.58)	0.32 (-0.70, 1.34)	-0.53 (-1.56, 0.51)	-0.14 (-1.16, 0.87)	-0.85 (-1.91, 0.22)
<b>Lopata (2010)</b>	Summer MAX	18	17	-0.7 (-1.39, -0.02)	-0.31 (-0.98, 0.36)	-0.23 (-0.89, 0.44)	-0.76 (-1.45, -0.07)	-0.96 (-1.67, -0.26)	-0.51 (-1.19, 0.16)
<b>Thomeer (2012)</b>	Summer MAX	17	17	-0.66 (-1.35, 0.03)	-0.4 (-1.08, 0.28)	-0.43 (-1.11, 0.25)	-0.59 (-1.28, 0.10)	-0.24 (-0.91, 0.44)	-1.04 (-1.76, -0.32)
<b>Thomeer (2016)</b>	Summer MAX	28	29	-1.31 (-1.88, -0.73)	-1.1 (-1.66, -0.54)	-1.33 (-1.90, -0.75)	-1.44 (-2.03, -0.86)	-1.35 (-1.93, -0.77)	-1.42 (-2.00, -0.84)
<b>Gantman (2012)</b>	PEERS	9	8	-0.63 (-1.61, 0.35)	-0.57 (-1.55, 0.40)	-0.54 (-1.51, 0.44)	-0.6 (-1.58, 0.38)	0.02 (-0.93, 0.97)	-0.87 (-1.87, 0.13)
<b>Schohl (2014)</b>	PEERS	29	29	-0.91 (-1.45, -0.37)	-	-	-	-	-
Total		125	121	<b>-0.85</b> (-1.12, -0.59)**	<b>-0.57</b> (-0.87, -0.28)**	<b>-0.53</b> (-0.98, -0.09)*	<b>-0.89</b> (-1.2, -0.59)**	<b>-0.55</b> (-1.02, -0.07)*	<b>-0.9</b> (-1.23, -0.57)**

**Table 4.4: Meta-analysis SRS total score and subscale effect sizes**

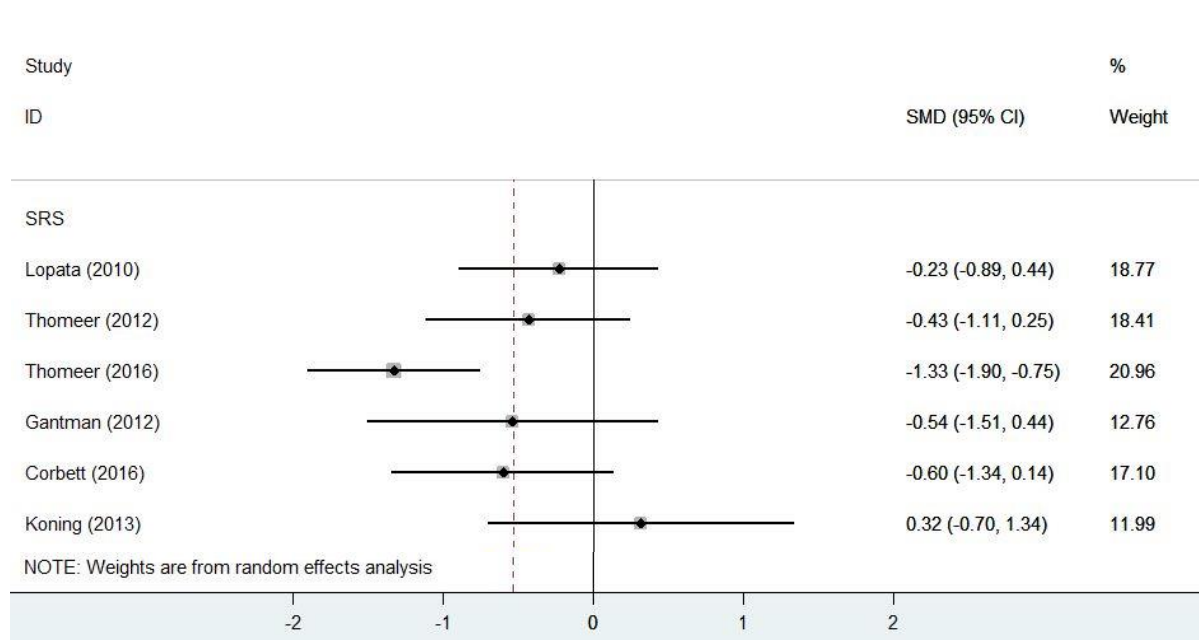
\* P<0.05

\*\* P<0.0001

Tx: treatment

WLC: waitlist control

On the cognition subscale one study's results favoured the control group rather than the treatment group (Koning 2013; Figure 4.3). In this study the control group improved more over time than the treatment group for this subscale.

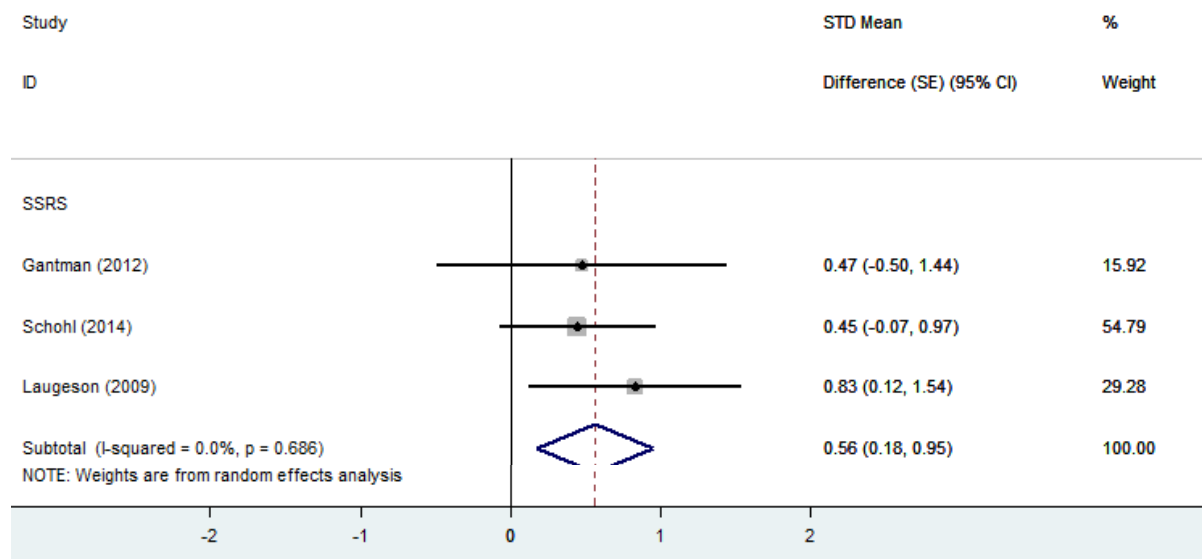


**Figure 4.3: Forest plot of SRS social cognition subscale scores**

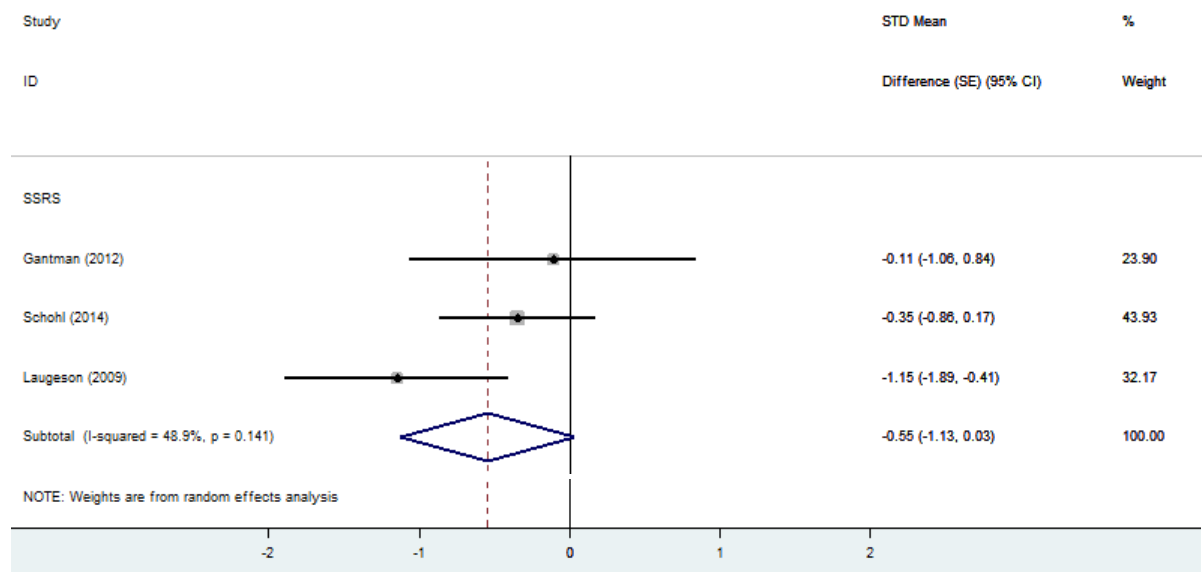
### *Social Skills Rating System (SSRS)*

A comparison of the treatment and control groups' post-intervention scores on the SSRS showed that participants who received a GSSI obtained better outcomes than the control group on the social skills subscale as seen by an increase in scores (SMD= 0.56, 95% CI [0.18,0.95], Z= 2.86, p=0.004; Figure 4.4) and better outcomes on the problem behaviours subscale as seen by a reduction in scores (SMD= -0.55, 95% CI [-1.13,0.03], Z= 1.86, p=0.06; Figure 4.4; Table 4.5). The effect size for both subscales was moderate, but only the social skills subscale effect was significant.

## Social Skills



## Problem behaviours



**Figure 4.4: Forest plot of SSRS social skills and problem behaviours subscale scores**

### *Meta-regressions*

There were insufficient studies to conduct a meta-regression on the SRS and SSRS (Thompson and Higgins, 2002).

### *Moderator analysis*

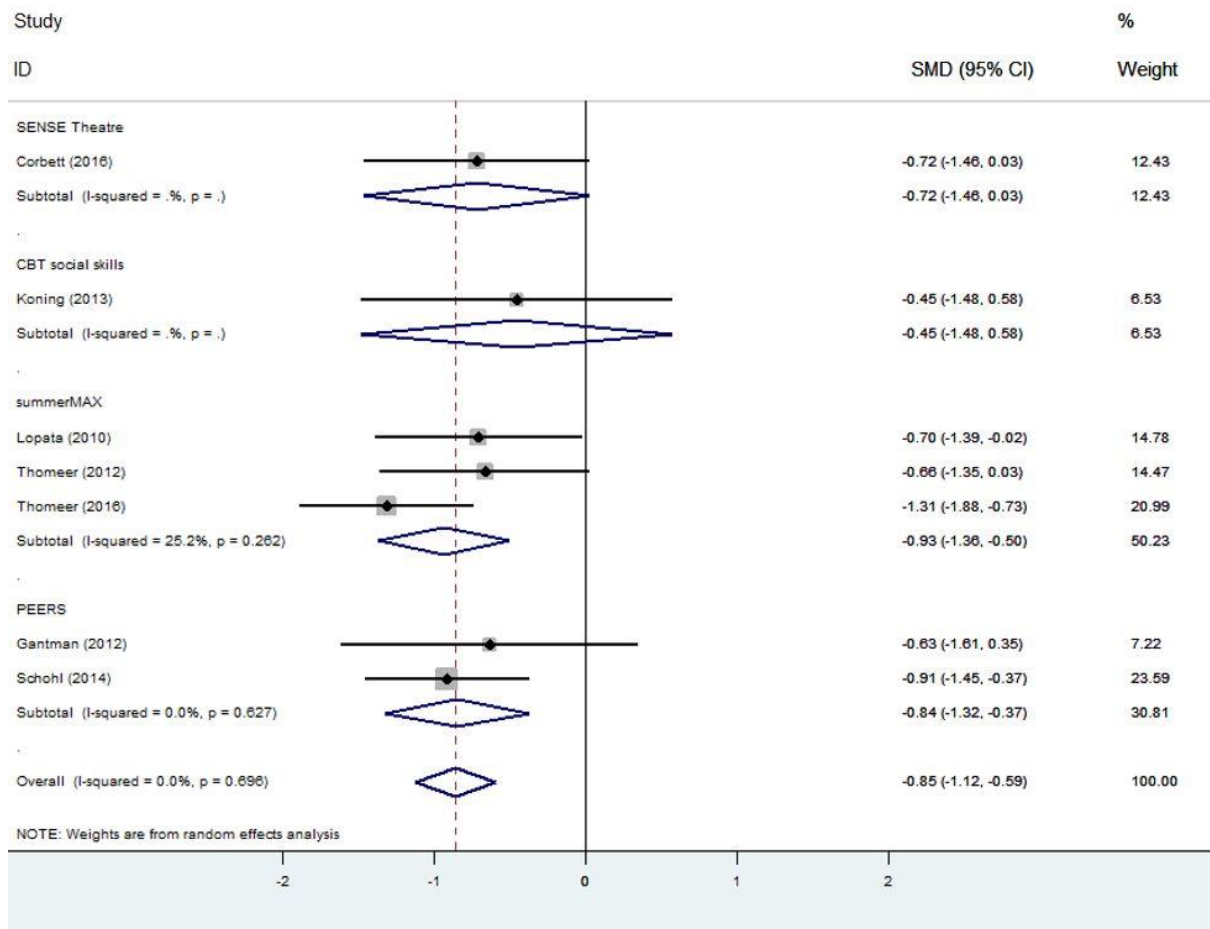
Moderator analyses were conducted on the SRS. There were insufficient studies to conduct moderator analyses on the SSRS.

### *SRS group analysis by intervention*

A post-hoc analysis analysed group differences on the total SRS scores by separating studies according to intervention type (Figure 4.5). The SENSE theatre and the CBT social skills interventions were only used in one study each. There was no statistical difference in the total SRS scores between the treatment and control groups for the SENSE theatre ( $p= 0.06$ ) and the CBT social skills intervention ( $p= 0.39$ ). SENSE theatre obtained a moderate effect size (SMD= -0.72, 95% CI [-1.46, 0.03],  $Z=1.88$ ) and the CBT intervention had a small effect size (SMD= -0.45, 95% CI [-1.48, 0.58],  $Z= 0.86$ ). SENSE theatre was the only GSSI to employ a performance teaching strategy.

The summerMax and PEERS interventions were used in three studies each. Participants receiving these interventions obtained better outcomes than controls ( $P<0.0001$ ). Both summerMAX (SMD= -0.93, 95% CI [-1.36,-0.5],  $Z= 4.22$ ) and PEERS (SMD= -0.85, 95% CI [-1.12,-0.59],  $Z= 3.49$ ) obtained large and significant effect sizes.





**Figure 4.5: Group analyses forest plot by intervention programme for the SRS total scores**

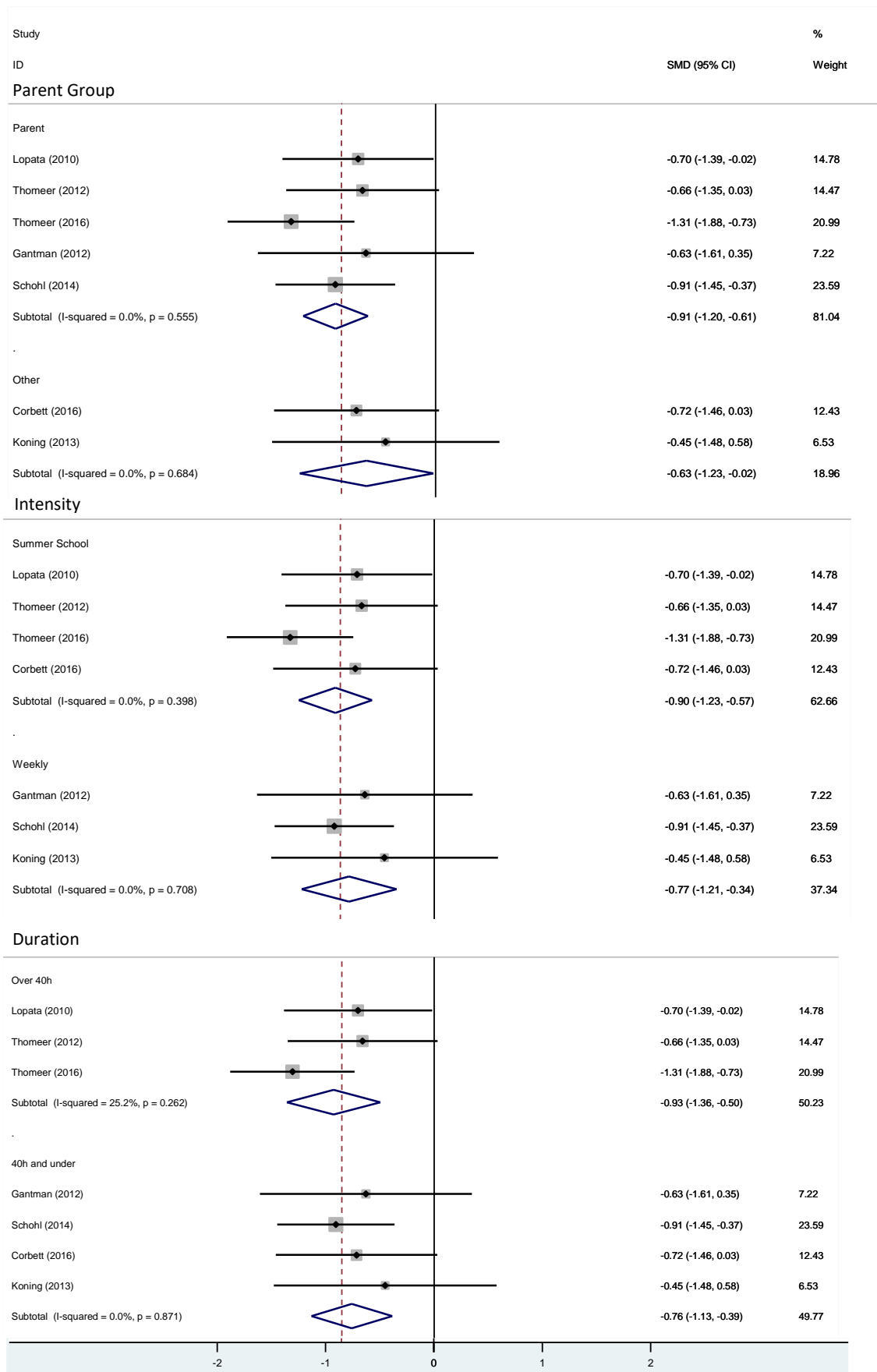
#### *SRS group analysis by parent involvement*

A group analysis was conducted on the total SRS score based on whether the interventions ran a concurrent parent group during the intervention (parental involvement yes/no). Participants performed better than controls regardless of whether they took part in an intervention that delivered concurrent parent groups, both effect sizes were significant (parent group  $p < 0.0001$ ; no parent group  $p = 0.04$ ). The GSSIs that delivered parent groups had a large effect size (SMD = -0.91, 95% CI [-1.20, -0.61],  $Z = 6.08$ ) whereas the GSSI that did not deliver parent groups had a moderate effect size (SMD = -0.63, 95% CI [-1.23, -0.02],  $Z = 2.03$ ; Figure 4.6).

### *SRS group analysis by intensity and duration*

Group analyses were conducted for the intensity and duration of GSSIs on total SRS scores (Figure 4.6). The effect sizes in both the intensity and duration group analyses were significant ( $P < 0.0001$ ). The more intensive GSSIs which took a summer camp format had a large effect size (SMD = -0.90, 95% CI [-1.23, -0.57],  $Z = 5.3$ ), whereas the GSSI taking place once a week had a moderate effect size (SMD = -0.77 moderate, 95% CI [-1.21, -0.34],  $Z = 3.35$ ).

GSSIs groups to examine the effect of duration of intervention as a co-variate were created with a median split. The GSSIs which required over 40h of contact time also had a large effect size (SMD $>40h$  = -0.93, 95% CI [-1.39, -0.02],  $Z = 4.22$ ), whereas those requiring 40h and under had a moderate effect size (SMD $<40h$  = -0.76, 95% CI [-1.13, -0.39],  $Z = 4.00$ ; Figure 4.6).



**Figure 4.6: Group analyses forest plot for parent involvement, intervention intensity and intervention duration (treatment vs. control) for the SRS total scores**

### *Heterogeneity*

Heterogeneity was assessed using the I<sup>2</sup> statistic. The heterogeneity in the data was low to moderate, ranging from 0% to 58.2%. However, results did not differ across random and fixed effect models.

### *Publication bias*

Egger's regression test and the trim and fill method showed that there was no evidence of substantial publication bias.

### *Meta-regression*

Meta-regressions were not conducted as there were too few studies to include in the analysis (Thompson and Higgins, 2002).

## 4. Discussion

There has been a dramatic increase in the number of social skills intervention trials since the early 2000s (Volkmar et al. 2004; Reichow and Volkmar 2010; Reichow et al. 2012; Kasari et al. 2012; Matson et al. 2007). The first meta-analyses of GSSI studies found the evidence for their efficacy to be limited (Schneider 1992; Beelmann et al. 1994). Many subsequent meta-analyses highlighted concerns about the methodological quality of social skills intervention trials (eg. risk of bias), and hypothesized that this may be biasing their effect size estimates (White et al. 2007; Cappadocia and Weiss 2011; Ferraioli and Harris 2011; Rao et al. 2008; Reichow and Volkmar 2010; McMahon et al. 2013). A recent increase in the number of GSSI RCTs has allowed meta-analyses to be more selective about the way they chose to combine different studies for analysis. For example, a recent meta-analysis by Reichow et al. (2012) combined studies on the basis of the domain of social skills that their outcome measures assessed (eg. social competence, social communication, emotion recognition or quality of life). They found evidence for modest improvements in social competence on parent-report measures. Another meta-analysis by Gates et al. (2017) selected trials based on the domains of social skills assessed and the informant type. They found self-reports of knowledge acquisition were associated with large effect sizes in contrast to small effect sizes for parent and observer reports of performance (both blinded and non-blinded). Non-significant effects were observed for teacher reports. They also found that the self-report effect sizes appeared to be driven by increases in social knowledge rather than improvements in social performance (Gates et al. 2017). Our meta-analysis took an approach that aimed to maximise internal validity. We combined studies, based on the domains of social

competence they assessed, by selecting those that had used the SRS (Constantino & Gruber, 2012) and SSRS (Gresham & Elliott, 1990) parent-report questionnaires. This methodology allowed us to evaluate the efficacy of GSSI in each of the domains of social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviour. We found that GSSIs were effective in improving social performance in these domains in children with social communication difficulties.

On the SRS the treatment group improved compared to the control group on the total score measure and all the subscales. It also showed that the Social Communication, and the Restricted Interests and Repetitive Behaviour subscales obtained large effect sizes, and the Social Awareness subscale obtained a moderate effect size. This suggests that the GSSI studies that used this measure had the greatest impact on social communication and restrictive and repetitive behaviours. The Social Communication scale of the SRS is intended to capture “expressive social communication [and] ‘motoric’ aspects of reciprocal social behaviour” (Constantino, 2012). The restricted interests and repetitive behaviour scale is designed to capture the “stereotypical behaviours or highly restricted interests characteristic of autism” (Constantino, 2012). The DSM-5 diagnostic criteria for an ASD (e.g. A: persistent deficits in social communication and interaction; B: restricted, repetitive patterns of behaviour, interests of activities; American Psychiatric Association [APA], 2013) map directly onto these two subscales.

The SSRS (social skills and problem behaviours subscales) obtained moderate effect sizes in the meta-analysis. The SSRS social skills subscale effect was significant, but the problem behaviours subscale effect was not. The social skills subscale was comprised of items measuring cooperation, empathy, assertion, self-control and responsibility, and the problem behaviours subscale of items measuring internalising behaviours, externalising behaviours and hyperactivity. Unfortunately, there was insufficient data to conduct additional analyses on the social skills subscale, as it would have been interesting to see which items contributed the most to change.

Despite the differences in the social skills domains taught in GSSIs, the syllabuses did overlap in some key areas, such as social communication (e.g. pragmatic language, eye contact or facial expression). Given their common focus on social communication the large effect size on the Social Communication subscale of the SRS could have been anticipated. However, improvements on the RRB subscale were unexpected, as the teaching materials of group social skills interventions do not explicitly target the reduction of these behaviours. One

hypothesis might be that the cognitive and emotional skills taught during the interventions such as cognitive flexibility, problem solving or controlling emotional impulses are mediating this change. It may be that these skills help to make the participants more confident and less anxious in social situations, which in turn reduces their restrictive and repetitive behaviours (Rodgers, Glod, Connolly, & McConachie, 2012). Alternatively, participants may gain the social knowledge through GSSIs that some of their restrictive and repetitive behaviours are socially inappropriate, and learn not to perform these behaviours in front of their peers. This is consistent with the moderate effect size obtained on the Social Awareness subscale. Evidence from previous meta-analyses lends support to this hypothesis, as they reported their largest effect sizes in self-report measures of social skills, which were found to be driven by increases in social knowledge (Gates et al., 2017).

Moderator analysis provided some insight into the impact of intervention-specific factors. Moderator analysis was only possible on the SRS. A group analysis of parent involvement in GSSI compared interventions that delivered concurrent parent groups, to those that did not. It found that GSSI delivering parent groups obtained a large effect size, whereas those that did not obtained a moderate effect size. It is not known whether the difference between a moderate and a large effect size represents a significant or clinically relevant change; however, it does suggest that parents who attend parent GSSI might be more likely to report positive changes in their child. This is consistent with positive response biases often observed in psychological interventions and reflects the parents' investment in taking part in the group social skills intervention (McMahon et al., 2013). It has been proposed that parent groups are useful in group social skills interventions to help children to consolidate the social behaviours and knowledge acquired and to help support the formation of appropriate peer networks (Laugeson, Frankel, Mogil, & Dillon, 2009). However, given the evidence, it is difficult to untangle the therapeutic effect of parent involvement, from parent expectancy biases.

When analysed by intervention programme type the meta-analysis showed that individual programmes did not all significantly change the SRS total scores. The PEERS and summerMAX programmes obtained significant and large effect sizes on the SRS total score. The SENSE Theatre and CBT social skills interventions obtained non-significant effect sizes, but were only represented with one study each. This suggests that the PEERS and summerMAX programmes have a significant impact on social behaviour, but more research is needed in order to determine which GSSI programme is the most effective.

Group analyses on the intensity and duration of GSSI also showed that the more intensive and longer interventions had slightly larger effect sizes. Although this suggests that there might be a relationship between GSSI intensity/duration and behavioural outcomes, there is no evidence to suggest that the difference in effect sizes would translate into statistically significant differences in a direct comparison. The PEERS intervention is far less demanding in terms of participant and interventionist time, therefore it may be more cost-effective choice as it is easier to implement with less resources than summerMAX.

Only one out of the six interventions using the SRS employed a performance based teaching strategy, therefore a comparison between didactic and performance based interventions was not possible.

In isolation, these group analyses are not sufficient to ascertain the strengths and weaknesses of individual intervention programmes. Future meta-analyses on larger datasets with a variety of assessment tools are needed to fulfil this aim. Additionally, even though meta-regressions were not possible due to a small number of studies ( $n < 10$ ), the effect sizes in the SRS group analyses suggest that there might be a positive relationship between parental involvement and behavioural outcomes.

Given the highly varied nature of GSSI, it is important for researchers to continue to increase the variety of informants and assessment types used in order to capture the multi-dimensional nature of social skills, and to harmonise their assessment protocols.

## 5. Conclusion

GSSI are effective in improving social performance. Unfortunately, our analysis was unable to conclusively evaluate the moderating impact of intervention-specific factors such as intervention type, parent group inclusion, method of delivery, or duration of intervention.

The increasing harmonisation of social skills outcome measures means that GSSIs can be evaluated more effectively. It may be that certain interventions are better at targeting specific domains of social competence. Detailed findings of this type are needed in order to personalise GSSI to participants' social needs.

The positive results in the meta-analysis for the PEERS intervention, as well as intervention characteristics (such as duration and intensity) support the use of the PEERS programme in the SOAR study pilot. Substantial improvements on the RRB and social communications subscales of the SRS-2 are also encouraging, as these were the areas of most difficulty in young women with TS (demonstrated in Chapter 2).

## **Chapter 5 Evaluating feasibility: Experiences of socialisation and acceptability of a social skills training intervention**

*This chapter includes some work that has been published in Child: Care, Health and Development: Wolstencroft, J., Mandy, W., & Skuse, D. (2019). Experiences of social interaction in young women with Turner syndrome: a qualitative study. Child: Care, Health and Development.*

### **1. Rationale**

In Chapters 2 and 3 we established that a high proportion of young women with TS experience social interaction difficulties. Evidence collated in Chapter 4 supports the efficacy of GSSI and provided good evidence for the efficacy of the PEERS intervention with young people with ASD.

A thorough understanding of how women with TS experience friendships and social interaction is critical to the successful implementation of social skills training. At present, the majority of the evidence for social skill deficits originates from parental-report questionnaires (Wolstencroft & Skuse, 2019) and very little is known about the social experiences and expectations of young women with TS. Therefore we conducted exploratory semi-structured interviews with young women with TS and their parents. The aim was to understand their experiences of socialisation and to assess whether a social skills intervention would be feasible and acceptable to families. This constituted the third step in the MRC complex interventions evaluation framework (Craig et al., 2008).

### **2. Social skills training for girls**

There are sex differences in the developmental trajectory of socialisation in typically developing children (Crombie, 1988). Neurotypical girls engage in cooperative and pretend play earlier than boys (Barbu, Cabanes, & Le Maner-Idrissi, 2011), and use more non-verbal skills than their male peers (Jamison & Schuttler, 2017). In adolescence, female social interaction becomes increasingly complex as they start to socialise through intimate social communication, which involves talking about their emotions and relationships, requiring complex social competencies such as reciprocal support, emotional support and problem solving (McLennan, Lord, & Schopler, 1993; Nichols, 2009; Solomon, Miller, Taylor, Hinshaw, & Carter, 2012). In contrast boys preferentially socialise with their peers through engaging in common activities (e.g. “doing things”). We do not know whether the trajectory of socialisation of young women with TS follows the same pattern as their female peers.



At present most of our knowledge about how to intervene with children with severe social skill difficulties is based on the management of boys with autism. Interventions developed for boys may need to be modified to support girls with autistic traits, in order to take into account a different range of strengths and weaknesses. Girls on the autistic spectrum without an intellectual disability are capable of social imitation, which enables them to compensate for their social differences in early- to mid- childhood (Cridland, Jones, Caputi, & Magee, 2014). But in adolescence the complexity of socialisation increases and imitation is no longer sufficient. As the socio-cognitive gap widens, young adolescent girls with autism may be more disadvantaged than boys in building relationships with same-sex peers (Cridland et al., 2014; Jamison & Schuttler, 2017; Solomon et al., 2012). They may be more liable to become the targets of relational aggression and relational conflict (e.g. gossiping and social exclusion), which they may not have the social insight to detect (Cridland et al., 2014; Sedgewick, Hill, Yates, Pickering, & Pellicano, 2016). Girls with ASD are also more socially motivated than boys with ASD, and desire friendships with neurotypical female peers (Sedgewick et al., 2016). We do not know whether the social interaction difficulties of young women with TS are comparable to those experienced by young women with a diagnosis of autism. Before piloting a social skills intervention with young women with TS it is important to understand their experiences of socialisation and whether they wish to improve their social skills.

### 3. Methods

#### Aims and objectives

Our main objective is to examine the experiences and perceptions of social interaction and friendships in young women with TS aged 16 to 25. To do so, we focused on three research aims; (1) examine the experiences of socialisation from childhood to emerging adulthood, (2) examine self-assessment of social competence, (3) ascertain the acceptability of a social skills training intervention. Prior research suggests that young people with social difficulties sometimes respond with a social desirability bias, reporting how they would like their relationships to be, rather than what they actually are (Bauminger & Kasari, 2000) or minimise their social difficulties (Suzigan et al., 2011). Therefore, to achieve these aims we conducted parental and young person interviews, and collected quantitative data on measures of social ability.

## Participants

Girls aged 16-25 with a diagnosis of TS with a range of social abilities were recruited from the Turner Syndrome Support Society or specialist Turner Syndrome clinics at University College London Hospitals as part of the SOAR Study (larger study on the mental health and social skills of young women with TS described in Chapter 2). We sought to conduct interviews with 20 young people and their parents (n=40) in order to achieve theme saturation (Sim, Saunders, Waterfield, & Kingstone, 2018).

Diagnoses of Turner Syndrome were confirmed by obtaining genetic reports or clinic letters. Hormone treatment status and occupation was recorded using a medical history questionnaire used as part of the SOAR study.

## Measures

*Interviews:* Semi-structured interviews followed the Social Competence Interview schedule (SCI; see Appendix VII). The interview schedule was designed in consultation with clinicians working with young women with TS. In line with guidelines for semi-structured interviews (Smith, 1995), the schedule was designed to be used flexibly in order to maximise the chances of collecting valid data from young people with social communication difficulties. The young person SCI schedule asks questions about friendships, bullying, group interaction and acceptability of a social skills intervention. The parent interviews were shorter, focusing on friendship history, making and keeping friends and the acceptability of conducting a social skills training intervention (Table 5.1).

*Social Responsiveness Scale 2 (SRS-2):* The SRS-2 is a measure of autistic symptomatology (Constantino & Gruber, 2012), which has convergent validity with ASD diagnostic tools such as the ADOS and ADI-R (Bölte et al., 2011). It assesses Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviour. Raw scores are converted into T-scores normed for age and sex. Total T-scores in the mild range are indicative of clinically significant deficits in reciprocal social behaviour that have a mild to moderate impact on everyday social interactions. T-scores in the moderate range are indicative of substantial deficits in everyday social interaction and typically associated with ASD of moderate severity. T-scores in the severe range are strongly associated with a clinical diagnosis of an ASD. The SRS-2 was completed by parents (Table 5.1).

*Strengths and Difficulties Questionnaire (SDQ):* The SDQ is a 25 item behavioural screening questionnaire (Goodman et al., 2010). It includes five subscales that measure emotional

symptoms, conduct problems, hyperactivity/impulsivity and inattention, peer relationship problems and prosocial behaviour. The first four scales are combined to create a total difficulties score. It has been validated for use in children aged 6-17 in UK national studies of psychological adjustment, and a new form for young people aged 18 and over has recently been developed. The SDQ was completed by parents and young people (Table 5.1).

*Social Competence with Peers Questionnaire (SCP)*: The SCP evaluates the consequences of young people’s interactions with peers, including questions about the existence and duration of friendships, as well as social invitations (Spence, 1995). A modified version of the SCP was used in order to adapt the tool for use in young adults (available from authors upon request). The SCP was administered to parents and young people (Table 5.1).

*Indices of Multiple Deprivation (IMD)*: Socio-economic status was ascertained through postcode data using the IMD (ONS, 2015). IMD scores combine information from seven domains to produce a relative measure of deprivation. The domains take into account income, employment, education, health, crime, barriers to housing and services, and the living environment. IMD scores are ranked and organised into deciles; the first decile includes the most deprived postcodes and the tenth decile includes the least deprived postcodes. IMD scores are available for England and Scotland.

