HHS Public Access

Author manuscript

J Intellect Disabil Res. Author manuscript; available in PMC 2018 February 23.

Published in final edited form as:

J Intellect Disabil Res. 2015 October ; 59(10): 902–913. doi:10.1111/jir.12192.

Social cognitive training in adolescents with chromosome 22q11.2 deletion syndrome: feasibility and preliminary effects of the intervention

V. Shashi[1], **W. Harrell**[1], **S. Eack**[2], **C. Sanders**[1], **A. McConkie-Rosell**[1], **M. S. Keshavan**[3], **M. J. Bonner**[1], **K. Schoch**[1], and **S. R. Hooper**[4]

[1]Department of Pediatrics, Duke University Medical Center, Durham, North Carolina, USA

[2]School of Social Work and Psychiatry, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

[3]Department of Psychiatry, Harvard Medical School, Boston, Massachusetts, USA

[4]Department of Allied Health Sciences, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

Abstract

Background—Children with chromosome 22q11.2 deletion syndrome (22q11DS) often have deficits in social cognition and social skills that contribute to poor adaptive functioning. These deficits may be of relevance to the later occurrence of serious psychiatric illnesses such as schizophrenia. Yet, there are no evidence-based interventions to improve social cognitive functioning in children with 22q11DS.

Methods—Using a customised social cognitive curriculum, we conducted a pilot small-group-based social cognitive training (SCT) programme in 13 adolescents with 22q11DS, relative to a control group of nine age- and gender-matched adolescents with 22q11DS.

Results—We found the SCT programme to be feasible, with high rates of compliance and satisfaction on the part of the participants and their families. Our preliminary analyses indicated that the intervention group showed significant improvements in an overall social cognitive composite index.

Conclusions—SCT in a small-group format for adolescents with 22q11DS is feasible and results in gains in social cognition. A larger randomised controlled trial would permit assessment of efficacy of this promising novel intervention.

Keywords

behavioural phenotypes; genetics; intellectual disability; mental health; psychiatric disorders

Correspondence: Dr Vandana Shashi, Department of Pediatrics, Duke University Medical Center, Durham, NC, USA (vandana.shashi@duke.edu).

Introduction

Chromosome 22q11.2 deletion syndrome (22q11DS), a microdeletion occurring on the 22nd chromosome at band q11.2, is also referred to as velocardiofacial syndrome or DiGeorge syndrome. It is the commonest microdeletion in humans, occurring in 1:4000–6000 live births (Wilson *et al.* 1994; Tezenas Du Montcel *et al.* 1996). Clinical features are variable and include congenital heart disease, palatal abnormalities, immunodeficiency and hypocalcaemia (Shprintzen 2008; Philip & Bassett 2011). Cognitive impairment is almost universally prevalent, and average IQ is typically reported to be in the 70s (Moss *et al.* 1999; De Smedt *et al.* 2007; Lewandowski *et al.* 2007).

A dramatically increased risk for psychiatric disorders is seen in individuals with 22q11DS. In childhood, anxiety disorders and attention deficit hyperactivity disorder (ADHD) occur in approximately 30–50% and 30–40% of children, respectively (Jolin *et al.* 2009; Young *et al.* 2011; Schneider *et al.* 2014). By the early twenties, approximately 25–40% develop schizophrenia spectrum disorders (Murphy *et al.* 1999; Schneider *et al.* 2014) and 4–10% can have bipolar disorder or major depression (Shprintzen *et al.* 1992; Papolos *et al.* 1996; Murphy *et al.* 1999; Schneider *et al.* 2014), with the first symptoms of these serious illnesses typically emerging in early adolescence (Baker & Skuse 2005; Debbane *et al.* 2006; Stoddard *et al.* 2010).

Of the childhood psychological manifestations, impairments in social skills are frequent in children with 22q11DS, being seen in approximately 50% (Shashi *et al.* 2012). Social immaturity has been described in the early years (Shprintzen 2000), with more problem behaviours compared with norms in older children (Woodin *et al.* 2001), compared with sibling controls (Kiley-Brabeck & Sobin 2006), or age- and gender-matched healthy controls (Shashi *et al.* 2012). Social cognitive impairments are also highly prevalent in about 50%, such as difficulty in interpreting facial expressions (Campbell *et al.* 2011; Shashi *et al.* 2012), theory of mind (Jalbrzikowski *et al.* 2012) and abnormal visual scan pathways during a face emotion recognition task (McCabe *et al.* 2011). The poor social skills have been associated with higher rates of anxiety disorders and ADHD in childhood (Shashi *et al.* 2012). It has also been suggested that the social cognitive impairments in children and young adults (aged 10–25 years) with 22q11DS are predictive of positive prodromal symptoms (Jalbrzikowski *et al.* 2012). Thus, social skill impairments in children with 22q11DS are associated with behavioural/emotional functioning and potentially psychotic symptoms, raising the possibility that an improvement in social functioning could improve emotional/behavioural functions and also influence the incidence and/or severity of psychiatric disorders in these individuals. However, there have been no established or emerging interventions to improve the social cognitive deficits and social skill impairments associated with 22q11DS.

