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Social Cognition and Interaction Training (SCIT) versus Training in Affect Recognition (TAR) in patients with schizophrenia: A randomized controlled trial

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ABSTRACT

Introduction: Training in Affect Recognition (TAR) is a "targeted" and computer-aided program that has been shown to effectively attenuate facial affect recognition deficits and improve social functioning in patients with schizophrenia. Social Cognition and Interaction Training (SCIT) is a group "broad-based" intervention, that has also been shown to improve emotion recognition, theory of mind (ToM), and social functioning. To date, no study has compared the efficacy of two different social cognitive interventions.

Objectives: We aim to compare the efficacy of TAR and SCIT on schizophrenia patients' performance on facial affect recognition, theory of mind, attributional style and social functioning before, after treatment, and three months thereafter.

Methods: One hundred outpatients with a diagnosis of schizophrenia were randomly assigned to the TAR or SCIT condition and completed pre- (T0) and posttreatment (T1) assessments and a 3-month follow up (T2) of emotion recognition (ER-40), theory of mind (Hinting Task), attributional style (AIHQ) and social functioning (PSP).

Results: The entire sample, receiving TAR or SCIT, showed improvements in theory of mind, attributional style, clinical symptoms and social functioning. This effect was maintained at three-months. The TAR intervention was more efficacious than the SCIT program in improving the recognition of facial emotions (ER-40). The TAR intervention also demonstrated a lower drop-out rate than the SCIT intervention.

Conclusions: There were improvements in social cognition, symptomatology and functioning of patients in the entire sample, receiving SCIT or TAR. Both TAR and SCIT appear as valuable treatments for people with schizophrenia and social cognitive deficits.

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1. Introduction

Social cognition refers to how individuals think about themselves, others, social situations, and social interactions (Penn et al., 1997, 2008). People with schizophrenia show significant difficulties in the performance of social cognition tasks in the National Institute of Mental Health - defined domains of: theory of mind, social perception, social knowledge, attributional bias, and emotional processing (Alfimova et al., 2009; Green et al., 2008; Savla et al., 2013), which are associated with impairments in social functioning (Halverson et al., 2019; Fett et al., 2011; Green et al., 2015). For example, theory of mind (ToM) has been found to be a better predictor than "non-social" cognition of social competence in schizophrenia (Brüne, 2005). In addition, social cognition is a mediator between neurocognition and social functioning (Halverson et al., 2019; Schmidt et al., 2011). Furthermore, given the relationships between reduced social functioning and increased stigma (Hill and Startup, 2013; Penn et al., 2000), the role of social cognition as a mediator is an attractive target to improve functioning as well as reduce stigma and social isolation frequently experienced by individuals with schizophrenia.

In recent years, there has been an interest in the development of social cognition training programs (Grant et al., 2017; Tan et al., 2016). Several reviews and meta-analyses have been conducted to date, which demonstrate promising results of the efficacy of such interventions on social cognitive deficits and functional outcomes (e.g., Horan et al., 2008; Kurtz et al., 2016; Kurtz and Richardson, 2012; Statucka and Walder, 2013; Tan et al., 2016). The overall effect of social cognition training was moderate to large on emotion recognition (d = 0.71; Kurtz and Richardson, 2012) and moderate on theory of mind (g = 0.53; D'Arma et al., 2021). Some approaches are focused on one specific domain of social cognition ("targeted" interventions, such as Training in Affect Recognition [TAR; Wölwer et al., 2005]), and others incorporate multiple domains leading to more complex, eclectic programs ("broad-based" interventions, such as Social Cognition and Interaction Training (SCIT; Penn et al., 2007; Roberts et al., 2016).

TAR (Frommann et al., 2003) has sound empirical support (Statucka and Walder, 2016) and has been shown to effectively attenuate facial affect recognition deficits in patients with schizophrenia (Luckhaus et al., 2013; Sachs et al., 2012; Wölwer et al., 2005; Wölwer and Frommann 2011). TAR teaches compensation strategies using errorless learning principles, positive reinforcement, feature abstraction, self-instruction and, most importantly, verbalization of characteristic features of facial affect. In several controlled trials, the TAR group demonstrated significant improvements in facial affect recognition, with preliminary evidence of enduring effects for at least eight weeks after the end of treatment (Wölwer et al., 2005; Luckhaus et al., 2013; Drusch et al., 2014). Furthermore, TAR was also associated with improvement in social functioning, some aspects of cognitive functioning, and a reduction in negative symptoms (Sachs et al., 2012; Wölwer and Frommann 2011).