Assessment	Parent	Young Person
Social Competence Interview	✓	✓
Social Responsiveness Scale 2	✓	X
Strengths and Difficulties Questionnaire	✓	✓
Social Competence with Peers Questionnaire (adapted)	✓	✓

**Table 5.1: Assessment schedule by respondent type**

#### Procedure

Psychometric questionnaires were administered to the participants online or as pen and paper forms. Interviews were conducted with the participants (parents and young people) separately over the phone, Skype for business or in person. Young person interviews lasted on average 37min (SD=17) and parent interviews lasted on average 25min (SD=14).

Audio footage was recorded and transcribed verbatim following the “alternative abbreviated instructions for transcribers” procedure outlined by Poland (2001) in the

Handbook of Interview Research. All transcripts were checked against the audio recordings by the primary author to ensure accuracy.

Ethical approval for the study was obtained through the University College London Committee and the NHS REC West London GTAC (UCL REC: 11837/001; IRAS: 219817).

### **Analysis**

Thematic analysis was conducted following the six steps outlined by Braun and Clarke (2006); (1) data familiarization, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining themes, and (6) report production. This inductive and recursive approach allows for a complex account of the data through the identification of patterns across the data set. In line with a phenomenological approach to qualitative research, analysis also included reflections on the author's epistemological stance, which is grounded in developmental psychology.

Guidelines for good qualitative research were also followed in order to increase the transparency and credibility of the analysis (Barker & Pistrang, 2005). The initial codes were generated by the student (JW) and audited by the supervisors of this study (DS & WM) who are experts in social communication in females. Once consensus around the codes was achieved, the finalised codes were organised into themes and subthemes.

ID	Age	Genetics	Occupation	HRT Age	Country	IMD Decile
1	16	Monosomy	School student	14	England	10
2	16	Complex mosaic	School student	15	England	8
3	16	Isochromosome	School student	12	England	5
4	16	Complex mosaic	School student	14	USA	-
5	16	Monosomy	School student	14	England	4
6	17	Isochromosome	School student	12	England	10
7	17	Mosaic XY	College student	14	Scotland	9
8	17	Mosaic XY	College student	11	England	2
9	17	Monosomy	College student	14	England	4
10	18	Isochromosome	College student	14	England	4
11	18	Partial deletion	College student	13	England	6
12	19	Monosomy	Unemployed	14	England	3
13	20	Monosomy	University student	14	England	9
14	20	Monosomy	University student	11 <sup>b</sup>	England	10
15	20	Mosaic	University student	16	England	3
16	20	Mosaic	Care worker	12	England	3
17	20	Isochromosome	Teaching assistant	16	England	2
18	21	Isochromosome	University student	14	England	9
19	21	Monosomy	University student	11	England	9
20	24	Monosomy	Care worker	15	England	9

**Table 5.2: Participant demographics**

HRT: Hormone replacement therapy. <sup>a</sup> Daughters did not take part in the interviews due to not feeling comfortable talking about friendships (participants 5 and 12) or due to being too socially anxious to answer the interview questions (participant 9). <sup>b</sup> Not currently on hormone replacement therapy (HRT).

IMD Decile: Indices of Multiple Deprivation 1 most deprived – 10 least deprived

## 4. Results

### Situating the sample

The majority of participants were from the UK and of white or Caucasian ethnic origin (Table 5.2). The Indices of Multiple Deprivation (IMD, where available) were evenly distributed (47% in deciles 1-5, 53% in deciles 6-10), showing that there was no socio-economic ascertainment bias. None of the participants were intellectually disabled, but three received special educational needs assistance at school. The majority of participants were attending mainstream schools, colleges or studying at university. The mean age of the sample was 18.5 years (SD=2.24). All except for one participant were on hormone replacement therapy (HRT) treatment, the average age for starting HRT was 13.5 years (SD=1.6).

### Quantitative measures

There were no significant differences between the young person self-report and parent responses on the SDQ ( $t_{(17)}=0.78$ ,  $p=0.44$ ). The parent and young person responses to the SCP were significantly different ( $t_{(17)}=-2.46$ ,  $p=0.025$ ), but they were also strongly correlated (Pearson 0.82,  $p<0.0001$ ). Young people consistently rated themselves as more socially competent than their parents did (Table 5.3).

Assessment	Parent M (SD) n=20	Young Person M (SD) n=18	P (paired t-test)
Strengths and Difficulties Questionnaire (SDQ)	11.44 (6.72)	12.5 (6.11)	0.44
Adapted Social Competence with Peers (SCP)	8.30 (3.94)	10.39 (4.72)	0.025

**Table 5.3: Comparison of parent and young person SDQ and SCP ratings**

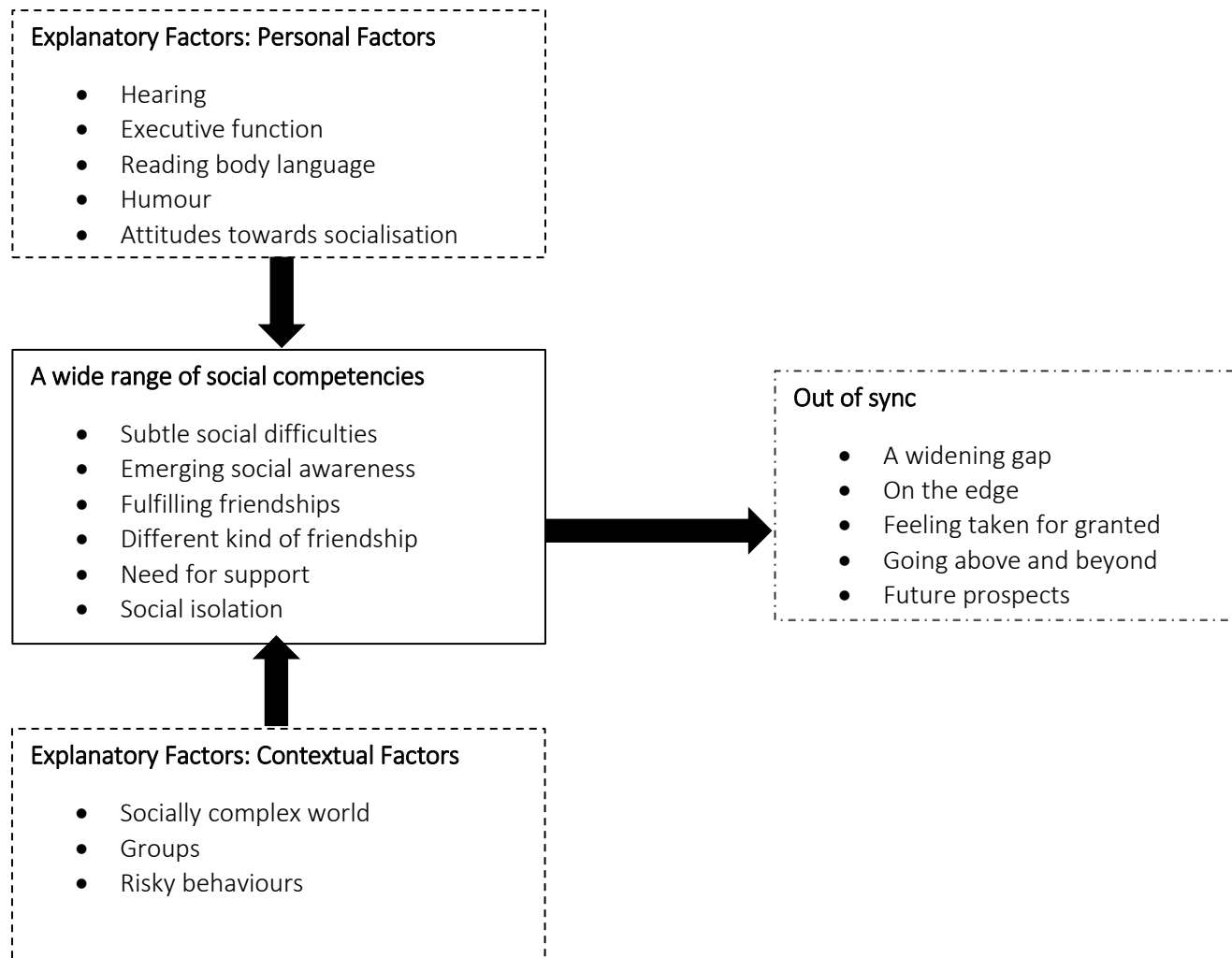
Higher scores on the SDQ indicate more difficulties, whereas higher scores on the SCP are indicative of better social competence.

A wide range of autistic symptomatology was reported on the parent SRS-2, with half of the sample scoring within the normal range, 30% within the mild to moderate range and 20% scoring within the severe range. This suggests that half of the young people experience social skills difficulties that are likely to interfere with their everyday social functioning (Table 5.4). The prevalence of autistic traits is much higher than in the normal population controls.

<b>SRS-2 Severity Ratings (n=20)</b>	<b>TD</b>	<b>TS</b>
<b>Normal</b>	84.1%	50%
<b>Mild</b>	9.2%	15%
<b>Moderate</b>	6.1%	15%
<b>Severe</b>	0.6%	20%

**Table 5.4: Parent rating of autistic symptomatology on the SRS-2 compared to population norms**

The sample's average scaled SRS-2 score was 62.9 (SD=16.29), which falls in the 'mild' range.



**Figure 5.1: Theme map**



## Qualitative interviews

Three main themes and 19 subthemes were identified (Figure 5.1). The central theme, “*A wide range of competencies*”, describes the history of socialization and current friendships. The second theme, “*Explanatory factors*”, identifies personal and contextual factors that shape the social experience. The third theme, “*Out of sync*”, describes the consequences of the social differences.

### Central theme: A wide range of competencies

#### *Subtle social difficulties*

Participants recounted diverse social experiences. Most of the young people experienced difficulties with friendships growing up, with only three families describing no or little social problems. On the whole, the young women described making and keeping friends as something that didn’t come naturally to them:

“I did find it very, very hard friendship wise and still now I still struggle a bit, I’m much better than I was, but I still struggle” – [Young Person]

“I’m still figuring out what’s socially ok and what’s not ok, because I don’t think I’m very socially skilled” – [Young Person]

For the most part the socialisation difficulties were qualified as very subtle and often felt difficult to articulate:

“She easily made friends, there’s just a slight disconnect somewhere that’s hard to put into words” - [Parent]

“I really can’t put my finger on it. I don’t know whether it’s being able to relate to others. She’s someone quite different I don’t really know what it is” - [Parent]

However, parents highlighted that even subtle social differences had a significant impact on their daughter’s daily functioning:

“All the medical things you can do your best and do tests and it is what it is. But the social skills thing: that’s the thing that really impacts on their daily life the most” – [Parent]

#### *Emerging social insight*

Some young people and their parents reported becoming aware of their social difficulties as they got older:

“She’s very much aware of it and now she is older, she tries to assess the situation a bit more” – *[Parent]*

“It’s something that’s been at the back of my mind since I was fairly young, maybe eight or nine, when I first properly started noticing it.” – *[Young Person]*

### *Fulfilling friendships*

Despite most of the interviewees describing friendship difficulties in childhood and adolescence, all those with friends affirmed that they were satisfied with their current friendships:

“I’m quite happy with the number of friends that I have because I find it a lot easier to feel more comfortable in that group size” – *[Young Person]*

For a few of the young women, lower levels of social interaction were satisfactory:

“I think I’m quite comfortable with where I am, because sometimes I’ll find it hard to talk to people for long periods of time or see people a lot and then still think of stuff to say, or still feel as comfortable. So I think that I’m happy with the situation that I have at the moment, where I can have a lot of time to myself, but still be close to them and still see them” – *[Young Person]*

However, most interviewees were keen to get involved in a social skills group if it were available to them. Some were very keen to improve their social skills:

“I’ve got a lot of people that I know and I get on with, but I would like to have close friends again.” – *[Young Person]*

“I would like more friends, but it’s just confidence.” – *[Young Person]*

### *A different kind of friendship*

Most of the young women described having friends at the time of interview. More often than not, young women who described having close friends had a close family friend that they had known all their lives or a friend with Turner Syndrome. Parents described their daughter’s close friendships with other young women with TS in very positive terms, explaining that they connected with each other in a way that they didn’t experience with their neurotypical peers:

“She’s always tried to fit herself into a hole that’s not quite the right shape, a lot of people have that without Turner’s, people have social difficulties. But because we go to the TS conference every year, I’ve noticed that she just belongs, they get on, they understand each other, there’s no edge, there’s no bitchiness” – *[Parent]*

One mum described how her daughter had established friendships with young women who themselves had social differences, and that this made the friendship more equitable:

“The other two girls are a bit different themselves, that’s probably more in the equal footing” – *[Parent]*

### *Need for support*

For those that had friends, the young women systematically described their friends as being “supportive”. The other common friendship descriptors included being kind, caring, reliable and protective:

“They’re all really supportive of me and I always feel really comfortable when I’m around them, which I think is really important for me” – *[Young Person]*

The need for support was described in terms of providing reassurance and being accommodating of differences. This suggests that young women with TS may need their friends to be more patient and accepting of their differences for the friendship to flourish:

“I still do have trouble understanding [conversations] sometimes and I really struggle to like read lips and stuff, but they [friends] sort of come to expect that every now and then.” – *[Young Person]*

“I use my different coping mechanisms to work my way around it. If I realise I have lost track of the conversation, I just take a minute to just listen and kind of re-engage the conversation, then I join back in and pick up the thread or, I’ll just go up and be like: ‘sorry I was away with the fairies then’ and ‘have I missed anything?’. You kind of put a funny spin on it or one of my friends I’m closer with will have picked up on it and then they’ll be like: ‘oh, were you even listening to that love?’ ” – *[Young Person]*

### *Social isolation*

Four parents described severe difficulties which resulted in social isolation. In two cases the social isolation occurred during adolescence but had ceased in early adulthood. In two cases the social isolation had begun in adolescence and persisted. These participants experienced severe levels of anxiety:

“She went through school with no friends if I’m honest. Nobody disliked her at all, everybody liked her, but she never ever did have a best friend or even a group of people she hung around with.” – *[Parent]*

## Secondary theme: Explanatory factors

### *Personal factors*

The young women linked their difficulties with socialisation to a number of personal factors including reading social cues and body language, understanding humour, hearing, attention and concentration, whilst their parents highlighted differences in attitudes towards socialisation:

#### *Hearing*

Those with hearing problems described that it could interfere with conversations and explained how they compensated for their difficulties:

“My hearing does go down a bit because of my surgeries. In terms of actually listening and hearing and stuff sometimes it can be difficult and it’s one of those things where you pretend that you’ve heard someone or laugh it off” – *[Young Person]*

#### *Cognitive difficulties*

Cognitive deficits in attention and processing speed were often brought up as challenges in social interaction:

“I struggle to like concentrate in conversations, so I might not always know what they’re on about and what’s going on. Sometimes I’ll zone out and then I’ll just miss bits of the conversation” – *[Young Person]*

“I don’t contribute as much cause I always want to sit back and think” – *[Young Person]*

Parents also noted processing time issues, exemplified by inappropriate interruptions of a conversation or speaking out of turn:

“She’ll be listening to conversation and she’ll want to say something and she might not come in at necessarily the appropriate point, (...) but by the time there’s a gap in the conversation, it’s moved away, but she still wants to say her bit” – *[Parent]*

#### *Reading facial expressions and body language*

Most of the young women found reading subtle facial expressions, body language and social cues difficult in people that they didn’t know well:

“There are some expressions and body language that are really easy to recognise for what it is. But it seems to be the much smaller details, like, where their eyes are going or whatever for example. I find that more difficult to recognise.” – *[Young Person]*

“I’ll probably get it wrong as judging by facial expressions. It’s hard to know when to speak, when to let others, when to give something or when to sit back. When someone else is talking it’s hard to find a balance, it’s a bit hard to figure out” – *[Young Person]*

### *Humour*

Understanding humour and sarcasm was often highlighted as a challenge:

“I wouldn’t understand their joke, I think that’s the thing with Turners sometimes, you take things very literally you don’t see sometimes they were only intending a joke” – *[Young Person]*

“If someone’s joking and they don’t show it on their face I won’t realise” – *[Young Person]*

### *Attitudes towards socialising: Initiation and flexibility*

Parents often commented on their daughter’s attitude to socialisation, suggesting they lacked the necessary social initiative to maintain friendships. Some parents linked this to low self-confidence:

“I mean, just generally, she just didn’t have very much ‘oomph’ - is the only way I can describe it - and it was really hard to parent her generally, because you’re forever trying to ‘gee’ her up” – *[Parent]*

“I don’t think she puts herself out there. She doesn’t always initiate conversations and things like that, but then I think she’s not bothered, so you know, you get fed of up of trying to prompt her” – *[Parent]*

Parents also highlighted some social inflexibility reminiscent of cognitive rigidity. A few parents recounted that their daughters declined social invitations because they weren’t interested in the activity, rather than taking part because their friends might want to:

“Friends from school who come home from Uni in the summer are doing holidays together. Some of them are going inter-railing. I said to her: ‘do you not fancy it?’ And she said ‘oh they asked me on the group, but it’s not for me’ ” – *[Parent]*

“She will go out during the day by herself. She won’t wait for people and she won’t change her plans if people won’t suddenly go, she’ll still go” – *[Parent]*

### *Contextual factors: Adolescence*

The history of socialisation varied from family to family, however there were some common difficulties concerning contextual changes such as transitions to new environments, and especially concerning developmental changes in adolescence.

### *Socially complex world*

Adolescence marks the beginning of a developmental period where the complexity of socialisation increases hugely. Some parents described noticing their daughters struggle more as the complexity of socialisation increased:

“As she’s starting to mature she’s found keeping up with that social interaction and the complexity of the conversations and different role-playing and things a little bit more difficult” – [Parent]

In adolescence peers become a more important source of support than parents. During this period parents only recounted social difficulties in interacting with peers, socialising with younger children and adults was never described as a difficulty:

“She has a really good relationship with the adults that she meets, but in terms of girls, well anyone who’s in her peer group, I think she struggles” – [Parent]

In adolescence girls start having more intimate social interactions, which include sharing secrets. Some parents also described that their daughter’s style of interacting was different to their neurotypical peers, with an emphasis on companionship rather than intimate social interaction:

“Very often they’ll both quite happily sit together and not interact, they’ll watch something or they’ll sit and both read. When she does have a friend round they might do some cooking together but they often tend to sit and either watch something together, or they’ll read a book together. There’s very little actual interaction and chat” – [Parent]

### *Groups*

In adolescence young girls start to socialise more frequently in groups. The young people described how some personal factors were amplified when socializing in groups. This could sometimes become overwhelming:

“If it’s a big group I feel like I am a bit swamped, there’s too many interactions going on. Then I’m not really sure where to look, or if someone is talking to me then I won’t be able to hear them” – [Young Person]

However, socialising in groups did also provide some advantages in regards to attention and concentration. Young people described how group situations allowed them to cover up/get away with zoning out in conversations. They also expressed some relief in not feeling that they had a responsibility to carry the conversations, which reduced anxieties around socialisation:

“(In a group) I could easily drift in and out of the conversation and not feel that all the conversation is on me, whereas if I’m just one on one with another person I need to be directly involved” – [Young Person]

### *Experimenting and risky behaviours*

During adolescence young people are more likely to experiment and engage in risk-taking behaviours. Most of the interviewees that referred to drinking alcohol said that they steered clear of it, which set them apart from their peers, and at times made them subject to peer pressure:

“I don’t not like drinking, but I don’t like to get really drunk and tipsy. People make fun of me because I’ve never been drunk” – [Young Person]

Tertiary theme: Out of sync

### *A Widening gap*

The interaction of the personal factors and the environmental changes appear to create a gap between the participants and their peers. Parents and young people noted that they started to drift away from the friends that they had formed in childhood and that their daughters appear to be more socially immature than their peers. This was attributed both to diverging interests, as well as an aversion to risk-taking behaviours and experimentation:

“It’s the friends going through a normal teenage phase that she lost. I think certain friends she hasn’t been able to keep because they’ve changed as she hasn’t. They’ve grown up with boys, alcohol and parties and she’s completely lost those friends because she’s not like them” – [Parent]

### *On the edge*

The young women that described themselves as having a few close friends often alluded to the fact that they were not part of the “popular” clique at school:

“I’ve never been the person who had lots of friends or had lots of parties, or been like in big friendship groups or anything particularly”- [Young Person]

A few young women described being part of a larger social circle, but did not think they were central to the group’s structure:

“I tend to be the one who speaks less, who’s more of the outsider in the group, so it’s obviously less important than someone who is generally the centre of attention or the one who’s bought the group together.” - [Young Person]

“I feel like I sometimes say something and if other people are talking when I say something, they don’t sometimes take as much notice” – [Young Person]

Many of the young women described splitting their time between different friendship circles and flitting between cliques at school:

“I didn’t necessarily fit in, I guess you could say a bit of a floater. I never quite found a group of people to sit in with” – [Young Person]

In most cases it was not clear whether the social flitting was something that the girls enjoyed doing, or whether it was a coping strategy to ensure they were never alone. One mum explained that her daughter flitted between different social groups in an effort to keep everyone happy:

“She just wanted everybody to be ok and some of the girl said to her eventually: ‘look, you can’t spend your break with one group and your lunch time with another just because you want to keep everybody happy. You’ve got to do what you want to do’ “– [Parent]

### *Feeling taken for granted*

The negative repercussions of “hanging-back” and little social initiation were that the young women sometimes felt taken for granted:

“With kind of being on the outside, you always feel like you’re there if you’re needed, but if you’re not needed as much it’s less important. It’s a bit complicated, it’s like you’re less important to the group dynamic maybe, than some other members” – [Young Person]

### *Going above and beyond: Vulnerable to exploitation?*

The young women and their parents often described themselves as eager to please and too nice. Some of the young women recognised that friends had on occasion taken advantage of their kindness, as the favours were not reciprocated. However, as one interviewee explained, going above and beyond for a friend was the right thing to do in a friendship, regardless of the repercussions:

“Sometimes I’m a bit too nice and I’m too willing to do things for people, but I think ‘that’s just me’. It’s not because I have to get them stuff to know that they’re my friend. If I’d have got them something, they’ll say thank you, and stuff like that, but then part of me is like; ‘was that really a thank you, or was that just because it was kind of expected because of my nature?’ So I think they probably have in ways like that taken advantage of me without me realising” – [Young Person]



Parents were often concerned about their daughter's ability to deny their friends favours and worried that people would exploit their daughter's kindness:

"She doesn't know when to say no. If for example she's decided she's going to be doing something then somebody rings up and say 'can you do this for me?' she'll say yes, and then we'll be like 'you're tired, or you got to do this', and she'll be like 'I'll do that later', then she'll put herself out for people" – [Parent]

### *Future prospects*

Some parents described that making friends had gotten easier with age:

"In her later years it was a lot easier than what it was. Since leaving last year of secondary through to college and university she's had no problems at all" – [Parent]

However, others described that finding new sources of friends in early adulthood was more difficult as they had fewer opportunities to socialise with large groups of people their age:

"At the moment she's not in education and she's not working, so obviously that's quite difficult in itself because she's not naturally going outside, she doesn't really socialise with anybody outside of the family and friends group" – [Parent]

Most of the young people were on the cusp of applying to go to university or had started a university degree. Most parents were worried for their daughter's friendships in early adulthood:

"I don't want her to be used and abused and I don't want her to struggle in the work place because people might think she operates differently. I know how hard she's trying to fit in. I suppose friendship issues will be swapped for work place issues. I just hope that she has enough friends who she feels comfortable with and she doesn't get socially isolated as she gets older" – [Parent]

Most parents and young people were interested in taking part in a social skills training programme. The main barrier impeding them from taking part would be the disruptions to family life caused by attending a weekly face-to-face group (e.g. travel time, cost, scheduling):

"I'd definitely give it a go I think it sounds like a really good idea" – [Young Person]

"If we can get to it logistically then we would definitely come" – [Parent]

Some parents suggested delivering the intervention online would be more suitable:

“Have you thought about doing interactive webinars and stuff like that? So that it’s not always just face-to-face” – [Parent]

## 5. Discussion

To our knowledge, this was the first piece of research to examine the experiences of friendship and social interaction of young women with TS in detail. It was not intended to produce generalizable facts, but rather, to yield new insights for future quantitative and qualitative research.

The thematic analysis has shown that young women with TS have a wide range of social experiences and social abilities, with some participants experiencing social isolation and others thriving socially. However, most of the young women experienced social interaction deficits that interfered with everyday life. For the most part these difficulties became more noticeable in adolescence, which is likely to be symptomatic of the sharp increase in complexity of socialisation during this developmental period.

These findings are best conceptualised using a developmental psychopathology model, which captures the complex interaction of personal-level and contextual-level factors during development (Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2015). Parents and young people identified a number of personal and contextual factors that could explain the emergence of a social difference. The personal factors included deficits in hearing, reading body language, and executive function skills such as attention and processing speed. Contextual factors included changes in complexity of socialisation, evolving group dynamics and engaging in risky behaviours. The confluence of these personal and contextual factors resulted in the widening of the socio-cognitive gap. The young people felt out of sync with their peers.

Personal factors such as height have often been causally linked to social competence deficits (Rovet & Ireland, 1994), yet it was rarely mentioned in relation to social deficits by the interviewees. Interviewees also seldom brought up physical differences due to delayed puberty. Perhaps this was not a common theme because oestrogen replacement therapy was started at a young age (13.5years) and the induction of puberty was developmentally appropriate. Those that discussed height and puberty often said it made them feel different to their peers, but neither were perceived to be causally linked to social competence.

The young women were sometimes described as having a different attitude to socialising and different interests to their neurotypical peers. During get-togethers parents noticed that their daughters tended to engage in “doing things” rather than engage in intimate social communication. Parents also identified social initiation deficits, which some linked to low self-esteem and

confidence. Previous research has suggested that shying away from social interaction may be a coping strategy for those experiencing social difficulties (Lesniak-Karpiak et al., 2003). Some parents also described personal traits that could be interpreted as cognitive inflexibility; when their daughters declined social activities that were not of interest to them, went ahead with their social plans even if their friends had dropped out (rather than re-scheduling) and were un-affected by peer pressure. Some of these reports are reminiscent of autistic traits. Regardless of the diagnostic status of young women with TS, it may be helpful for families and practitioners to adapt clinical intervention strategies from the autism field.

Participants that reported having fulfilling friendships had typically formed stable friendships with other young women with TS or longstanding family friends, rather than neurotypical peers at school. This suggests that forming friendships with other young women with TS may be a protective factor. Building self-confidence is one of the key supportive features of friendships in childhood, as it help children to develop a positive self-image (Parker et al., 2015). It may be that these relationships provide safe spaces in which the young people can practice their social skills and develop social understanding through social comparison (Berndt, 1999; Parker et al., 2015), which in turn boosts their confidence.

Socialisation became easier with age and the young people indicated that they were satisfied with a small group of close friends. But the opportunities for forming new friendships were limited for those that had left formal educational settings. This suggests that ameliorating a lack of confidence and promoting social initiation are key targets for any future social skills intervention.

For the most part, parent and young person accounts of friendships were aligned, but, there was a tendency for young people to rate their social ability as being higher than their parents did on the quantitative measure of social competence. The same pattern was present in the qualitative interviews, especially in regards to the frequency of get-togethers and the reciprocity of the friendships. The young people tended to exaggerate the frequency of their social interactions. It was the parents who indicated that they felt they needed to encourage their young person to organise get-togethers. The exaggerations were also apparent in regards to the reciprocity of relationships, where parents were concerned that their daughters were being taken advantage of.

There are a number of possible explanations for the discrepancies between young people and parent's accounts of socialisation. It could be explained by a lack of social insight. The young people may be reporting their desired rather than their actual socialisation. This has previously been reported in qualitative interviews with young people diagnosed with an ASD (Bauminger & Kasari, 2000). Alternatively, the young women could perceive the social deficits as un-problematic. This may

be due to needing less social interaction than others or it may indicate an inappropriate degree of social satisfaction.

Conversely, it may be that the discrepancies are driven by the young people's insight into their social difficulties. The young people may have answered the questions in a socially desirable (or ego-protective) way, as they are unsatisfied or uncomfortable with their current level of socialisation. Some of the young people and their parents described social insight emerging throughout childhood. In which case, the socially desirable responses are likely to be indicative of good social knowledge, which is consistent with previous research findings (Suzigan et al., 2011).

It would appear that the majority of young women with TS interviewed do not have a social knowledge deficit, as they are sufficiently aware of social norms to answer questionnaires in a socially desirable way. Personal factors such as processing speed, inattention, anxiety, reading body language, low confidence and fewer opportunities to practice social skills may however, be contributing to a social performance deficit.

Taken together this suggests that young people with TS have some insight into their social difficulties, but may underestimate the degree of their impairment. Most of the young people expressed interest in taking part in a social skills training programme and some expressed a profound desire to improve their social skills.

This research provides preliminary evidence to support the acceptability of delivering a social group. We have collected evidence in the previous chapters that the PEERS social skills programme is well evidenced and could be suitable for adolescents and young women with TS. PEERS involves weekly attending weekly face-to-face sessions. Participants expressed concerns about being able to commit to an intensive weekly face-to-face programme, and highlighted the disruption that this would cause to family life. The delivery of the programme may need to be adapted to a combined online and face-to-face delivery in order to ensure feasibility. PEERS focuses on practicing social skills and encourages attendees to seek new sources of friends locally and/to initiate social interactions (Laugeson & Frankel, 2011). The programme does not aim to be a friend-matching service for its attendees, but a skills building programme. However, it is likely that the friendships formed between those attending the programme would be an important outcome in itself.

## 6. Strengths and limitations

Our interviews were the first to give a platform for young women with TS and their parents to explore their experiences of social interaction. However, our findings are not representative of the whole TS community, as our sample is predominantly comprised of highly verbal white British

women. Efforts were made to include participants experiencing social isolation, however this was not always possible and two participants declined to take part in the interviews due to finding it too difficult a topic to discuss. Had these participants chosen to take part, it is likely that a new set of themes would have been developed, as they would have expressed a different range of experiences.

We chose to combine the analysis of the young women and their parents' transcripts, rather than analyse them separately. This approach was primarily adopted for pragmatic reasons. We aimed to avoid excessive repetitions because there was a considerable degree of overlap between the parental and self-report accounts. The advantage of combining the parent and young person interviews was that they highlighted some of the subtle, but important differences between their accounts of social interaction. In our experience many young women with TS do not have sufficient social awareness to give objective accounts of their socialisation. We wanted to provide an opportunity for them to talk about their experiences of social relationships and understand their attitudes toward meeting social challenges. Because our study also aimed to assess the feasibility of conducting a social skills intervention, our analysis needed to take into account independent information about their observed behaviour as well as their personal experiences. The parental interviews allowed for such observations to be included and offered insights into the limits of the young women's social awareness and self-insight. There were subtle discrepancies between the parental and self-reports that have important implications for clinical management. We concluded that to build an objective picture of these young women's social strengths and weaknesses it was necessary to triangulate information from the self-report with accounts provided by their parents, teachers and (ideally) from peers too.

This approach also allowed for a richer developmental perspective, as parents were able to recount how socialisation had changed during infancy to adolescence and emerging adulthood. Information from parental reports helped us to gain insights about when, during development, it would be most beneficial to intervene with social skills training. We acknowledge that a disadvantage of our approach is that it has the potential to inadvertently reduce the visibility and autonomy of the voices of young women with TS.

The interview schedule explored experiences of socialisation, but did not examine the meaning of friendship. Recent studies with children with ASD have shown that their understanding of friendship is qualitatively different to their neurotypical peers, with an emphasis on companionship rather than intimacy (Bauminger & Kasari, 2000). Future research will need to address whether the meaning of friendship is different for young women with TS. Future studies will also need to explore factors that

moderate friendship outcomes; these might include age of diagnosis, co-morbid mental health diagnoses or karyotype.

## 7. Conclusion

This study demonstrated that young women with TS experience a wide range of social interaction challenges throughout development. Young people linked their socialisation difficulties to both biological (hearing) and cognitive factors (executive functioning, reading body language), and parents highlighted some differences in interaction styles. Socialisation was often described to be the most difficult in adolescence when the complexity of social interaction increased. The young person and parent accounts of socialisation were broadly aligned, with a tendency for the young women to over-inflate their social ability. This indicated that the women had some insight into their social differences, but were not always aware of the extent of their difficulties. The willingness to improve social skills suggests that a social skills training intervention such as PEERS is acceptable. However, the mode of delivery of the intervention will need to be modified in order for families to engage with the programme, as weekly face-to-face sessions would cause too much disruption to family life.

## Chapter 6 PEERS intervention pilot and evaluation

*This chapter includes some work that has been published in F1000: Wolstencroft, J., Mandy, W., & Skuse, D. (2018). Protocol: New approaches to managing the social deficits of Turner Syndrome using the PEERS programme. F1000Research, 7.*

### 1. Rationale

At present psychosocial intervention research with children, adolescents and young women with TS is scarce; only one cognitive behavioural therapy based intervention targeting self-esteem in adults aged 18-30 has been documented in the literature (Chadwick et al., 2014). The latest TS Clinical Care Guidelines recommend that a social skills training intervention should be trialled in this population (Gravholt et al., 2017). We hypothesized that using an intervention developed for adolescents and young people with ASD would be suitable. Evidence collected in Chapters 2 and 5 support the use of the “Programme for the Education and Enrichment of Relational Skills” (PEERS; Laugeson & Frankel, 2011) intervention with young women with TS. There is good evidence for the efficacy of PEERS when delivered with children and young adults with ASD without intellectual disabilities (Gantman, Kapp, Orenski, & Laugeson, 2012; Laugeson, Frankel, Mogil, & Dillon, 2009; Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015; Schohl et al., 2014; Wolstencroft et al., 2018). Additionally, pre-pilot interviews conducted in Chapter 6 indicated that a social skills training programme would be acceptable to young women with TS and their families. This pilot project was the first to examine the feasibility and acceptability of the PEERS Protocol in young women with TS and to adapt the intervention to be delivered online.

The main objectives of the study were to (1) pilot the PEERS intervention in young women with TS and (2) assess the feasibility and acceptability of online administration to families.

We hypothesised that social skills training would improve social competence with peers and produce secondary improvements in social cognition, self-esteem and anxiety (social and generalised). We also hypothesized that online administration would be feasible and considered acceptable to families.

### 2. Methods

#### Study design

We employed an uncontrolled trial design. To maximise the clinical reliability of the trial we used a systematic multiple-case series design with case tracking. All participants were matched for age,

degree of social impairment, intellectual ability and hormone therapy treatment. The PEERS intervention manual recommends a group size of 6-10 young people.

### Study centres and recruitment

Participants were recruited from the *Social Skills and Relationships in Turner Syndrome Study (SOAR)*, which recruited children, adolescents and young women with TS from the Turner Syndrome Support Society, the NHS Great Ormond Street Hospital and the NHS University College London Hospitals. The study was approved by the West London GTAC Ethics Committee (IRAS: 219817). A subset of families from this large cohort that met the trial's inclusion criteria was invited to take part in the intervention study.

### Participant inclusion and exclusion criteria

Inclusion criteria for the intervention included (1) a confirmed diagnosis of TS (any karyotype); (2) age 16-20 years; (3) significant social skills difficulties screened for in the online questionnaires (precise criteria described in Assessments section). The exclusion criteria for the intervention included (1) severe impairments with hearing or vision (e.g. blindness or complete deafness); (2) intellectual disability (VIQ<70); (3) concurrent participation in other psychological treatment.

### Intervention

The UCLA PEERS for Adolescents is a manualised treatment programme that consists of 14 weekly face-to-face 90 min lessons (Laugeson & Frankel, 2011). The programme runs two concurrent groups, one for the young people and one for parents. Between sessions the young person group were given homework tasks, which they were to complete with the help of their parent who was trained to support them as their social coach. Parents were provided with concise handouts for each session, which include an overview of the lesson material and the homework.