Psychosocial interventions in adults with schizophrenia have shown promising improvements in social cognition and functioning (Eack *et al.* 2011). Cognitive enhancement therapy (CET), a small-group-based coaching programme to enhance social cognitive milestones, has been found to have lasting positive effects on social cognition and functioning in adults with schizophrenia (Hogarty *et al.* 2004, 2006; Hogarty & Greenwald

2006; Eack *et al.* 2009, 2010, 2011). The programme has also been generalisable to other populations with social cognitive impairments, such as adults with autism (Eack *et al.* 2013).

Taking into consideration the age and developmental needs of adolescents with 22q11DS, we developed a social cognitive training (SCT) programme based on CET that consists of a structured curriculum with new and tailored exercises applicable to adolescents with 22q11DS, while attempting to retain many of the core principles of CET, such as perspective taking, gistful social thinking and identification of non-verbal social clues.

In this pilot study of implementing the newly adapted SCT programme in adolescents with 22q11DS, our primary question was if weekly small-group sessions to deliver the SCT curriculum would be feasible, overcoming the challenges of recruitment and adherence to the programme; the secondary question was if social cognition could be improved with the use of this SCT programme. We hypothesised that the intervention would result in moderate-to-large effect sizes for improvements in social cognition in adolescents with 22q11DS group relative to control subjects with 22q11DS. We now present feasibility data and preliminary efficacy results for this novel intervention.

Methods

Demographics

Participants were recruited through the medical genetics clinic of the university medical centre and through the statewide 22q11DS family support group. Twenty-two subjects with 22q11DS between the ages of 12 and 17 years completed the study and the post-intervention assessments, with 13 and nine subjects in the intervention and control groups, respectively. Three other subjects in the intervention group have participated in the intervention, but their data are not presented in this study due to pending post-test assessments. One additional intervention subject dropped out of the study after attending two group sessions and her data are not included. The study was approved by the institutional review board and was open labelled, primarily due to the unanimous request by the families who were in the vicinity of the small-group sessions to be recruited into the intervention group and not be assigned control status. Thus, subjects within 40 miles of the geographical location of a group meeting site were given the option of being enrolled into the intervention group. Subjects who were not in the vicinity were offered assignment to the control group. The two groups were matched for age, gender and ethnicity. The mean ages for the intervention (14.84 ± 1.44) and control groups (14.02 ± 2.12) were not significantly different ($t = 1.0$, $P = 0.32$). Similarly, there were no significant group differences in gender [50 and 57% female in the intervention and control groups, respectively, Fisher's exact test (FET) $P = 1.00$]. In the intervention group, 83% were Caucasian, with 100% of the control group being Caucasian ($\chi^2 = 0.13$, $P = 0.52$). Parental socioeconomic status (SES) as derived with the Hollingshead Index (Hollingshead 1975) was similar across the two groups (SES in intervention group = 27.83 ± 11.66 and control group = 33 ± 19.47, $t = 0.72$, $P = 47$).

Pre- and post-intervention assessments

A set of psychological measures were administered before and after the intervention period, to both groups, to assess preliminary effects of the intervention on social cognition, social and adaptive functioning. The research assistants who performed these assessments were blinded to group assignment and these individuals also did not participate in the intervention. Conversely, the postdoctoral associate (coach), who was responsible for the small-group sessions, was not involved in conducting the pre- or post-assessments to prevent bias.

The assessments captured the following domains: (1) *Measures of intelligence and neurocognition:* Verbal and Performance Scales on the Wechsler Intelligence Scale for Children (WISC-IV) for those less than 16 years of age (Wechsler 2003) and the Wechsler Adult Intelligence Scale Fourth Edition for subjects 16 years of age and above (Wechsler 2008). (2) *Social cognition measures:* The Mayer-Salovey-Caruso Emotional Intelligence Test-Youth Version (MSCEIT-YV) (Peters *et al*. 2009), a performance-based measure of emotional intelligence for youth, 10–18 years of age. The MSCEIT has an overall reliability of 0.93 and good construct validity. The Diagnostic Analysis of Nonverbal Accuracy (DANVA) (Nowicki 1994) was used for visual (face emotion recognition) and auditory emotion recognition (paralanguage). The reliabilities of the DANVA face emotion recognition and paralanguage tasks are high (0.88 and 0.77, respectively) and it has been found to have good construct validity (Pitterman & Nowicki 2004). (3) *Social function measures:* Global Functioning-Social (Cornblatt *et al*. 2007) for social functioning (Cornblatt *et al*. 2007), for academic/work functioning and the Social Skills Rating Scale (Gresham & Elliot 1990). (4) *Measures of psychiatric status and general adaptive function:* Adaptive Behavior Assessment Systems (ABAS Second Edition) for assessment of adaptive function (Harrison & Oakland 2003) and the Computerized Diagnostic Interview Schedule for Children, a structured psychiatric interview (NIMH-CDISC 2004).

Parent and child satisfaction with the groups was assessed using questionnaires administered at the midpoint and end of the programme. Finally, the Side Effects Rating Scale (SERT) (Barkley 1981), an emotional distress rating scale, was modified to include a question about suicidal ideation and was administered on a weekly basis for the sole purpose of assessing any ongoing behavioural or psychiatric symptoms that would merit further psychiatric or psychological evaluation. The study Principal Investigator (PI) (an MD with expertise in clinical management of 22q deletion syndrome) and the coach called parents monthly to review progress and to discuss any concerns raised by the modified SERT forms or any other parental concerns. This was a unique element that was not part of CET that was incorporated to enable close contact with the parents.