SCIT is a 24-session manual-based group treatment, which includes elements of cognitive behavioral therapy and social skills training. SCIT was designed for patients with schizophrenia spectrum disorders to improve their social functioning through enhancing social cognition. SCIT has also been shown to improve emotion recognition, ToM, and social functioning (Bartholomeusz et al., 2013; Hasson-Ohayon et al., 2014; Parker et al., 2013; Roberts et al., 2014, 2016; Wang et al., 2013). While some SCIT studies are underpowered and there is not yet an available meta-analysis, effect sizes suggest a small but significant advantage for SCIT over treatment as usual in patients with schizophrenia (e.g., d = 0.27; Roberts et al., 2014).

The efficacy of both SCIT and TAR has been demonstrated in randomized controlled trials comparing these interventions to treatment as usual, occupational therapy, and cognitive remediation (Kurtz et al., 2016). To date, no study has compared the efficacy of two different social cognitive interventions (a direct comparison design). More precise knowledge about the efficacy of each intervention on the five main domains of social cognition (ToM, social perception, social knowledge, attributional bias, and emotional processing) is needed, and a direct comparison design enables identification of the potential differential efficacy of each intervention. SCIT and TAR also vary in length and scope (e.g., targeted versus more comprehensive or broad-based) and a direct comparison design may identify structural elements that contribute to treatment efficacy.

In this study, we compared the efficacy of a "targeted" (i.e., TAR) and a "broad-based" (i.e., SCIT) intervention on schizophrenia patients' performance on facial affect recognition (primary outcome), ToM and attributional style before (T0) and after treatment (T1). A secondary aim was to compare the efficacy of SCIT and TAR on general cognition, functioning, and symptomatology. We hypothesized that the patient group receiving TAR would exhibit greater improvement in emotion recognition performance at post-intervention (T1) comapred to patients receiving SCIT. Conversely, we hypothesized that patients receiving SCIT would show greater improvement on ToM and attributional style compared with TAR. Given the broad-based nature of SCIT, we also hypothesized that this patient group would exhibit greater improvements in social functioning and cognition compared to patients receiving TAR, a more targeted treatment. To assess the durability of these effects, performance on measures of social cognition, cognitive functioning, symptomatology and functional capacity were also assessed three months after the end of treatment (T2).

2. Methods

2.1. Participants

Outpatients who met DSM-IV criteria for schizophrenia or schizoaffective disorder (SCID-P; First et al., 2002), were between the ages of 18–65 years of age, and with stable symptoms were included in the study. Patients were recruited through clinical referrals from four mental health centers in Madrid, Barcelona, Zaragoza and Teruel (Spain), from June 2016 to March 2019. All were clinically stable, with no psychiatric hospitalizations in the past three months, with the same antipsychotic medication regimen for the previous six weeks, and no planned medication changes for the next three months. Exclusion criteria were: 1. Meeting criteria for a disorder other than schizophrenia or schizoaffective disorder, according to DSM-IV diagnosis criteria; 2. Additional Axis-I or Axis-II diagnosis; 3. Dependence on alcohol or other drugs (except nicotine); 4. Serious somatic disorders or organic brain damage; 5. Severe impairment in intellectual functioning or difficulty speaking or understanding the Spanish language.

This study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee at each site. A blind and external researcher utilized a computer program for randomization and allocation of subjects. In total, 100 participants were randomly allocated to the TAR (n = 49) or SCIT group (n = 51; See Fig. 1 for CONSORT diagram).

2.2. Treatment

TAR is a 12-session training targeting facial affect recognition administered over a period of six weeks (two sessions per week). Sessions include one therapist and two patients. TAR also includes neuropsychological strategies, similar to cognitive remediation, such as restitution and compensation, as well as principles of errorless learning, direct positive reinforcement, verbalization, and self-instruction (Frommann et al., 2003). TAR is divided into three blocks of four sessions each: during the first block, patients learn to identify and discriminate prototypical facial signs of the six basic emotions (happiness, sadness, fear, disgust, anger and surprise). The next block teaches a more holistic processing mode involving fast decisions, relying on first impressions, nonverbal processing and recognition of facial expressions