In our study the young people and parents attended separate concurrent sessions led by a Certified PEERS Instructor. Research assistants (graduate psychology students) assisted with role-playing demonstrations, and provided social coaching with performance feedback during behavioural rehearsal exercises. All research assistants were trained and supervised throughout the intervention.

Based on feedback from participants the sessions were delivered both online and in person (Chapter 5). Prospective participants explained that attending a weekly session in London would be too disruptive to family life and they wouldn't have time to commit to the programme. Therefore, the first, middle and last PEERS sessions were administered face-to-face in London. All other sessions



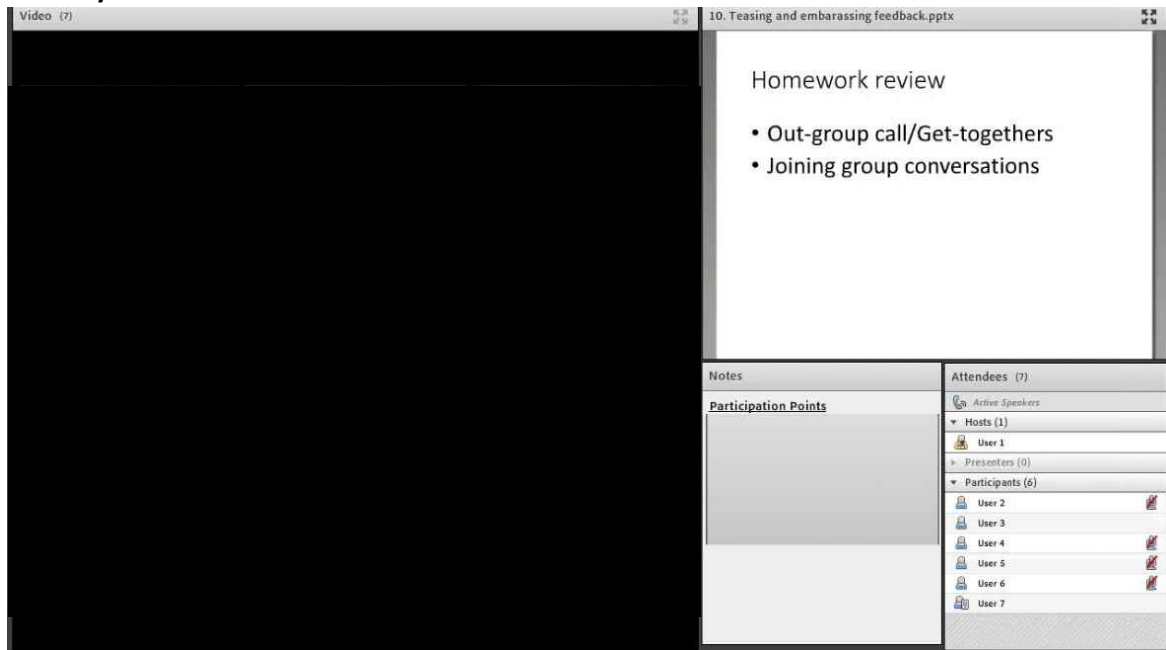
were administered using virtual meeting rooms hosted by Adobe Connect. Adobe Connect is an online video-conferencing software which allows for large group discussions in a main meeting room or concurrent small group discussions (Box 6.1).

### **Box 6.1: Adobe Connect Meeting Rooms**

The Adobe Connect meetings platform is a live online conference for multiple users. The meeting room is an online application used to conduct a meeting. Participants log in to the meeting using their phone, tablet or computer using a unique url. This process is very user friendly and participants had no difficulty joining the meeting rooms every week.

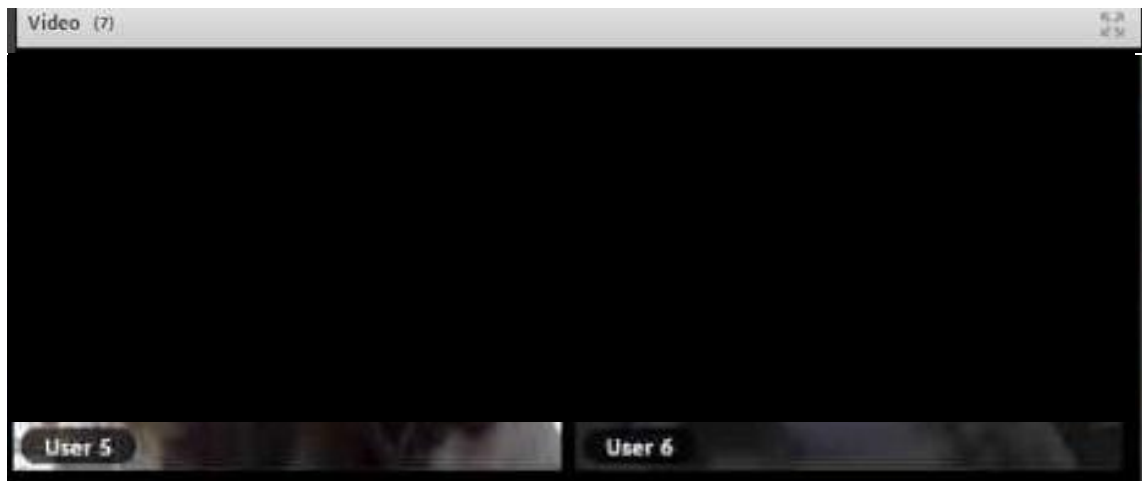
The virtual meeting room includes various display panels called “pods”. We created a custom layout with multiple video pods so that all the participants could see the presenters and the other participants. We also included a PowerPoint pod that acted as a visual aid during the presentation of the didactic lesson and a notes pod to assign participants with participation points.

#### **Pods layout:**



The meeting room allows the meeting attendees talk to each other, broadcast audio, and video, and participate in interactive online activities. During the skills rehearsal component of the session participants were assigned to “breakout rooms” where they completed their assignments with a smaller group of two or three participants.

#### **Breakout session:**



The structure and pace of the intervention was adapted in order to minimise the number of face-to-face sessions. The 14 lessons were delivered as 11 sessions over a two-month period (Table 6.1). The face-to-face sessions delivered two lessons back to back, whereas the virtual meeting sessions delivered one lesson per week.

Session	Lesson	Delivery
1	Conversational Skills I: Trading Information	Face-to-face
	Conversational Skills II: Two-Way Conversations	
2	Conversational Skills III: Electronic Communication	Virtual meeting room
3	Choosing Appropriate Friends	Virtual meeting room
4	Appropriate Use of Humour	Virtual meeting room
5	Peer Entry I: Entering a Conversation	Face-to-face
	Peer Entry II: Exiting a Conversation	
6	Get-Togethers	Virtual meeting room
7	Good Sportsmanship	Virtual meeting room
8	Rejection I: Teasing and Embarrassing Feedback	Virtual meeting room
9	Rejection II: Bullying and Bad Reputations	Virtual meeting room
10	Handling Disagreements	Virtual meeting room
11	Rumours and Gossip	Face-to-face
	Graduation and Termination	

**Table 6.1: Session schedule for intervention**

The PEERS young person group sessions are structured to provide (1) a homework review, (2) didactic lesson, (3) social skill rehearsal, (4) activity, (5) setting homework and (6) parent and young person group reunification. The parent group lessons mirror the young person lessons and provide a space for the parents to problem-solve any difficulties they may have encountered the previous week.

The virtual meeting room sessions were adapted in order to retain the core components of didactic instruction, skill rehearsal and a group activity. The main differences between the PEERS face-to-face manual and the virtual meeting room administration were (1) the absence of parent and young person reunification at the end of sessions and (2) the introduction of a new group activity. From week seven onwards the PEERS manual recommends for the group activity to involve playing games outdoors whilst practicing the newly acquired skills. It was not possible to implement these games in the online weekly sessions, therefore the young person activity was replaced with a new online game developed by the research team called the Awkward Situations game (Box 6.2).

The PEERS didactic lessons were delivered as prescribed in the manual. The lessons provided instruction on (a) conversational skills; (b) electronic forms of communication; (c) developing friendship networks and finding sources of friends; (d) appropriate use of humour; (e) peer entry strategies; (f) peer exit strategies; (g) organizing get-togethers with friends; (h) handling teasing and embarrassing feedback; and (i) resolving arguments with friends (Laugeson & Frankel, 2011).

**Box 6.2: Awkward Situations game**

The Awkward Situations game presents the group with a social dilemma and 4 multiple choice answers presented as a poll. Once the group answered the poll, they were encouraged to discuss their answers with the group. The multiple choice answers are designed so that none of the answers are wholly satisfactory, with the aim of reaching a consensus on how best to handle the situation through group discussion. The educational objectives of this game are threefold; (1) it promotes group bonding and demonstrates that everyone encounters social dilemmas; (2) it reinforces the social etiquette rules learnt throughout the programme; and (3) it encourages participants to resolve social dilemmas through discussions with their peers.

**Examples:**

**You've stopped for a chat. It's fine. You catch up, exchange pleasantries, and the conversation should be coming to its natural end, but no one knows how to end it.**

- a) Laugh and let the conversation fade/die out
- b) Say you're really sorry but you have to get to an appointment that you've just realised you're late for
- c) Try and hug the person
- d) Start to walk away as if to leave and wait for the other person to end the conversation

**You meet someone that you know you know, but you have no idea where from.**

- a) Say hello and let them ask you a question first
- b) Apologise and admit that you can't remember where it is that you know them from
- c) Ask how they are and pretend you remember them
- d) Say you're really sorry but you have to dash off then go away and think about where it is you know them from so if it happens again in the future you will know

**You go over to talk to someone and realise that they're in the middle of an in-depth conversation.**

- a) Apologise and leave immediately
- b) Nod and slowly walk away
- c) Leave without saying anything and then try and find the person later to apologise in case you intruded
- d) Stay and offer your support

## Fidelity

In order to assess treatment fidelity, each lesson was broken into four to eight individual component parts (e.g. homework review, didactic lesson, behavioural rehearsal etc.). Treatment fidelity assessment was conducted in two phases. In a first phase, the *intended* deviations were compared to the original PEERS programme using the “components” as a mean of comparison. This created a numerical score, which records how closely the pilot followed the original PEERS manual. In a second phase the *unintended* deviations from the adapted PEERS protocol were recorded using the “components”. This created a numerical score, which recorded how closely the pilot adhered to the planned adapted protocol. (Table 6.2)

This fidelity procedure was carried out by two research assistants (graduate psychology students). Their initial scores were calculated blind and disagreements were resolved at a consensus meeting.

Components	1. Didactic Lesson	2. Homework Review	3. Role Play	4. Activity	5. Behavioural Rehearsal	6. Homework Assignment	7. Reunification
<b>PEERS Manual</b>	Handling Disagreements	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations 4. Outdoor Equipment	Resolving an argument	Good sportsmanship and Outdoor activities	Resolving argument with teen group leader	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations 4. Handling Disagreements 5. Outdoor Equipment	Review rules and homework
<b>Planned</b>	Handling Disagreements	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations	Resolving an argument	Awkward Situations Game	Resolving argument with teen group leader	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations 4. Handling disagreements	N/A
<b>Actual</b>	Handling Disagreements	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations	Resolving an argument	Awkward Situations Game	Resolving argument with teen group leader	1. Get-together 2. Tease the tease 3. Handling bullying/Bad reputations 4. Handling disagreements	N/A

**Table 6.2: Young person group fidelity monitoring framework**

Alterations shown in blue.

Fidelity to original manual (e.g. planned modifications): 1 component missing and one replaced = 5/7= 71%

Pilot adherence to modified PEERS protocol (e.g. unintended modifications): All planned component delivered = 6/6 = 100%

## Assessments

Participants completed assessments at different time points throughout the study. The study lasted 8 months in total including a 3 month baseline, a 2 month of intervention and a 3 month follow up period. The screening measures were delivered at T=1, the baseline assessments were delivered at T=4, the post-intervention assessments were delivered at T=6 weeks and the last follow up measure was administered at T=9. The primary outcome measure was administered at regular intervals of 4 weeks throughout the course of the study to parents (Table 6.3). The secondary outcome measures were administered to parents, young people and their teachers' pre and post intervention.

<b>Timeline</b>		<b>Assessments</b>
<b>T=1</b>		SCP (P) 1 PEERS Screener (P,YP) SASI (YP) WAIS (YP)
<b>T=2</b>	<b>4 weeks</b>	SCP (P) 2
<b>T=3</b>	<b>8 weeks</b>	SCP (P) 3
<b>T=4</b>	<b>Baseline</b> <b>12 weeks</b>	SCP (P,YP,T) 4 SWS (P,YP,T) PEERS QSQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P,T) SDQ (P,T)
<b>T=5</b>	<b>16 weeks</b>	SCP (P) 5
<b>T=6</b>	<b>Post-intervention</b> <b>20 weeks</b>	SCP (P) 6 SWS (P,YP,T) PEERS QSQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P,T) SDQ (P,YP,T) IAQ (P,YP) SASI (YP)
<b>T=7</b>	<b>24 weeks</b>	SCP (P) 7
<b>T=8</b>	<b>28 weeks</b>	SCP (P) 8
<b>T=9</b>	<b>Follow-up</b> <b>32 weeks</b>	SCP (P,YP,T) 9

**Table 6.3: Assessment timeline**

Informants for each assessment are included in brackets (P – Parent; T – Teacher; YP – Young Person). Assessment acronyms: BAI – Beck’s Anxiety Inventory; IAQ – Intervention Acceptability Questionnaire; PEERS – Programme for Education and Enrichment of Relational Skills; PEERS QSQ – PEERS Quality of Socialisation Questionnaire; PEERS TASSK – PEERS Test of Adolescent Social Skills Knowledge; RSE – Rosenberg Self-esteem Scale; SCP – Social Competence with Peers; SDQ – Strengths and Difficulties Questionnaire; SRS – Social Responsiveness Scale; SASI - Schedules for the Assessment of Social Intelligence; SWS – Spence Social Worries Scale; WAIS-Wechsler Adult Intelligence Scale.



Based on work conducted in Chapters 2, 3 and 4, the assessment battery was designed to capture changes in social competence in areas of importance to young women with TS that are targeted by the intervention (Table 6.4).

<b>Social Competence Framework</b>		<b>TS Profile</b>	<b>Intervention</b>	<b>Assessment</b>
<b>Motivation</b>		Difficulties with social initiation and desire for social interaction	✓	- PEERS screening interview - QSQ - SRS-2 - SWS - SCP - SDQ
<b>Social knowledge</b>		Evidence of social desirability responding	✓	- TASSK
<b>Social skills</b>		Poor social skills	✓	- SCP - SRS-2 - QSQ - SDQ
<b>Personal factors</b>				
<b>Communication</b>	<b>Verbal Communication</b> <sup>a</sup>	Good verbal communication	-	-
	<b>Non-verbal communication</b>	Difficulties with understanding body language	-	- SRS-2 - SASI
	<b>Pragmatics</b>	Difficulties understanding pragmatic language	✓	- SRS-2
<b>Cognitive</b>	<b>Executive function</b>	Slow processing speed	✓	- SRS-2 - QSQ
	<b>Attentional control</b>	Some difficulties with inattention in childhood	-	- SRS-2
	<b>Social Perception</b>	Difficulties with theory of mind, face emotion perception and social attention	✓	- SRS-2 - QSQ - SWS - SASI
<b>Emotional</b>	<b>Self-perception</b>	Low self-esteem	-	- RSE - SWS
	<b>Affect</b>	Emotional difficulties in regards to anxiety and depression	✓	- BAI - SWS - SDQ

**Table 6.4: Social competence framework to develop the pilot assessment battery**

<sup>a</sup> Pre-requisite at screening VIQ>70

## Screening assessments

*Development and Wellbeing Assessment (DAWBA):* The DAWBA was used to collect information on the child's behavioural adjustment and mental health. The DAWBA has been used both in UK national and international surveys (Emerson & Hatton, 2007; Ford et al., 2003; Green et al., 2004; Heiervang et al., 2007). The DAWBA data were reviewed by a psychiatrist in accordance with the ICD-10/DSM-V diagnostic criteria. This methodology has been used successfully to gather data of high quality by parental online report. The DAWBA autism module includes a social aptitude scale (SAS), which measures social understanding and social ability (Liddle et al., 2009). Participants displaying significant difficulties in the SAS were eligible for the intervention. The DAWBA is available in 26 languages (<http://www.dawba.com/>). The DAWBA was completed online by parents.

*Strengths and Difficulties Questionnaire (SDQ):* The SDQ is a brief behavioural screening questionnaire (Goodman et al., 2010). The SDQ includes scales that measure hyperactivity-impulsivity/inattention difficulties, emotional difficulties, peer difficulties and prosocial skills. These scales are combined to create a total difficulties score. An additional impact scale measures the impact of this composite score on daily life. Participants scoring poorly on the peer relationships subscale were eligible for the intervention. It has been validated for use in children aged 4-17 in UK national studies of psychological adjustment, and a new form for 18+ years old has recently been developed ([www.sdqinfo.com](http://www.sdqinfo.com)). The SDQ was completed online by the young people, parents and teachers.

*Social Responsiveness Scale, 2 (SRS-2):* The SRS-2 measures the severity of autistic traits and the instrument has convergent validity with other ASD diagnostic tools (Constantino & Gruber, 2007, 2012). The SRS-2 subscales measure Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviour (RRB). The SRS-2 was administered online to parents and teachers.

*Health Questionnaire (HQ):* The HQ records information about physical health, health care, education, social life, physical activity and relationships (Cameron- Pimblett et al., 2017). The self-report version of the questionnaire was completed by the young people.

*Schedules for the Assessment of Social Intelligence (SASI):* The SASI is a socio-cognitive assessment that measures facial expression recognition, face recognition memory, gaze-monitoring and theory of mind. The SASI is sensitive to subtle deficits in social cognition and has been shown to have

excellent reliability and validity (Skuse, Lawrence, & Tang, 2005). Young people completed the SASI online.

*Wechsler Adult Intelligence Scale - Fourth UK Edition (WAIS-IV UK)*: The WAIS-IV is an IQ test which measures verbal comprehension, perceptual reasoning, working memory and processing speed. It has been widely used and validated (Wechsler, Coalson, & Railford, 2008). It was administered to the young people in person.

*PEERS Screener*: The PEERS Screener Questionnaire assesses the participant's willingness to take part in the PEERS intervention (Laugeson & Frankel, 2011). It was administered to parents and adolescents over the phone or in person.

*Indices of Multiple Deprivation (IMD)*: Socio-economic status was ascertained through postcode data using the IMD (Office National Statistics, 2015). IMD scores combine information from seven domains to produce a relative measure of deprivation. The domains take into account income, employment, education, health, crime, barriers to housing and services, and the living environment. IMD scores are ranked and organised into deciles; the first decile includes the most deprived postcodes and the tenth decile includes the least deprived postcodes.

### Primary outcome measures

The assessment battery was designed to measure changes in social competence, in the domains of social performance, social knowledge, social cognition, anxiety (social and generalised) and self-esteem.

*Social Competence with Peers (SCP)*: The SCP assesses the consequences of young people's interactions with peers such as the existence and duration of friendships or social invitations (Spence, 1995). A modified version of the SCP was used to adapt the tool for use in young adults (Appendix VIII). The young person group and the parent group were asked to complete the SCP at regular intervals (every 4 weeks) from baseline to follow-up. Teachers were asked to complete the SCP at baseline, post-intervention and follow-up.

### Secondary outcome Measures

*Strengths and Difficulties Questionnaire (SDQ)*: Described previously. It was administered to the young people, parents and teachers at baseline and post-intervention.

*Social Responsiveness Scale, 2 (SRS-2)*: Described previously. It was administered online to parents and teachers at baseline and post-intervention.

*Spence Social Worries Scale (SWS)*: The Spence Social Worries Scale is a psychological questionnaire designed to identify symptoms of social phobia and other forms of anxiety, in children and adolescents. The parent and teacher forms are reported to have excellent internal validity (Spence, 1995). It was administered online to the young people, parents and teachers at baseline and post-intervention.

*Schedules for the Assessment of Social Intelligence (SASI)*: Described previously. It was administered online to the young people at baseline and post-intervention.

*PEERS Test of Adolescent Social Skills Knowledge (TASSK)*: The TASSK is a questionnaire designed to evaluate what the participants have learned from the intervention (Laugeson & Frankel, 2011). This is the only outcome measure to evaluate changes in social knowledge. It was administered to the young people at baseline and post-intervention.

*PEERS Quality of Play Questionnaire (QPQ)*: The QPQ is designed to evaluate the quality of young people's socialization and frequency of get-togethers (Laugeson & Frankel, 2011). It was completed online by the parents at baseline and post-intervention.

*Rosenberg Self-esteem Scale (RSE)*: The RSE scale assesses global self-esteem (Rosenberg, 1965). It was completed online by the young people at baseline and post-intervention.

*Beck's Anxiety Inventory (BAI)*: This scale is a self-report measure used for measuring the severity of anxiety in children and adults (Beck, Steer, Ball, Ciervo, & Kabat, 1997). It was completed online by the parent and young person groups at baseline and post-intervention.

*Camouflaging measure (CAT-Q)*: The CAT-Q measures camouflaging (e.g. strategies to mask or compensate autistic characteristics) behaviour in social situations. It is comprised of 25 items and has high internal reliability in autistic adults. Its subscales measure compensation, masking and assimilation (Hull, Petride & Mandy, 2018). The CAT-Q was completed by the young people.

*Intervention Acceptability Questionnaire (IAQ)*: The Intervention Acceptability Questionnaire has been developed to assess parent and young person satisfaction with the intervention (see Appendix IX). It was completed by the parent and young person groups once the intervention had ended.

## Planned analyses

We planned to analyse the primary outcome measure (Social Competence with Peers Questionnaire; Spence, 2003) using visual analysis (Smith, 2012) and planned to conduct a one-way repeated measures ANOVA to track individual participant changes over 8 months from baseline to follow up.

The secondary outcome measures were analysed for pre-post differences using paired t-tests or non-parametric equivalents. We anticipated that we would be underpowered to detect any significant statistical differences between the pre and post intervention scores, therefore effect sizes (Cohen's *d*) would also be calculated. The parent, teacher and young person responses to the questionnaires were also be compared to investigate the consistencies between different informants.

We anticipated that the young people and their parents would report improvements. We also anticipated that the young people would report greater improvements on the social knowledge on the TASSK, than on the social performance on the SCP or SDQ (prosocial or peer scale) and social cognition on the SASI. We also expected to see secondary improvements on young person self-reports of anxiety on the BAI raw score, social anxiety on the SWS raw total score and self-esteem on the RSE raw total score. We expected to see an increase in camouflaging on the CAT-Q.

In line with previous social skills intervention research we anticipated that positive changes in social performance would be noted by the parents, but that schoolteachers would not observe a change post-intervention on the SRS-2, SDQ and SWS. Specifically we expected to see improvements in the SWS total raw score, as well as improvements on the SDQ raw prosocial scale and peer difficulties scale. We also predicted improvements on the SRS-2 social communication scale and repetitive and ritualised behaviours scale.

The acceptability of the intervention to families was assessed using the IAQ. Descriptive statistics were used to summarise the responses alongside a qualitative summary of the open text answers. We expected that most families would report having positive experiences of the PEERS programme. Based on previous randomised controlled trials we predicted that adherence would be on average 80% and that up to two participating families would dropout (Laugeson et al., 2015; Schohl et al., 2014).

### 3. Results

#### Missing data

Teachers were contacted to complete questionnaires, but none were returned. No missing data are reported for the parent assessments. One data point is missing from one young person on the SCP at follow-up (i.e. T9).

#### Participants

40 participants from the SOAR cohort were eligible for screening for the PEERS study. 19 of these were approached to take part in the PEERS intervention based on assessment completion and geographical proximity. Seven agreed to take part in the additional screening procedures and took part in the intervention. During the PEERS screening interviews seven young women and their parents expressed a strong desire to take part in the intervention. The mean age of the sample was 18.7 years ( $SD=1$ ; range 17-20). One participant had a classic TS monosomy, three had an isochromosome X, two had a partial X deletion and one had a complex variant. Most participants were of white or Caucasian ethnic origin, all were British (Table 6.5). The Indices of Multiple Deprivation (IMD) indicated a bias towards higher socio-economic statuses (2 families in deciles 1-5, 5 families in deciles 6-10). All were on hormone replacement therapy (HRT) treatment; mean age of commencement was 13.7 years ( $SD=1.5$ ). Two young women had hearing aids, no other auditory difficulties were recorded.

ID	Genetics Group	Ethnicity	IMD Decile	HRT started
1	Isochromosome	White or caucasian	10	12
2	Deletion	White or caucasian	6	13
3	Isochromosome	White or caucasian	4	14
4	Complex Variant	White or caucasian	8	15
5	Isochromosome	Mixed white and black caribbean	2	16
6	Deletion	White or caucasian	8	12
7	Monosomy	White or caucasian	8	13

**Table 6.5: Participant demographic and health characteristics**

On the DAWBA none reported having a diagnosis of autism. On the parent screening measures the young women scored in the “low” range on the DAWBA’s Social Aptitude Scale (SAS;  $M=17$ ,  $SD=4.77$ ) and in the “high” range on the SDQ’s Peer Difficulties scale ( $M=4$ ,  $SD=1$ ; Table 6.6).

ID	Social Aptitude	SDQ Peer Relationship difficulties
1	14	6
2	16	6
3	11	3
4	18	6
5	24	3
6	10	5
7	18	4
<b>M (SD)</b>	17 (4.77)	4 (1)

**Table 6.6: Social aptitude scale and SDQ peer relationships scale by parent report**

On the SRS-2 three young women scored in the normal range, two in the mild range and two in the moderate range (Table 6.7). On average the young women were rated as having the most difficulties in the domains of social motivation and restricted and repetitive behaviours.

ID	SRS T Score	Severity Band	Social Awareness	Social Cognition	Social Communication	Social Motivation	Restricted and Repetitive Behaviours
1	52	Normal	52	44	48	64	53
2	69	Moderate	59	69	67	69	66
3	65	Mild	58	65	64	59	70
4	66	Moderate	64	58	63	67	70
5	47	Normal	38	48	49	52	45
6	64	Mild	59	69	63	54	68
7	50	Normal	61	53	47	49	45
<b>M (SD)</b>	59 (8.98)	Normal	55.86 (8.66)	58 (10.1)	57.29 (8.81)	59.14 (7.78)	59.57 (11.53)

**Table 6.7: SRS parent-report scores**

No participants were intellectually disabled and all scored over 70 on the verbal subtest of the WAIS-IV (Table 6.8); five were in full time education (college or university) and two were working. The IQ profiles were unbalanced, with overall strengths in verbal comprehension and relative weaknesses in perceptual reasoning, working memory and processing speed.

ID	Verbal Comprehension	Perceptual Reasoning	Working Memory	Processing Speed	Full Scale IQ	
1	130	94	100	86	104	Average
2	136	98	100	79	106	Average
3	85	81	80	84	79	Borderline
4	112	117	89	108	110	High Average
5	120	96	71	86	96	Average
6	78	86	102	65	79	Borderline
7	143	88	100	68	102	Average
<b>M (SD)</b>	114.9 (25)	94.3 (11.7)	91.7 (12.1)	82.3 (14.2)	96.6 (12.7)	

**Table 6.8: Participant IQ scores**

#### Intervention fidelity

Fidelity to the original manual was 70.6% for the young person group and 73.1% in the parent group. Adherence to the modified PEERS protocol (i.e. 100% - planned modifications) was 98.5% in the young person group and 100% in the parent group.

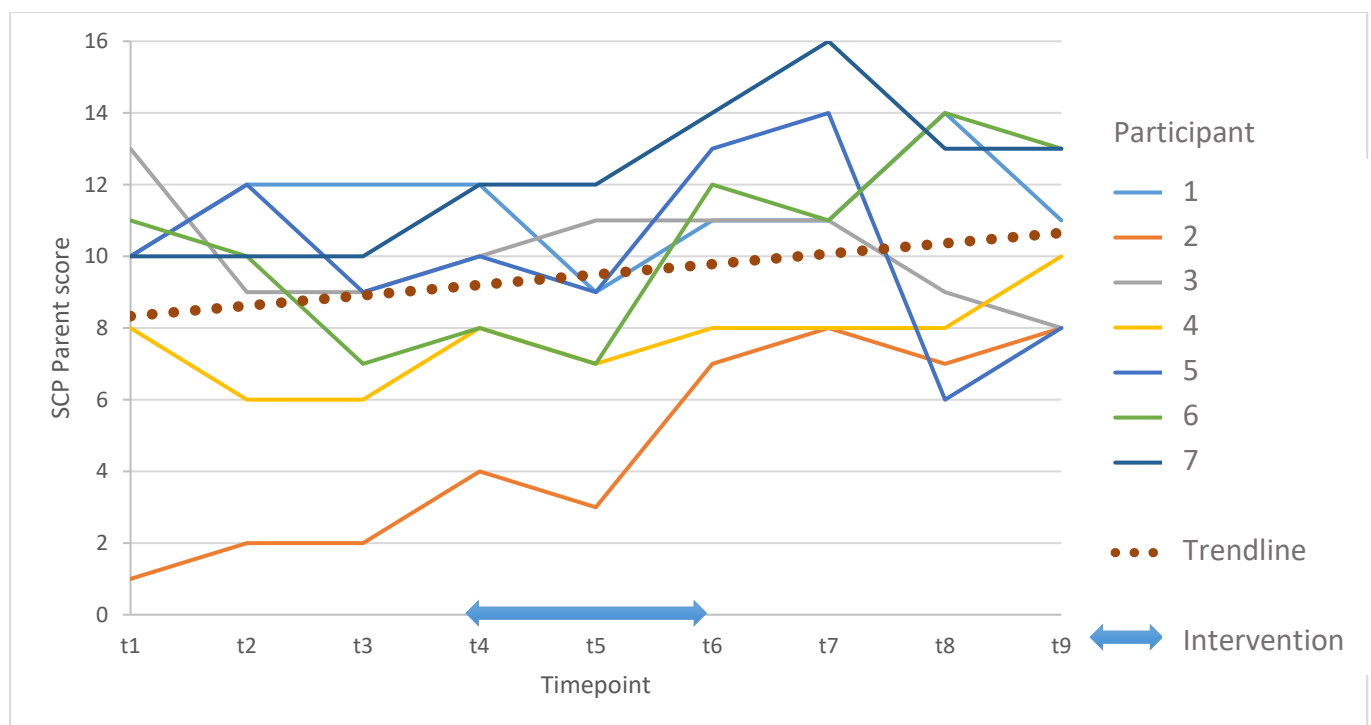
#### Intervention attendance and adherence

Attendance to the parent (85.7%) and young person (97.4%) groups were high. In the young person group participants did not miss more than one session. In the parent group individuals missed a maximum of three sessions. No participants dropped out.



### Primary outcome measure

Visual analysis of the parent report SCP scores showed an improvement in social competence from baseline to post-intervention (Figure 6.2). SCP scores during the extended baseline were stable. The largest gains were observed between T5 and T7, which is equivalent to 4 weeks into the intervention and 4 weeks after intervention. For most participants gains in social competence were maintained during the 3 month follow up period.



**Figure 6.2: Graph of parent SCP scores from baseline to follow up**

A one-way repeated measures ANOVA was conducted on the parent SCP scores. Mauchly's test indicated the assumption of sphericity had been violated ( $\chi^2(35)=0$ ,  $p=0$ ), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ( $\epsilon=0.38$ ). The main effect of time on SCP scores did not reach significance ( $F(3,18)=2.72$ ,  $p=0.075$ ).

Exploratory paired samples t-test between the pre and post-intervention parent SCP scores (T4 vs T6) revealed a significant improvement in social competence ( $t(6)=-2.52$ ,  $p=0.045$ ), with a medium effect size ( $\delta=0.64$ ; Table 6.9). An exploratory paired samples t-test between the young person SCP pre and post intervention scores was non-significant with a small effect size ( $t(6)=-1.45$ ,  $p=0.2$ ,  $\delta=0.27$ ). These exploratory analyses must be interpreted with caution, as the level of significance has not been corrected for multiple comparisons.

Social Competence with Peers	Pre		Post		t	p	d
	M	SD	M	SD			
Young person (10 items)	12.29	3.73	13.29	3.55	-1.45	0.2	0.27*
Parent (8 items)	9.14	2.79	10.86	2.54	-2.52	0.045	0.64**

**Table 6.9: Parent and young person pre/post intervention SCP scores**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size

Higher scores are indicative of better social competence

A one sample t-test between the parent rated post-intervention score (T6) and the average for typically developing children norms (M=14.82, SD=3.12) was significant ( $t(6)=-4.12$ ,  $p=0.006$ , Table 6.10). This suggests that although social competence improved, the young people remained less competent than their typically developing peers.

However, a one sample t-test between the young person post-intervention score (T6) and the average for typically developing children self-reporting (M=15.53, SD=3.17) was not significant ( $t(6)=-1.68$ ,  $p=0.15$ , Table 6.10). This suggests that the young people perceived themselves to be as socially competent as their peers.

Timeline		Parent SCP M (SD)	Young Person SCP M (SD)
Baseline	T1	9.00 (3.83)	-
	T2	8.71 (3.59)	-
	T3	7.86 (3.24)	-
Intervention	T4	9.14 (2.8)	13.33 (2.73)
	T5	8.29 (2.98)	-
	T6	10.86 (2.55)	14.5 (1.64)
Follow up	T7	11.29 (2.93)	-
	T8	10.14 (3.44)	-
	T9	10.14 (2.27)	15.67 (1.86)

**Table 6.10: SCP parent and young person scores from baseline to follow up**

Note: SCP parent and young person scores cannot be directly compared as they contain a different number of questions.

### Secondary outcome measures

Due to the small sample size and non-normally distributed data Wilcoxon signed rank tests were conducted on the secondary outcome measures. To account for multiple comparisons Bonferroni corrections were applied to the level of significance. After multiple corrections some effects will not remain significant, therefore effect sizes will be referred to for an indication of a genuine effect.

### *Social knowledge*

The young people answered significantly more questions correctly on the TASSK questionnaire of social knowledge after the intervention. The effect size was very large ( $Z=-2.36$ ,  $p=0.02$ ,  $d=4.2$ , Table 6.11).

Assessment	Pre		Post		Z	p	d
	Median	IQR	Median	IQR			
Test of adolescent social skills knowledge	14	7	25	3	-2.36	0.02	4.2***

**Table 6.11: Young person reported pre/post changes on social knowledge**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size

### *Social performance*

Social performance was assessed using the strengths and difficulties questionnaire (SDQ) peer difficulties scale, the quality of socialisation questionnaire (QSQ), the social responsiveness scale (SRS-2) and the social camouflaging measure (CAT-Q).

#### *Strengths and Difficulties Questionnaire (SDQ) and Quality of Socialisation Questionnaire (QSQ):*

After corrections for multiple testing there were no significant differences in pre/post measures as rated by the young people or their parents on the SDQ or the QSQ (Table 6.12). The QSQ results suggest that both parents and young people reported an increased level of social performance in regards to organising and being invited to get-togethers. However, there were differences in the patterns of response by informant on the SDQ. Parents reported improvements on the SDQ peer problems subscale scale with a large effect size. This is equivalent to scoring in the “high” range prior to intervention, and in the “slightly raised” range after intervention compared to female population norms. However, the young people did not report any changes on the SDQ peer problems scale. Compared to population norms the young people rated themselves in the “slightly raised” range before and after intervention (Table 6.12).