The social cognitive training curriculum

Over the first 6 months, the SCT curriculum was developed based on CET by a postdoctoral psychology fellow under the guidance of a child psychologist and a clinical geneticist to create a SCT manual for this programme. The developmental needs of children with 22q11DS guided this adaptation, specifically their age range and their cognitive and social cognitive impairments. Because CET had been developed originally for adults with

schizophrenia, extensive adaptation was necessary. The original CET manual consists of three sections of which we adapted the social cognitive group training curriculum. The two other components consisting of computerised training exercises to improve memory and attention and a module on the applications of CET to daily life such as seeking employment (Hogarty & Greenwald 2006; Hogarty *et al.* 2006) were not directly applicable to the goals of this project. We were sensitive to the core principles of the SCT curriculum, which is centred on perspective taking and the related social context appraisal, leading to appreciation of one's own and others' affect, reflection of past interpersonal experiences and the development of a shared understanding, leading to improved social cognition. Specific case scenarios, video clips and pictures were replaced to make these more applicable to children with 22q11DS, given their age and associated cognitive impairments. Once complete the adapted manual was reviewed by two experts in CET who had not been involved in the adaptation, as well as three adolescents with 22q11DS and one of their parents. Comments and suggestions made by the experts and the families were incorporated and a finalised version was approved prior to the beginning of the group sessions.

Logistics of social cognitive training sessions

After baseline assessment, the intervention arm was assigned to meet in small-group sessions for 1 h each week for 26 weeks. To minimise parents' travel time, groups were held in four different cities in the state. The same coach travelled to all four sites to conduct the weekly sessions. The four groups ranged in size from three to five subjects. The median miles parents drove per roundtrip to the group sessions was 37.3, and two families drove more than 70 miles roundtrip each week. The parents were reimbursed for mileage at the standard institutional rate. The adolescent participants were paid $10 for each session attended.

Social cognitive training group sessions

The 26 group sessions all followed the same format based on the CET principles of predictability and consistency. There was also redundancy built into and across the sessions in order to reinforce concepts and skills. One group member first asked others to present their homework, then new concepts were introduced and practiced, and then the leader assigned the next week's homework. Homework was assigned in 74% of sessions, excluding sessions that were incomplete, introductory or review sessions. Parents were informed weekly about the topics covered and the homework assignment. Video clips and audiovisual aids were utilised by the coach to introduce new concepts and for some of the exercises that were performed. The participants were always seated around a table, with the coach, facing one another, to facilitate interactions with each other.

In the first sessions, participants learned about the group's purpose and rules. The second session educated participants about 22q11DS. Subsequent sessions included perspective thinking, recognising physical cues of distress, emotional temperature taking, practicing of techniques for calming down, flexible thinking, identifying the main idea of a conversation, determine expected behaviour in different situations, using non-verbal cues to identify emotions, practicing active listening, providing verbal support, clearly expressing their own thoughts, how to respond to feedback and provide helpful feedback. The last four sessions

consisted of identifying maladaptive thoughts and replacing them with more adaptive thoughts, reinforcing concepts taught earlier and participants' evaluation of their progress.

Fidelity check

To ensure that the SCT sessions were uniformly conducted across the groups, the PI periodically observed each group to monitor the content of the curriculum at each site. To ensure fidelity to the principles of SCT, an expert in this area observed one session and reviewed videotapes of two other groups.

Data analyses

Qualitative analysis—The following sources provided qualitative data: (1) notes from monthly calls to parents by the principal investigator and study psychologist; (2) a parental focus group meeting at the end of the programme for the first three groups ($n = 11$ subjects), facilitated by a psychologist who did not participate in the intervention; and (3) parent and child questionnaires obtained at midpoint and end of SCT.

The focus group meeting was audiotaped and transcribed verbatim. Data were analysed for content using Atlas Ti (version 5.71, ATLAS.ti Scientific Software Development GmbH, Berlin, Germany) by a genetic counsellor and researcher experienced in qualitative analysis who was not involved with the intervention. A constant comparative method was used to code data (Boeije 2002).

Quantitative analysis—Data were analysed using R version 3.0.2. Linear mixed-effects models were used to examine differential rates of cognitive and behavioural change between those receiving SCT and those receiving usual care. Covariates in the analyses included gender, the verbal comprehension index score on the WISC-IV, any psychiatric diagnosis, any psychiatric medications and grade level at study entry. Although groups did not differ significantly on these covariates, they were included due to their likely impact on outcome. Missing data were estimated at the time of analysis using maximum likelihood estimation, and all models allow for heterogeneous variance between treatment groups. A social cognition composite score was created by scaling the branch scores on the MSCEIT (perceiving emotions, facilitating thought, understanding emotions, managing emotions), ABAS (social composite), SSRS (standard score), DANVA (faces and paralanguage total errors) and global function (social) scores to a common metric across time points, reverse coding error scores so that higher values would indicate better performance and averaging across items. Reliability coefficients were calculated using Cronbach's alpha. The composite score had fair reliability (alpha = 0.67), given the diverse set of measures and small sample size.