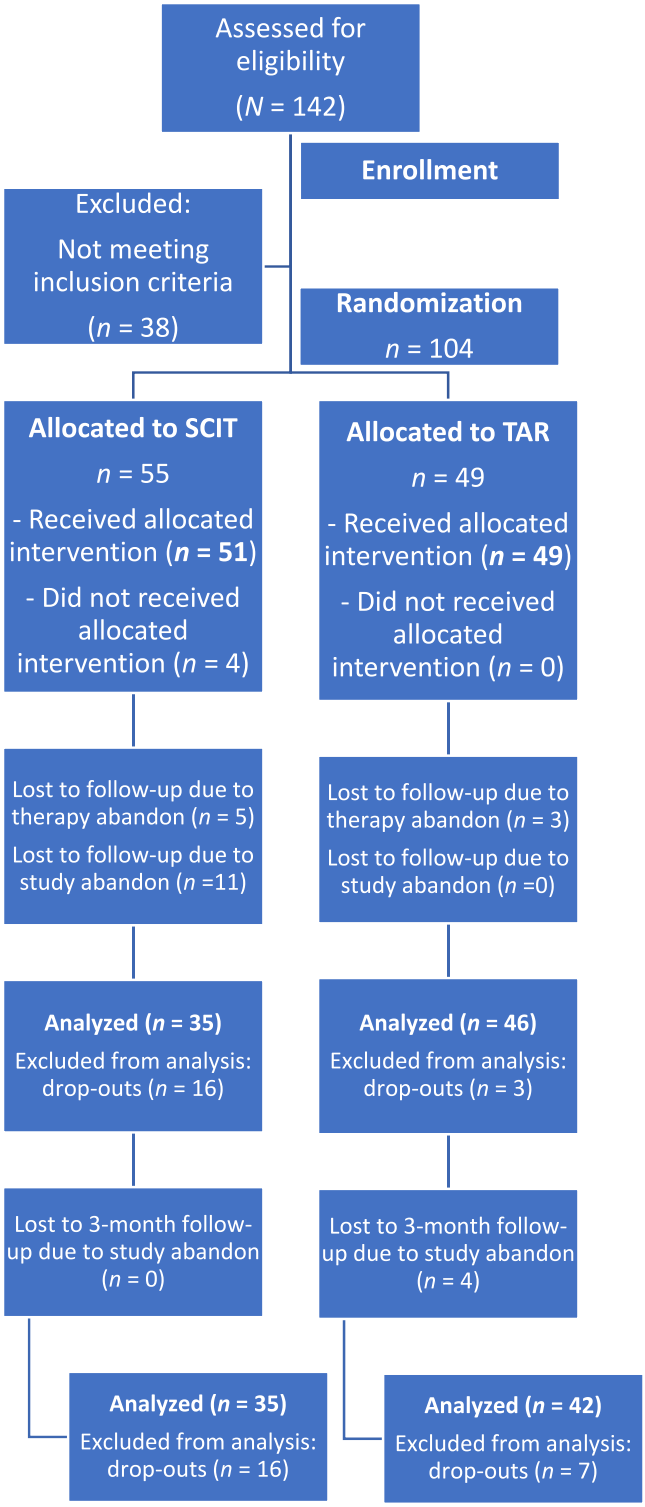

Fig. 1. CONSORT flow diagram of the clinical trial.

with small intensities. The third block emphasizes the role of facial emotions in social, behavioral, and situational contexts (Wölwer et al., 2005; Wykes et al., 2011).

SCIT is a manual-based group intervention that is delivered in 20–24 weekly, hour-long

Sessions. Sessions include two clinicians and six to ten patients. SCIT uses a combination of psychoeducation, drill-and-repeat skill practice, strategy games, heuristic rehearsal, and homework assignments to remediate deficits and decrease biases in social cognition. Each SCIT group participant was encouraged to identify a 'practice partner', a family member or acquaintance who was willing to practice SCIT skills with the participant weekly in lieu of, or in addition to, traditional homework. SCIT clinicians attempted to reach practice partners by phone each week to improve treatment adherence, check-in, and provide guidance in their efforts to support SCIT participants' learning (Roberts et al., 2014).

2.3. Study procedure

Baseline assessments (T0) were performed after enrollment in the study and post-treatment assessments were performed immediately after the end of the treatment period (T1) as well as three months thereafter (T2). Given the number of session differences between interventions, T1 was at week six for TAR and at week 24 for SCIT. Trained raters blind to treatment condition assessed participants on outcomes measures at baseline, post-treatment and three-month follow-up.