Assessment	Parent							Young Person						
	Pre		Post		Wilcoxon Signed Rank		Cohen's d	Pre		Post		Wilcoxon Signed Rank		Cohen's d
	Median	IQR	Median	IQR	z	p		Median	IQR	Median	IQR	z	p	
<b>SDQ</b>														
Total difficulties score	8	13	8	8	-1.55	0.12	0.46**	8	16	9	12	-2.23	0.03	0.3*
Emotional problems	2	3	3	2	-0.45	0.66	0.07	2	7	3	4	-1	0.32	0.26*
Conduct problems	0	2	0	1	-1	0.32	0.16	1	2	1	4	-1.3	0.26	0.39*
Hyperactivity/impulsivity & inattention problems	3	7	2	5	-2.06	0.04	0.57**	3	6	3	6	-1.86	0.06	0.29*
Peer problems	4	3	3	1	-1.29	0.2	0.72***	3	2	3	3	-0.45	0.66	0.09
Prosocial ability	9	3	9	2	-0.41	0.68	0.39*	8	1	8	2	0.00	1	0
<b>QSQ</b>														
Organised get-togethers	1	2	3	3	-2.06	0.04	0.75***	2	3	2	1	-0.86	0.39	0.35*
Invited get-togethers	2	2	2	2	-1.41	0.16	0.51**	1	2	1	2	-0.38	0.71	0.51**

**Table 6.12: Parent and young person pre/post SDQ and QSQ scores**

Significance level adjusted for multiple comparisons (Bonferroni alpha = 0.05/16 = 0.003).

Low scores are indicative of less autistic symptomatology.

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size.

*Social Responsiveness Scale-2 (SRS-2)*: Parent ratings of the SRS-2 total score showed significant reductions in autistic behaviours after the intervention ( $z=0.46$ ,  $p=0.03$ , Table 6.13). Post-hoc comparisons were conducted on the SRS-2 subscales, none of which reached significance after corrections for multiple comparisons. However, small to medium effect sizes were observed on all the subscales ( $\delta=0.30-0.61$ ). The largest effect sizes were obtained on the social awareness ( $\delta=0.61$ ) and social motivation subscales ( $\delta =0.51$ ).

SRS-2 T Score	Pre		Post		Z	p	Effect size
	Median	IQR	Median	IQR			
<b>Total score</b>	64	16	55	14	0.46	0.03	0.46**
<b>- Awareness</b>	59	9	49	4	0.61	0.2	0.61**
<b>- Cognition</b>	58	21	53	21	0.30	0.04	0.30*
<b>- Motivation</b>	59	15	56	8	0.51	0.03	0.51**
<b>- Communication</b>	63	16	56	12	0.36	0.09	0.36*
<b>- RRB</b>	66	25	58	14	0.33	0.15	0.33*

**Table 6.13: SRS-2 parent report pre/post scores**

Low scores are indicative of less autistic symptomatology.

Significance level adjusted for multiple comparisons (Bonferroni alpha =  $0.05/5 = 0.01$ ).

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size.

*Camouflaging Index (CAT-Q)*: The camouflaging index ratings showed a small, but non-significant increase in social camouflaging behaviours (Table 6.14). Unfortunately, norms for the CAT-Q have not yet been published.

Assessment	Pre		Post		Z	p	d
	Median	IQR	Median	IQR			
<b>Camouflaging traits</b>	93	14	92	16	-0.34	0.74	0.29*

**Table 6.14: Young person report pre/post camouflaging traits**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size.

### *Anxiety, social anxiety and self-esteem*

Changes in anxiety (generalised and social) and self-esteem were measured using the Beck's Anxiety Inventory (BAI), Social Worries Scale (SWS) and Rosenberg Self-Esteem (RSE) respectively.

*Beck's Anxiety Inventory (BAI)*: The young people rated themselves as being more anxious after the intervention on the Beck's anxiety inventory (BAI), but this difference did not reach significance and obtained a small effect size. The variability between anxiety rating within the group was high pre and post-intervention (IQR=8-12, Table 6.15) but both the pre and post scores were in the "low anxiety" range (Beck, Epstein, Brown, & Steer, 1988).

*Social Worries Scale (SWS)*: Parents and young people did not report changes in social anxiety on the SWS after intervention. The parent SWS rating pre and post-intervention scores are marginally higher than population norms ( $M_{(TS\ pre)}=7.43$  vs.  $M_{(norm)}=6.42$ ; one-sample t-test pre-intervention:  $t(6)=-0.2$ ,  $p=0.56$ ,  $\delta=0.19$ ), but the young people self-rating are in line with population norms ( $M_{(TS\ pre)}=8$  vs.  $M_{(norm)}=8.44$ ; one-sample t-test:  $t(6)=0.62$ ,  $p=0.84$ ,  $\delta=0.08$ ).

*Rosenberg Self-Esteem (RSE)*: The self-esteem rating remained unchanged after the intervention (Table 6.15). The young people's self-esteem scores were similar to those expected of their age-matched peers ( $M_{(norm)}=17$  vs  $M_{(TS)}=19.67$ ) (Sinclair et al., 2010).

Assessment	Pre		Post		Z	p	d
	Median	IQR	Median	IQR			
Rosenberg self-esteem	19	8	19	6	0	1	0.04
Beck anxiety inventory	7	8	11	12	-1.98	0.05	0.32*

**Table 6.15: Young person report pre/post anxiety and self esteem**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size.

### Social cognition

The Schedules of Assessment of Social Intelligence (SASI) assessed three socio-cognitive skills; facial emotion recognition, eye-gaze and face recognition memory.

*Emotion recognition:* Young people identified more emotions correctly on the emotion recognition measure of the SASI after the intervention, obtaining a large effect size on the total score ( $\delta=0.81$ ). In regards to changes in individual emotion recognition accuracy, there were improvements in the correct identification of disgust ( $\delta=0.95$ ; large effect size), sad ( $\delta=0.72$ ; large effect size) and surprised faces ( $\delta=0.42$ ; medium effect size) after intervention. The variability of the responses to fearful faces increased after the intervention ( $IQR_{(pre)}=30$ ,  $IQR_{(post)}=60$ ). The young people were also faster at identifying all of the emotions after intervention. All of the response times obtained medium to large effect sizes (Table 6.16).

SASI emotion recognition	Pre		Post		Z	p	Effect size Cohen's d
	Median	IQR	Median	IQR			
<b>Correct responses in %</b>							
Happy	100	0	100	0	-1	0.32	0.27*
Sad	80	20	90	20	-1.36	0.18	0.72**
Angry	80	30	90	10	-0.43	0.67	0.36*
Fear	50	30	70	60	-0.68	0.5	0.14
Surprise	100	10	100	20	-1.09	0.28	0.45*
Disgust	40	40	70	10	-1.51	0.13	0.95***
TOTAL	78.33	7	81.67	8	-1.89	0.6	0.81***
<b>Response time in s</b>							
Happy	4.13	10	2.9	1	-2.03	0.04	0.94***
Sad	6.85	4	4.45	3	-2.03	0.04	1.3***
Angry	6.17	1	4.25	2	-2.03	0.04	1.22***
Fear	6.47	2	4.51	3	-2.2	0.03	1.03***
Surprise	4.1	2	2.95	1	-1.52	0.13	0.64**
Disgust	4.51	7	3.3	1	-2.37	0.02	0.56*
Average response time	5.66	3	3.71	1	-1.183	0.24	0.74***

**Table 6.16: SASI social cognition pre/post intervention scores**

Significance level adjusted for multiple comparisons (Bonferroni  $\alpha = 0.05/14 = 0.003$ )

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size



Compared to age and sex matched peers our TS sample performed below average on the emotion recognition task for all emotions except surprise at baseline ( $z=0.42$ ). After the intervention, the only scores that remained below average were for the fear and disgust emotions (Table 6.17).

<i>SASI emotion recognition (Z scores)</i>	<i>Pre</i>		<i>Post</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<b>Happy</b>	-0.10	0.63	0.14	0.01
<b>Sad</b>	-0.18	1.14	0.50	0.74
<b>Angry</b>	-0.28	1.14	0.05	0.86
<b>Fear</b>	-0.82	1.14	-0.90	1.40
<b>Surprise</b>	0.42	0.49	0.17	0.94
<b>Disgust</b>	-1.66	0.81	-1.00	0.53

**Table 6.17: SASI emotion recognition z scores**

*Eye gaze:* On the eye gaze task there was a small improvement between the pre and post scores with a small effect size ( $\delta=0.23$ ). Young people got more answers right when the eye gaze and head direction were congruent than when they were incongruent (72% vs. 42%; Box 6.3). Response times on the eye gaze task were faster after intervention on the congruent and incongruent trials (Table 6.18). Z scores for the eye gaze response task showed that performance remained below average pre and post intervention ( $z_{(pre)}=-1.01$ ,  $z_{(post)}=-0.67$ , Table 6.18).

**Box 6.3: Congruent and incongruent faces**



**Incongruent head direction and eye gaze:**  
Head turned right, eye gaze looking left



**Congruent head direction and eye gaze:**  
Head turned right, eye gaze looking right

<b>Correct eye gaze responses in %</b>	<b>Pre</b>		<b>Post</b>		<b>Z</b>	<b>p</b>	<b>Effect size Cohen's d</b>
	<b>Median</b>	<b>IQR</b>	<b>Median</b>	<b>IQR</b>			
Correct eye gaze responses	53.33	13	56.67	17	-0.42	0.67	0.23*
Correct when head direction and eye gaze congruent	72.73	18	72.73	18	-1.19	0.24	0.68**
Correct when head and eye direction incongruent	42.11	16	42.11	21	0	1	0.04

<b>Response time in s</b>	<b>Pre</b>		<b>Post</b>		<b>Z</b>	<b>p</b>	<b>Effect size Cohen's d</b>
	<b>Median</b>	<b>IQR</b>	<b>Median</b>	<b>IQR</b>			
Total response time	3.34	2	3.06	1	-1.18	0.24	0.73**
Congruent response time	3.29	1	2.77	1	-1.859	0.06	0.78**
Incongruent response time	3.36	1	3.67	1	-1.014	0.31	0.6**

<b>Eye Gaze Z scores</b>	<b>Pre</b>		<b>Post</b>	
	<b>M</b>	<b>SD</b>	<b>M</b>	<b>SD</b>
<b>Correct eye gaze responses</b>	-1.01	0.81	-0.67	1.51

**Table 6.18: SASI eye gaze pre/post intervention scores and normed z-scores**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size

*Face memory:* On the face memory task young people remembered more faces correctly with a large effect size ( $\delta=0.82$ ). The young people also responded faster after the intervention (Table 6.19).

<b>SASI face memory</b>	<b>Pre</b>		<b>Post</b>		<b>Z</b>	<b>p</b>	<b>Effect size Cohen's d</b>
	<b>Median</b>	<b>IQR</b>	<b>Median</b>	<b>IQR</b>			
Correct responses (%)	76	12	86	16	-1.78	0.06	0.82***
Response Time (s)	3.62	3	3.22	2	-0.51	0.61	0.54**

**Table 6.19: SASI social cognition pre/post intervention scores**

\*\*\*Large effect size, \*\*Medium effect size, \*Small effect size

#### Intervention Acceptability IAQ

The intervention was rated as acceptable to participants. 100% of participants rated taking part in the group as “very helpful” and 93% thought their daughters’ social ability had improved (Table 6.20).

<b>Intervention acceptability questionnaire answers</b>	
<b>Parent</b>	
How would you compare your daughter's social ability prior to PEERS with her social ability now	Improved 100%
For your daughter, this intervention was:	Very helpful 100%
The parent training group was:	Very helpful 100%
Overall, how would you rate the PEERS group that your daughter attended?	Very helpful 100%
Would you recommend taking part in the PEERS programme to other families?	Definitely 100%
<b>Young People</b>	
How would you rate the PEERS group overall?	Very helpful 100%
Do you feel that the PEERS group helped you improve your social skills?	A lot 85%
Has taking part in the PEERS programme made you feel more confident in social situations?	A lot 71% A little 29%
Has taking part in the PEERS programme made you feel less anxious about social situations?	A lot 43% A little 57%
Did you enjoy taking part in the PEERS programme?	A lot 100%
Would you recommend taking part in the PEERS programme to a friend?	A lot 71% A little 29%
Do you feel like you have changed since taking part in the PEERS programme?	Definitely 43% Possibly 57%

**Table 6.20: Intervention acceptability questionnaire (IAQ) answers**

The qualitative comments highlighted the acceptability of the intervention to families. Participants were very positive about the combined online and offline format (Box 6.4, Appendix X). Young people and their parents described improvements in confidence, social motivation and gains in social knowledge (especially in regards to entering and exiting conversations; Appendix X). Many participants felt that they had created a support network through the group, explaining that they felt reassured by meeting other people who faced the same social difficulties.

**Box 6.4: Feedback on PEERS online/offline delivery**

**Please tell us what you thought of the online meeting rooms:**

“The breakaway sessions were good to exchange thoughts and ideas.”

“I liked them. Found them relatively easy to use.”

“The online meeting rooms worked really well, especially with everyone's busy schedules. I'm not sure I would have been able to take part if we had to go to London every week.”

“Really interesting, I think it's a good way of connecting people without worrying about a location or transport. They were especially useful during the week where you're busier.”

“I think this was a good method of communication because we all live in different parts of the country.”

**Please tell us what you thought of the face-to-face sessions:**

“Found the face to face more useful but obviously the practicality of travelling difficult.”

“It was nice to meet other girls who also have TS for the first time who also found social situations difficult.”

“Helped me to put some of the things that we learned into practice and helped me to meet new people.”

“I really enjoyed how interactive they are, it was nice to speak with the other young people in person. It really helped with certain topics (e.g. the slipping in and out of conversations) where role play and practice was useful.”

“I thought they were good and I've got to know the other members of the group. It was nice to practice the techniques with supportive members of the group.”

#### 4. Discussion

This was the first study to pilot a social skills training programme with adolescents and young women with TS. The assessment battery was designed to measure changes in social competence, in the domains of social performance, social knowledge, social cognition, anxiety and self-esteem. Our results suggest not only that the PEERS intervention is feasible and acceptable to families, but also that it had a positive impact on social competence in the domains of social performance, social knowledge and confidence/self-esteem.

##### Social knowledge

The young people gained a substantial amount of social knowledge through the intervention, as evidenced by improvements in the TASSK scores ( $d=4.2$ ) and the qualitative comments on the IAQ. This is in line with previous research which suggests that young person reported improvements relate to changes in their social knowledge rather than their social performance (Gates, Kang, & Lerner, 2017).

##### Social performance

Parents and young people reported positive changes on the SCP, SDQ (peer scale) and QSQ. Contrary to our expectations, parents reported improvements in social competence with a greater effect size than the young people. On the SCP parents reported improvements with a large effect size, that were maintained at follow up. They continued to rate their daughter's social performance significantly below typically developing children after intervention. Whereas, the young people rated themselves to be as competent as their peers both before and after the intervention. The discrepancy between parent and young person scores could be interpreted either as a lack of social self-insight at the start of the intervention from the young people or an over-estimation of improvement from the parents.

The parent and young people's answers were aligned when it came to reporting the increased number of organised and invited get-togethers. These data show more organised get-togethers, than get-togethers initiated by friends. This suggests that the intervention resulted in a rise in social initiation and motivation.

Parents reported reductions in autistic symptomatology on the SRS-2 after the intervention. The largest treatment gains were made on the social awareness and motivation subscales. Previous studies using the SRS-2 with young women with TS have consistently found the domain of social motivation to be the least impaired and the domain of restricted interests and repetitive behaviours to be the most impaired (Hong, Dunkin and Reiss, 2011; Lepage et al., 2013; Chapter 2). If social

motivation is a relative strength, it may be the domain that is the most amenable to change. Meta-analyses of social skills interventions with autistic children found the largest treatment gains were made in the social communication and the restricted interests and repetitive behaviours scales (Wolstencroft et al., 2018). It may be that these different patterns of improvement could be explained by gender differences, as the meta-analysis consisted of studies with predominantly male participants.

This pilot study used a novel measure of social camouflaging (Hull et al., 2017). Social camouflaging is a strategy adopted by people on the autistic spectrum to manage social situations. It has been likened to wearing a “social mask”, where the individual puts on “their best self” (Hull et al., 2017). Camouflaging typically involves masking and compensating for social deficits (Attwood, 2006; Hull et al., 2017; Lai et al., 2016). This might involve consciously performing a range of non-verbal cues such as making eye contact during conversations and imitating facial expressions and gestures, or following learnt social scripts such as using pre-prepared jokes or comments (Lai & Baron-Cohen, 2015). Recent research suggests that females are better at camouflaging than males (Dean, Harwood, & Kasari, 2017; Lai et al., 2016). We hypothesized that the young women were engaging in some camouflaging and anticipated that the intervention would help them become more aware of their camouflaging and to camouflage more effectively if they choose to use it as a strategy. However, this was not the case, as participants did not report any meaningful changes in camouflaging behaviour.

### Anxiety and self-esteem

We expected to see secondary improvements in generalised anxiety, social anxiety and self-esteem after the intervention. However, this was not the case.

On the generalised anxiety scale the young people rated themselves to be more anxious after the intervention. These increased scores still remained within the “normal” range for anxiety when compared to population norms. In previous research young people with TS report less anxiety symptoms compared to healthy controls, but scored highly on the assessment’s “lie” scale (McCauley et al., 2001). The rise in self-reported anxiety is likely to be linked to the increased variability in the post-intervention scores. This variability may be indicative of more individual differences in regards to anxiety than other domains. Another explanation may be an increase in self-awareness and introspection after the intervention.

Parents reported their children as having more social worries than their peers, but did not report any improvements in this domain after the intervention. The young people did not report any

improvements in their social anxiety after the intervention either, but consistently rated themselves as having the same level of social worries compared to their peers.

The standardised self-esteem measure scores remained unchanged before and after intervention, and scores were in line with those expected for age and gender matched peers. This is in stark contrast with the participants' qualitative comments, which highlighted substantial gains in confidence after the intervention. It may be that the standardised measure of self-esteem is not sensitive enough to detect changes in self-esteem in this group. Alternatively it may reflect a lack of self-insight before the intervention, as the scores were similar to those expected for young women of the same age.

### Social cognition

Changes on the SASI emotion recognition task suggest that the young people were better at recognising all emotions after the intervention. Z scores for this task showed that the young people were performing substantially worse than their peers in recognising fearful and disgusted faces, both before and after the intervention. These specific deficits in emotion recognition have been well documented in the literature (Good et al., 2003; Lawrence, Kuntsi, et al., 2003; Mazzola et al., 2006). Improvements in emotion recognition could be linked to a practice effect. Previous research exploring the utility of Ekman faces as a marker for neurodegenerative decline established that test-retest reliability for Ekman faces was stable after 2 or more administrations (Palmer, Langbehn, Tabrizi, & Papoutsis, 2018). Palmer et al. (2018) found less practice effects in participants with cognitive impairments and found the practice effects to affect all emotions equally. In TS the practice effects did not affect all emotions equally, as the recognition of fearful and disgusted faces was unaffected by practice effects. This suggests that the recognition of these emotions is not amenable to change through socio-cognitive training.

The young people performed better on the eye-gaze task after the intervention, but only on trials where the stimuli's eye-gaze and head direction were congruent. This suggests that the young people had difficulty identifying subtle cues such as eye gaze direction and were reliant on head direction to guide their answers. This improvement could be interpreted as task-specific strategy. Despite the improvement in scores after intervention, these were still lower than would be expected of age and sex matched peers, which is consistent with previous studies of eye-gaze detection tasks in TS (Elgar et al., 2002).

The face memory task performance was also improved after the intervention. No test-retest research has been conducted on the face memory task. On the first administration of the test

participants are naïve to the fact that this task is based on remembering the stimuli presented to them. However, on the second administration of the task they are likely to know that it is a memory task and pay more attention to the stimuli faces. Therefore it is probable that participants will obtain better scores during the re-test. Unfortunately there are no norms for the face memory task, but previous research indicates that young women with TS perform significantly worse than their peers (Reiss et al., 1993; Romans et al., 1998; Ross et al., 1997).

In all three social cognition tasks it is difficult to untangle practice effects from genuine intervention related effects. More research in this area is needed and new social cognition tools need to be developed.

### **Feasibility and acceptability**

Both the parents and participants reported high levels of satisfaction with the PEERS intervention. There was high compliance and none of the participants dropped out. Furthermore, participants enjoyed participating in the intervention using the online meeting rooms. Teaching social skills in an online environment was feasible. There is now preliminary evidence from other research groups that psychological interventions are just as effective when delivered online or face-to-face (Kasari, 2019).

The feasibility of this combined online and face-to-face approach is very important within the context of rare disorders. The use of technology has the potential to facilitate access to treatment and reach patients that live in geographically remote areas or that are unable to travel due to physical health disabilities. Not having to travel to the treatment centre is less disruptive to family life; many participants referred to this as an advantage and would not have been able to commit to taking part in the programme if it had required multiple face-to-face sessions.

### **PEERS for Turner Syndrome**

Taken together the results suggest that the PEERS programme affected change in social competence in the domains of social performance and social knowledge. Importantly, the gains in social knowledge were meaningful for the young women regardless of their baseline social ability. This suggests that the programme could be beneficial for young women with subtle social skills difficulties, as well as with young women with autistic traits or those experiencing social isolation.

The theoretical framework for social competence posited in Chapter 3 posited that social motivation is the foundation for improvement in social competence. The young women chosen to take part in the PEERS intervention were highly motivated to improve their socialization. The model also proposed that the interaction between personal factors (such as executive function, social cognition and social knowledge), the environment and acquiring interaction skills were critical to achieving



social competence. The key components of the PEERS intervention are the didactic lessons. Therefore it is not surprising that social knowledge improved dramatically.

Gaining social knowledge may be the main active ingredient in social skills training. We posit that improvements in social knowledge can lead to feeling of empowerment or confidence, which in turn boost the motivation to initiate social interaction and social awareness. Throughout adolescence young people learn about social etiquette by sharing experiences with their peers (Berndt, 1999). Without a stable friendship group during adolescence, only a superficial level of social knowledge can be attained, which becomes a self-perpetuating problem.

It is also likely that the PEERS programme would not be as effective if delivered on a one-to-one basis rather than in a group setting. We propose that the “group” setting is the second active ingredient in successful social skills training. Delivering the intervention in a group creates a proxy group of friends, with whom the young women practice their social skills during the sessions and share some of their successes and failures during homework discussions. This provides both a support network and social skills practice partners.

##### 5. Strengths, limitations and future directions

The biggest improvements noted by the parents and young people in the qualitative responses of the intervention acceptability questionnaire were gains in confidence. These improvements were not picked up by the RSE measure. It would be helpful to capture this boost in confidence using a different standardised measure in future research.

It was surprising to find improvements in social cognition, as these competencies had not been explicitly targeted by the intervention. It remains to be determined whether these effects were mediated through practice or genuine treatment effects. Developing better tools to assess changes in social cognition is needed.

We used a novel measure of social camouflaging, which did not reveal any changes in camouflaging during the intervention. In the absence of norms for the assessment it could not be ascertained whether the young women were engaging in a typical amount of camouflaging behaviours for young women of their age.

Parents and young people typically report changes in social skills after taking part in social skills interventions. But it is possible that their reports are vulnerable to expectancy biases (McMahon, Lerner, & Britton, 2013), as these improvements are rarely reported by teachers (Gates et al., 2017; Kaat & Lecavalier, 2014). We intended to use teachers as external observers to help understand these biases and assess whether changes in performance generalise to other settings (Gates et al.,

2017; White, Keonig, & Scahill, 2007). Unfortunately, none of the teachers invited to take part returned their questionnaires. Future studies will need to employ unbiased observer reports. Due to the difficulties in gaining responses from teachers, it may be advisable to use structured observations or peer rated measures such as social network connectivity maps (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011).

This pilot study was designed to take an approach of high internal validity, which is appropriate given that it is a feasibility pilot conducted with a small number of participants, however the disadvantage of the approach is that the study has low external validity, which reduces the generalizability of the findings. This study will need to be replicated with young people with TS with a wider range of social skills profiles, intellectual ability and hormone treatment status.

Future research will require developing this approach into a full multi-site randomised control trial (RCT). A mini-feasibility RCT should be conducted in order to inform the sample size and follow-up rates for a full RCT trial. Further adaptations of the programme should be made in order to ensure the delivery of this programme could be embedded within the current clinical care provision framework. An economic-cost evaluation would be useful in achieving this aim.

## **Chapter 7 Conclusions and future directions**

This PhD aimed to systematically evaluate the mental health and neurodevelopmental disorders of girls and women with TS aged 4 to 25 and to pilot a social skills intervention using the Medical Research Council framework for developing and evaluating complex interventions (Craig et al., 2008).

### **1. Mental health and neurodevelopmental disorders**

#### **Findings**

Our research conducted the first systematic evaluation of mental health and neurodevelopmental disorders during key developmental periods from the ages of 4 to 25. We showed that young women with TS were pre-disposed to neurodevelopmental disorders in childhood such as ADHD and ASD. They also experienced higher rates of anxiety in later adolescence.

ASD affected approximately one in five of our participants and 59% displayed autistic symptomatology, which interfered with everyday social relationships. The prevalence of difficulties with peers was high, especially during adolescence. Appropriate social performance is reliant on having good social knowledge and social skills. Having proficient social skills is necessary for the development of friendships and relationships, which in turn are essential for good psychological and emotional adjustment. Some of the anxiety and depression experienced by adolescents and women with TS may be mediated by poor social skills and social isolation. Social isolation is known to be associated with poorer mental and physical health outcomes (Holt-Lunstad, Smith, & Layton, 2010; Waldinger & Schulz, 2010). Therefore, the value of introducing social skills training in childhood and adolescence has the potential to reduce the risk of psychopathology experienced by women with TS in later life.

13% of participants met criteria for ADHD. This was consistent with the high levels of hyperactivity/impulsivity and inattention reported in the SDQ. The ADHD-like symptoms appeared to resolve in adolescence without intervention. Although our TS sample appeared to have ADHD symptoms, we collected little evidence from teacher reports. Therefore, we cannot state with confidence that the symptom presentation was consistent across different environments.

#### **Limitations**

This research was conducted with a large group of genetically representative girls, adolescents and young women with TS. However, the prevalence rates of TS are 1 in 2,500, which suggests that there could be 12,000 women with TS in the UK. A relatively small proportion of the TS population attend clinical services and engage with the support society. The largest clinic in the country at UCLH, with

whom we collaborate has a register of 800 adult patients and GOSH has a register of 100 children. The support society has 800 active members. It is possible that many of the women who did not take part in the study were not affected by neurodevelopmental or mental health disorders, therefore our estimates may be inflated. However, this ascertainment bias affects all clinical TS cohorts.

Parents provided information on their daughters using an online psychiatric interview called the DAWBA. The gold standard for the clinical assessment of psychopathology and neurodevelopmental disorders would involve assessing the child in person, as well as collecting information from parents and teachers. Although the DAWBA has been well validated and has been used in UK national studies of child and adolescent mental health, it cannot be considered a substitute for face-to-face clinical examination. Additionally parent informants may not be able to report on all aspects of their daughter's psychopathology. Future research will need to seek child and adolescent reports of anxiety and depression in order to paint a complete picture.

This research has yielded new insights by taking a developmental perspective on mental health, neurodevelopment and socialisation. It was beyond the scope of this piece of work to examine the developmental trajectory of these domains using a longitudinal study design.

Adults with TS have difficulties in identifying facial affect, but little is known about the development of face emotion recognition skills in childhood and adolescence in TS (Good et al., 2003; Lawrence, Kuntsi, et al., 2003; Ross et al., 2002). In typically developing children the ability to identify facial affect correctly follows a developmental pattern (Lawrence, Campbell, & Skuse, 2015). It is possible that some of the social challenges in TS presenting during adolescence may be linked to developmental deficits in facial affect recognition. Unfortunately it was also beyond the scope of this thesis to conduct this work and future research is needed.

## 2. Social skills intervention

The Medical Research Council complex interventions framework (Craig et al., 2008) guided the planning and evaluation of the first GSSI in young women with TS, which comprised four stages: (A) Identify and develop theory; (B) Identify the evidence base; (C) Evaluate feasibility; and (D) Pilot and evaluation.

### A. Identify and develop theory

*Findings:* A review of the social skills theory literature highlighted the theoretical biases in the conceptualisation and assessment of social competence. In order to evaluate these theoretical constructs in more detail a novel theoretical framework was created. Our initial systematic review, which used this framework, revealed that social skills interventions have different approaches to

improving social competence. Despite their differences, all of the reviewed interventions taught social knowledge (rules and etiquette), pragmatics and executive function. Unfortunately, the choice of outcome measure was not always well matched to the targeted domains of social competence. Few studies adopted multi-informant approaches and there was a lack of ecologically valid tools to capture peer reports; such tools need to be developed.

*Limitations:* We conducted the first review of the syllabus of social skills interventions.

Unfortunately, not all of the interventions reviewed had published their manual or made their manual available. Therefore, the depth of our review was limited to the descriptions of the interventions from published articles and the research group's website. Future research will need to conduct more thorough assessments of the content of social skills interventions.

Our review also highlighted the over-reliance of social skills studies on parental report outcome measures. The use of multiple (including blind) informants is integral to a comprehensive and objective assessment of social performance and social knowledge. Future research needs to develop less labour-intensive methods of gaining objective informant reports from professionals involved in educational settings as well as the participants' peers. New methods of social network mapping have high ecological validity, but face the same practical challenges in regards to engaging external stakeholders.

## B. Identify the evidence base

*Findings:* Mindful to reduce heterogeneity in the assessment measures, we conducted a systematic review and meta-analysis that focused exclusively on social skills interventions employing the same outcome measures. This enabled us to challenge previously held assumptions that social skills interventions were not effective. It showed that the largest gains were made in the domains of social communication (e.g. pragmatic language, eye contact or facial expression), and restricted interests and repetitive behaviours. The review also confirmed the suitability of the PEERS for the TS group, backed by evidence for its efficacy in RCTs and the availability of a published manual.

*Limitations:* This approach meant that we could only assess the social performance component of social competence. Insufficient studies used comparable measures of social knowledge that could be combined for meta-analysis. Future replications of this work will need to take into account the distinction between social knowledge and social performance.

Additionally, there were too few studies available to conduct meta-regression analyses to investigate the effects of study characteristics on outcomes (minimum of 10 studies needed). Future research should continue to investigate intervention-specific features (such as duration, intensity, didactic/performance etc.) on efficacy.

Our statistical analysis of publication bias did not reveal any concerns (e.g. Egger's regression test and the trim and fill method). Nevertheless, like all other meta-analyses of GSSI studies, our study is likely to have been biased by publication bias, as intervention studies with positive results are more likely to be published.

### C. Evaluate feasibility

*Findings:* Semi-structured interviews conducted with young women with TS and their parents provided important insights into experiences of socialisation. Although young women with TS experienced a "wide range of social competencies," they attributed social challenges to "personal and contextual factors." The magnitude of these challenges to social integration intensified during adolescence. They felt increasingly "out of sync" with their peers. Critically, most of the families involved in the pilot interviewed expressed that social skills training was desirable and that they would be interested in taking part.

The interviews also provided insights on the best time to intervene and identified barriers to participation. Periods of transition, such as from primary school to secondary school and secondary school to university, were noted to be a particularly challenging time for friendships. To gain the full benefits of early intervention it would be advisable to initiate social skills training at the start of secondary education. However, our experience of recruiting to this pilot study suggests that difficulties with social skills need to have intensified before the girls feel it is relevant to them. Therefore intervening during the teen years 13-17 or just before the transition to higher education is advisable. The main barriers to participation were the logistics of attending a face-to-face group once a week. This information was invaluable and led to the PEERS pilot's novel online modifications.

The qualitative study revealed that young women with TS's awareness of their social differences developed over time. They indicated that they were satisfied with the friendships and social interactions that they had, despite evidence from their parents that the degree of socialisation was insufficient or not always reciprocated. Further investigation into this discrepancy may reveal a response bias. Alternatively, investigations focused on the meaning of friendships may reveal a desire for companionship rather than closeness (Bauminger & Kasari, 2000). The young women's expectations of friendships may also change over time and such findings would aid the development of future social skills treatments.

Young women with TS highlighted the impact of hearing impairments on their social interactions. Recent evidence also highlights the impact of hearing impairments on quality of life (Krantz et al., 2019). Therefore a closer examination of the relationships between hearing and socialisation is

merited. Future studies should investigate the audiometry profiles of girls with TS, as they may correlate with social ability.

*Limitations:* Qualitative research is very useful for generating insights into the experiences of socialisation of young women with TS. But the experiences recounted were not representative of all young women with TS. Unfortunately, we were unable to interview some young women who felt socially excluded, as they felt too anxious or too uncomfortable to take part in the study. Future research will need to develop novel methodologies to include the experiences of these young women.

#### D. Pilot and evaluation

*Findings:* The PEERS pilot was a success. The outcome measures showed substantial gains in social knowledge and social performance, as well as some improvements in emotion recognition. The SRS-2 measures of autistic symptomatology indicated improvements in social awareness and social motivation. Unfortunately teacher informants did not engage with the study, therefore it is not possible to assess whether the newly acquired social skills and knowledge generalised to the school environment.

All of the young women taking part in the pilot experienced social skills difficulties, and there was a substantial amount of variability within the group's social ability at baseline. Regardless of their initial social ability, participants benefitted from the PEERS programme. This suggests that the programme is well suited to the TS population, given that their social skills abilities are variable. A future moderator analysis on a larger group of PEERS participants will help identify the features of sub-groups that are most responsive to treatment.

High rates of attendance and the absence of attrition indicate that the online/face-to-face hybrid model of administration was acceptable to families. Although some families would have preferred to meet face-to-face each week, many would not have been able to partake in the programme if this were the case. This study was unable to assess whether the online delivery of PEERS was as effective as the traditional face-to-face mode of delivery in the TS population. However, there is evidence from other research groups delivering social training interventions that there is no difference in the efficacy of the intervention when delivered online or face-to-face (Kasari, 2019). This is encouraging, as it suggests that the online delivery of social skills training could be adopted by other patient groups and interventionists.

*Limitations:* The PEERS intervention is akin to teaching people the grammar of the social world, and empowers its students by helping them to understand the un-written rules of the social world. Gaining this social knowledge in combination with a pre-existing desire to be more sociable is likely

to increase the participants' chances of social success. However, it is important to bear in mind that it is the quality and depth of relationships that is beneficial and not the quantity. The PEERS programme helps its students to identify good relationships that are worth pursuing and strengthening. Our outcome measures did not assess the quality or closeness of the burgeoning friendships established over the course of the programme. Therefore the PEERS programme could be seen as a gateway programme into making friends and a means of boosting confidence or promoting social initiation by harnessing the desire for social interaction. Further support may be necessary in order to help young women with TS develop the emotional connection or closeness in their friendships.

The PEERS programme for adolescents was designed for young people aged 13 to 18. The age range of the participants in our group was wider and included participants up to the age of 20 years. It was deemed appropriate to use the adolescents programme due to the social naivety of the participants. Since conducting the trial a new PEERS programme for young adults aged 18 to 25 has been published and validated (Laugeson, 2017). The young adults programme replaces lessons on good sportsmanship and rumours/gossip, for lessons on dating etiquette. It is our view that these lessons would be of more interest and more useful to young women with TS.

The success of the hybrid online/face-to-face delivery suggests that this approach should be piloted with other patient groups, as it has the potential to broaden access to care and reduce delivery costs. To build on this small-scale PEERS online feasibility study for the TS population, the next steps would involve conducting a feasibility RCT. This will be essential to estimate the sample size and willingness of participants to be randomized, before progressing to a full RCT pilot trial.