Results

Pre-intervention characteristics

The intervention and control groups did not differ significantly on demographic measures. Verbal comprehension ($t = 1.2$, $P > 0.05$) and perceptual organisation ($t = 0.45$, $P > 0.05$) were similar in both groups. There were no significant differences in medication status for

ADHD (3/9 control participants vs. 5/13 intervention group participants took ADHD medications, FET $P > 0.05$) or any psychotropic medication (one control subject and three intervention group subjects were on an anxiolytic, FET $P > 0.05$). Based on the Computerised Diagnostic Interview Schedule for Children (NIMH-CDISC 2004), three intervention and one control participants met criteria for ADHD (FET $P > 0.05$), whereas seven intervention and five control participants met criteria for an anxiety disorder (FET $P > 0.05$). Overall, there was no significant group difference for subjects having any psychiatric diagnosis, with six control and eight intervention participants having a psychiatric diagnosis (FET $P > 0.05$). None of the subjects in either group had a psychotic disorder.

Post-intervention characteristics

As before, there were no significant differences between the two groups in medication status for ADHD (three control and four intervention subjects, FET $P > 0.05$) or for any psychotropic medication (two control subjects and three intervention subjects were on anxiolytics, FET $P > 0.05$). None of the subjects in either group had a psychotic disorder. The rates of ADHD (two control and three intervention subjects, FET $P > 0.05$), anxiety disorder (three control and six intervention subjects, FET $P > 0.05$) or any psychiatric diagnosis (three control and six intervention subjects, FET $P > 0.05$) were similar in the two groups.

Treatment compliance and satisfaction

Compliance with the SCT programme was high, with all subjects completing the programme. Eleven of the 13 (92%) attended at least two-thirds of the sessions, whereas seven (58%) attended at least 80% of the sessions. Because they were minors and/or not driving independently, all participants depended on relatives for transportation to the groups. Reasons for absences included illnesses, parents' work, family vacations, inclement weather and attending a special event for a sibling. One participant missed several sessions because he joined his school's basketball team, one attended a summer camp for children with medical problems and another took part in a school play for a few weeks. Whenever sessions were missed by a participant, the coach reviewed the material whenever feasible with that participant. Additionally, due to the redundancy built into the structure of the sessions, participants were exposed to all the elements of the curriculum, despite absences. Parents' and children's satisfaction levels with the SCT groups were high (Tables 1 and 2).

Qualitative analyses

The following themes emerged from the qualitative data: (1) changes observed in participants carry over into activities of daily life; (2) observations of the group processes; (3) negatives/barriers to group participation; (4) recommendations to improve the programme.

1. *Changes observed in participants and carry over into activities of daily life:* All the parents reported changes observed in group participants, with improvements in their children's social interactions outside of the group. They also noted positives related to maturation. Not all parental expectations were met by the end of the group. When asked about unmet expectations, a few parents indicated they

had hoped for more positive change, and one noted only minimal changes. The participants' written comments identified the most positive aspects of the group as making friends, learning to read facial expressions and learning strategies for talking to people.

2. *Observations of the group processes:* Many topics covered during the group were noted by the parents to be germane to the participant's difficulties. The group was perceived by parents and the adolescents as a 'safe' place to be, and many liked that it allowed for socialisation with peers with the same genetic disorder. Some parents tried to reinforce group activities into the child's daily life when an opportunity arose. Most parents thought the duration of individual sessions and of the curriculum as a whole were appropriate. They emphasised the need for communication between the study team and the parents; the email summary the parents received each week from the coach describing the activities and goal of the previous session was cited as a critical channel of communication.

3. *Negatives/barriers to group participation:* Finding the time for the group sessions could be difficult, but parents recognised that it would be hard to find a perfect time and that participation required a family commitment. A few families had difficulty with the length of the drive to get to the group. Finding time to complete the homework was challenging for both parent and child. Some parents prompted children to do their SCT homework during the drive. A few parents expressed concern about the composition of their children's groups in terms of gender, age and developmental level. One parent expressed concern that the lack of typically developing peers in the group might lead her child to regress behaviourally.

4. *Recommendations to improve the program:* Parents strongly recommended that the coach's weekly email include practical suggestions that could be used to reinforce SCT content. They felt it was important that the developmental levels and ages of the children in each group be as similar as possible. Some parents would also have liked the group to continue so as to reinforce content or to allow skills practice in the real world. The adolescents indicated that they would have liked more fun activities or less homework, or that the time at which the group met was difficult. Written comments were similar at the midpoint and at the final session.

The weekly SERT forms showed concerns in two children who expressed occasional suicidal ideation as reported by their parents. Upon further discussion, one parent strongly felt that her son expressed this feeling when frustrated and that she did not think that he would harm himself. In both instances a risk assessment and further psychological evaluation was arranged for both adolescents and neither was thought to be suicidal.

Additional data from monthly telephone calls

Additional topics that were discussed during these telephone calls included children increasingly isolating themselves and losing interest in activities ($n = 2$), academic problems ($n = 6$), bullying ($n = 1$) and possible prodromal symptoms of schizophrenia ($n = 1$). The PI

and the coach recommended and arranged evaluations by a psychologist/psychiatrist, as necessary, for these children. Strategies to address each of these concerns were provided.