2.4. Measures

2.4.1. Social cognition assessment

Emotion recognition was measured with the *Penn Emotion Recognition-40* (ER40) task, in which participants are asked to judge, one at a time, which emotion is shown on a series of 40 faces (Kohler et al., 2003).

Emotion recognition was measured with the *Face Emotion Identification Task* and the *Face Emotion Discrimination Task* (FEIT and FEDT; Kerr and Neale, 1993). The FEIT is comprised of 19 photographs of faces expressing one of six basic emotions; the participant's task is to identify the emotion expressed by each face. The FEDT is comprised of 30 pairs of black and white pictures with faces presented concurrently. Participants need to determine whether the two faces in each pair of pictures are displaying the same or different emotions. ToM was assessed with the Spanish version of the *Hinting Task* (Corcoran et al., 1995; Gil et al., 2012), which consists of ten brief vignettes containing social hints that the participant is asked to interpret.

Attributional Style was assessed using the *Ambiguous Intentions Hostility Questionnaire* (AIHQ; Combs et al., 2007). AIHQ vignettes consist of situations in which the intentions of the vignette characters are ambiguous. Participants are asked to rate on a Likert scale why they think the protagonist acts this way (AIHQ-Hostility Bias), whether the other person performed the action on purpose (AIHQ-Intentionality Score) and how much they would blame him/her (AIHQ-Blame score). Participants also rate how angry the situation would make them feel (AIHQ-Anger Score) and how they would respond to this situation (AIHQ-Aggression Bias). Additionally, participants provided two open-ended responses: an explanation of why the event occurred, and what they would do in response to the event. These items are scored by trained raters (on a 1 to 5 scale) according to the extent to which the participant interpreted the situation in a hostile manner (AIHQ-Hostility Bias) and the extent to which the individual reported aggression in their response (AIHQ-Aggression Bias) (Combs et al., 2007; Buck et al., 2017). Raters were required to achieve a high degree of agreement on training responses before completing ratings for the present study.

2.4.2. Cognitive assessment

2.4.2.1. Trail Making Test–Part A and B (TMT; Reitan and Davison, 1974). A paper and pencil measure of visual processing and visuo-motor tracking (Lezak, 1995). The TMT-A is used to measure sustained attention and speed of processing, which depends on the ability to organize and sequence information. Efficient performance on the TMT–B depends on working memory and cognitive flexibility.

2.4.2.2. Controlled verbal fluency task (FAS; Borkowski et al., 1967). In

this verbal fluency test, participants were given a total of three letters, one letter at a time (F, A and S). The overall test score reflects the total number of correct words participants generated within the 60 s allotted for each of the three trials.

2.4.2.3. Numbers and letters sequence (LNS; WAIS-III, Wechsler, 1997). A measurement of attention and working memory from the WAIS. After listening to a sequence of mixed letters and numbers (e.g., Q-1-B-3-J-2), participants must remember the sequence, and first place the numbers in numerical order and then the letters in alphabetical order.

2.4.2.4. Benton Facial Recognition Test (Benton et al., 1983). This test consists of a series of sheets in which a single "face model" is presented. Participants are asked to correctly match the face model with a set of photographs showing different faces.

2.4.3. Functioning assessment

The Personal and Social Performance Scale (PSP; Morosini et al., 2000; Spanish version, Garcia-Portilla et al., 2011) is a brief, clinician-rated, reliable, valid and sensitive instrument for measuring functioning in schizophrenia. After a structured interview, clinicians score four domains: 1. Socially useful activities (i.e., housework, voluntary work) including work and study; 2. Personal and social relationships (i.e., partner, family relationships, friends); 3. Self-care (i.e., personal hygiene, care of one's appearance); 4. Disturbing and aggressive behavior.

2.4.4. Symptom assessment

Clinical symptoms in both treatment groups were assessed using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). The 30-item PANSS is a seven-point rating instrument that captures the severity of positive and negative symptoms as well as global psychopathology. The PANSS includes three sub-scales: negative symptoms (PANSS-NS), positive symptoms (PANSS-PS), and general psychopathology (PANSS-GP). The composite scale score (PANSS-C) is obtained by subtracting the PANSS-NS from the PANSS-PS. This score reflects the degree of predominance of one symptom presentation over the other, and its valence (negative or positive, range is −42 to 42) indicates predominant symptom presentation (i.e., positive or negative symptoms). Depressive symptoms were assessed, at every time point, with the Hamilton Depression Rating Scale (Hamilton; Hamilton, 1960). A random subset of participants (n = 10) were selected to calculate interrater reliability for the rater-scored items with good agreement observed between raters (ICCs > 0.80).