### 3. Conclusion

This PhD has highlighted the mental health and neurodevelopmental disorders that affect children, adolescents and young women with TS. The day-to-day social interaction difficulties experienced were similar to those which affect girls with ASD. Our successful pilot of an ASD social skills programme with young women with TS showed that these difficulties are amenable to change. Informal feedback from our participants in the PEERS pilot six months after the intervention ended are positive, suggesting that the gains in social performance and social knowledge have been maintained. The ability to form positive relationships across the lifespan has a substantial impact on promoting good mental and physical health.

The methodological innovations in treatment delivery using virtual meeting rooms proved acceptable and feasible. Furthermore we found positive improvements in social performance and



social knowledge. Using virtual meeting rooms to deliver psychological treatments has the potential to break down barriers to access care.

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# Appendices

I: Genetic changes in TS

II: Protocol (excerpt from NHS ethics application 16PP35)

III: Mental health and neurodevelopmental disorders

IV: Literature search strategy by database

V: Risk of bias assessment criteria

VI: Social competence assessment framework for individual outcome measures

VII: Social competence interview schedule

VIII: Modified SCP for young people

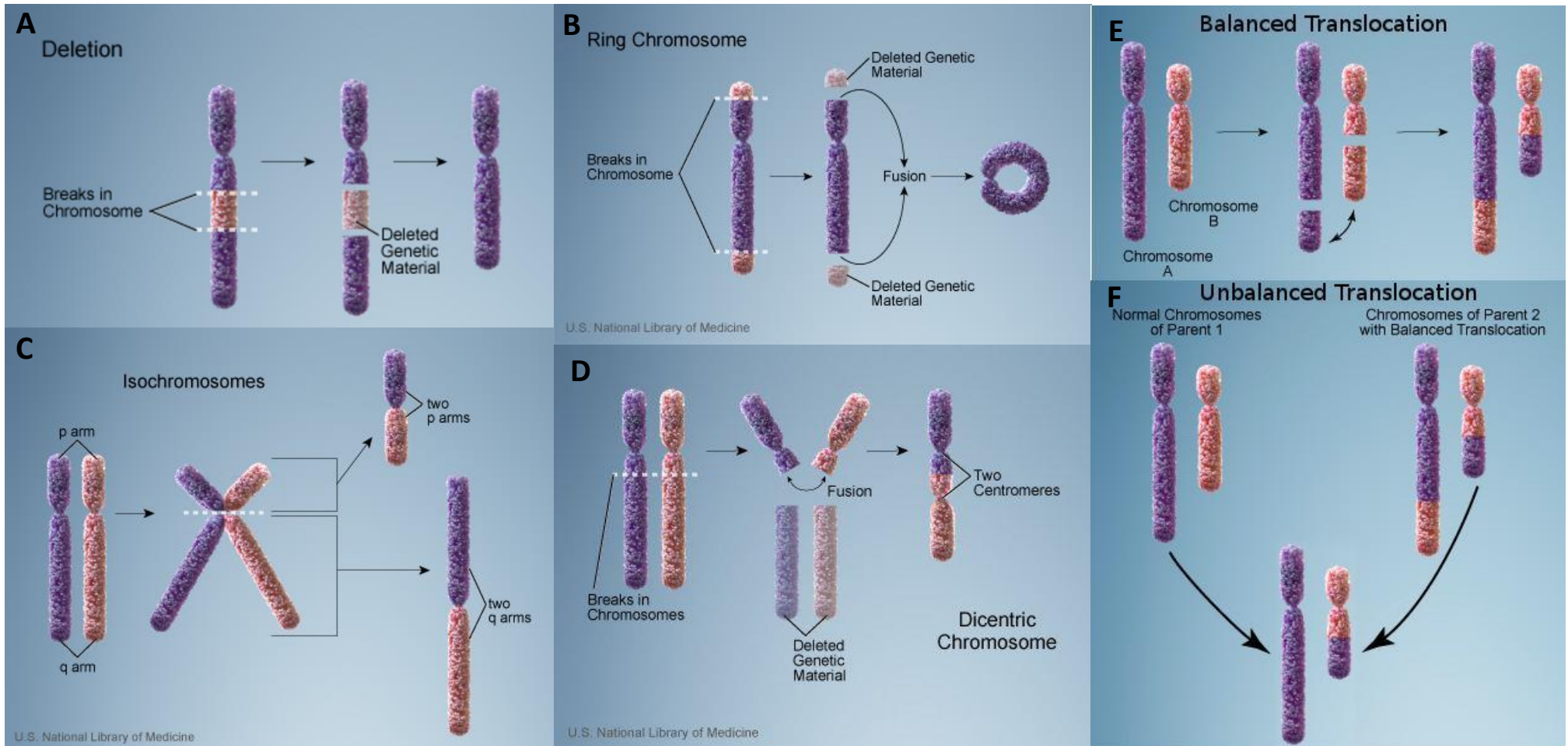
IX: Intervention acceptability questionnaire

X: IAQ Answers

XI: Publications arising from this thesis



**Appendix I: Genetic changes in TS**



**Figure: Illustrations of structural genetic changes**

*A. Deletion:* loss of genetic material

*B. Ring chromosome:* structure that occurs when a chromosome breaks in two places and its broken ends fuse together to form a circle

*C. Isochromosome:* the arms of the chromosome are mirror images of each other from the centromere

*D. Isodicentric:* structural change resulting in a dicentric X chromosome with two q-arms

*E & F. Translocation:* chromosomal abnormality in which a chromosome breaks and a portion of it reattaches to a different chromosome (balanced and unbalanced illustrated).

## **Appendix II: Protocol (excerpt from NHS ethics application 16PP35)**

### **Objective and Purpose**

<b>Objectives</b>	<b>Outcome Measures/Endpoints</b>
<b>Primary Objective</b>	<p>The primary objective of the study is to pilot the acceptability and feasibility of the PEERS social skills training intervention with girls with Turner Syndrome in order to produce an improvement in social skills.</p> <p>The primary outcome measure is the 'Social Competence with Peers Questionnaire'.</p>
<b>Secondary Objectives</b>	<p>The secondary outcome measures are:</p> <ul style="list-style-type: none"><li>-Social Responsiveness Scale</li><li>-Social Worries Questionnaire</li><li>-Rosenberg Self-esteem Scale</li><li>-Beck's Anxiety Inventory</li><li>-Strengths and Difficulties Questionnaire</li><li>-Test of adolescent social skills knowledge</li><li>-Quality of Play Questionnaire</li><li>-Intervention Acceptability Questionnaire</li></ul> <p>These tools will measure whether the social skills interventions also has a secondary influence on social cognition, anxiety, social anxiety and self-esteem.</p>

### **Study design and description of study**

**Study Design** - The study is comprised of three parts:

**Part A** is a large online study that will examine the social functioning of 200 girls with TS from childhood to early adulthood (age 5-25). This will allow us to understand the developmental trajectory of peer problems and assess the scope for early intervention. Part A of the study will also allow us to screen for participants with social skills difficulties, whom will be invited to take part in part B and/or C. Parts B and C of the study will explore the social skills deficits in more detail with a smaller group participants aged 16 to 25.

**Part B** consists of stakeholder interviews, which will be conducted with 10% of the cohort (n=20).

**Part C** is a feasibility study for a psychological intervention of the PEERS Programme (n=6-10). The feasibility study will use a systematic multiple-case series design with case tracking. All participants will be similar in age, degree of social impairment and hormone therapy to increase external validity and maximise direct clinical replication.

**Study Timeline:**

0-6 months: Part A - Recruitment and online questionnaire completion

7-9 months: Part B - Stakeholder interviews

10-18 months: Part C - Intervention

19-25 months: Analysis and write-up

**Centres Involved:**

The centres involved will be GOSH, UCLH, GOS ICH (30 Guilford Street) and the Wolfson Centre. GOSH and UCLH will be involved in the recruitment of families, and the assessments will be conducted at the UCL GOS ICH and the Wolfson Centre.

**Inclusion criteria**

The inclusion criteria for the online questionnaires are (Part A):

- Diagnosis of Turner Syndrome
- Female
- Aged 5-25
- A parent/carer who is also willing to take part in the study

Additional inclusion criteria for the stakeholder interviews and intervention are (Part B & C):

- Significant social skills difficulties screened for in the online questionnaires

**Exclusion criteria:**

For the online component of the study (Part A & B) being male is the only exclusion criteria.

For the intervention component of the study (Part C) participants will be excluded if they have severe hearing or visual impairments.

**Study procedures**

**Recruitment**

Over 500 girls and women with Turner Syndrome attend specialist clinics at UCLH and GOSH. Participants will be identified retrospectively and prospectively for recruitment:

**Retrospective recruitment:**

Members of the clinical care team at UCLH and GOSH will identify eligible participants and send them an invitation letter and study information sheet in the post. The invitation letter will ask prospective participants to get in touch with the study team directly if they are interested in taking part. Only once participants have expressed interest in taking part in the study, will they be sent the consent forms by the study team.

**Prospective recruitment:**

Patients attending the GOSH clinics, receive a psychological consultation as part of their routine appointments. The lead researcher in the SOAR study attends these appointments as part of routine clinical care. If the clinical care team feels it would be beneficial for the family to take part in the

SOAR study, it will be discussed with the family during the appointment. If families express an interest in taking part in the study they will be given an information sheet and consent form.

Patients attending the UCLH clinics will be invited to take part in the study by their clinical care team. The clinical care team will decide whether it is appropriate to invite the patient to the study. If the patient express an interest in taking part in the study they will be given an information sheet and consent form.

### **Informed consent**

Participants will either receive a letter from their clinical care team inviting them to take part in the study or discuss the study with a researcher at clinic. Families that express an interest in taking part will be sent an information sheet and consent form by the study team.

Families will be encouraged to take the time to read the study information sheet and ask questions about the study. A record of when the patient information sheet was given and when it was returned will be kept. No study-related procedures will be carried out before consent has been obtained.

When communicating with the prospective participant the research team will make themselves available for further questions by phone, email or post depending on the participant's preference. Once the consent forms have been sent back to the research team, a copy of the consent form with a counter-signature from the researcher will be returned to the participant. A unique ID will then be allocated and the participant will be contacted with their login details, so that they may complete the online assessments.

Informed consent will be obtained by the study researcher (Jeanne Wolstencroft) once participants have got in touch with the research team to express interest in taking part in the study. Jeanne Wolstencroft is GCP trained and has 2 years' experience recruiting families to a national study of intellectual disability (IMAGINE ID).

### **Screening and eligibility assessment**

#### **Part A: Online Questionnaires (5-25 years)**

All families with daughters who have Turner Syndrome and are aged 5 to 25 will be eligible to take part in the online component of the study.

#### **Part B & C: Face to Face Assessments (16-25 years)**

Participants identified to have social skills difficulties by questionnaires administered in Part A (Development and Wellbeing Assessment and Social Responsiveness Scale) will be invited to take part in further face to face assessments.

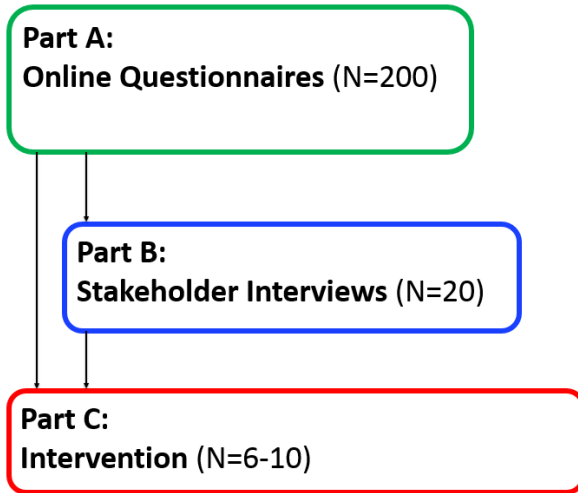
**Part B – Stakeholder Interviews:** All families with daughters identified to have social skills difficulties will be eligible for the stakeholder interviews.

**Part C – Intervention:** A medical history questionnaire (Health Questionnaire; administered in Part A) will screen for auditory or visual impairments, participants with severe difficulties in these areas will be excluded from the intervention.

### **Baseline assessments**

The online component of the study (Part A) will collect information about social skills difficulties across a wide range of ages and screen for eligibility for the face to face assessments (Parts B and C). See Figure 1 (See Appendix A for more detail).

Participants will be given up to 3 months to complete Part A of the study.



### Study Structure

#### **Part A: Online questionnaires (age 5-25)**

**Completion time:** ~2-3h parents; 50 mins age 16-25. The questionnaires do not have to be completed in one go, as the answers are automatically saved. Participants can complete the questionnaires at their convenience, in smaller chunks of time.

**Location:** Families can complete the questionnaires online at home. Should families not have access to the internet, the questionnaires will be sent in paper form by post or administered over the phone.

#### **Assessments:**

- **Development and Wellbeing Assessment (DAWBA 1h30; parent)**

The DAWBA will be used to collect information on the child's behavioural adjustment and mental health. The DAWBA has been used both in UK national and international surveys (Ford et al., 2003; Green et al., 2004; Heiervang et al., 2008; Emerson et al., 2007).

This methodology has been used successfully to gather data of high quality by parental on-line report. We will use a validated automated diagnostic algorithm system devised for this purpose, compatible with ICD-10/DSM-V. The DAWBA is available in 26 languages (<http://www.dawba.com/>) and we do not intend to exclude families on the basis of ethnicity or inability to speak/understand English.

- **Strengths and Difficulties Questionnaire (SDQ 10 mins; parent, teacher and self-report)**

The SDQ is a brief behavioural screening questionnaire about 3-16 year olds (Goodman et al., 2011). Many child and adolescent mental health clinics now use the SDQ as part of the initial assessment.

- **Social Responsiveness Scale (SRS 15mins; parent and teacher)**

The SRS measures the severity of social skill impairment in detail (Constantino et al., 2007).

- **Health Questionnaire** (HQ 30 mins; parent and self-report)

The HQ records information about physical health, health care, education, social life, physical activity and relationships. This is already established as acceptable to families as a means of collecting data with the Turner Syndrome population in the Turner Syndrome Life Course Study (Prof Conway, UCLH). The Adult version of the questionnaire will be complete by TS participants aged 16 and over. Parents will complete the Child version of the questionnaire on behalf of their daughters under the age of 16.

- **PEERS Screener** (15 mins; parent and self-report)

Questionnaire to screen for eligibility to the PEERS intervention. See PEERS manual (Laugeson and Frankel, 2011).

### **Part B: Face to Face Stakeholder Interviews (age 16-25)**

**Completion time:** ~1h parents; ~1h age 16-25

**Location:** Interviews will be conducted in person at the participant's home or over skype.

#### **Assessments:**

- **Social Competence Interview** (1h; parent and self-report)

A semi-structured social skills interview has been devised to be used with participants aged 16-25 and their parents (see supplementary materials – Social Competence Interview).

### **Part C: Intervention assessments (age 16-25)**

**Completion time:** 45min parent; 25min teacher; ~3h young person

**Location:** The intervention assessments will be conducted online, in person (at GOS ICH Wolfson Centre) or over the phone:

- **Social Competence with Peers** (SCP 10 mins, parent, teacher and self-report)

The Social Competence with Peers Questionnaire assesses the consequences of children's interactions with peers such as the existence and duration of friendships or invitation to playdates (Spence, 1995).

- **Spence Social Worries Scale** (SWS 15 mins, parent, teacher and self-report)

The Spence Social Worries Scale is a psychological questionnaire designed to identify symptoms of social phobia and other forms of anxiety, in children and adolescents. It is available in various languages. (Spence, 1995).

- **PEERS Quality of Play Questionnaire** (QPQ 10 mins; parent)

Questionnaire in PEERS intervention manual to evaluate the quality of children's socialization and frequency of get-togethers. See PEERS manual (Laugeson and Frankel, 2011).

- **PEERS Test of Adolescent Social Skills Knowledge** (TASSK 10 mins; parent and self-report)

Questionnaire in PEERS intervention manual to evaluate what the participants have learned from the intervention (Laugeson and Frankel, 2011).

- **Rosenberg Self-esteem Scale** (RSE 10 mins; self-report)

The Rosenberg self-esteem scale is used to assess global self-esteem and it is one of the most widely used self-esteem tests among psychologists and sociologists (Rosenberg, 1965).

- **Beck's Anxiety Inventory** (BAI 10 mins; self-report)

This scale is a self-report measure used for measuring the severity of anxiety in children and adults (Steer and Beck, 1997).

- **Intervention Acceptability Questionnaire** (IAQ 20 mins; parent and self-report)

The Intervention Acceptability Questionnaire has been used to assess parental and young person satisfaction with the intervention (see supplementary materials – Intervention Acceptability Questionnaire).

- **IQ test (WAIS-IV)** 50-70 mins; task for young person)

The WAIS is a widely used test that measures intelligence and cognitive ability (Wechsler, 2014).

- **Schedules for the Assessment of Social Intelligence** (SASI 30 mins; task for young person)

The SASI is a socio-cognitive assessment that measures facial expression recognition, face recognition memory, gaze-monitoring and theory of mind. The SASI is sensitive to subtle deficits in social cognition and has been shown to have excellent reliability and validity (Skuse et al., 2005).

### **Subsequent visits**

#### **Part A: Online assessments only**

No subsequent visits

#### **Part B: Stakeholder interviews (n=20)**

Semi-structured interviews will be conducted with 10% of the cohort (20 participants aged 16-25 and their parents). The interviews will ask parents and their children about the child's social skills and the acceptability of the PEERS Intervention materials will be discussed. The interview with the parent and the child will be conducted separately, each interview will last approximately 45-60 minutes. (See supplementary materials for the full interview schedule – Social Competence Interview).

#### **Part C: Intervention (n=6-10)**

Depending on participant preferences all questionnaires will be completed online, over the phone or in person at GOS ICH Wolfson Centre). All intervention sessions and assessments will take place at the at GOS ICH Wolfson Centre. See Table 1 below.

None of the procedures described below are part of routine clinical care.

## Intervention visits

Visit	Questionnaire	Time	Intervention	Time	Assessment	time	timeline
1	SCP (P) PEERS Screener (P,YP)	10min 10min					0
2	SCP (P)	10min					+ 4 weeks
3	SCP (P, YP, T) SWS (P, YP, T) PEERS QPQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P, T) SDQ (P,T)	10min 15min 10min 10min 10min 10min 10min 10min			WISC (YP) SASI (YP)	1h30 1h 30min	+ 8 weeks
4	SCP (P)	10min	PEERS Session 1 (P,YP)	1h30			+ 12 weeks
5			PEERS Session 2 (P,YP)	1h30			+ 13 weeks
6			PEERS Session 3 (P,YP)	1h30			+ 14 weeks
7			PEERS Session 4 (P,YP)	1h30			+ 15 weeks
8	SCP (P)	10min	PEERS Session 5 (P,YP)	1h30			+ 16 weeks
9			PEERS Session 6 (P,YP)	1h30			+ 17 weeks
10			PEERS Session 7 (P,YP)	1h30			+ 18 weeks
11			PEERS Session 8 (P,YP)	1h30			+ 19 weeks
12	SCP (P)	10min	PEERS Session 9 (P,YP)	1h30			+ 20 weeks
13			PEERS Session 10 (P,YP)	1h30			+ 21 weeks
14			PEERS Session 11 (P,YP)	1h30			+ 22 weeks
15			PEERS Session 12 (P,YP)	1h30			+ 23 weeks
16	SCP (P)	10min	PEERS Session 13 (P,YP)	1h30			+ 24 weeks
17			PEERS Session 14 (P,YP)	1h30			+ 25 weeks
18	SCP (P, YP, T) SWS (P, YP, T) PEERS QPQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P, T) SDQ (P, T) IAQ (P,YP)	10min 15min 10min 10min 10min 10min 10min 10min			SASI (YP)	1h30 30min	+ 26 weeks
19	SCP (P)	10min					+ 30 weeks
20	SCP (P)	10min					+ 34 weeks

**Acronyms:** BAI – Beck’s Anxiety Inventory; IAQ – Intervention Acceptability Questionnaire; PEERS – Program for Education and Enrichment of Relational Skills; PEERS QPQ – PEERS Quality of Play Questionnaire; PEERS TASSK – PEERS Test of Adolescent Social Skills Knowledge; RSE – Rosenberg Self-esteem Scale; SCP – Social Competence with Peers; SDQ – Strengths and Difficulties Questionnaire; SRS – Social Responsiveness Scale; SASI - Schedules for the Assessment of Social Intelligence; SWS – Spence Social Worries Scale; WISC - Wechsler Intelligence Scale for Children



## **Study duration**

The study will last 18 months in total:

**Part A:** The online questionnaire phase will last 6 months. Participants taking part in the online component of the study will be given up to 3 months to complete the online assessments.

**Part B:** Stakeholder interviews will be conducted over a 3 month period.

**Part C:** Families invited to take part in the intervention will be asked to take part in the study for 9 months following completion of the online questionnaire (pre 3 month baseline, 16 weeks intervention, post 3 months assessment).

## **Withdrawal/Discontinuation from study**

Every participant has the right to withdraw from the study at any time and the Investigator may discontinue a participant from the study at any time if they considers it necessary for any reason. No procedures or observations will be required if the treatment has been withdrawn, unless the participant requests a follow up.

Withdrawal from the study will result in exclusion of the data for that participant from analysis, unless the participant requests for their data to be excluded.

## **Definition of end of study**

The end of the study will be marked by the last participant follow up session. At the end of the study participants will be thanked for their involvement and informed that they have completed all of the study assessments.

## **Intervention**

The intervention being used is called the Program for the Education and Enrichment of Relational Skills (PEERS). The full protocol for the intervention can be found in the intervention's manual (Laugeson and Frankel, 2011). PEERS has been successfully used in a number of studies with families and children with autism spectrum disorders (Laugeson et al., 2009; Laugeson et al., 2015).

## **Subject withdrawal criteria**

Participants will be free to withdraw from the study at any time. Due to the nature of the intervention, participants in the treatment group who choose to withdraw will not be replaced.

### Appendix III: Mental health and neurodevelopmental disorders

Mental health disorder prevalence (%)	TD girls				TS girls			
	5 to 10	11 to 16	17 to 19	All ages	5 to 10 n=44	11 to 16 n=42	17 to 19 n=14	All ages n=100
<b>Any disorder</b>	6.6	14.4	23.9	<b>12.9</b>	36.4	33.3	28.6	<b>34</b>
<b>Emotional disorders</b>	3.6	10.9	22.4	<b>10</b>	9.1	16.7	14.3	<b>13</b>
<b>Anxiety disorders</b>	3.4	9.7	20.3	<b>9.1</b>	9.1	16.7	14.3	<b>13</b>
Separation anxiety disorder	1.1	0.4	-	<b>0.6</b>	2.3	2.4	-	<b>2</b>
Generalised anxiety disorder	0.2	2.2	4.6	<b>1.8</b>	2.3	9.5	14.3	<b>7</b>
Obsessive compulsive disorder	0.1	0.6	0.7	<b>0.4</b>	-	2.4	-	<b>1</b>
Specific phobia	0.9	1.0	0.9	<b>0.9</b>	4.5	2.4	-	<b>3</b>
Social phobia	0.2	1.3	2.6	<b>1.1</b>	2.3	2.4	-	<b>2</b>
Agoraphobia	-	0.7	2.8	<b>0.8</b>	-	-	-	-
Panic disorder	-	1.6	5.6	<b>1.7</b>	-	-	-	-
Post-traumatic stress disorder	0.2	0.8	2.4	<b>0.9</b>	-	-	-	-
Body dysmorphic disorder (BDD)	0.1	1.9	5.6	<b>1.8</b>	-	-	-	-
Other anxiety disorder	0.9	2.2	3.4	<b>1.9</b>	-	-	-	-
<b>Depressive disorders</b>	0.2	3.8	6.5	<b>2.8</b>	-	-	7.1	<b>1</b>
Major depressive episode	0.1	2.8	4.7	<b>2</b>	-	-	7.1	<b>1</b>
Other depressive episode	0.1	1.1	1.8	<b>0.8</b>	-	-	-	-
<b>Bipolar affective disorder</b>	-	-	0.3	<b>0.1</b>	-	-	-	-
<b>Behavioural disorders</b>	3.2	5.0	0.5	<b>3.4</b>	-	-	-	-
Oppositional defiant disorder	2.5	3.0	-	<b>2.2</b>	-	-	-	-
Conduct disorder confined to family	0.1	0.2	-	<b>0.1</b>	-	-	-	-
Unsocialised conduct disorder	0.2	0.5	-	-	-	-	-	-
Socialised conduct disorder	0.1	1.0	0.1	-	-	-	-	-
Other conduct disorder	0.3	0.3	0.5	-	-	-	-	-
<b>Hyperactivity disorders</b>	0.8	0.7	-	<b>0.6</b>	15.9	11.9	7.1	<b>13<sup>1</sup></b>
<b>Other less common disorders</b>	1.0	2.0	2.2	<b>1.6</b>	22.7	23.8	28.6	<b>24</b>
Autism Spectrum Disorder (ASD)	0.4	0.7	0.0	<b>0.4</b>	22.7	23.8	21.4	<b>23</b>
Eating disorders	0.1	1.0	1.6	<b>0.7</b>	-	-	7.1	<b>1</b>
Tics/other less common disorders	0.6	0.4	0.8	<b>0.6</b>	2.3	2.4	-	<b>2</b>

## **Appendix IV: Literature search strategy by database**

### **Medline 13.12.16**

1. Social Skills/
2. Intervention.mp
3. Therapy.mp
4. Group therapy.mp
5. Group.mp
6. 2 or 3 or 4
7. 1 and 5 and 6
8. limit 7 to (English language and ("all child (0 to 18 years)" or "all adult (19 plus years)" or "child (6 to 12 years)" or "adolescent (13 to 18 years)" or "young adult (19 to 24 years)" or "adult (19 to 44 years)" or "young adult and adult (19-24 and 19-44)"))

### **CINAHL 13.12.16**

1. social skills training
2. social skills intervention
3. social skills
4. group
5. 1 or 2 or 3
6. 4 and 5
7. Narrow by SubjectAge: - adult: 19-44 years; Narrow by SubjectAge: - adolescent: 13-18 years; Narrow by SubjectAge: - child: 6-12 years; Narrow by SubjectAge: - all child

### **PsycInfo 13.12.16**

1. social skills/ or social skills training
2. group intervention/
3. 1 and 2

### **Embase Search 01/01/2017**

1. social adaptation/ or adjustment
2. intervention study/
3. group therapy
4. 2 or 3
5. 1 and 4
6. limit 5 to (english and (child <unspecified age> or school child <7 to 12 years> or adolescent <13 to 17 years> or adult <18 to 64 years>))

## **Appendix V: Risk of bias assessment criteria (Criteria adapted from Higgins et al., 2016.)**

The risk of bias criteria were assessed using the following criteria:

### **Sequence generation**

*Low Risk:* participants were allocated to groups using randomisation including coin-tossing, simple randomisation or random numbers table

*Unclear:* randomisation method not clearly stated or unknown

*High Risk:* true randomisation was not achieved (e.g. quasi-randomisation)

### **Allocation concealment**

*Low Risk:* consent and decisions about eligibility were obtained prior to group allocation. Participants and researchers were naïve to the future allocation of participants to control or intervention group

*Unclear:* allocation concealment was not clearly stated or unknown

*High Risk:* allocation concealment was not used or allocation was not concealed from participants and researchers

### **Baseline measurements**

*Low Risk:* participant outcome measures were measured prior to intervention and there were no significant differences between the intervention and control groups

*Unclear:* baseline outcome measures were not reported or it was difficult to establish if the groups were different on outcome measures at baseline.

*High Risk:* differences in baseline outcome measures were present and likely to undermine post-intervention differences

### **Blinding of participants and personnel**

*Low Risk:* blinding of participants and researchers was confirmed

*Unclear:* blinding of participants and researchers was not reported

*High Risk:* blinding of participants and researchers was incomplete or not ensured

### **Blinding of outcome assessments**

*Low Risk:* outcome assessors were blind to the participants' group status

*Unclear:* outcome assessor blinding to group status was unclear or not addressed

*High Risk:* outcome assessor blinding was not ensured

### **Addressing incomplete outcomes**

*Low Risk:* no or low attrition, outcome data was available on all or nearly all participants (>90%)

*Unclear:* unclear which participants completed the study (intervention and outcome measures)

*High Risk:* clear evidence of attrition or exclusion from analysis in at least one participant group, unbalanced dropout in control and intervention group

### **Selective reporting**

*Low Risk:* all data collected seems to be reported

*Unclear:* unclear whether other data were collected and not reported

*High Risk:* data from measures in the trial are not reported

### **Other biases**

No other sources of bias such as stopping the trial, changing models or other anomalies were present.

**Appendix VI: Social competence assessment framework for individual outcome measures**

Assessment	Motivation	Social rules & knowledge	Communication			Cognitive			Emotional	
			Verbal	Non-verbal	Pragmatics	Executive Function	Attentional control	Perception	Self-perception	Affect regulation
<b>Self-report</b>										
Social interactions survey	N	N	N	N	N	N	N	N	Y	N
Self-efficacy and outcome expectancy	N	N	N	N	N	N	N	Y	Y	N
Social anxiety scale for children revised	Y	N	N	N	N	N	N	N	Y	N
TASSK	N	Y	N	N	N	N	N	N	N	N
TYASSK	N	Y	N	N	N	N	N	N	N	N
Loneliness scale	Y	N	N	N	N	N	N	N	Y	Y
SELSA	N	N	N	N	N	N	N	N	Y	N
QSQ	Y	N	N	N	N	Y	N	Y	N	N
Social knowledge*	Y	N	N	N	Y	Y	N	Y	N	N
FQS	Y	N	N	N	N	Y	N	N	Y	Y
SIAS	N	N	N	N	N	N	N	N	N	Y
CASL	N	N	N	N	Y	Y	N	Y	Y	Y
<b>Child Task</b>										
NEPSY	N	N	N	N	Y	Y	Y	Y	N	N
Incidental face memory	N	N	N	Y	N	N	N	Y	N	N
Child and adolescent perception measure	N	N	N	Y	Y	N	N	Y	N	N
DANVA	N	N	Y	Y	N	N	N	Y	N	N
SKA	Y	N	N	N	N	N	N	N	N	N
Cambridge mind reading face-voice battery for children	N	N	Y	N	Y	N	N	Y	N	N
TOPS- elementary	N	Y	N	N	N	Y	N	Y	N	Y
Strange stories	N	N	N	N	Y	N	N	Y	N	N
Faux pas stories	N	N	N	N	Y	N	N	Y	N	N
Revised version of the strange stories task	N	N	N	N	Y	N	N	Y	N	N
Theory of mind task	N	N	N	N	Y	N	Y	Y	N	N

Assessment	Motivation	Social rules & knowledge	Communication			Cognitive			Emotional	
			Verbal	Non-verbal	Pragmatics	Executive Function	Attentional control	Perception	Self-perception	Affect regulation
<b>Parent</b>										
SRS	Y	N	N	Y	Y	Y	Y	Y	N	N
SSRS	N	N	N	N	N	Y	Y	N	N	Y
ABAS	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
QPQ	Y	N	N	N	N	Y	N	Y	N	N
QSQ	Y	N	N	N	N	Y	N	Y	N	N
EQ	N	N	N	N	Y	Y	N	Y	N	N
Clinical global impressions	N	N	N	N	N	N	N	N	N	N
Social competence inventory	Y	N	N	N	N	Y	N	Y	N	Y
VABS-2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ASC	Y	Y	N	N	Y	Y	Y	Y	Y	Y
BASC-PRS	Y	N	Y	Y	Y	Y	Y	N	Y	Y
<b>Teacher</b>										
Pupil evaluation inventory	Y	N	N	N	N	Y	Y	Y	Y	Y
SSRS	Y	Y	N	N	N	Y	Y	N	N	Y
SRS	N	N	N	N	N	Y	Y	N	N	Y
<b>Observation</b>										
Peer interaction paradigm	Y	N	N	N	N	N	N	N	N	N
Contextual asesment of social skills	Y	N	Y	Y	Y	N	N	N	N	Y
Peer interaction measure	Y	N	N	N	Y	N	N	N	N	N
<b>Peer</b>										
Sociometrics	N	N	N	N	N	N	N	Y	N	N

**Table: Social competence assessment framework for individual outcome measures by informant type**

\* Not published

Children's depression inventory, excluded as not social skills and used in German

A close examination of the individual outcome measures shows that not all social skills questionnaires assess the same domains of social competence.

## **Appendix VII: Social competence interview schedule**

### **Social Competence Interview for parents**

#### **1. Questions for discussion**

How easy does your daughter find it to keep and make friends?

If yes to friendship difficulties; at what age did these difficulties begin?

Are you concerned about any of her social skills/ friendships at the moment?

Would a social skills training programme be useful?

Would you be able to make time for a 16 week training programme (once a week 1h30mins)?

What would stop you from coming?

Would you be happy to do some homework between sessions?

Would you be happy to take part in the parent group?

Do you think your daughter would be happy to take part in the young person's group?

#### **2. Discussion of PEERS Content**

The PEERS programme targets different areas of difficulty each week. How useful would a training programme targeting the following areas be?

- How to use appropriate conversational skills
- How to find common interests in conversations
- How to enter and exit conversations between peers
- How to use appropriate humour
- How to use electronic communication
- How to handle gossip and rumours
- How to be a good host during get-togethers
- How to choose appropriate friends
- How to be a good sport

- How to handle arguments with peers
- How to change a bad reputation
- How to handle teasing and bullying

Which sessions/areas are the least relevant and why?

Which sessions/areas are the most relevant and why?

How easy to understand are the handouts?



## Social Competence Interview for young people aged 16-25

### 1. Friendships:

Did you experience any difficulties with friendships when you were growing up?

If you experienced difficulties, at what age did they begin?

How many friends did you have growing up?

How many close friends do you have at the moment?

What do you do together?

Would you like more friends?

How easy do you find it to make friends?

How easy do you find it to keep friends?

Are you happy with your friendship circle?

Do you feel accepted as part of your peer group?

Have you ever felt like an outsider?

What are your friends like? What makes them good friends?

Would your friends say that you're a good friend? What makes you a good friend?

What would make your friendships better?

Have any of your close friendships ended? If so, why do you think the friendship ended?

If difficulties with friendships; what do you think your friendship difficulties are caused by?

Do you ever feel that your friends have taken advantage of you?

### 2. School and bullying

Were you ever bullied at school or online?

If so, what was the source of the bullying?

Did you feel different to your peers at school?

If yes; what make you feel different?

### 3. Conversations and reciprocal social interaction

Do you feel more comfortable being with a group of friends or with one person?

If yes to one person: Do you enjoy being with a group of friends? Is it more difficult to interact with a group of people than it is with one person?

When you look at someone's facial expressions and body language, do you feel able to recognise what the other person is feeling?

Do you sometimes find it difficult to follow a conversation?

#### 4. PEERS Intervention:

Would you find a social skills training programme useful?

Would you be able to make time for a 16 week training programme (1h30mins / once a week)?

What would stop you from coming?

Would you be happy to do some homework between sessions?

The PEERS programme targets different areas of difficulty each week. How useful would a training programme targeting the following areas be?

- How to use appropriate conversational skills
- How to find common interests in conversations
- How to enter and exit conversations between peers
- How to use appropriate humour
- How to use electronic communication
- How to handle gossip and rumours
- How to be a good host during get-togethers
- How to choose appropriate friends
- How to be a good sport
- How to handle arguments with peers
- How to change a bad reputation
- How to handle teasing and bullying

Which sessions/areas are the least relevant and why?