Quantitative analyses

The intervention group showed a significant differential improvement on the composite index of social cognition: $t = 2.58$, $P < 0.05$, with a moderate effect size; Cohen's $d = 0.77$. For the individual measures, a significant difference between the groups was seen for the perceiving emotion scores on the MSCEIT (with a decline in these scores for the control group). No significant group differences were seen on social competence, global function social and general adaptive functioning (Table 3). It is to be noted that scores in the intervention group remained stable or improved across all the domains.

Discussion

Social cognition, consisting of the mental operations that underlie social behaviour, is necessary to understand and predict other people's behaviour. It includes a variety of procedures such as emotional processing, theory of mind and attributional style and is critically important for the optimal social functioning of individuals (Adolphs 2009). Children and adolescents with 22q11DS have impairments in social cognition, performing poorly on tasks of theory of mind (Jalbrzikowski *et al.* 2012) and facial emotion recognition (Shashi *et al.* 2012), focusing on the eyes rather than the mouth during these tasks (Campbell *et al.* 2010; Glaser *et al.* 2010) and demonstrating abnormal activation in areas of the brain that are critical to facial emotion recognition, such as the fusiform gyrus (Andersson *et al.* 2007). Social competence that is closely linked to social cognition is impaired in close to 50% of children with 22q11DS and has been associated with high rates of anxiety disorders, ADHD and poor global functioning, but is not differentially associated with IQ in these children (Shashi *et al.* 2012). These findings lead to the possibility that an intervention for social cognition may improve social competence as well as behavioural and overall functioning of children with 22q11DS. A previous study demonstrated that a cognitive intervention is feasible in children with 22q11DS and shows promise in improving neurocognition (Harrell *et al.* 2013), thus providing the context to develop a psychosocial intervention for the social cognitive impairments.

Our pilot study on SCT in adolescents with 22q11DS, the first of its kind, was based on the principles of CET, which have been demonstrated to be efficacious in improving social cognitive skills in adults with schizophrenia. The premise of the intervention is that social cognition can be improved through graduated procedural learning, resulting in better abstract thinking about oneself and others (Hogarty & Greenwald 2006; Hogarty *et al.* 2006). The 26-week SCT curriculum was customised to adolescents with 22q11DS and the small-group format was chosen as it is thought to be critical to enhancing social cognition, with interactions with other individuals facilitating the formation of a shared understanding of specific themes (Hogarty & Greenwald 2006; Hogarty *et al.* 2006).

We found the small-group intervention to be feasible. Attendance was high, with absences due primarily to other family members' commitments and participants' engagement in extracurricular activities. Parents reported high satisfaction with the quality of the sessions

and group size and all reported that they would likely return to the programme if the opportunity became available. Most of the children reported liking the group sessions and given a choice, they would keep attending the sessions. These high satisfaction rates attest to the feasibility of such an intervention, all the more remarkable given that the children attended partly at their parents' behest and that attendance required a major time commitment in the evening hours by families.

Qualitative improvements in the children's social interactions were reported by the parents and many cited specific examples of how changes had been carried over into their daily life. Curricular topics were generally considered appropriate for the population. The group sessions were viewed by the parents as a safe space and the interaction with other participants who had the same condition was of value. Negative perceptions about the group sessions included the observation that the changes seen were not as dramatic as hoped for and the considerable family commitment to the group participation. Suggestions to improve the groups included having sites close to participants' homes, an even gender balance, and to enrol children of similar developmental level.

This study was intended to demonstrate feasibility and acceptability and was not powered to show efficacy. However, preliminary quantitative analyses showed that a composite social cognition index demonstrated a significant improvement in social cognition in the intervention group compared with the control group ($P < 0.05$), attesting to the potential value of this intervention. A large effect size was seen on the MSCEIT perceiving emotions, with a significant group difference due to a decline in this skill in the control group. The exact cause for this decline in the control group is unclear; there were no significant group differences in psychiatric diagnoses such as anxiety disorders at the end of the intervention period, to account for this, nor were there any subjects in either group who had developed serious psychopathology such as psychoses. It is possible that the age-related changes in emotion recognition in 22q11DS adolescents include a diminishing ability to perceive emotions and that the intervention group maintained their emotion recognition ability, but this cannot be conclusively derived with this small sample size and thus is a topic of future research. We do believe that our results are valid as the MSCEIT has been found to be especially reliable in detecting differences among individuals that have lower than average emotional intelligence (a characteristic applicable to adolescents with 22q11DS) (Fiori *et al.* 2014). Overall, the intervention group showed gains in facial and auditory emotion recognition across the measures. The DANVA and the MSCEIT are both self-completed, thereby eliminating the parental bias that could occur with parent-based interviews of social cognition. Additionally, the improvements that were evident in the intervention group occurred mainly on measures that directly assessed the participants' skills rather than in those reported by parents, such as the ABAS.

Our study is limited by the small sample size and the lack of randomisation. We also were underpowered to assess the efficacy of this intervention on other concurrent psychopathology in these children, such as anxiety disorders/symptoms. A particular strength of our programme was the in-person interaction for the participants with the coach and the interactions between themselves, neither of which could happen with easier forms of interventions such as online modules. Topics to be examined in a larger randomised

controlled trial would include measuring efficacy of this SCT in improving social skills and overall functioning in adolescents with 22q11DS, including studying potential moderators of treatment effects and durability and its generalizability. It is also unclear at this point whether interventions such as our SCT should be performed in conjunction with a wider set of interventions for other neurocognitive functions.