2.5. Statistical analysis

All statistical analyses were carried out using Stata v15 for PC (StataCorp, 2013; College Station TX). Sociodemographic and clinical outcomes were presented using means and standard deviations, and for categorical data relative frequencies were used. The parametric distribution of quantitative variables was evaluated with the Kolmogorov-Smirnov test. Baseline comparisons of the two groups utilized t-tests for independent samples or Wilcoxon tests, as appropriate, for continuous variables, and Pearson's χ2-test or Fisher's exact test, as appropriate, for categorical variables. Whole-sample comparisons of scores at baseline vs. after intervention and after three months of follow-up utilized paired t-tests or Wilcoxon tests - based on meeting the assumption of normal distribution.

Analyses of treatment efficacy followed a modified intention-to-treat (ITT) approach: we conducted a complete-case analysis including patients in the intervention they were randomized to, regardless of whether they received the intervention. Follow-up differences between treatment groups were checked using longitudinal linear mixed models, thus allowing for observations to be considered clustered within individuals, where baseline scale scores were included as covariates. For each scale, effect sizes were expressed as within- and between-subject Cohen's ds, calculated as the mean score difference divided by the pretest standard deviation. We used separate estimates of the pretest standard deviations in each group for within-group comparisons and pooled estimates of the pretest standard deviation for between-group comparisons, as both groups were similar in size and had roughly similar standard deviations.

Finally, uni- and multi-variable linear regressions were conducted to assess the prognostic role of various sociodemographic and baseline clinical variables with social cognition measures included as dependent variables.

3. Results

The CONSORT flow diagram for the recruitment and participation in this trial is shown in Fig. 1. Out of 142 patients assessed for eligibility, 104 met the inclusion criteria and entered the randomization procedure. Four patients allocated to SCIT decided to not start treatment. From the 100 patients who received the allocated intervention, 81 were assessed at post-treatment and 77 at the three-month follow up.

The criteria for considering that a patient had completed the therapy was attendance of a minimum of two sessions of each phase of the SCIT program and a minimum of six sessions of the TAR program. Drop-outs at the end of the intervention were significantly different between groups: three in TAR and 16 in SCIT (OR = 6.29, $p < .01$). At the three-month follow-up, 16 individuals from SCIT and seven from TAR were considered dropouts (OR = 2.46, $p = .07$).

Regarding the comparability of the treatment groups, as shown in Table 1, there were no significant group differences on any sociodemographic, clinical, or cognitive characteristics.

There were also no differences between treatment completers (n = 77) and non-completers (n = 23) at the three-month follow-up regarding age ($p = .37$), sex ($p = .64$), duration of illness ($p = .92$), age of illness onset ($p = .70$), number of illness relapses ($p = .70$), PANSS total score ($p = .65$), depressive symptoms as evaluated by the Hamilton ($p = .72$), global functioning measured by the PSP ($p = .67$), ER40 ($p = .43$), Hinting Task ($p = .80$), and AIHQ task performance ($p = .31$).

3.1. Social cognition

As shown in Table 2, the entire sample showed improvements on all emotion recognition tests.

The TAR group demonstrated greater improvement over time than SCIT in emotion recognition assessed with the ER-40 at post-treatment assessment (Z-score from the longitudinal linear mixed model = −1.60, $p = .10$). This difference was maintained at the three month follow-up assessment ($Z = -2.22$, $p = .03$) (Table 3). There were no significant differences between interventions on FEIT and FEDT scores measured at post-treatment (Table 3).

The entire sample showed improvement on the Hinting Task from baseline to post-treatment ($Z = -3.55$; $p < .01$; Table 2), without significant between-group differences ($Z = -0.56$; $p = .58$, Table 3).

In terms of attribution bias, the entire sample demonstrated reductions in the AIHQ-Hostility Bias ($t = 3.13$; $p < .01$). This improvement was not maintained at three-month follow-up ($t = 0.22$; $p = .83$). Interestingly, the AIHQ-Blame Score increased over time in both interventions ($t = 1.91$; $p = .06$; see Table 2). There were no differential effects of TAR and SCIT on attributional bias ($Z = -0.19$; $p = .84$; Table 3).