Which sessions/areas are the most relevant and why?

How easy to understand are the handouts?

**Appendix VIII: Modified SCP for young people**

**Social Competence with Peers Questionnaire**

Your name: .....

Date: .....

Time point: 1 2 3 4 5 6 7 8 9

Please put a circle around the rating which best describes you *over the past four weeks*.

**Circle the number 0 if the item is not true. Circle the number 1 if the item is sometimes true. Circle the number 2 if the item is mostly true.**

Please answer all the questions.

		Not true	Sometimes true	Mostly true
1	I have at least one close friend	0	1	2
2	My friendships with other young people last a long time	0	1	2
3	I find it easy to make friends	0	1	2
4	Other young people choose me to be on their team at school or work	0	1	2
5	Other young people invite me to their homes	0	1	2
6	Other young people invite me to their parties or social events	0	1	2
7	I get on well with my classmates or colleagues	0	1	2
8	I am popular amongst other young people	0	1	2
9	Other young people like to sit next to me in class	0	1	2
10	I see my friend or friends at weekends	0	1	2

**Appendix IX: Intervention acceptability questionnaire**

**Young Person Intervention Acceptability Questionnaire**

*Please tick the appropriate answer*

<b>1. How helpful did you find this session?</b>	<b>Not helpful</b>	<b>A little helpful</b>	<b>Very helpful</b>
Introduction and conversational skills I: trading Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conversation skills II: two-way conversations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conversation skills III: electronic communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Choosing appropriate friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of humour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Peer Entry I: entering a conversation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Peer Entry II: exiting a conversation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Get-togethers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good sportsmanship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling teasing and embarrassing feedback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling bullying and bad reputations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling disagreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rumours and gossip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**2. How would you rate the PEERS group overall?**

Not helpful                       A little helpful                       Very helpful

Please let us more about your experience of taking part in the social group:

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**3. Do you feel that the PEERS group helped you improve your social skills?**

No

A little

A lot

Please tell us more:

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**4. Has taking part in the PEERS programme made you feel more confident in social situations?**

No

A little

A lot

Please tell us more:

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**5. Has taking part in the PEERS programme made you feel less anxious about social situations?**

- No                       A little                       A lot

Please tell us more:

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**6. Please tell us what you thought of the online meeting rooms:**

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**7. Please tell us what you thought of the face to face sessions:**

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**8. What did you learn from the Awkward Social Situations Game?**

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**9. Did you enjoy taking part in the PEERS programme?**

No

A little

A lot

Please tell us more:

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**10. Would you recommend taking part in the PEERS programme to a friend?**

No

A little

A lot

Please tell us more:

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**11. Do you feel like you have changed since taking part in the PEERS programme?**

No

Possibly

Definitely

Please tell us more:

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**12. Any other comments or feedback:**

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## Parent Intervention Acceptability Questionnaire

*Please tick the appropriate answer*

1. How helpful did you find this session?	Not helpful	A little helpful	Very helpful
Introduction and conversational skills I: trading Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conversation skills II: two-way conversations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conversation skills III: electronic communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Choosing appropriate friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of humour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Peer Entry I: entering a conversation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Peer Entry II: exiting a conversation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Get-togethers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good sportsmanship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling teasing and embarrassing feedback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling bullying and bad reputations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling disagreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rumours and gossip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Where do go from here	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. How would you compare your daughter's social ability prior to PEERS with her social ability now:

- Worse                       The same                       Improved

Please tell us more:

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**3. For your daughter, this intervention was:**

- Not helpful       A little helpful       Very helpful

Please let us know what you found helpful or unhelpful:

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**4. The parent training group was:**

- Not helpful       A little helpful       Very helpful

Please let us know what you found helpful or unhelpful:

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5. Overall, how would you rate the PEERS group that your daughter attended?

- Not helpful       A little helpful       Very helpful

Please tell us more:

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**6. Please tell us what you thought of the online meeting rooms:**

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**7. Please tell us what you thought of the face to face sessions:**

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8. Is there anything we could have done differently?

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9. Would you recommend taking part in the PEERS programme to other families?

- No                       Possibly                       Definitely

Please tell us more:

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## **Appendix X: Intervention acceptability questionnaire answers**

### **Parent Answers**

How would you compare your daughter's social ability prior to PEERS with her social ability now?

She is more open to joining in conversations and asking 'open questions'. More eye contact. Not taking 'no' as a personal rejection. Try again to arrange alternative dates.

Holly wouldn't organise get-togethers as she was worried about rejection. She now knows that most of the time it's not rejection, but the other person is busy at that particular time. She is now confident enough to suggest more dates etc. She is actually excited to arrange social things with one friend at a time as she finds this better for herself.

Her confidence on slipping in and out of conversations has improved and able to say no to less helpful relationships. Able to discuss things more openly at home as to what is and isn't working for her.

Vicki has become more aware that she can do something about her 'social awkwardness' (her words) rather than accepting it as the way things are. It is still difficult and she is great at finding excuses but she is trying.

As she is at university it is difficult to monitor the detail of her social ability, however I know she has gone outside her comfort zone in making social arrangements.

I think she's more likely to take the initiative to organise social events. Better within a two-way conversation.

The study has opened up to us both (and the family) the opportunity and freedom to discuss the most common issues she faces. She is more aware of the social issues.

For your daughter, this intervention was:

Practicing what we have discussed in 'role plays'. Learning from other mums experiences. Be positive, take things at own pace. Encouraging change.

Holly found 'slipping in and out' of conversations very helpful, both in person and on the telephone.

Confidence building. Seeking out new activities. Able to distinguish between good and bad relationships better. Able to say no without as much anxiety that she's upsetting the other person. Handling and willing to have disagreements.

Helpful: Finding groups with common interests, slipping in and out of conversations, handling disagreements, rumours

Meeting new people and being able to discuss social difficulties. Seeing steps written down.

Discussing common patterns of behaviour. Building social skills to make a keep friendships going.

Discussing her issues with the other girls. Sharing the ideas and how to put them into practice. Building confidence through the process.

The parent training group was:

Talking about our daughters and their behaviours. Learning how to encourage from a distance. Recognising that I am not alone, great new support network.

All of our lessons have been very helpful. The support from Ellie and Hayley and all the other mums has been the best thing about the whole thing.

Nice to have guidelines and practices to follow - that I would even use with sibling. Helps open up a number of conversations previously not had. Actually showed she already has a number of skills, just needed the guidelines and push to have confidence to use.

Support for stepping back and stepping in. Sharing experiences: good and bad. Encouragement of how much being achieved.

Sharing experiences with other parents. Going through same topics with daughters and then having to give feedback the following week opened up the channels of communication at home which I hope will continue. Seeing the 'rules' or 'steps' of communication written down to help us break up a task so you can see what worked and what needs changing.

Again, finding the common behaviour patterns. Opening up the opportunities to discuss social issues because it's been instigated by the SOAR study and not by us.

Sharing experiences and ideas with other parents/mums/ All the lessons were relevant in some way or another. Helpful tools for the future for both my daughter and myself.

Overall, how would you rate the PEERS group that your daughter attended?

Has made her more positive and confident. Given her tools to use, open questions, dealing with disagreements etc.

Holly has grown in confidence. She has really enjoyed being part of the group.

Very helpful and great to meet and discuss similar issues with other parents and 'bounce' ideas off each other, especially regarding activities

Creating connections and the support they give each other. Getting the chance to practice in a safe environment. Another significant adult telling her tactics which would help with her social challenges.

Having an automatic group to support each other. Even if it is not the aim, she now has an extended social life. As above, it opened up the channels of communication. Whereas in line with others in the group, she has been reluctant to talk about some things, now we do talk more. Anna has said she has liked the steps of communication written down.

We've learnt a lot of skills and mechanisms for social situations and behaviour within friendship groups

Excellent programme dealing with an area of Turner's Syndrome that is rarely covered. It built her confidence to try to join groups, make calls and plans and not to be too worried if someone says no. The sharing of experiences has really helped to open up the topics for us to discuss.



**Please tell us what you thought of the online meeting rooms:**

Once worked out how to log on they were a great way to communicate. The breakaway sessions were good to exchange thoughts and ideas.

Apart from all our weekly technical difficulties! The sessions were a really good way of catching up on progress/outcomes rather than having to meet in person.

Online meetings practical and a good way to keep things on track.

Once we got used to them I think they worked really well. We needed the face to face sessions in between to develop relationships between us. Well-structured and well presented.

This worked well subject to tech issues. Once we learned the best way to use it over the first 2 weeks or so it was then peoples home tech issues.

I thought they were okay, better than expected. Very easy to chat and discuss all the lessons. It would have been nice to meet face to face for all the sessions, but this was definitely the next best thing.

Good to have parents in one room and girls in the other. Gave the atmosphere of a 'hub' for them and a forum for honest thoughts from us.

**Please tell us what you thought of the face to face sessions:**

Great opportunity to meet other parents.

Really enjoyable. As a group it gave us the opportunity to bond over our mutual interest in our girls' progress. Sharing our experiences has been so so helpful, getting ideas/suggestions on certain aspects of the girls' lives.

Found the face to face more useful but obviously the practicality of travelling difficult.

They really helped us bond together as a group and gave us the opportunity to share thoughts and ideas. Well-structured and well presented.

Vital to the group bonding. Ellie and Hayley led well.

Great. Really friendly and relaxed, but informative. Good lesson structure, allowing for plenty of time for discussions.

Easier and we covered more. Good to start with face to face to get to know each other better first.

**Suggestions for improvement:**

No

No, think the course has been really well implemented.

Maybe slightly more time between online sessions to allow for more practice.

Sharing handouts as soon as the sessions were over would have been useful. Possibly sending out reminders of actions/homework between sessions. Changing some of the Americanisms in the materials (minor point only). Slightly more time between sessions as time went on. Weekly to begin with and then perhaps monthly after first half?

No. Group discussion: weekly sessions to start with and then some bigger gaps to allow more time for the get-togethers. Time of year - more groups start in September.

I can't think of any changes I would make.

Great first attempt. I'm sure it will developed further after all the feedback.

**Would you recommend it to other families?**

I had never met anyone else with Turners and no parents. The chats I have had have helped me identify my daughter's characteristics are Turners related and enabled me to adapt and change how I deal and help XX. We will hopefully be attending the conference in October.

I have even suggested it to a friend but unfortunately she wouldn't be able to make the timing during the week.

Absolutely would recommend

This has been a fantastic experience for my daughter and me. It should be something that is offered to all girls with TS in late teens/early 20s to help them with life skills that will help them at works/university.

The more girls with TS and families understand about their strengths and challenges and the more you can talk about it, I believe the better the long term outcomes for those with TS.

This is a valuable course, appropriate for all young people as well as girls with Tuners.

Yes, but it may be too subtle for some of the girls I have met who are extremely socially awkward or suffer with very low self-esteem.

## Young Person answers

### **Please let us know what you found helpful or unhelpful**

It will definitely help me as I feel very inadequate when it comes to social situations, this will help me and guide me through them much more effectively.

The group has helped me to be more confident and come out of my shell - thank you!

I really enjoyed the course and found it very helpful. Some of the stuff might be more relevant to younger people (such as when discussing sportsmanship) but could be helpful for people my age too.

The group was very useful in forcing me to put more effort into arranging get-togethers when I might not have before. It has also increased the contact I have with friends who don't live nearby.

I made new friends which was great! It was good that I was able to learn and gain information on different social situations/difficulties. Even if I haven't been able to use it during the group I now have that knowledge and can use it when appropriate in the future.

It has reminded me and made me think of better ways to handle different situations. It's given me more confidence for handling these situations and even allows me to give advice to others about what they could do better.

This PEERS group has given me the courage to organise get-togethers. It has put me out of my comfort zone which has been good for me. These techniques will help me when making friends in the future.

### **Do you feel that the PEERS intervention helped you improve your social skills?**

It helped me by introducing me to cover stories and the steps needed to enter and exit a conversation.

I feel like I have more conversations and have more input as well.

Helped by giving me information and making me step back and think about how I socialise and how that relates to the tips.

I think about things more in social situations and I put more effort into contacting friends and arranging get-togethers.

Few of the issues covered, such as rumours and gossip and good sportsmanship, applied to me specifically. However, I hope that I could use the skills to become an even better sport and deal with rumours or gossip even better at the relevant opportunities, for example.

It has made me think of better ways of dealing with social situations.

I have more courage to make friends

**Has taking part in the PEERS programme made you feel more confident in social situations?**

It has shown me that I am not the only one who struggles in social situations.

I feel like I am included more and I have a lot more to say rather than sitting in the corner and being shy.

It has helped me feel more confident but I still overthink social situations a lot.

I feel that I now have ideas and rules to fall back on when I feel awkward or I don't know what to do.

The entering and exiting a conversation sessions I think have helped me be more confident about joining conversations, especially where the number of people I know is limited.

It's given me confidence to handle different situations in the right way, knowing that I know how to handle them.

Yes, I know some techniques to help with this.

**Has taking part in the PEERS programme made you feel less anxious about social situations?**

It has helped me feel less awkward about exiting a conversation.

It has helped me to come out of my shell and be more confident.

In some aspects it has, such as exiting and leaving conversations, but I'm still constantly worried I've done something to annoy the other person when logically I know I haven't.

I now don't worry about things as much, as I now have a set of rules and ideas to help me.

I am more confident that I could deal with situations better, some issues such as difficulty hearing will always make me a bit anxious about social situations but PEERS has definitely helped.

Social situations will still be slightly nerve-racking (like if it is a party with a lot of people you don't know) but it's given me the reassurance and confidence that I can handle them.

Yes, before this I used to not like organising get-togethers but now I have more courage to organise them.

**Please tell us what you thought of the online meeting rooms:**

An interesting way of meeting and effective at delivering the lessons/programme.

Helped me to improve my skills on a video call.

I liked them. Found them relatively easy to use.

The online meeting rooms worked really well, especially with everyone's busy schedules. I'm not sure I would have been able to take part if we had to go to London every week. There were very few technical issues and the ones that we did have were sorted quickly.

The online meeting rooms were really good and easy to use once set up after the first session in London. Only issue would be that it would seem I couldn't use my Bluetooth headphones with it which would have been useful.

Really interesting, I think it's a good way of connecting people without worrying about a location or transport. They were especially useful during the week where you're busier.

I think this was a good method of communication because we all live in different parts of the country.

**Please tell us what you thought of the face to face sessions:**

It was nice to meet other girls who also have TS for the first time who also found social situations difficult.

Helped me to put some of the things that we learned into practice and helped me to meet new people.

I really enjoyed them.

The face to face sessions worked really well and generally they were easy to work around and I could make sure I was available for them.

Really good and really enjoyable with lots of laughs.

I really enjoyed how interactive they are, it was nice to speak with the other young people in person. It really helped with certain topics (e.g. the slipping in and out of conversations) where role play and practice was useful.

I thought they were good and I've got to know the other members of the group. It was nice to practice the techniques with supportive members of the group.

**What did you learn from the awkward situations game?**

That there are ways of dealing with them.

That it's ok for situations to be awkward and helped develop awkward situation skills as well.

Tips on how to deal with different situations and why each option might/might not work.

I learnt that your gut reaction might not always be right but when you think about it logically it is easier to find the best solution.

There's rarely one right answer, it often depends on the specifics from which you should make a judgement.

It was a good way to reflect on how I would deal with different situations. Usually I did find myself being a mixture of two options.

I will know what to do in these situations.

**Did you enjoy taking part in the PEERS programme?**

It was highly beneficial for me!

Helped me gain confidence.

I found it really fun and really helpful and the team running it were all lovely.

Everyone was really nice on the programme and I learnt a lot.

I made friends and really enjoyed it and there were lots of laughs.

I met other people similar to me and had fun discussing different topics with them.

Everybody was really friendly and I have benefitted a lot from doing this.

**Would you recommend taking part in PEERS to a friend?**

It is a programme that all who struggle socially could consider.

If they feel like they struggle with social situations, then I would tell them.

Because it can be very helpful, even if it only makes you step and consider your own behaviour.

I thought it was very useful and it makes you think about things more and encourages you to improve friendships and create more friends.

If I knew someone who was really struggling I would definitely recommend. I think its effectiveness would possibly be more limited for someone who is mostly there and not struggling quite as much.

Even if you feel relatively confident in social situations and with your social skills it's good to be reminded of how to handle situations in the right way.

Yes, I would because it's helped me.

**Do you feel like you have changed since taking part in the PEERS programme?**

I have become a little bit more confident in social situations.

My family and teachers at college have noticed a confidence boost.

I feel like I've changed a little bit and want to work to keep improving after the course.

I feel better equipped to make friends at uni and I have put more effort into my existing friendships.

I don't think my friends would say I've changed that much but I haven't quite had the opportunity to put some of the skills into proper practice yet.

I feel more confident in my ability to socialise and recognise when things aren't right and how to deal with that.

I have become less anxious about making friends and before I wouldn't have the courage to meet up with friends.

**Any other comments or feedback:**

Would recommend to anyone!!

Thank you for running this, it has helped me gain confidence as well as bring out the confidence I did not know I had!

I felt that the beginning of the bullying part, e.g. what is a bully, was possibly not needed as it's fairly self-explanatory but the advice on dealing with them is good.

More practical application would have been good as far as it's possible - the practice entering and exiting conversations was particularly good.

I think that perhaps the programme is more useful to younger teenagers (14/15) purely because they might have more time to change how they deal with situations or change their reputation as they're still in school and they aren't so busy. Also, they'll be able to find more clubs and activities suited to their age group.

A really good programme and I would definitely recommend this.

## **Appendix XI: Publications arising from this thesis**

1. Wolstencroft, J., & Skuse, D. (2019). Social skills and relationships in Turner syndrome. *Current Opinion in Psychiatry*, 32(2), 85-91. <https://doi.org/10.1097/YCO.0000000000000472>
2. Wolstencroft, J., Robinson, L., Srinivasan, R., Kerry, E., Mandy, W., & Skuse, D. (2018). A systematic review of group social skills interventions, and meta-analysis of outcomes, for children with high functioning ASD. *Journal of Autism and Developmental Disorders*, 48(7), 2293-2307. <https://doi.org/10.1007/s10803-018-3485-1>
3. In press: Wolstencroft, J., Mandy, W., & Skuse, D. (2019). Experiences of social interaction in young women with Turner syndrome: a qualitative study. *Child: Care, Health and Development*. <https://doi.org/10.1111/cch.12710>
4. Wolstencroft, J., Mandy, W., & Skuse, D. (2018). Protocol: New approaches to managing the social deficits of Turner Syndrome using the PEERS program. *F1000Research*, 7. <https://doi.org/10.12688/f1000research.15489.2>





# Social skills and relationships in Turner syndrome

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*Jeanne Wolstencroft and David Skuse*

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# A Systematic Review of Group Social Skills Interventions, and Meta-analysis of Outcomes, for Children with High Functioning ASD

J. Wolstencroft<sup>1</sup> · L. Robinson<sup>2</sup> · R. Srinivasan<sup>1</sup> · E. Kerry<sup>1</sup> · W. Mandy<sup>3</sup> · D. Skuse<sup>1</sup>

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## Abstract

Group social skills interventions (GSSIs) are a commonly offered treatment for children with high functioning ASD. We critically evaluated GSSI randomised controlled trials for those aged 6–25 years. Our meta-analysis of outcomes emphasised internal validity, thus was restricted to trials that used the parent-report social responsiveness scale (SRS) or the social skills rating system (SSRS). Large positive effect sizes were found for the SRS total score, plus the social communication and restricted interests and repetitive behaviours subscales. The SSRS social skills subscale improved with moderate effect size. Moderator analysis of the SRS showed that GSSIs that include parent-groups, and are of greater duration or intensity, obtained larger effect sizes. We recommend future trials distinguish gains in children’s social knowledge from social performance.

**Keywords** Social skills · Social competence · Social responsiveness scale

## Introduction

The social difficulties in autism spectrum disorders (ASD) are characterized by deficits in social cognition, interaction and communication (American Psychiatric Association 2013). These deficits are often referred to collectively as

*social skills* difficulties. The term *social skills* is a complex and multi-faceted construct.

## Definitional Issues

Many competing definitions and theoretical models of social skills exist (Elliott and Gresham 1987; Gresham 1986; Merrell and Gimpel 2014; Nangle et al. 2010), but the core features invariably include behaviours that are performed in a social context (McFall 1982) and entail person to person engagement (Cordier et al. 2015).

Social skills deficits are an important target for intervention because they have a significant impact on academic, adaptive and psychological functioning (Coie et al. 1995; Elliott et al. 2001; Spence 1995). Group social skills interventions (GSSIs) are often recommended for children with high functioning ASD. As their name indicates they aim to improve social skills, suggesting that well-designed programmes aim to improve both social performance and social knowledge. Their use has increased substantially in the last 15 years (Volkmar et al. 2004; Reichow and Volkmar 2010; Reichow et al. 2012; Kasari et al. 2012; Matson et al. 2007).

The content, teaching strategy, mode of delivery and intensity of therapy provided by GSSIs is variable. Manualised group GSSIs typically include behavioural modelling of a specific social skill, practising the skill through role-play and individualised feedback on performance. Some

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✉ J. Wolstencroft  
j.wolstencroft@ucl.ac.uk

L. Robinson  
lauren.robinson@kcl.ac.uk

R. Srinivasan  
ramya.srinivasan.12@ucl.ac.uk

E. Kerry  
ellie.kerry@ucl.ac.uk

W. Mandy  
w.mandy@ucl.ac.uk

D. Skuse  
d.skuse@ucl.ac.uk

<sup>1</sup> The Great Ormond Street Institute of Child Health, University College London, 30 Guilford Street, London WC1N 1EH, UK

<sup>2</sup> Institute of Psychiatry, King’s College London, 103 Denmark Hill, London SE5 8AF, UK

<sup>3</sup> Division of Psychology and Language Sciences, Faculty of Brain Sciences, University College London, 1-19 Torrington Place, London WC1E 6BT, UK



teaching strategies are ‘didactic’, with structured lessons. Others elicit social skills through play; these are called ‘performance’ interventions (Kaat and Lecavalier 2014). The mode of delivery differs between GSSIs, and can require a combination of parent, peer or teacher involvement. Some programmes are intense, requiring 12 or more 90 min sessions, delivered weekly. Others require attendance at summer camps.

### Effectiveness of GSSIs

Despite the popularity of GSSIs, evidence for their effectiveness is limited (Schneider 1992; Beelmann et al. 1994), in part because of weak study methodology (White et al. 2007; Cappadocia and Weiss 2011; Ferraioli and Harris 2011; Rao et al. 2008; Reichow and Volkmar 2010; McMahon et al. 2013). Objective analysis has been hindered because outcomes are often measured by just one mode (e.g. questionnaire or observation) and by a limited range of informants (often parents, and/or teachers). Both the choice of outcome measures and the choice of informants can influence expectancy biases and mask or exaggerate treatment effects (McMahon et al. 2013). Parents are the most commonly used informants, but their reports are prone to expectancy bias (McMahon et al. 2013). They may also find it difficult to characterise their child’s social limitations in comparison to other (typical) children (Schneider and Byrne 1989).

Besides parents, other potential sources of information about treatment effectiveness include ratings of outcomes by the participants themselves, the study’s own administrators, teachers, peers, study staff and blind observers. Teachers and blinded study administrative assessors can report on whether changes of performance generalise to other settings, outside the family (White et al. 2007; Gates et al. 2017). Self-report is particularly valuable to evaluate gains in social knowledge.

### Outcome Measures

Whilst blind-rated observations of behavioural change are potentially the most objective measures of outcome, questionnaires are used more frequently (Kaat and Lecavalier 2014). Questionnaires can yield biased data, for instance if rated by parents who are subject to expectancy effects. For that reason, they are sometimes combined with cognitive measures, behavioural observations and sociometric tasks (McMahon et al. 2013; Kaat and Lecavalier 2014). Each mode of reporting has advantages and disadvantages. Observations invariably encompass only a brief period of data collection, in limited environments, so may lack external validity unless repeated observations are obtained in different settings. In contrast, self-report of increases in knowledge and parental-reports of behavioural change, whilst reflecting

broader environmental contexts, are both subject to positive expectancy biases. Teacher reports, whilst less subject to expectancy bias, may in contrast reflect a lack of sensitivity to real change, due to limited opportunities to identify social behaviour and potential problems associated with their interpretation and scoring of measures.

Gresham (1997) made a useful distinction between social skills *acquisition* deficits (an individual lacks the knowledge to perform a social behaviour) and social skills *performance* deficits (the individual has relevant skills knowledge but fails to apply that knowledge in real-life situations). There is evidence to support a theoretical distinction between social performance and social knowledge (Lerner and Mikami 2012; Lerner et al. 2012; Lerner and White 2015).

Several recent reports have conducted meta-analyses on the effectiveness of GSSIs (Gates et al. 2017; Reichow et al. 2012). Reichow et al. (2012) found evidence for modest improvements in social competence on both parent-report measures and self-report measures of friendships. Gates et al. (2017) found self-reports of knowledge acquisition were associated with large effect sizes in contrast to small effect sizes for parent and observer reports of performance (both blinded and non-blinded). Non-significant effects were observed for teacher reports. The self-report effect sizes appeared to be driven by increases in social knowledge rather than improvements in social performance (Gates et al. 2017). As indicated, a risk with participants rating themselves is that they tend to overestimate perceived improvements in their social skills (Gates et al. 2017; Kaat and Lecavalier 2014).

In this review, the assessment of social skills acquisition is focused on changes in *social performance* as measured by parental report, because the GSSIs meeting our criteria for inclusion had in common parent-rated outcomes. We acknowledge that a more complete account would include *social knowledge acquisition* (Gresham 1997) but the relevant data were lacking. Parents are the most frequently used informants. Among parent-rated measures employed by studies of GSSI effectiveness, the social responsiveness scale (SRS) (Constantino and Gruber 2012) and the social skills rating system (SSRS) (Gresham and Elliott 1990) predominate (Crowe et al. 2011; Kaat and Lecavalier 2014; Matson and Wilkins 2009).

To date, GSSI reviews have assumed that diverse social skills outcome measures reflect the same underlying constructs, hence they have assumed that it is legitimate to combine the scores of a wide range of different tools for the purpose of outcome analysis (Reichow et al. 2012; Gates et al. 2017). As discussed, because social skills encompass distinct dimensions of, at least, social knowledge and social performance, this approach is not ideal (Kaat and Lecavalier 2014). We have taken advantage of the fact there are recently published well-designed studies on performance

change using the same outcome measures (SRS and/or the SSRS), hence an opportunity to conduct a new meta-analysis with higher internal validity.

## Aims

In this review, we conducted a meta-analysis focussed on individual parent-report measures of outcome, with a focus on the degree to which change in SRS and/or SSRS scores is mediated by a GSSI.

There has been no systematic review of the GSSI teaching syllabus content (Koenig et al. 2009). Few manualised intervention programmes have been published, but it is thought that intervention-specific factors such as treatment duration, intensity, teaching strategy (e.g. didactic or performance) and parental involvement may moderate program success (Reichow et al. 2012; McMahon et al. 2013). We thus also aimed to evaluate whether intervention-specific factors such as type of parent group, method of delivery, or duration have a moderating impact on specific aspects of social knowledge or performance improvement, by means of moderation analysis.

We hypothesised that specific dimensions of social skills are responsive to specific aspects of GSSI, providing support for the relative strengths (and weaknesses) of different GSSI programmes.

## Methods

### Literature Search

Online electronic searches were conducted on the EMBASE, Medline (Ovid), PsycINFO and CINAHL databases in December 2016. Eligibility criteria included medical subject heading (MeSH) key terms including ‘social skills’ and ‘group interventions’, as well as filters for the age of participants (filters overlapping with a 6–25 years age range) and the language of publication (English language). The complete search strategy can be found in the supplementary materials. The reference lists of studies included in the electronic search were screened to identify additional studies.

### Box 1 Properties of the SRS and SSRS

The SRS and the SSRS are both norm-referenced questionnaires. They can be completed in 15–20 min. Both assessments predominantly focus on social performance. The SRS was designed to measure autistic traits quantitatively and the instrument has convergent validity with other ASD diagnostic tools (Constantino and Gruber 2012). The SSRS was designed to provide a comprehensive picture of social behaviour rather than specific ASD traits (Gresham and Elliott 1990). The SRS subscales comprise social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviour (RRB). The SSRS subscales examine social skills (including cooperation, assertion, self-control, responsibility) and problem behaviours (including externalising behaviours, internalising behaviours and hyperactivity).

## Inclusion and Exclusion Criteria

### Systematic Review

Two independent reviewers (JW and EK) rated the abstracts against the eligibility criteria. Disagreements between reviewers were resolved through discussion. A third independent reviewer was available for further consultation if consensus could not be reached, but was not required. Published studies were eligible if they met the following criteria: (1) randomised control trials (RCT) using a delayed treatment control group (2) multi-modal group social skills intervention including two or more children delivered by professionals (3) participants aged 6–25 years (4) assessment of social skills using the SRS and/or SSRS (Box 1). Only RCTs employing a delayed treatment control group were retained to reduce heterogeneity and increase internal validity.

The exclusion criteria were: (1) interventions conducted or assessed in a language other than English (2) studies including children with intellectual disabilities (Verbal IQ < 70) (3) reviews, conference proceedings, abstracts, theses, or protocols. Studies that were not conducted and assessed in English were excluded in order to reduce the possibility of changes occurring due to translations or the cultural context. Studies including children with ID were also excluded to reduce sample heterogeneity.

### Meta-analysis

The authors of studies using the SRS and/or SSRS were contacted for missing total and subscale scores.

### Quality Assessment: Risk of Bias

Two reviewers (JW and EK) independently assessed the quality of eligible studies employing the Cochrane Collaboration Risk of Bias (RoB) v2 tool (Higgins 2016). The studies were assessed for bias in sequence generation, allocation concealment, baseline measurements, blinding or participants and personnel, blinding of outcome assessments, addressing incomplete outcomes, selective reporting and other potential biases (Higgins 2016) (Supplementary

materials). Any disagreements between reviewers were resolved through discussion and consensus was reached on all ratings.

## Data Extraction

Two reviewers independently extracted data (JW and EK) using a bespoke data extraction spreadsheet. The extraction spreadsheet is available from the authors upon request. Data were extracted on the intervention characteristics, patient characteristics, parental outcome measures used, and subsequent outcome scores. Authors were contacted for additional information when necessary.

Authors were contacted to provide total scores and subscale scores of the SRS and SSRS that were not published. The co-variables were the intervention type, duration (in hours), intensity (weekly vs summer camp), teaching strategy (didactic vs performance) and whether (yes/no) there was parental involvement in the intervention.

## Data Analysis

### Meta-analysis

Statistical analysis was conducted using STATA 14. The standardized mean difference (SMD) and 95% confidence interval for each outcome measure were used as a summary statistics. The post treatment measures of the treatment and delayed control groups were compared across studies. The SMD was interpreted as a small effect size for values of 0.20–0.50, moderate for values of 0.50–0.80, large for values of 0.80–1.30 and very large for values above 1.30 (Cohen 1988).

The random-effects model was used, as heterogeneity was suspected in the data. Heterogeneity was assessed using the Higgins heterogeneity  $I^2$  statistic. The degree of heterogeneity was considered low for values of 25–49%, moderate for values of 50–74% and high for values of 75% or more (Higgins et al. 2003). Statistically significant heterogeneity was assumed when  $p < 0.05$ .

### Sensitivity Analyses

Publication bias was assessed using funnel plots with Egger's test, and the trim and fill method (Egger et al. 1997).

## Results

### Study Selection

#### Systematic Review

The electronic search returned 593 articles after duplicates were removed. Additional articles were identified through correspondence with authors and by screening reference lists of review articles picked up in the initial screening search. Studies were excluded if they did not fit the inclusion criteria or did not fit this review's definition of group social skills interventions (Fig. 1). The screening process reduced the number of eligible articles to 123 that were fully assessed for eligibility. 10 studies that met criteria for eligibility were retained for qualitative synthesis.

#### Meta-analysis

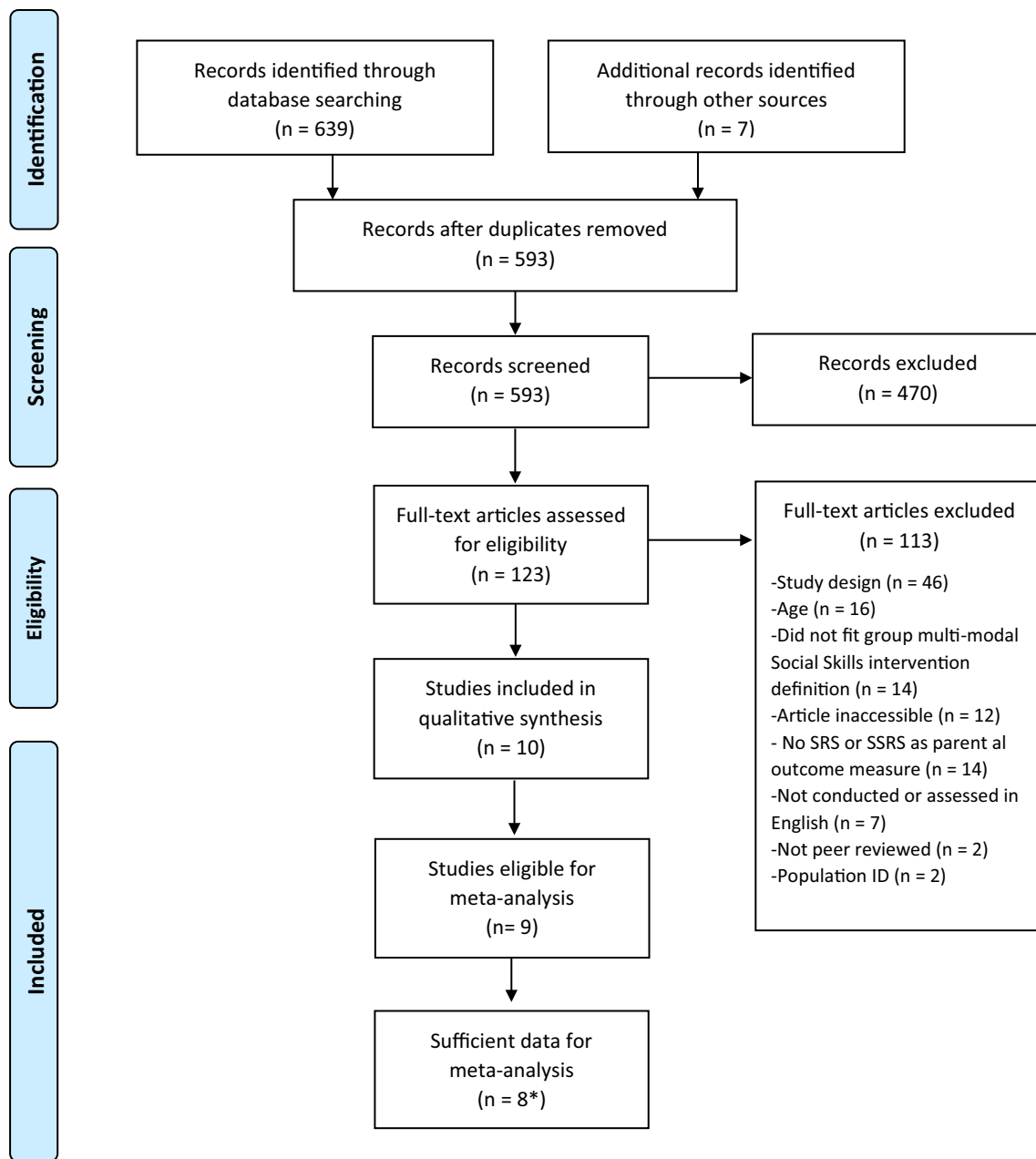
The use of outcome measures was assessed in the 10 studies retained for qualitative synthesis. The authors were contacted for unpublished total and subscale scores. Following this correspondence there were sufficient data to conduct meta-analyses on 8 studies (5 used the SRS, 1 used the SSRS and 2 used both the SRS and SSRS).