In conclusion, we have shown that our social cognition training curriculum is feasible and well liked by adolescents with 22q11DS and their parents. An improvement in overall social cognition was found in the intervention group compared with the control group. Due to the relatively high prevalence of 22q11DS and its associated psychological morbidity, interventions improving outcomes could substantially reduce the public health impact of this disorder and in the future could be informative on whether the social cognitive deficits associated with major psychiatric illnesses in these individuals can be mitigated.

References

Adolphs R. The social brain: neural basis of social knowledge. Annual Review of Psychology. 2009; 60:693–716.

Andersson F, Glaser B, Spiridon M, Debbane M, Vuilleumier P, Eliez S. Impaired activation of face processing networks revealed by functional magnetic resonance imaging in 22q11.2 deletion syndrome. Biological Psychiatry. 2007; 63:49–57. [PubMed: 17651704]

Baker KD, Skuse DH. Adolescents and young adults with 22q11 deletion syndrome: psychopathology in an at-risk group. British Journal of Psychiatry. 2005; 186:115–20. [PubMed: 15684233]

Barkley, RA. Hyperactive Children: A Handbook for Diagnosis and Treatment. Guilford Press; New York, NY: 1981.

Boeije H. A purposeful approach to the constant comparative method in the analysis of qualitative interviews. Quality & Quantity. 2002; 36:391–409.

Campbell L, McCabe K, Leadbeater K, Schall U, Loughland C, Rich D. Visual scanning of faces in 22q11.2 deletion syndrome: attention to the mouth or the eyes? Psychiatry Research. 2010; 177:211–15. [PubMed: 20381171]

Campbell LE, Stevens AF, McCabe K, Cruickshank L, Morris RG, Murphy DG, et al. Is theory of mind related to social dysfunction and emotional problems in 22q11.2 deletion syndrome (velo-cardio-facial syndrome). Journal of Neurodevelopmental Disorders. 2011; 3:152–61. [PubMed: 21544568]

Cornblatt BA, Auther AM, Niendam T, Smith CW, Zinberg J, Bearden CE, et al. Preliminary findings for two new measures of social and role functioning in the prodromal phase of schizophrenia. Schizophrenia Bulletin. 2007; 33:688–702. [PubMed: 17440198]

De Smedt B, Devriendt K, Fryns JP, Vogels A, Gewillig M, Swillen A. Intellectual abilities in a large sample of children with Velo-Cardio-Facial Syndrome: an update. Journal of Intellectual Disability Research. 2007; 51:666–70. [PubMed: 17845235]

Debbane M, Glaser B, David MK, Feinstein C, Eliez S. Psychotic symptoms in children and adolescents with 22q11.2 deletion syndrome: neuropsychological and behavioral implications. Schizophrenia Research. 2006; 84:187–93. [PubMed: 16545541]

Eack SM, Greenwald DP, Hogarty SS, Cooley SJ, DiBarry AL, Montrose DM, et al. Cognitive enhancement therapy for early-course schizophrenia: effects of a two-year randomized controlled trial. Psychiatric Services. 2009; 60:1468–76. [PubMed: 19880464]

Eack SM, Greenwald DP, Hogarty SS, Keshavan MS. One-year durability of the effects of cognitive enhancement therapy on functional outcome in early schizophrenia. Schizophrenia Research. 2010; 120:210–16. [PubMed: 20472402]

Eack SM, Hogarty GE, Greenwald DP, Hogarty SS, Keshavan MS. Effects of Cognitive Enhancement Therapy on employment outcomes in early schizophrenia: results from a 2-year randomized trial. Research on Social Work Practice. 2011; 21:32–42. [PubMed: 23885163]

Eack SM, Greenwald DP, Hogarty SS, Bahorik AL, Litschge MY, Mazefsky CA, et al. Cognitive enhancement therapy for adults with autism spectrum disorder: results of an 18-month feasibility study. Journal of Autism and Developmental Disorders. 2013; 43:2866–77. [PubMed: 23619953]

Fiori M, Antonietti JP, Mikolajczak M, Luminet O, Hansenne M, Rossier J. What is the Ability Emotional Intelligence Test (MSCEIT) good for? An evaluation using item response theory. PLoS ONE. 2014; 9:e98827. [PubMed: 24901541]

Glaser B, Debbane M, Ottet MC, Vuilleumier P, Zesiger P, Antonarakis SE, et al. Eye gaze during face processing in children and adolescents with 22q11.2 deletion syndrome. Journal of the American Academy of Child and Adolescent Psychiatry. 2010; 49:665–74. [PubMed: 20610136]

Gresham, FM., Elliot, SN. Social Skills Rating System. American Guidance Service, Inc; Circle Pines, MN: 1990.

Harrell W, Eack S, Hooper SR, Keshavan MS, Bonner MS, Schoch K, et al. Feasibility and preliminary efficacy data from a computerized cognitive intervention in children with chromosome 22q11.2 deletion syndrome. Research in Developmental Disabilities. 2013; 34:2606–13. [PubMed: 23751300]

Harrison, P., Oakland, T. Adaptive Behavior Assessment System. 2. The Psychological Corporation; San Antonio, TX: 2003.

Hogarty, GE., Greenwald, DP. Cognitive enhancement therapy: the training manual. 2006.