3.2. Cognitive function

The entire sample showed improvement on some cognitive scales (see Table 2), but there was no effect of intervention type (see Table 4).

Table 1
Sociodemographic, clinical and cognitive baseline characteristics.

	Mean ± SD or %	Global	TAR	SCIT	*p*-value
Age		43.0 ± 9.1	42.5 ± 8.9	43.5 ± 9.3	.56
Sex (female)	%	30.8	30.6	30.9	.97
Education Level	Basic %	7.7	6.1	9.0	.46
	Primary %	46.2	40.8	50.9	
	Secondary %	31.7	34.7	29.1	
	University %	14.4	18.4	10.9	
Occupation	Working %	13.5	16.3	10.9	.24
	Unemployed %	16.3	10.2	21.8	
	Disability pension %	70.2	73.5	67.3	
Family life	Alone %	11.5	12.2	10.9	.46
	Living with parents %	60.6	67.4	54.6	
	With own family %	14.4	10.2	18.2	
	Residence, supervised apartment %	13.4	10.2	16.4	
Diagnosis	Paranoid %	51.0	42.9	58.2	.18
	Residual %	5.8	8.2	3.6	
	Simple %	2.9	6.1	0.0	
	Undifferentiated %	12.5	8.2	16.4	
	Schizoaffective %	20.2	24.5	16.4	
	Schizophreniform %	3.9	4.1	3.6	
	Others	4.9	6.1	1.8	
Duration of illness (yrs)		18.7 ± 9.8			
Age at onset		24.3 ± 8.7	23.1 ± 7.5	25.3 ± 9.6	.20
Relapses		3.7 ± 4	4.2 ± 4.4	3.3 ± 3.5	.23
Hospitalizations		3.2 ± 3.1	3.7 ± 3.5	2.8 ± 2.7	.15
PANSS		25.7 ± 11.5	26.4 ± 11.5	25.1 ± 11.6	.57
PANSS-PS		11.9 ± 4.3	12.1 ± 4.4	11.7 ± 4.3	.64
PANSS-NS		16.0 ± 6.7	16.2 ± 6.6	15.8 ± 7.0	.78
PANSS-C		−2.2 ± 9.2	−2.5 ± 8.4	−1.9 ± 9.9	.74
HAM-D		8.3 ± 6.1	9.2 ± 6.6	7.5 ± 5.6	.15
PSP Global		66.6 ± 14.2	67.4 ± 12.3	65.8 ± 12.2	.58
PSP A		1.9 ± 0.9	1.9 ± 1.0	1.8 ± 0.9	.40
PSP B		2.7 ± 1.1	2.7 ± 1.1	2.8 ± 1.0	.48
PSP C		2.7 ± 1.1	2.7 ± 1.1	2.8 ± 1.0	.74
PSP D		1.2 ± 0.6	1.2 ± 0.6	1.2 ± 0.5	.77
FAS Total		28.2 ± 9.8	27.5 ± 10.0	28.9 ± 9.6	.46
ER-40		28.4 ± 4.8	28.7 ± 5.5	28.1 ± 4.1	.50
FEIT		8.4 ± 5.4	9.5 ± 4.6	7.5 ± 5.9	.16
FEDT		25.2 ± 2.8	25.7 ± 2.7	24.7 ± 2.8	.09
HINTING		16.3 ± 3.4	16.4 ± 3.3	16.3 ± 3.4	.99
AIHQ		183.9 ± 35.1	181.6 ± 33.5	185.9 ± 36.6	.54
LNS		8.8 ± 4.2	9.5 ± 5.5	8.1 ± 2.2	.24
TMTA		46.9 ± 22.9	45.0 ± 17.9	48.5 ± 26.6	.44
TMTB		109.8 ± 64.3	107.9 ± 63.8	111.5 ± 65.5	.79
BENTON		37.9 ± 10.4	39.3 ± 9.5	36.7 ± 11.0	.20

Note: presented sample includes all participants allocated to a treatment condition. TAR: Training in Affect Recognition; SCIT: Social Cognition and Interaction Training; SD: standard deviations; PANSS: Positive and Negative Syndrome Scale; PANSS-PS: Positive Scale; PANSS-NS: Negative Scale; PANSS-C: Composite scale; HAM-D: Hamilton Depression Rating Scale; PSP: Personal and Social Performance Scale; FAS: Controlled Verbal Fluency Task; ER-40: Penn Emotion Recognition-40 (ER40); FEIT: Face Emotion Identification Task; FEDT: Face Emotion Discrimination Task; Hinting: Hinting Task; AIHQ: Ambiguous Intentions Hostility Questionnaire; LNS: Numbers and Letters Sequence; TMTA: Trail Making Test–Part A; TMTB: Trail Making Test–Part B; Benton: Benton Facial Recognition Test.