## Qualitative Synthesis

### Intervention Characteristics

Five different types of intervention programmes were used, including established protocols such as PEERS, Children's Friendship Training, summerMAX and SENSE Theatre; as well as an unnamed manualised Cognitive Behavioural Therapy (CBT) social skills programme. The programmes varied by teaching strategy, parent assistance, duration and intensity (Table 1). All but one of the programmes (SENSE Theatre) took a didactic teaching approach. SENSE theatre was the only GSSI to employ a performance teaching strategy.

All GSSIs ran children groups, most interventions also ran parallel parent groups. Only the SENSE Theatre and the unnamed CBT social skills programme did not run parent groups (the CBT intervention did provide a handout for parents). The summerMAX and the SENSE Theatre programmes ran intense summer-camp style interventions where participants were required to attend 4–5 h of training 5 days a week for 2–5 weeks. The other programmes were less intensive and comprised 60–90 min sessions once a week for 10–16 weeks.



**Fig. 1** Prisma flow diagram. \*Eight studies used the SRS (n = 5), the SSRS (n = 1) or both (n = 2)

The syllabuses of GSSIs varied. Each GSSI emphasised different domains of social skills. These included social knowledge, social communication, social cognition and social emotions. Specifically, the interventions taught social rules and social cues, pragmatic language skills, cognitive social skills including problem solving, cognitive flexibility, social perception and/or perspective taking. All but PEERS taught non-verbal skills, such as social eye contact, facial expression, posture and social distance. Only the summerMAX programme focussed explicitly on self-perception (e.g. understanding one's own emotions).

Only SENSE theatre and PEERS addressed the issue of affect regulation (e.g. how to be a good sport, controlling emotional impulses or anxiety).

### Assessment Characteristics

Although the programmes selected for this meta-analysis must have employed the SRS/SSRS, other parent-rated measures included the adapted skillstreaming checklist (ASC), the empathy (EQ) and the behavior assessment system for children–parent rating scales (BASC-PRS-2)

**Table 1** Intervention characteristics

Article	Intervention	M age	N	Number of sessions	Teaching Strategy	Additional input	Parent
Corbett et al. (2016)	SENSE theatre	11.27	30	240 min/10 sessions	Performance	Peer assisted	- SRS - ABAS
Gantman et al. (2012)	PEERS young adults	20.4	17	90 min/14 sessions	Didactic	Parent group	- SSRS - SRS - EQ - QSQ
Koning (2013)	Not named—CBT social skills	11.07	15	120 min/15 sessions	Didactic	Parent handout	- VABS-2 - SRS
Laugeson et al. (2009)	PEERS	14.6	33	90 min/12 sessions	Didactic	Parent group	- SSRS - QPQ
Laugeson et al. (2015)	PEERS young adults	21.39*	22	90 min/16 sessions	Didactic	Parent group	- SRS - SSRS - QSQ - EQ
Lopata et al. (2010)	Adapted skillstreaming	9.47	36	350 min/5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS - BASC-2-PRS - Satisfaction survey
Schohl et al. (2014)	PEERS	13.65	58	90 min/14 sessions	Didactic	Parent group	- QSQ - SRS - SSRS
Thomeer et al. (2012)	Adapted skillstreaming	9.31	35	350 min/5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS - BASC-2-PRS - Satisfaction survey
Thomeer et al. (2016)	summerMAX	9.15	57	350 min/5 days per week for 5 weeks	Didactic	Parent group	- ASC - SRS-2 - BASC-2-PRS - Satisfaction survey
Waugh and Peskin (2015)	SSToM CFT	9	49	SSToM: not disclosed CFT: 60 min/10 weekly sessions	Didactic Didactic	Parent group Parent group	- SRS-2

Interventions—*CFT* children's friendship training, *PEERS* program for the education and enrichment of relational skills, *SENSE theatre* SENSE theatre, *SSToM* social skills and theory of mind

Parent outcome measures—*ABAS* adaptive behaviour assessment schedule, *ASC* adapted skillstreaming checklist, *BASC-2-PRS* behavior assessment system for children—parent rating scales, second edition, *EQ* empathy quotient, *QSQ* quality of socialisation questionnaire, *QPQ* quality of play questionnaire, *SRS* social responsiveness scale, *SSRS* social skills rating scale, *VABS-2* vineland adaptive behaviour system, second edition

(Table 2). We have not examined the psychometric properties of any of these assessment instruments in detail (see Cordier et al. 2015; Matson and Wilkins 2009 for comprehensive reviews).

All of the studies retained for qualitative synthesis used more than one type of informant, not only parents but also the participants themselves, study staff and teachers (Table 2). Two studies reported only on questionnaires completed by parents and participants; five used socio-cognitive tasks and three used an idiomatic language task with participants. Four used self-report questionnaires in conjunction with a socio-cognitive or idiomatic language task. None

used validated self-report questionnaires in conjunction with socio-cognitive tasks; participants are best placed to report on changes in their social knowledge, implying the GSSI studies reviewed here may not be capturing changes in this social skills dimension.

Two studies used teacher-report measures (SRS and SSRS). Two also used observation schedules to measure social performance. Participants were filmed interacting with confederate peers, one was blind-rated. The studies that used staff questionnaires administered satisfaction surveys that were not validated; the questionnaires were completed by non-blind observers.

**Table 2** Assessments by informant type

Article	Parent questionnaire	Self-report questionnaire	Task	Teacher questionnaire	Staff/observation
Corbett et al. (2016)	- SRS - ABAS		- NEPSY - ERP incidental face memory task		- Peer interaction paradigm
Gantman et al. (2012)	- SSRS - SRS - EQ - QSQ	- SELSA - QSQ - TYASSK - SSI			
Koning (2013)	- VABS-2 - SRS	- Social knowledge	- CASP		- Peer interaction measure - Verbal and nonverbal behaviors coding
Laugeson et al. (2009)	- SSRS - QPQ	- QPQ - TASSK - FQS		- SSRS	
Laugeson et al. (2015)	- SRS - SSRS - QSQ - EQ	- QSQ - TYASSK			
Lopata et al. (2010)	- ASC - SRS - BASC-2- PRS - Satisfaction survey	- Satisfaction survey	- DANVA-2 - CASL idioms - SKA		- Satisfaction survey - ASC - SRS - BASC-2-TRS
Schohl et al. (2014)	- QSQ - SRS - SSRS	- TASSK - QSQ - FQS - SIAS		- SRS - SSRS	
Thomeer et al. (2012)	- ASC - SRS - BASC-2-PRS - Satisfaction Survey	- Satisfaction survey	- DANVA-2 - CASL idioms - SKA		- Satisfaction survey - ASC - SRS - BASC-2-TRS
Thomeer et al. (2016)	- ASC - SRS-2 - BASC-2-PRS - Satisfaction survey	- Satisfaction survey	- CASL idioms		- Satisfaction survey - ASC - SRS 2 - BASC-2-TRS
Waugh and Peskin (2015)	- SRS-2		- Revised version of the strange stories test - Theory of mind inventory		

Outcome measures—*ABAS* adaptive behaviour assessment schedule, *ASC* adapted skillstreaming checklist, *BASC-2-PRS* behavior assessment system for children—parent rating scales, second edition, *BASC-2-TRS* behavior assessment system for children—teacher rating scales, second edition, *CASL* comprehensive assessment of spoken language, *CASP* child and adolescent social perception measure, *EQ* empathy quotient, *DANVA-2* diagnostic analysis of nonverbal accuracy2, *FQS* friendship qualities scale, *NEPSY* developmental neuropsychological assessment, *QSQ* quality of socialisation questionnaire, *QPQ* quality of play questionnaire, *SELSA* social and emotional loneliness scale for adults, *SIAS* social interaction anxiety scale, *SKA*: skillstreaming knowledge assessment, *SRS* social responsiveness scale, *SSI* social skills inventory, *SSRS* social skills rating scale, *TASSK* test of adolescent social skills knowledge, *TYASSK* test of young adult social skills knowledge, *VABS-2* vineland adaptive behaviour system, second edition

### Quality Assessment: Risk of Bias

A ‘risk of bias’ analysis was conducted on all the RCTs (Table 3). Two studies obtained a ‘high risk’ rating in four or more of the seven risk of bias criteria; these will be discussed separately. All others obtained a ‘low risk’ or ‘unclear’ rating for the *sequence generation* and *allocation*

*concealment* criteria. The incomplete blinding of outcome by participants, personnel and outcome assessors conferred a ‘high risk’ for all of the studies. A few studies did employ observational outcome measures (where the coders were blind to the participants’ group status) but these were always used in conjunction with outcome measures where the assessors were not blind. The incomplete-outcome

**Table 3** Risk of bias assessment

RCTS	Sequence generation	Allocation concealment	Baseline measurements	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective outcome reporting
Corbett et al. (2016)	Low risk	Low risk	High risk	High risk	High risk	High risk	Low risk
Gantman et al. (2012)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Koning (2013)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Laugeson et al. (2009)	Unclear	Unclear	Low risk	High risk	High risk	High risk	Low risk
Laugeson et al. (2015)	Low risk	Low risk	Low risk	High risk	High risk	High risk	Low risk
Lopata et al. (2010)	Low risk	Unclear	Low risk	High risk	High Risk	Low risk	Low risk
Schohl et al. (2014)	Unclear	Unclear	Low risk	High risk	High risk	High Risk	Low risk
Thomeer et al. (2012)	Unclear	Unclear	Unclear	High risk	High risk	Low risk	Low risk
Thomeer et al. (2016)	Low risk	Unclear	Low risk	High risk	High risk	Low risk	Low risk
Waugh and Peskin (2015)	High risk	High risk	High risk	High risk	High risk	High risk	Low risk

criteria were rated ‘high risk’ for two-thirds of the studies, because of participant attrition from either or both the waitlist control and the intervention groups. The selective-outcome reporting criterion was rated ‘low risk’ in all studies. No other sources of bias were detected.

Two studies, (Corbett et al. 2016; Waugh and Peskin 2015) obtained more ‘high risk’ ratings than others reviewed here. The Waugh and Peskin (2015) study scored ‘high risk’ for all except selective-outcome reporting criteria. The baseline measures were ‘high risk’ because SRS scores differed significantly at baseline between the control and experimental groups, and this study was excluded from the meta-analysis. The Corbett study obtained a ‘high risk’ rating for the baseline measurements criteria due to a discrepancy between control and experimental groups on two outcome measures (theory of mind and delayed faces memory). As this baseline discrepancy did not affect the

SRS or SSRS scores, the Corbett study was retained for analysis.

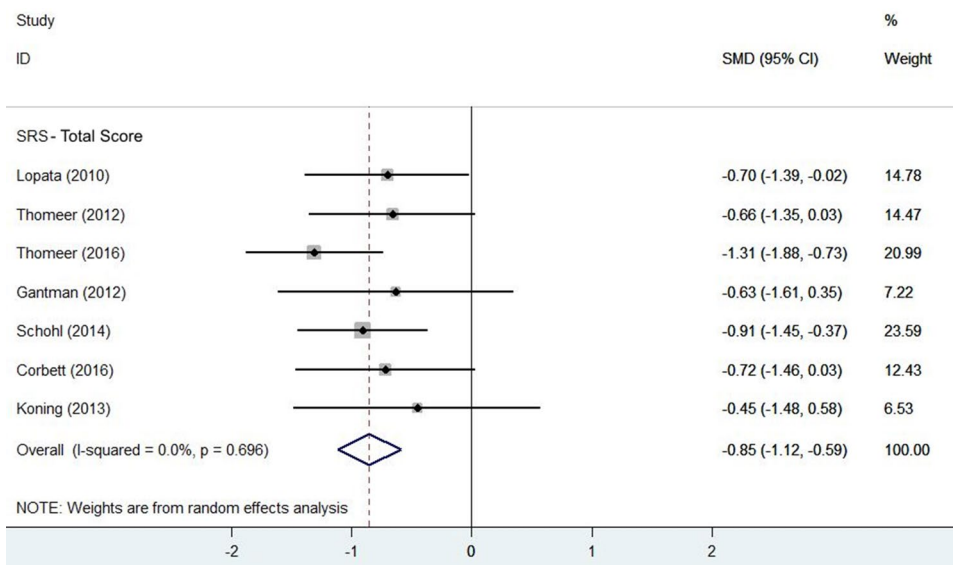
**Meta-analysis**

**Social Responsiveness Scale (SRS)**

A comparison of the treatment and control groups’ post-intervention scores showed GSSI participants obtained better outcomes than controls, with a substantial reduction in SRS total scores (SMD = - 0.85, 95% CI [- 1.12, - 0.59], Z = 6.35, p = 0.000; Fig. 2; Table 4). This is a significant (p < 0.0001) and large effect size.

GSSI participants also improved on all SRS subscales, relative to controls (Table 5). The effect sizes for the social awareness (SMD = - 0.57, 95% CI [- 0.87, - 0.28], Z = 3.78, p = 0.000), social cognition (SMD = - 0.53, 95%

**Fig. 2** Forest plot of SRS total scores



**Table 4** Meta-analysis summary table

Study	n		SRS	SSRS	SSRS
	T	WLC	Total score SMD (95% CI)	Social skills SMD (95% CI)	Problem behaviours SMD (95% CI)
Corbett et al. (2016)	17	13	-0.72 (-1.46, 0.03)	-	-
Koning (2013)	7	8	-0.45 (-1.48, 0.58)	-	-
Lopata et al. (2010)	18	17	-0.7 (-1.39, -0.02)	-	-
Thomeer et al. (2012)	17	17	-0.66 (-1.35, 0.03)	-	-
Thomeer et al. (2016)	28	29	-1.31 (-1.88, -0.73)	-	-
Gantman et al. (2012)	9	8	-0.63 (-1.61, 0.35)	0.47 (-0.50, 1.44)	-0.11 (-1.06, 0.84)
Schohl et al. (2014)	29	29	-0.91 (-1.45, -0.37)	0.45 (-0.07, 0.97)	-0.35 (-0.36, 0.17)
Laugeson et al. (2009)	17	16	-	0.83 (0.12, 1.54)	-1.15 (-1.89, -0.41)
Total			<b>-0.85</b> (-1.12, -0.59)**	<b>0.56</b> (0.18, 0.95)*	<b>-0.55</b> (-1.13, 0.03)

Laugeson 2015 data is not presented in this table as we were not able to gain access to the primary data

T treatment, WLC waitlist control

\*p < 0.05

\*\*p < 0.0001

**Table 5** Meta-analysis SRS total score and subscale effect sizes

Study	Intervention	n		Total score	Social awareness	Social cognition	Social communication	Social motivation	Restricted interests and repetitive behaviour
		T	WLC	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)	SMD (95% CI)
Corbett et al. (2016)	SENSE Theatre	17	13	-0.72 (-1.46, 0.03)	-0.26 (-0.99, 0.46)	-0.6 (-1.34, 0.14)	-0.89 (-1.65, -0.13)	-0.24 (-0.96, 0.49)	-0.49 (-1.22, 0.25)
Koning (2013)	Not named – CBT Social Skills	7	8	-0.45 (-1.48, 0.58)	-0.45 (-1.48, 0.58)	0.32 (-0.70, 1.34)	-0.53 (-1.56, 0.51)	-0.14 (-1.16, 0.87)	-0.85 (-1.91, 0.22)
Lopata et al. (2010)	summerMAX	18	17	-0.7 (-1.39, -0.02)	-0.31 (-0.98, 0.36)	-0.23 (-0.89, 0.44)	-0.76 (-1.45, -0.07)	-0.96 (-1.67, -0.26)	-0.51 (-1.19, 0.16)
Thomeer et al. (2012)	summerMAX	17	17	-0.66 (-1.35, 0.03)	-0.4 (-1.08, 0.28)	-0.43 (-1.11, 0.25)	-0.59 (-1.28, 0.10)	-0.24 (-0.91, 0.44)	-1.04 (-1.76, -0.32)
Thomeer et al. (2016)	summerMAX	28	29	-1.31 (-1.88, -0.73)	-1.1 (-1.66, -0.54)	-1.33 (-1.90, -0.75)	-1.44 (-2.03, -0.86)	-1.35 (-1.93, -0.77)	-1.42 (-2.00, -0.84)
Gantman et al. (2012)	PEERS	9	8	-0.63 (-1.61, 0.35)	-0.57 (-1.55, 0.40)	-0.54 (-1.51, 0.44)	-0.6 (-1.58, 0.38)	0.02 (-0.93, 0.97)	-0.87 (-1.87, 0.13)
Schohl et al. (2014)	PEERS	29	29	-0.91 (-1.45, -0.37)	-	-	-	-	-
Total		125	121	<b>-0.85</b> (-1.12, -0.59)**	<b>-0.57</b> (-0.87, -0.28)**	<b>-0.53</b> (-0.98, -0.09)*	<b>-0.89</b> (-1.2, -0.59)**	<b>-0.55</b> (-1.02, -0.07)*	<b>-0.9</b> (-1.23, -0.57)**

T treatment, WLC waitlist control

\*p < 0.05

\*\*p < 0.0001



CI [- 0.98, - 0.09],  $Z=2.34$ ,  $p=0.019$ ) and social motivation subscales (SMD = - 0.55, 95% CI [- 1.02, - 0.07],  $Z=2.27$ ,  $p=0.023$ ) were moderate. The effect sizes on the social communication (SMD = - 0.89, 95% CI [- 1.2, - 0.59],  $Z=5.71$ ,  $p=0.000$ ) and restricted interests and repetitive behaviours subscales (SMD = - 0.9, 95% CI [- 1.23, - 0.57],  $Z=5.4$ ,  $p=0.000$ ) were large. All subscale effect sizes were significant ( $p<0.05$ ).

Koning et al. (2013; Fig. 3) was the only study not to report improvement in the social cognition subscale.

### Social Skills Rating System (SSRS)

GSSI participants improved relative to controls on the social skills subscale (SMD = 0.56, 95% CI [0.18, 0.95],  $Z=2.86$ ,  $p=0.004$ ) and had better outcomes on the problem behaviours subscale (SMD = - 0.55, 95% CI [- 1.13, 0.03],  $Z=1.86$ ,  $p=0.06$ ; Fig. 4). The effect size for both subscales was moderate, but only the social skills subscale effect was significant.

### Moderator Analysis

Moderator analyses was conducted on the SRS. There were insufficient studies to conduct moderator analyses on the SSRS.

### SRS Group Analysis by Intervention

A post-hoc analysis analysed group differences on the total SRS scores by separating studies according to intervention type (Fig. 5). There was no statistical difference in the total SRS scores between the treatment and control group for the SENSE theatre ( $p=0.06$ ) or the CBT social skills

intervention ( $p=0.39$ ), but sample size was small so there was a potential Type II error. The SENSE theatre intervention obtained a moderate effect size (SMD = - 0.72, 95% CI [- 1.46, 0.03],  $Z=1.88$ ); the CBT intervention had a small effect size (SMD = - 0.45, 95% CI [- 1.48, 0.58],  $Z=0.86$ ).

summerMAX was used in 3 studies and PEERS was used in 2 studies. Participants receiving these interventions obtained better outcomes than controls ( $p<0.0001$ ). Both summerMAX (SMD = - 0.93, 95% CI [- 1.36, - 0.5],  $Z=4.22$ ) and PEERS (SMD = - 0.84, 95% CI [- 1.32, - 0.37],  $Z=3.49$ ) obtained large and significant effect sizes.

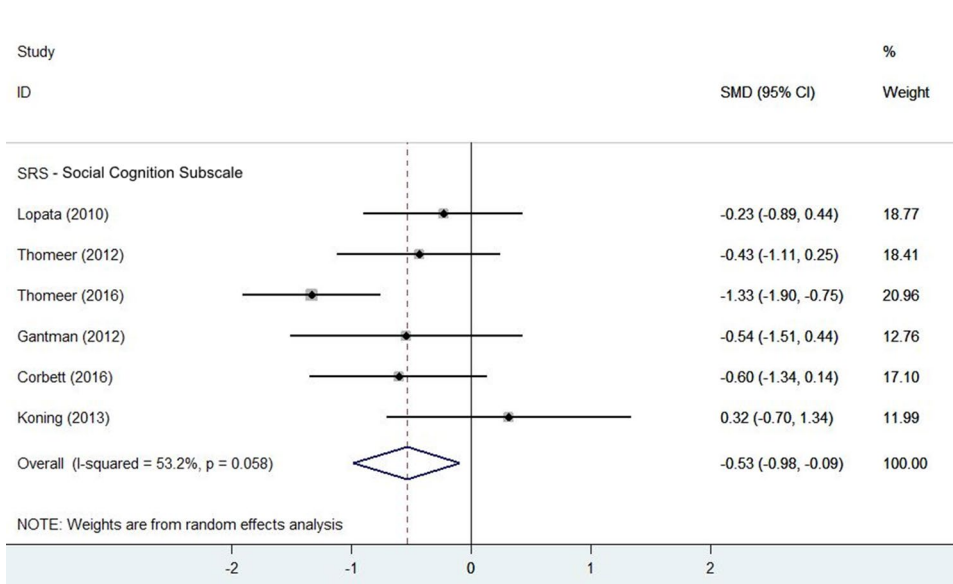
### SRS Group Analysis by Parent Involvement

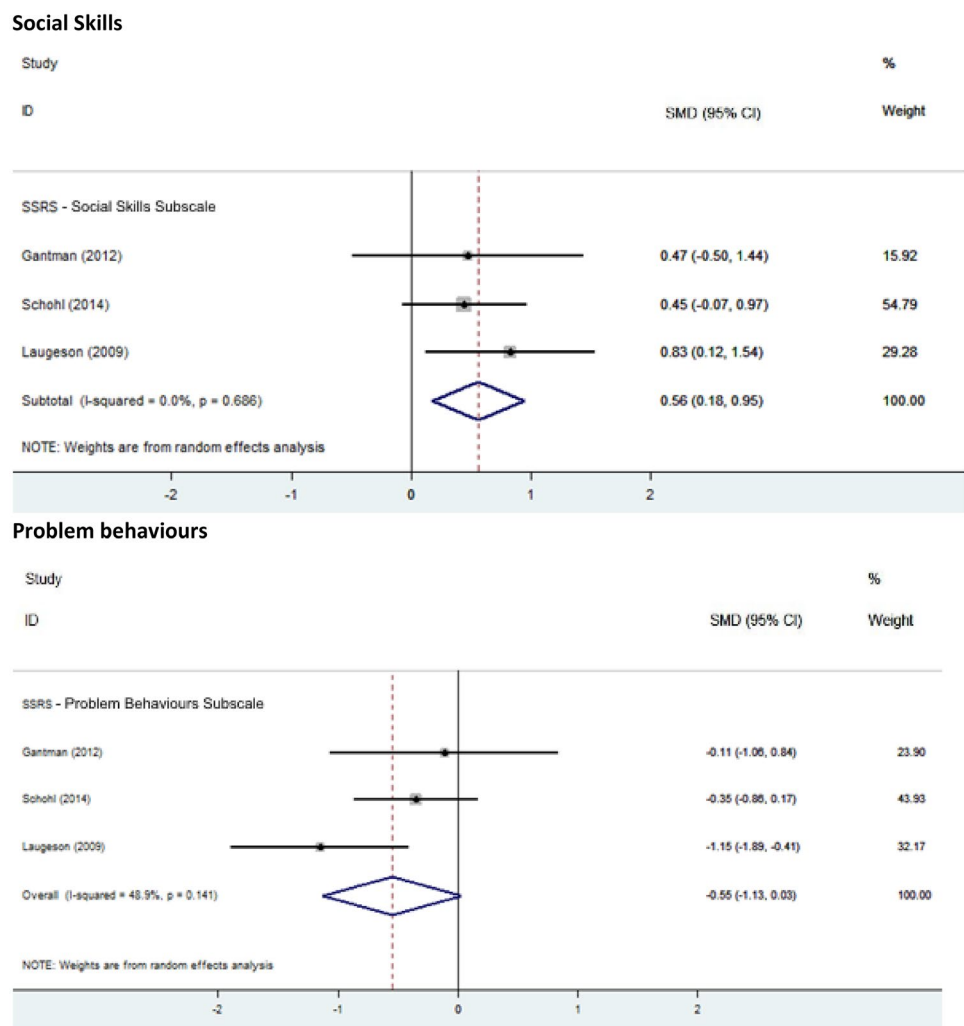
A group analysis was conducted on the total SRS score according to parent involvement. Participants performed better than controls regardless of whether they took part in an intervention that delivered concurrent parent groups, both effect sizes were significant (parent group  $p<0.0001$ ; no parent group  $p=0.04$ ). The GSSIs that delivered parent groups had a large effect size (SMD = - 0.91, 95% CI [- 1.20, - 0.61],  $Z=6.08$ ) whereas the GSSI that did not deliver parent groups had a moderate effect size (SMD = - 0.63, 95% CI [- 1.23, - 0.02],  $Z=2.03$ ; Fig. 6).

### SRS Group Analysis by Intensity and Duration

Group analyses were conducted for the intensity and duration of GSSIs on total SRS scores (Fig. 6). The effect sizes in both the intensity and duration group analyses were significant ( $p<0.0001$ ). The more intensive GSSIs which took a summer camp format had a large effect size (SMD = - 0.90, 95% CI [- 1.23, - 0.57],  $Z=5.3$ ), whereas

**Fig. 3** Forest plot of SRS social cognition subscale scores. Schohl et al. 2014 cognition subscales were not included in the analysis as the source data was not available



**Fig. 4** Forest plot of SSRS social skills and problem behaviours subscale scores

the GSSI taking place once a week had a moderate effect size (SMD = -0.77, 95% CI [-1.21, -0.34], Z = 3.35).

GSSIs groups to examine the effect of duration of intervention as a co-variate were created with a median split. The GSSIs which required over 40 h of contact time also had a large effect size (SMD<sub>>40h</sub> = -0.93, 95% CI [-1.36, -0.50], Z = 4.22), whereas those requiring 40 h and under had a moderate effect size (SMD<sub><40h</sub> = -0.76, 95% CI [-1.13, -0.39], Z = 4.00; Fig. 6).

### Heterogeneity

Heterogeneity was assessed using the I<sup>2</sup> statistic. The heterogeneity in the data was low to moderate, ranging from 0 to 58.2%. However, results did not differ across random and fixed effect models.

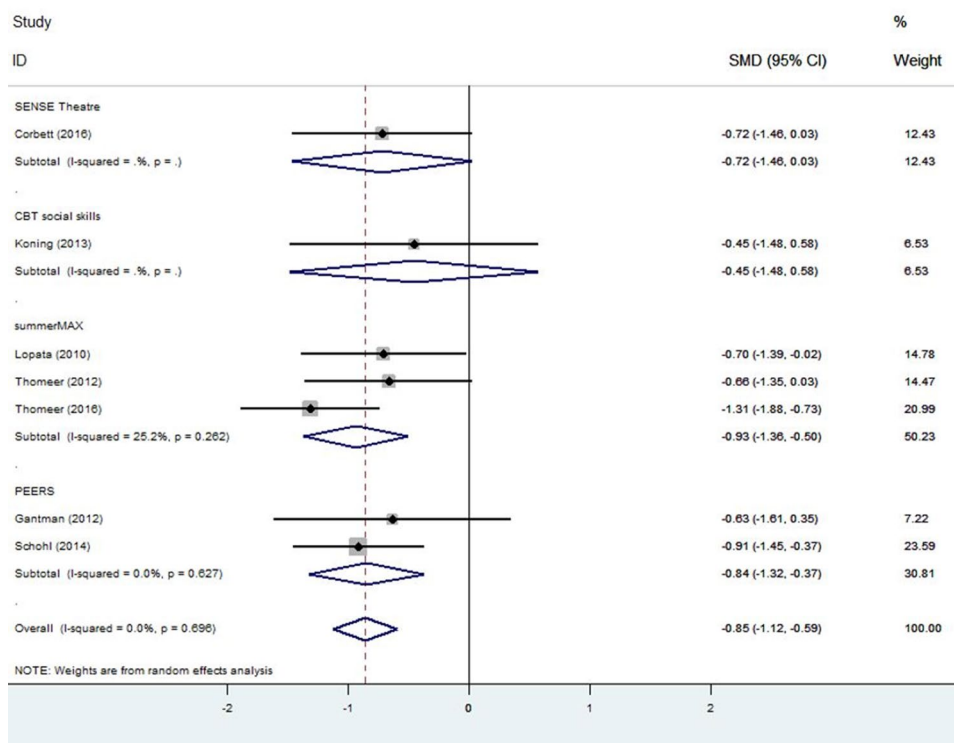
### Publication Bias

Egger's regression test and the trim and fill method showed that there was no evidence of substantial publication bias.

### Discussion

Our systematic review of RCTs using multi-modal GSSIs has shown that studies use a variety of social skills measures, assessment types and informants. There was a predominant reliance on parent-report and self-report assessments of effectiveness, both prone to expectancy bias. Even when evidence of outcome was obtained from external observers such as support staff or teachers, these observers were seldom blind to treatment group. In future, evaluations of GSSI should employ blind-rated

**Fig. 5** Group analyses forest plot by intervention programme for the SRS total scores



observer-reports (of performance). There is currently a lack of validated participant self-reports (of increase in social skills knowledge), yet previous meta-analyses of social knowledge improvement indicate this may be one of the main gains from group social skills interventions (Gates et al. 2017).

Evidence of the effectiveness of interventions from the meta-analysis of the SRS indicated treatments do bring about a significant reduction in autistic traits as measured by total and subscale scores, by parental report. Large effect sizes were found in terms of improved Social Communication, and reduced Restricted Interests and Repetitive Behaviour (RRB). The Social Communication scale of the SRS is intended to capture ‘expressive social communication [and] “motoric” aspects of reciprocal social behaviour’ (Constantino and Gruber 2012). Both subscales were derived from clinical definitions, rather than factor analysis, and reflect the main components of DSM-5 diagnostic criteria for Autism Spectrum Disorders.

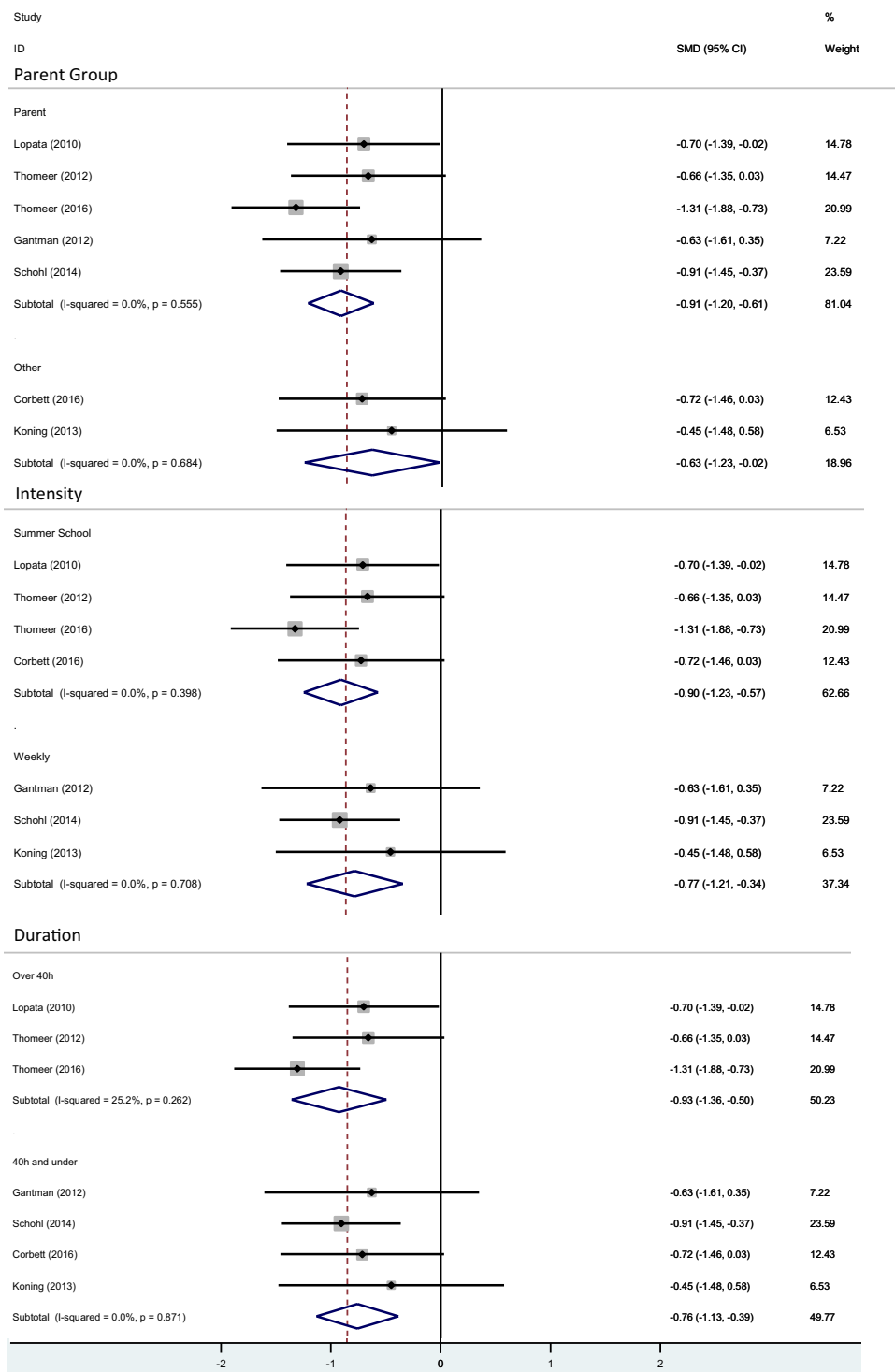
Moderate effect sizes for improvement following intervention, explicitly in terms of social skills, were found for the Social Skills subscale of the SSRS, which measures cooperation, empathy, assertion, self-control and responsibility. Unfortunately, there were insufficient data available to enable further analysis of the Social Skills subscale, as it would have been interesting to see which items contributed the most to the significant changes in behaviour. The Problem Behaviours subscale of the SSRS measures internalising

and externalising behaviours, and hyperactivity; no significant change was found in these behaviours.

Despite the differences in the social skills domains taught in GSSIs, the syllabuses did overlap in some key areas. For instance, they all aimed to improve social communication skills, and evidence from this review that Social Communication does improve significantly could have been anticipated. However, improvements on the RRB subscale of the SRS were unexpected; no teaching materials reviewed here explicitly target RRB. Perhaps the cognitive and emotional skills taught during GSSIs, such as cognitive flexibility, problem solving or controlling emotional impulses are mediating this change. Consequently, participants become more confident and less anxious in social situations, which in turn reduces their anxiety-related restrictive and repetitive behaviours (Rodgers et al. 2012). Also, participants may learn that restrictive and repetitive behaviours are socially inappropriate, and consequently they conceal them, a hypothesis that is consistent with the moderate effect size obtained on the Social Awareness subscale. Evidence from previous meta-analyses of GSSI shows increases in social knowledge drive effect sizes in self-report measures of social skills (Gates et al. 2017).