Hogarty GE, Flesher S, Ulrich R, Carter M, Greenwald D, Pogue-Geile M, et al. Cognitive enhancement therapy for schizophrenia: effects of a 2-year randomized trial on cognition and behavior. Archives of General Psychiatry. 2004; 61:866–76. [PubMed: 15351765]

Hogarty GE, Greenwald DP, Eack SM. Durability and mechanism of effects of cognitive enhancement therapy. Psychiatric Services (Washington, DC). 2006; 57:1751–7.

Hollingshead, AB. Four Factor Index of Social Status. Yale University Department of Sociology; New Haven: 1975.

Jalbrzikowski M, Carter C, Senturk D, Chow C, Hopkins JM, Green MF, et al. Social cognition in 22q11.2 microdeletion syndrome: relevance to psychosis? Schizophrenia Research. 2012; 142:99–107. [PubMed: 23122739]

Jolin EM, Weller RA, Jessani NR, Zackai EH, McDonald-McGinn DM, Weller EB. Affective disorders and other psychiatric diagnoses in children and adolescents with 22q11.2 deletion syndrome. Journal of Affective Disorders. 2009; 119:177–80. [PubMed: 19269692]

Kiley-Brabeck K, Sobin C. Social skills and executive function deficits in children with the 22q11 deletion syndrome. Applied Neuropsychology. 2006; 13:258–68. [PubMed: 17362146]

Lewandowski KE, Shashi V, Berry PM, Kwapil TR. Schizophrenic-like neurocognitive deficits in children and adolescents with 22q11 deletion syndrome. American Journal of Medical Genetics. Part B, Neuropsychiatric Genetics. 2007; 144:27–36.

McCabe K, Rich D, Loughland CM, Schall U, Campbell LE. Visual scanpath abnormalities in 22q11.2 deletion syndrome: is this a face specific deficit? Psychiatry Research. 2011; 189:292–8. [PubMed: 21831452]

Moss EM, Batshaw ML, Solot CB, Gerdes M, Donald-McGinn DM, Driscoll DA, et al. Psychoeducational profile of the 22q11.2 microdeletion: a complex pattern. Journal of Pediatrics. 1999; 134:193–8. [PubMed: 9931529]

Murphy KC, Jones LA, Owen MJ. High rates of schizophrenia in adults with velo-cardio-facial syndrome. Archives of General Psychiatry. 1999; 56:940–5. [PubMed: 10530637]

NIMH-CDISC. Computerized diagnostic interview schedule for children. 2004.

Nowicki SDM. Individual differences in the nonverbal communication of affect: the diagnostic analysis of nonverbal accuracy scale. Journal of Nonverbal Behavior. 1994; 18:9–36.

Papolos DF, Faedda GL, Veit S, Goldberg R, Morrow B, Kucherlapati R, et al. Bipolar spectrum disorders in patients diagnosed with velo-cardio-facial syndrome: does a hemizygous deletion of chromosome 22q11 result in bipolar affective disorder? American Journal of Psychiatry. 1996; 153:1541–7. [PubMed: 8942449]

Peters C, Kranzler JH, Rossen E. Validity of the Mayer-Salovey-Caruso emotional intelligence test: youth version-research edition. Canadian Journal of School Psychology. 2009; 24:76–81.

Philip N, Bassett A. Cognitive, behavioural and psychiatric phenotype in 22q11.2 deletion syndrome. Behavior Genetics. 2011; 41:403–12. [PubMed: 21573985]

Pitterman H, Nowicki S Jr. A test of the ability to identify emotion in human standing and sitting postures: the diagnostic analysis of nonverbal accuracy-2 posture test (DANVA2-POS). Genetic, Social, and General Psychology Monographs. 2004; 130:146–62.

Schneider M, Debbane M, Bassett AS, Chow EW, Fung WL, van den Bree M, et al. Psychiatric disorders from childhood to adulthood in 22q11.2 deletion syndrome: results from the International Consortium on Brain and Behavior in 22q11.2 deletion syndrome. American Journal of Psychiatry. 2014; 171:627–39. [PubMed: 24577245]

Shashi V, Veerapandiyan A, Schoch K, Kwapil T, Keshavan M, Ip E, et al. Social skills and associated psychopathology in children with chromosome 22q11.2 deletion syndrome: implications for interventions. Journal of Intellectual Disability Research. 2012; 56:865–78. [PubMed: 21883601]

Shprintzen RJ. Velo-cardio-facial syndrome: a distinctive behavioral phenotype. Mental Retardation and Developmental Disabilities Research Reviews. 2000; 6:142–7. [PubMed: 10899808]

Shprintzen RJ. Velo-cardio-facial syndrome: 30 years of study. Developmental Disabilities Research Reviews. 2008; 14:3–10. [PubMed: 18636631]

Shprintzen RJ, Goldberg R, Golding-Kushner KJ, Marion RW. Late-onset psychosis in the velo-cardio-facial syndrome. American Journal of Medical Genetics. 1992; 42:141–2. [PubMed: 1308357]

Stoddard J, Niendam T, Hendren R, Carter C, Simon TJ. Attenuated positive symptoms of psychosis in adolescents with chromosome 22q11.2 deletion syndrome. Schizophrenia Research. 2010; 118:118–21. [PubMed: 20056393]

Tezenas Du Montcel S, Mendizabai H, Ayme S, Levy A, Philip N. Prevalence of 22q11 microdeletion. Journal of Medical Genetics. 1996; 33:719.