3.3. Symptoms

The results demonstrated general improvement in the entire sample (i.e., SCIT and TAR) on all clinical measures used in the study (see Table 2).

3.4. Functioning

A significant improvement in global functioning, assessed with the PSP Scale, was found in the entire sample (Table 2). Specifically, these improvements were found in the overall scale score ($Z = -2.49$; $p = .01$) and in the self-care area (subscale PSP a), ($Z = 2.27$; $p = .02$), interpersonal relationships (subscale b), ($Z = 3.92$; $p < .01$), and social activities that included work and study (subscale c), ($Z = 2.23$; $p = .03$). Only subscale d, which measured disturbing and/or aggressive behavior, was unchanged ($t = 0.89$; $p = .37$). Improvements in functionality (PSP) were maintained at the three-month follow-up (Table 2). In terms of global functioning, the TAR group demonstrated similar improvements over time with SCIT, captured with the PSP overall score ($Z = 0.35$; $p = .73$) and subscale scores (Table 4).

3.5. Prediction of social cognition performance from baseline variables

Linear regressions were conducted with baseline and post-intervention scores as dependent variables (i.e., Hinting Task, ER-40, and PANSS total scores) and patient variables (i.e., age, sex, duration of illness, number of illness relapses, duration of illness) as predictors. Patient characteristics did not predict scores on the PANSS or Hinting Task performance at baseline or post-treatment. Patient characteristics did not predict baseline scores on the ER-40, but age was a significant predictor of ER-40 scores at post-treatment. To examine effects of age, patients were split into two groups based on median age. Following a univariate regression model, patients in the older age group ($M = 50.2$) performed 1.93 (range 0.05–3.81, $p = .05$) points below average on the ER-40 compared to the younger age group ($M = 35.8$). These results suggest a significant inverse correlation between age and post-treatment ER-40 performance.

We did not detect an interaction between the role of intervention group and age on ER-40 improvement: younger participants in both TAR and SCIT improved similarly on emotion recognition ability at post-treatment.

4. Discussion

The main findings of the study are:

1. All participants, regardless of treatment condition, significantly improved in emotion recognition (as measured by the ER-40, FEIT and FEDT), ToM (as measured by the Hinting Task) attributional style (reductions in hostility bias, measured by the AIHQ-Hostility Bias), and global functioning (as measured by PSP overall scale score, self-care areas, interpersonal relationships, and social activities). 2. The TAR intervention was more efficacious than the SCIT program in improving the recognition of facial emotions (as measured by the ER-40) in outpatients with schizophrenia at post-treatment, which was maintained at three-month follow up. 3. The TAR intervention demonstrated a lower drop-out rate than the SCIT intervention. 4. Younger age was a

Table 2
Outcome measures of the overall sample.