Moderator analysis was only possible for studies in which the SRS was the outcome measure. A group analysis compared interventions that delivered concurrent parent groups, with those that did not. We found that GSSIs that included parent groups were more effective, associated with a large

**Fig. 6** Group analyses forest plot for parent involvement (parent group vs no parent group), intervention intensity (summer school vs weekly) and intervention duration (over 40 vs 40 h and under) for the SRS total scores



(compared with a moderate) effect size. Parents who attend GSSIs might display positive response biases (McMahon, Lerner et al., 2013), but parent involvement in treatment can nevertheless consolidate the social behaviours and knowledge acquired by their child, and help support the formation of appropriate peer networks (Laugeson and Frankel 2011).

Not all GSSI programmes reduced autistic traits (as measured by SRS total scores). The PEERS and summer-MAX programmes obtained significant and large effect sizes compared to the SENSE Theatre and CBT social skills interventions (though associated with less power to

detect benefit) which obtained small to moderate and non-significant effects effect sizes.

More intensive and longer-lasting interventions had slightly larger effect sizes. The cost-benefit comparison between programmes is hard to interpret. For instance, whereas the PEERS intervention is demanding in terms of participant and interventionist time, it may nevertheless be a more cost-effective choice as it is easier to implement with less resources than the summerMAX programme. Only one out of the six interventions employed a performance-based teaching strategy, therefore a comparison between didactic and performance based interventions was not possible.

## Conclusion

A recent increase in methodological rigour in GSSI RCTs, and the use of common instruments to assess outcomes, has presented an opportunity to examine the effectiveness of social-skills interventions in a multi-dimensional context. Understanding what works for whom will be key to the future personalisation of GSIs, improving the efficacy of GSSI programmes. Examining which social performance and social knowledge characteristics are responsive to specific GSSI design features is critical to unlocking our understanding of the active ingredients of social skills instruction. We need to develop more sensitive tools in order comprehensively to capture how treatments impact on the multi-dimensional nature of social skills.

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## Compliance with Ethical Standards

**Conflict of interest** The authors have no conflict of interest to declare.

**Ethical Approval** This article does not contain any studies with human participants or animals performed by any of the authors.

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# Experiences of social interaction in young women with Turner syndrome: A qualitative study

Jeanne Wolstencroft<sup>1</sup>  | William Mandy<sup>2</sup> | David Skuse<sup>1</sup>

























STUDY PROTOCOL

**REVISED** Protocol: New approaches to managing the social deficits of Turner Syndrome using the PEERS program [version 2; peer review: 2 approved]

Jeanne Wolstencroft<sup>1</sup>, William Mandy<sup>2</sup>, David Skuse<sup>1</sup>

<sup>1</sup>Great Ormond Street Institute of Child Health, University College London, London, WC1N 1EH, UK

<sup>2</sup>Clinical, Education and Health Psychology, University College London, London, WC1E 6BT, UK

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**Abstract**

Turner Syndrome (TS) is a sex chromosome aneuploidy (45,X) associated with social skill difficulties. Recent clinical care guidelines recommend that the Program for the Education and Enrichment of Relational Skills (PEERS) social skills intervention programme be trialled in this population. PEERS has been successfully used in adolescents with autism spectrum conditions without intellectual disabilities. The PEERS program will be piloted with adolescents and young women with TS aged 16-20 using an uncontrolled study trial with a multiple-case series design. The program will be delivered face to face and online. The assessment battery is designed to measure social skills comprehensively from diverse informants (parent, teacher young person). It includes measures of social performance, social knowledge and social cognition. Parents and young people taking part in the intervention will also feedback on the acceptability and feasibility of the pilot. The outcomes of this small scale pilot (n=6-10) will be used to adapt the programme based on feedback and estimate the sample for a future randomised controlled trial.

**Keywords**

social skills training, social skills, peers, turner syndrome, sex chromosome aneuploidy

This article is included in the [UCL Child Health gateway](#).

**Open Peer Review**

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	Invited Referees	
	1	2
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- 1 **David E. Sandberg** , University of Michigan, USA
- 2 **Claus H. Gravholt** , Aarhus University Hospital, Denmark

Any reports and responses or comments on the article can be found at the end of the article.

**Corresponding author:** Jeanne Wolstencroft ([j.wolstencroft@ucl.ac.uk](mailto:j.wolstencroft@ucl.ac.uk))

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**REVISED Amendments from Version 1**

The protocol has been updated with clarifications suggested by the reviewers. These include precisions on the trial's inclusion criteria such as hearing ability and karyotype, as well as precisions on the level of social ability and the screening measure subscales used to detect these.

In the response to reviewers we discuss the variability of social ability within girls with TS and justify the value of piloting the PEERS program with a small group of participants before embarking on a full-scale randomized-controlled trial.

We have also updated some of the outcome measures used in the trial, for example, we originally stated that we'd used the second edition of the TASSK-R, but upon realizing that they were not widely available we are now using the first edition of the questionnaire (TASSK). We have also replaced the 'Quality of Play Questionnaire' for the 'Quality of Socialization Questionnaire' as it is more appropriate for the age-group of our participants.

**See referee reports**

**Introduction**

Turner Syndrome (45,X; TS) is one of the most common sex chromosome aneuploidies, with an incidence of 1 in 2500 female births<sup>1</sup>. TS is associated with a variety of morbidities affecting nearly every bodily system, including skeletal abnormalities such as short stature, dysmorphic features, hearing difficulties, infertility, cardiac abnormalities, diabetes and thyroid problems. These difficulties have been well characterized in the literature (see Gravholt *et al.* 2017<sup>2</sup> for the most recent review) and require clinical monitoring across the lifespan.

TS females have social difficulties throughout childhood, but these become more apparent in adolescence when socialisation becomes more complex<sup>3</sup>. Social deficits are exemplified by difficulties integrating within social groups, with poor deciphering and processing of social cues<sup>3</sup>. Previous research has shown TS is associated with specific deficits in social cognitive competence, especially forming and maintaining peer relationships<sup>4</sup>.

Some of the social deficits observed in TS are reminiscent of difficulties associated with Autism Spectrum Disorders (ASD). Psychosocial evaluations of young women with TS have found an association with ASD<sup>5-9</sup>, anxiety disorders, depression and low self-esteem<sup>10-13</sup>.

Social skills deficits are known to have a significant impact on academic, adaptive and psychological functioning<sup>14-17</sup>, and are likely to have a substantial impact on the wellbeing of girls and women with TS across the lifespan<sup>3</sup>. At present, psychosocial intervention research with young women with TS is scarce; only one intervention targeting self-esteem in adults aged 18-30 has been documented in the literature<sup>10</sup>. The latest TS Clinical Care Guidelines recommend that a social skills training intervention should be trialled in this population<sup>2</sup>. They suggest using the Program for the Education and Enrichment of Relational Skills (PEERS) developed for children

with ASD<sup>18</sup>. There is good evidence for the efficacy of PEERS when delivered with children and young adults with ASD without intellectual disabilities<sup>19-24</sup>. This pilot project will be the first to examine the feasibility and acceptability of the PEERS Protocol in adolescents with TS.

**Protocol****Objectives and hypothesis**

The main objectives of the study are:

- 1) To pilot the PEERS intervention in adolescents with TS;
- 2) Assess its feasibility and acceptability to families.

We hypothesise social skills training will improve social competence with peers and may produce secondary improvements in social cognition, self-esteem and anxiety (social and generalised).

**Study design**

We will be employing an uncontrolled trial design. To maximise the clinical reliability of the trial we will use a systematic multiple-case series design with case tracking. We aim to recruit participants with a similar degree of social impairment, and intellectual ability.

**Sample size**

A sample size of 6-10 girls and their parents will be invited to take part in the study - this is the group size recommended by the PEERS intervention manual. At present the effect size for this intervention in girls with TS is unknown. This pilot will serve as the basis to estimate the intervention's effect size and sample size for a future randomised control trial.

**Study centres/Recruitment**

Participants will be recruited from the *Social Skills and Relationships in Turner Syndrome Study* (SOAR), which recruits children and young women with TS from the Turner Syndrome Support Society, the NHS Great Ormond Street Hospital and the NHS University College London Hospitals.

The SOAR study is conducting online mental health and social cognition questionnaires with 200 girls and young women with TS and their parents. A subset of families from this large cohort that meet the trial's inclusion criteria will be invited to take part in the intervention study.

**Participant inclusion and exclusion criteria**

Inclusion criteria for the intervention include: 1, a confirmed diagnosis of TS (monosomy, variant, mosaic etc.); 2, age 16-20 years; 3, significant social skills difficulties as screened for in the SOAR online questionnaires (see screening assessment measures section for details) and clinical judgement; 4, motivation to take part.

The exclusion criteria for the intervention include: 1, profound hearing or vision impairments (eg. complete deafness or blindness); 2, intellectual disability (VIQ<70); 3, concurrent participation in other psychological treatment.

**Intervention**

The UCLA PEERS for Adolescents is a manualized treatment program that consists of 14 90 min sessions<sup>18</sup>. The program runs two concurrent groups, one for the adolescents and one for parents. At the end of each session the two groups are reunited for review and questions. Between sessions the adolescent group are given homework tasks, which they are to complete with the help of their parent who is trained to support them as their social coach. Parents are provided with concise handouts for each session, which include an overview of the lesson material and the homework.

The adolescent group sessions are structured to provide didactic instruction as well as social skill rehearsal. The parent sessions mirror the adolescent sessions and provide a space for the parents to problem-solve any difficulties they may have encountered the previous week. The didactic lessons provide instruction on (a) conversational skills; (b) electronic forms of communication; (c) developing friendship networks and finding sources of friends; (d) appropriate use of humour; (e) peer entry strategies; (f) peer exit strategies; (g) organizing get-togethers with friends; (h) handling teasing and embarrassing feedback; and (i) resolving arguments with friends<sup>18</sup>.

The adolescents and parents will attend separate concurrent sessions led by a certified PEERS Instructor. Three face to face sessions will take place in London at the start, middle and end of the program. All other sessions will be conducted online using a virtual meeting room. The face to face sessions will deliver two PEERS lessons, whereas the weekly online sessions will deliver one lesson. Research assistants (graduate or undergraduate psychology students) will monitor treatment fidelity, assist with role-playing demonstrations, and provide social coaching with performance feedback during behavioural rehearsal exercises. All research assistants will be trained and supervised throughout the intervention.

**Assessments**

Participants will complete assessments at different time points throughout the study. The study will last 9 months in total, including a 3 month baseline, 2 months of intervention and a 3 month follow-up period. The screening measures will be delivered at T=0, the baseline assessments will be delivered at T=12 weeks and the post intervention assessments will be delivered at T=20 weeks. The primary outcome measure will be delivered at regular intervals of 4 weeks throughout the course of the study (see Table 1).

**Screening assessments**

*Development and Wellbeing Assessment (DAWBA):* The DAWBA will be used to collect information on the child’s behavioural adjustment and mental health. The DAWBA has been used both in UK national and international surveys<sup>25–28</sup>. The DAWBA data will be reviewed by a psychiatrist in accordance with the ICD-10/DSM-V diagnostic criteria. This methodology has been used successfully to gather data of high quality by parental online report. The DAWBA autism module includes a social aptitude scale (SAS) which measures social understanding and social ability (Liddle *et al.*, 2009). Participants displaying

**Table 1. Assessment timeline.** Informants for each assessment are included in brackets (P – Parent; T – Teacher; YP – Young Person). Assessment acronyms: BAI – Beck’s Anxiety Inventory; IAQ – Intervention Acceptability Questionnaire; PEERS – Program for Education and Enrichment of Relational Skills; PEERS QSQ – PEERS Quality of Socialisation Questionnaire; PEERS TASSK – PEERS Test of Adolescent Social Skills Knowledge; RSE – Rosenberg Self-esteem Scale; SCP – Social Competence with Peers; SDQ – Strengths and Difficulties Questionnaire; SRS – Social Responsiveness Scale; SASI - Schedules for the Assessment of Social Intelligence; SWS – Spence Social Worries Scale; WAIS-Wechsler Adult Intelligence Scale.

Timeline	Assessments
t=0	SCP (P) 1 PEERS Screener (P,YP) SASI (YP) WAIS (YP)
4 weeks	SCP (P) 2
8 weeks	SCP (P) 3
<b>Baseline</b> 12 weeks	SCP (P,YP,T) 4 SWS (P,YP,T) PEERS QSQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P,T) SDQ (P,T)
16 weeks	SCP (P) 5
<b>Post-intervention</b> 20 weeks	SCP (P) 6 SWS (P,YP,T) PEERS QSQ (P) PEERS TASSK (YP) RSE (YP) BAI (YP) SRS (P,T) SDQ (P,YP,T) IAQ (P,YP) SASI (YP)
24 weeks	SCP (P) 7
28 weeks	SCP (P) 8
<b>Follow-up</b> 32 weeks	SCP (P,YP,T) 9

significant difficulties in the SAS will be eligible for the intervention. The DAWBA is available in 26 languages. The DAWBA will be completed online by parents.

*Strengths and Difficulties Questionnaire (SDQ):* The SDQ is a brief behavioural screening questionnaire<sup>29</sup>. The SDQ includes scales that measure emotional symptoms, conduct problems, hyperactivity/inattention difficulties, peer relationship problems

and prosocial behaviour. The first four scales are combined to create a total difficulties score. An additional impact scale measures the impact of this composite score on daily life. Participants scoring poorly on the peer relationships subscale will be eligible for the intervention. It has been validated for use in children aged 4–17 in UK National studies of psychological adjustment, and a new form for 18+ years old has recently been developed. It will be completed online by the adolescents, parents and teachers.

*Social Responsiveness Scale (SRS)*: The SRS measures the severity of autistic traits and the instrument has convergent validity with other ASD diagnostic tools<sup>30,31</sup>. The SRS subscales measure Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviour. The SRS will be administered online to parents and teachers.

*Health Questionnaire (HQ)*: The questionnaire was developed by the UCLH Turner Syndrome Life Course Project to record information about physical health, health care, education, social life, physical activity and relationships<sup>32</sup>. The self-report version of the questionnaire will be completed by adolescents.

*Schedules for the Assessment of Social Intelligence (SASI)*: The SASI is a socio-cognitive assessment that measures facial expression recognition, face recognition memory, gaze-monitoring and theory of mind. The SASI is sensitive to subtle deficits in social cognition and has been shown to have excellent reliability and validity<sup>33</sup>. Adolescents will be asked to complete the SASI online.

*Wechsler Adult Intelligence Scale - Fourth UK Edition (WAIS-IV UK)*: The WAIS-IV is an IQ test which measures verbal comprehension, perceptual reasoning, working memory and processing speed. It has been widely used and validated<sup>34</sup>. It will be administered to adolescents in person.

*PEERS Screener*: The PEERS Screener Questionnaire assesses the participant's motivation to take part in the PEERS intervention<sup>18</sup>. It will be administered to parents and adolescents over the phone or in person. Only participants motivated to take part will be considered for the intervention.

### Primary outcome measures

*Social Competence with Peers (SCP)*: The SCP assesses the consequences of young people's interactions with peers, such as the existence and duration of friendships or social invitations<sup>35</sup>. A modified version of the SCP will be used to adapt the tool for use in young adults. The adolescent group and the parent group will be asked to complete the SCP at regular intervals (every 4 weeks) from baseline to follow-up. Teachers will be asked to complete the SCP at baseline, post-intervention and follow-up.

### Secondary outcome measures

*Strengths and Difficulties Questionnaire (SDQ)*: Described previously. It will be completed by the young people, parents and teachers at baseline and post-intervention.

*Social Responsiveness Scale (SRS)*: Described previously. It will be completed online by parents and teachers at baseline and post-intervention.

*Spence Social Worries Scale (SWS)*: The Spence Social Worries Scale is a psychological questionnaire designed to identify symptoms of social phobia and other forms of anxiety, in children and adolescents. The parent and teacher forms are reported to have excellent internal validity<sup>35</sup>. It will be completed online by the adolescents, parents and teachers at baseline and post-intervention.

*Schedules for the Assessment of Social Intelligence (SASI)*: Described previously. It will be administered online to the adolescent at baseline and post-intervention.

*PEERS Test of Adolescent Social Skills Knowledge (TASSK)*: The TASSK is a questionnaire designed to evaluate what the participants have learned from the intervention<sup>18</sup>. This is the only outcome measure to evaluate changes in social knowledge. It will be administered to the adolescents at baseline and post-intervention.

*PEERS Quality of Socialisation Questionnaire (QSQ)*: The QSQ is designed to evaluate the quality of young people's socialization and frequency of get-togethers<sup>18</sup>. It will be completed online by the parents at baseline and post-intervention.

*Rosenberg Self-esteem Scale (RSE)*: The RSE scale assesses global self-esteem<sup>36</sup>. It will be completed online by the adolescent at baseline and post-intervention.

*Beck's Anxiety Inventory (BAI)*: This scale is a self-report measure used for measuring the severity of anxiety in children and adults<sup>37</sup>. It will be completed online by the parent and adolescent groups at baseline and post-intervention.

*Camouflaging measure (CAT-Q)*: The CAT-Q measures camouflaging (e.g. strategies to mask or compensate autistic characteristics) behaviour in social situations. It is comprised of 25 items and has high internal reliability in autistic adults. Its subscales measure compensation, masking and assimilation<sup>38</sup>. The CAT-Q will be completed by adolescents.

*Intervention Acceptability Questionnaire (IAQ)*: The IAQ has been developed for the study to assess parent and adolescent satisfaction with the intervention ([Supplementary File 1](#)). It will be completed by the parent and adolescent groups once the intervention has ended.

### Missing data and intervention adherence

The occurrence of missing data will be reported for each questionnaire and study time point. Participant intervention adherence, planned absences and study dropouts will be recorded and reported. When possible the causes for missing data, absences or dropout will be reported. Families that miss sessions will be caught up over the phone or conference call before the next session.

### Adverse events

Adverse events will be recorded.

### Statistical analysis

The primary outcome measure (SCP questionnaire)<sup>16</sup> will be analysed using visual analysis and multi-level modelling to track individual participant changes over 9 months from baseline to follow up<sup>39</sup>.

The secondary outcome measures will be analysed for pre-post differences. Data will be analysed using SPSS version 22 statistical software. It is likely that we will be underpowered to detect any significant statistical differences between the pre and post intervention scores; therefore effect sizes (Cohen's *d*) will also be calculated. The parent, teacher and adolescent responses to the questionnaires will also be compared to investigate the consistencies between different informants.

We anticipate that adolescent informants will report the greatest positive changes compared to other informants. We also anticipate that the adolescents will report greater improvements on the social knowledge on the TASSK, than on the social performance on the SCP or SDQ (prosocial or peer scale) and social cognition on the SASI. We also expect to see secondary improvements on adolescent self-reports of anxiety on the BAI raw score, social anxiety on the SWS raw total score and self-esteem on the RSE raw total score. We expect to see an increase in camouflaging on the CAT-Q on all the subscales.

In line with previous social skills intervention research we anticipate that positive changes in social performance will be noted by the parents, but that schoolteachers will not observe a change post intervention on the SRS, SDQ and SWS. Specifically we expect parents to report improvements in the SWS total raw score, as well as improvements on the SDQ raw prosocial scale and peer difficulties scale, and improvements on the SRS social communication scale and repetitive and ritualised behaviours scale.

The acceptability of the intervention to families will be assessed using the IAQ. Descriptive statistics will be used to summarise the responses alongside a qualitative summary of the open text answers. We expect that most families will report having positive experiences of the PEERS programme. Based on previous randomised controlled trials we predict that adherence will be on average 80% and that up to two participating families may dropout (Laugeson *et al.*, 2015; Schohl *et al.*, 2014).

### Ethics and dissemination

#### Ethics and consent

All participants (young people aged 16–20 and their parent) will give written informed consent prior to entry to the SOAR study. The study has been approved by the West London GTAC Ethics Committee (IRAS: 219817).

#### Dissemination

The results of the study will be disseminated at the Turner Syndrome Support Society conference, the study website, at

international research conferences and in research articles published in peer-reviewed journals.

### Discussion

This is the first study to pilot a social skills training program with adolescents and young women with TS. Given the PEERS program's success with teenagers on the spectrum, it is anticipated that young women with TS will also benefit from taking part.

This pilot study has been designed to take an approach of high internal validity. This approach is appropriate given that it is a feasibility pilot conducted with a small number of participants ( $n=6-10$ ), however the disadvantage of the approach is that the study has low external validity, which reduces the generalizability of the findings. This study will need to be replicated with young people with different social skills profiles, intellectual ability and hormone treatment status.

To our knowledge this will also be the first trial of PEERS delivered online and offline. TS is a rare genetic disorder and the delivery of the full program face to face would have resulted in many families being excluded due to geographical constraints. The program's acceptability to families will be assessed and this feedback will be used to inform future replications of the intervention. Should the combination of online and offline prove successful, this will enable the program to be made more widely available.

When assessing social skills it is important to employ a range of assessment tools, which assess different domains of social skills (social knowledge, performance and cognition), as well as a variety of informants<sup>40,41</sup>. Meta-analyses of social skills intervention studies show that parents and young people report changes in social skills after taking part in social skills interventions. However, these improvements are rarely reported by teachers<sup>41,42</sup>. There is a trend for young people to overestimate the changes in their social skills compared to other informants<sup>41,42</sup>. However, a recent meta-analysis of the young person self-report measures suggests that the improvements relate to changes in their social knowledge rather than their social performance<sup>41</sup>.

The assessment battery has been designed to measure changes in social skills, in the domains of social performance, social knowledge and social cognition. These outcomes will be reported on by the parents, teachers and the young people themselves. Teachers and parents will be asked to report on changes in social performance through questionnaires. The young people will complete questionnaires which measure social performance and social knowledge, as well as an online task to measure changes in social cognition. The maintenance of any potential treatment gains in social performance will be assessed by the parent report at a 3 month follow-up.

It is likely that the adolescent and parent reports will be prone to expectancy biases<sup>43</sup>. They may exaggerate treatment effects

due to their investment in taking part in the intervention. Using external observers (such as teachers or blinded study administrative assessors) is essential to help understand these biases and assess whether changes in performance generalise to other settings<sup>41,44</sup>. Unfortunately, due to the small scale of this project, assessments by external observers will not be feasible.

Meta-analyses of social skills interventions for children on the autistic spectrum using the SRS have shown that the largest treatment gains are made in the social communication and repetitive and ritualised behaviours scale<sup>21</sup>. The changes in repetitive and ritualised behaviours may be mediated by reductions in anxiety or increases in social awareness<sup>21,45</sup>. The majority of the participants included in the meta-analyses were adolescent males, therefore it remains to be seen whether these patterns of improvement will be replicated in females with TS.

This study will also use a novel measure of social camouflaging<sup>46</sup>. Social camouflaging is a strategy adopted by people on the spectrum to manage social situations. It has been likened to wearing a 'social mask', where the individual puts on 'their best self'<sup>46</sup>. Camouflaging typically involves masking and compensating for social deficits<sup>46-48</sup>. This might involve consciously performing a range of non-verbal cues such as making eye contact during conversations and imitating facial expressions and gestures, or following learnt social scripts such as using pre-prepared jokes or comments<sup>49</sup>. Recent research suggests that

females are better at camouflaging than males<sup>48,50</sup>. We anticipate that the intervention will help the participants become more aware of their camouflaging and help them to camouflage more effectively if they choose to use it as a strategy.

## Conclusion

This will be the first social skills training programme trialled with adolescents and young women with TS. Should the trial prove successful, the initial results will be used to inform the sample size for a future randomised controlled trial. Additionally, neither research trials using the PEERS program exclusively in girls, nor trials delivering PEERS online have been published. Therefore, this trial may have a broader impact on the development of treatment strategies for both for young women that experience social skills difficulties (including those on the autistic spectrum), but also for broadening access to treatment by using technology.

## Data availability

No data are associated with the article.

## Grant information

This work was supported by NIHR BRC and Child Health Research Charitable Incorporated Organisation.

*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

## Supplementary material

Supplementary File 1: Young Person Intervention Acceptability Questionnaire; Parent Intervention Acceptability Questionnaire.

[Click here to access the data.](#)

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# Open Peer Review

Current Referee Status:  

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## Version 2

Referee Report 05 April 2019

<https://doi.org/10.5256/f1000research.20091.r45871>



**David E. Sandberg** 

Department of Pediatrics, Medical School, University of Michigan, Ann Arbor, MI, USA

I thank the authors for their responses. I have no further comments.

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Referee Report 19 March 2019

<https://doi.org/10.5256/f1000research.20091.r45872>



**Claus H. Gravholt** 

Department of Endocrinology and Internal Medicine, Aarhus University Hospital, Aarhus, Denmark

I have no further comments. The authors have dealt with all questions raised.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Turner syndrome. Other sex chromosome abnormalities. Endocrinology, epidemiology, genetics

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

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## Version 1

Referee Report 15 January 2019

<https://doi.org/10.5256/f1000research.16884.r41839>



**Claus H. Gravholt** 

Department of Endocrinology and Internal Medicine, Aarhus University Hospital, Aarhus, Denmark

Wolstencroft et al presents a pilot protocol designed to improve the social cognition of adolescents with Turner syndrome (TS) based on the PEERS program. Overall, this study is very interesting and timely, given that many with TS have a social skills deficit.

I have some comments:

1. Design and sample size: uncontrolled, with the aim of including 6-10 TS. The uncontrolled design is acceptable in a pilot trial. I'm more worried about the rather low n. There is a large variability, perhaps even larger than among normal females, in the presentation of females with TS and that may not be captured satisfactorily with a n of 6-10. However, one could ask if it is at all necessary to perform a pilot study, given that this program has shown to be a success in other study groups?
2. Inclusion criteria: the inclusion criteria are rather strict, and I think that the authors will end up excluding a rather large proportion of females with TS, which is a pity. Many females that in their youth may not present with social skills difficulties, will actually do this at a later age, and I think it would be interesting to have some of these females included as well. Can females with hearing difficulties, but treated with a hearing aid, be included?
3. The intervention program, PEERS, is certainly very relevant.
4. The scales used to monitor effect seem relevant. The primary and secondary outcomes are relevantly described.
5. The intervention program seems rather massive with multiple scales and 12 times 90 minutes interventions. Have the authors considered how this will affect the participation rate in the study? I guess they must have contemplated this. Are there experience from other groups of patients? The authors expect 2 family dropouts – and if the inclusion ends at 6 families, that would then leave 4 families – hardly enough to call it a pilot study?
6. Conclusively, if this pilot study proves successful, it will be a welcome addition to the program of care established by excellence center for TS around the world.

**Is the rationale for, and objectives of, the study clearly described?**

Yes

**Is the study design appropriate for the research question?**

Partly

**Are sufficient details of the methods provided to allow replication by others?**

Yes

**Are the datasets clearly presented in a useable and accessible format?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Turner syndrome. Other sex chromosome abnormalities. Endocrinology, epidemiology, genetics

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 20 Feb 2019

**Jeanne Wolstencroft**, UCL Great Ormond Street Institute of Child Health, UK

Dear Claus Gravholt,

Thank you for your comments. We are encouraged to hear that you are convinced of the value of using the PEERS protocol with young women with TS. We have addressed your concerns in turn below:

1. As you correctly point out, there is large variability between young women with TS. Our pilot will only recruit young women experiencing difficulties with friendships who wish to improve their social skills, but within this group there will still be a substantial amount of variability. We are currently conducting a survey of mental health and social skills difficulties in TS (SOAR Study). Our preliminary findings indicate that girls and women with TS have significantly more peer interaction problems when compared to population female norms as measured by the Strengths and Difficulties Questionnaire (Goodman et al., 2010). On our measure of autistic symptomatology (SRS-2; Constantino et al., 2012) 40% of young women with TS scored in the normal range, 14.5% in the mild range, 17.1% in the moderate range and 27.4% in the severely impaired range (SOAR study unpublished findings; n=117). Our sample for the PEERS pilot is representative of this range of social skills difficulties; among our enrolled participants, scores lie in the normal to abnormal range on the Strengths and Difficulties subscale for quality of peer-interactions and they also range from normal to severely impaired on the SRS-2.

We believe it is necessary to conduct a pilot of the PEERS program with young women with TS before conducting a full-scale trial because the program was initially developed to treat adolescent boys with autism. The emerging literature on young women with autism shows clearly that women with social communication impairments face different challenges to those experienced by young men with autistic traits. We will therefore need to adapt the content of the program. For example, some of the lessons focus on issues such as 'good sportsmanship' and 'appropriate uses of humour'; females with TS would not regard these skills as being of core relevance to their social adaptation. Additionally, there is no precedent for delivering social skills training online, therefore there is a need to pilot the acceptability of virtual meeting rooms and to adapt the behavioural rehearsal components of the training to an online environment.

2. You are correct in noting that many girls with TS have impaired adaptation to the social environment that manifests most obviously once they enter adolescence. We have found that social difficulties emerge and intensify over that period, from the time of entry into secondary education to early adulthood. Therefore, our pilot study's age range (16-20 years) is designed to help young women at a time when their social difficulties are emerging, and they are becoming aware of them.

We are not excluding anyone on the grounds of impaired hearing, if that problem is being successfully managed. Two young women who wear hearing aids are currently enrolled in the pilot study. Unfortunately, the program would need to be substantially modified in order to accommodate those with more profound hearing impairments. The inclusion criteria have been clarified in the protocol v2.

5. As originally devised, the PEERS program required there to be no more than 8-10 participants in

the treatment group. The program is very intensive and is characterized by a focus on individual needs as well as on group dynamics. Several staff are required on site to manage the child/parent groups. By adapting the program to be delivered from an online platform we aim to increase its acceptability to participants and to reduce the associated costs. Randomized control trials of PEERS have reported attrition rates of 7-13% (Schohl et al., 2014; Laugeson et al., 2015), hence our prediction that 1-2 participants out of 10 may drop out. However, we are now three-quarters of the way through the pilot trial and we have not yet had any dropouts.

Best wishes,  
Jeanne Wolstencroft

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**Competing Interests:** N/A

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**David E. Sandberg** 

Department of Pediatrics, Medical School, University of Michigan, Ann Arbor, MI, USA

The study protocol describes a pilot project that examines the effectiveness of a social skills training program – originally developed for youth on the autism syndrome spectrum – applied to the social skills deficits of adolescent and young women with Turner syndrome (TS)(45,X). The neurocognitive profile of girls and women with TS has been extremely well documented and has repeatedly been shown to be associated with deficits in social cognition and skills. This aspect of the TS phenotype is likely a significant factor accounting for the gap between educational attainment in this population (shown to exceed to population norms), and their occupational status and measures of independence from family caregivers. Women with TS have also been shown to exhibit both delays and arrest in psychosexual milestones which are more than likely linked to the characteristic social behaviour phenotype associated with this

karyotype<sup>1</sup>.

The investigators should be commended for proposing to adopt a proven efficacious and effective intervention for social skills deficits to potentially modify the behavioural phenotype in TS. The PEERS program is well-suited to the task because of the similarities in social skills deficits in high-functioning ASD and TS. Work on this topic is long overdue.

The rationale for the pilot study is well described, although the authors have possibly overstated, in the Introduction, the lack of “systematic evaluations of the mental health of young women with TS...”. In fact, there are multiple studies assessing both the psychiatric status and psychosocial/sexual adaptation of this population. What has been sorely missing are psychosocial interventions to potentially ameliorate deficits, and the proposed study is directed precisely toward this objective.

There are the following elements I found missing from the protocol or require further consideration:

1. p.2 Study Design - it's unclear what the following refers to: “All participants will be matched for age, degree of social impairment, intellectual ability and hormone therapy treatment.” Each participant will serve as their own control, so I don't understand the “matching” piece.
2. p. 2. Participant inclusion and exclusion criteria – details are not provided regarding the SOAR questionnaire screening for eligibility based on social skills deficits.
3. Will recruitment be restricted to girls/women with a 45,X karyotype or will those with a variant, including chromosomal mosaicism, be eligible?
4. The Discussion notes that self and parent reports are prone to bias because of expectations regarding the intervention and note that a remedy to overestimating the benefits can come from employing external observers. The investigators justify not employing external observers because of the small scale of this project. However, one could turn that argument around by questioning whether it would be worthwhile to pursue a full-scale trial of PEERS in TS if the effects observed in the pilot are driven by biased reports.

## References

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**Is the rationale for, and objectives of, the study clearly described?**

Yes

**Is the study design appropriate for the research question?**

Yes

**Are sufficient details of the methods provided to allow replication by others?**

Yes

**Are the datasets clearly presented in a useable and accessible format?**

Not applicable

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** I am a pediatric psychologist involved in clinical care and research focusing on people born with disorders/differences of sex development (DSD): TS is classified as a “sex chromosome DSD”. I served as co-lead for the neurocognition and behaviour section of the updated 2017 clinical practice guidelines for DSD the investigators refer to in the Introduction to their proposal. I have been funded by the US National Institutes of Health for methods development and intervention studies in the area of DSD. I was also a member of the writing group for the Consensus Statement on DSD.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 20 Feb 2019

**Jeanne Wolstencroft**, UCL Great Ormond Street Institute of Child Health, UK

Dear David Sandberg,

Thank you for your comments. We are encouraged to hear that you are convinced of the value of using the PEERS protocol with young women with TS. We have addressed your concerns in turn below:

1. Participants in the treatment group were chosen because they have similar degrees of social impairment and intellectual ability. We have clarified the wording around the ‘matching of participants’ in the protocol v2. You are correct, they will act as their own controls.

2. Motivation to take part in the intervention is assessed using the PEERS screener interview (Laugeson et al., 2009). It was essential to ensure that the young people and their parents were motivated to take part in the social group in order to minimize potential attrition over the 12 week intervention period. Their social deficits were assessed using a combination of clinical judgement and screening questionnaires:

- Social Aptitude Scale (SAS): The SAS is presented as part of the Development and Wellbeing Assessment’s autism module. The SAS is a ten item parent-report measure which assesses social understanding and social ability (as opposed to peer interaction deficits) (Liddle et al., 2008).
- Strengths and Difficulties Questionnaire (SDQ): The SDQ is a brief behavioural screening questionnaire (Goodman et al., 2010). The SDQ includes scales that measure emotional symptoms, conduct problems, hyperactivity/inattention difficulties, peer relationship problems and prosocial behaviour.

3. Recruitment will not be restricted to young women with a monosomic non-mosaic 45,X karyotype. This has now been clarified in the protocol v2.

4. Objectively evaluating the outcome of social skills interventions presents a number of challenges. We agree that expectancy biases are likely to occur. Some outcome measures focus only on self-assessment of social performance or social knowledge. Questionnaires that have been designed for parents, teacher or adult observer respondents, may lack ecological validity. To our knowledge, the outcome of PEERS has not yet been measured by peer-ratings of change. We are currently testing a novel methodology that could address this deficiency.

Currently, we do have some potentially objective measures of change. We obtain teacher ratings

of social behaviour, parent reports of changes in the TS girl's social relationships, and individual increases in social knowledge.

As we have indicated, the intervention is designed to take account of individual differences. Accordingly, outcomes are diverse. There will be variability within the sample, and it is unlikely that treatment benefits will be captured by standardized questionnaires alone.

Jeanne Wolstencroft

References:

Goodman, A., Lamping, D. L., & Ploubidis, G. B. (2010). When to use broader internalising and externalising subscales instead of the hypothesised five subscales on the Strengths and Difficulties Questionnaire (SDQ): data from British parents, teachers and children. *Journal of abnormal child psychology*, 38(8), 1179-1191.

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**Competing Interests:** N/A

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