Wechsler, D. Intelligence Scale for Children. 4. The Psychological Corporation; San Antonio, TX: 2003.

Wechsler, D. Wechsler Adult Intelligence Scale. 4. The Psychological Corporation; San Antonio, TX: 2008.

Wilson DI, Cross JE, Wren C, Scramble P, Burn J, Goodship J. Minimum prevalence of chromosome 22q11 deletion. American Journal of Human Genetics. 1994; 55:A169.

Woodin M, Wang PP, Aleman D, Donald-McGinn D, Zackai E, Moss E. Neuropsychological profile of children and adolescents with the 22q11.2 microdeletion. Genetics in Medicine. 2001; 3:34–9. [PubMed: 11339375]

Young AS, Shashi V, Schoch K, Kwapil T, Hooper SR. Discordance in diagnoses and treatment of psychiatric disorders in children and adolescents with 22q11.2 deletion syndrome. Asian J Psychiatr. 2011; 4:119–24. [PubMed: 21743818]

Table 1

Responses to a written survey from the parents of the 22q11DS adolescents in the intervention group after completion of the study ($n = 13$)

Question	Answers			
How would you rate the quality of the small-group sessions?	Excellent/good: 100%		Fair/poor: 0	
Did you feel that the size of the small groups was ideal for your child?	Excellent/good: 92.3%		Fair/poor: 7.7%	
Was the study staff responsive to your child's individual needs?	Always/most of the time: 100%		Sometimes/never: 0	
Do you think that your child learned new skills during these sessions?	Yes, definitely/Yes, generally: 92.3%		No, not really/No, definitely: 7.7%	
What would make you more likely to continue participating in the small-group sessions?	Fine as it is: 84.6%	Fewer sessions: 7.7%	More compensation: 7.7%	Smaller/larger groups: 0
If you were to seek help again, would you come back to our programme?	Yes, definitely/Yes, I think so: 100%		No, I don't think so/No, definitely not: 0	

Table 2

Responses to written surveys of adolescents with 22q11DS in the intervention group, obtained at the completion of the programme (n = 13)

	Answers		
Question	**Very much**	**Somewhat/a little**	**Not at all**
I liked going to the group sessions	61.5%	38.5%	0%
I was nervous about going to the group sessions	7.7%	55%	45%
When I left the small-group sessions, I felt like I learned	100%	0%	0%
The leader of the small-group sessions was helpful	69.2%	30.8%	0%
If I had a choice about coming to these sessions, I would keep coming	53.9%	46.2%	0%
I liked to talk in front of the group	55%	45%	7.7%

Table 3

Summary of performance of adolescents with 22q11DS prior to and after social cognitive intervention, relative to the control group

Measure	Intervention pre-test mean (SE)	Intervention post-test mean (SE)	Within-group effect size	Control pre-test mean (SE)	Control post-test mean (SE)	Within-group effect size	*t*-value	*P*-value	Between-group effect size
Measures of social cognition									
MSCEIT-YV perceiving emotions	104.15 (4.74)	99.17 (4.74)	−0.37	103.22 (4.88)	87.09 (4.88)	−1.20	2.01	0.062	0.83
MSCEIT-YV facilitating thought	84.06 (5.62)	89.77 (5.62)	0.35	87.97 (5.82)	89.80 (5.82)	0.11	0.43	0.676	0.24
MSCEIT-YV understanding emotions	77.99 (2.27)	81.71 (2.27)	0.37	83.42 (3.85)	81.56 (3.85)	−0.19	0.98	0.344	0.56
MSCEIT-YV managing emotions	86.14 (5.13)	97.09 (5.13)	0.92	98.77 (6.54)	95.18 (6.54)	−0.30	1.28	0.221	1.22
DANVA face emotion recognition	0.07 (0.29)	0.60 (0.29)	0.47	0.02 (0.44)	0.49 (0.44)	0.41	0.14	0.894	0.06
DANVA auditory emotion recognition	−0.01 (0.34)	0.48 (0.34)	0.45	−0.06 (0.41)	0.42 (0.41)	0.44	0.02	0.984	0.01
Measures of social functioning									
GF: social	6.41 (0.40)	6.50 (0.40)	0.06	6.07 (0.64)	6.38 (0.64)	0.20	−0.26	0.796	−0.14
SSRS social skills	83.61 (5.45)	85.26 (5.46)	0.09	97.71 (8.48)	99.34 (8.57)	0.09	0.00	0.998	0.00
Measures of general adaptive function ABAS social	77.55 (5.25)	80.73 (5.25)	0.21	87.90 (6.02)	88.71 (5.98)	0.05	0.54	0.598	0.15
Social cognitive composite index									
Composite index	−0.33 (0.15)	0.02 (0.15)	0.68	0.03 (0.18)	−0.02 (0.18)	−0.09	2.58	0.021	0.77

Scores were scaled to a common metric, utilising reverse coding, so that higher values indicate better performance. ABAS, Adaptive Behavior Assessment Systems; DANVA, Diagnostic Analysis of Nonverbal Accuracy; GF, Global Functioning; MSCEIT-YV, Mayer-Salovey-Caruso Emotional Intelligence Test-Youth Version; SE, standard error; SSRS, Social Skills Rating System.