	Baseline ($n = 81$)	Post-treatment	*D1*	*p*-value	3-month follow-up ($n = 77$)	*D2*	*p*-value
ER-40	28.6 ± 4.8	30.0 ± 4.4	**0.30**	**.01**	30.7 ± 4.3	**0.47**	< **.01**
FEIT	8.6 ± 5.1	10.7 ± 5.7	**0.39**	< **.01**	11.3 ± 5.6	**0.50**	< **.01**
FEDT	25.2 ± 2.6	25.9 ± 2.8	**0.26**	**.02**	25.6 ± 3.1	**0.14**	< **.01**
Hinting	16.2 ± 3.5	17.3 ± 3.0	**0.34**	< **.01**	18.1 ± 3.9	**0.51**	< **.01**
AIHQ	184.7 ± 36.8	181.2 ± 43.9	0.09	.29	185.9 ± 36.6	0.03	.34
AIHQ-Hostility Bias	27.3 ± 5.0	25.4 ± 5.2	**−0.37**	< **.01**	27.2 ± 5.8	−0.02	.83
AIHQ-Intentionality Score	46.6 ± 10.0	45.2 ± 11.3	−0.13	.19	47.8 ± 10.9	0.11	.43
AIHQ-Anger Score	42.9 ± 11.7	42.6 ± 13.4	−0.03	.79	42.5 ± 13.2	−0.03	.62
AIHQ-Blame Score	43.3 ± 12.0	43.6 ± 13.9	0.02	.82	46.0 ± 13.7	0.21	.06
AIHQ-Aggression Bias	24.6 ± 6.1	24.3 ± 0.7	−0.07	.70	25.6 ± 6.9	0.15	.21
PANSS	25.9 ± 12.3	23.9 ± 10.5	**−0.17**	< **.01**	23.6 ± 10.7	**−0.20**	< **.01**
PANSS-PS	12.3 ± 4.2	10.8 ± 3.8	**−0.37**	< **.01**	10.6 ± 3.8	**−0.57**	< **.01**
PANSS-NS	15.9 ± 6.8	13.9 ± 6.2	**−0.31**	< **.01**	13.5 ± 5.9	**−0.38**	< **.01**
PANSS-C	−1.5 ± 9.6	−1.9 ± 8.4	−0.04	.34	−1.5 ± 8.1	0.00	.71
Hamilton	8.5 ± 6.2	6.1 ± 5.3	**−0.42**	< **01**	6.0 ± 5.3	**−0.43**	< **.01**
PSP Global	66.4 ± 15.0	68.5 ± 14.0	**0.14**	**.01**	69.6 ± 14.5	**0.22**	< **.01**
PSP Self Care	1.9 ± 0.9	1.7 ± 0.9	**−0.22**	**.02**	1.7 ± 0.9	**−0.22**	< **.01**
PSP Interpersonal	2.7 ± 1.1	2.4 ± 1.0	**−0.29**	< **.01**	2.3 ± 1.0	**−0.38**	< **.01**
PSP Social Activities	2.7 ± 1.1	2.6 ± 1.2	**−0.09**	**.03**	2.5 ± 1.2	−0.17	.04
PSP Aggression	1.2 ± 0.6	1.2 ± 0.5	0.00	.37	1.1 ± 0.3	**−0.21**	**.02**
FAS Total	27.7 ± 9.9	29.4 ± 9.2	**0.18**	**.04**	31.7 ± 9.4	**0.42**	< **.01**
LNS	8.8 ± 4.2	8.5 ± 4.5	−0.07	.43	8.7 ± 2.8	−0.03	.82
Benton	38.5 ± 9.9	39.4 ± 10.0	**0.09**	**.05**	39.3 ± 9.9	0.08	.26
TMTA	46.8 ± 23.7	42.9 ± 18.4	**−0.18**	**.04**	43.4 ± 18.9	−0.16	.08
TMTB	109.3 ± 65.2	101.7 ± 63.9	−0.12	.19	90.3 ± 53.4	**−0.32**	**.01**

Note: sample includes participants completing both baseline and post-treatment assessments. ER-40: Penn Emotion Recognition-40; FEIT: Face Emotion Identification Task; FEDT: Face Emotion Discrimination Task; Hinting: Hinting Task; AIHQ: Ambiguous Intentions Hostility Questionnaire; PANSS: Positive and Negative Syndrome Scale; PANSS-PS: Positive Scale; PANSS-NS: Negative Scale; PANSS-C: Composite scale; Hamilton: Hamilton Depression Rating Scale; PSP: Personal and Social Performance Scale; FAS: Controlled verbal fluency task; LNS: Numbers and letters sequence; TMTA: Trail Making Test–Part A; TMTB: Trail Making Test–Part B; Benton: Benton Facial Recognition Test. *p*-values come from paired sample t-tests or Wilcoxon signed-rank tests, as appropriate based on data normality. D1: Cohen's d for the whole study sample post-treatment vs. at baseline. D2: Cohen's d for the whole study sample after 3 months of follow-up vs. at baseline.

Table 3
Performance in the Social Cognition tests in patients treated with TAR vs. SCIT.

	TAR			SCIT						
	T0	T1	T2	T0	T1	T2	D1	D2	P1	P2
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD				
N	49	46	42	55	39	39				
ER-40	28.7 ± 5.5	30.9 ± 4.3	31.9 ± 3.8	28.1 ± 4.1	29.0 ± 4.5	29.6 ± 4.6	0.42	0.55	**.11**	**.03**
FEIT	9.5 ± 4.6	11.7 ± 5.2	12.2 ± 4.6	7.5 ± 5.9	9.5 ± 6.0	10.4 ± 6.4	0.39	0.33	.73	.93
FEDT	25.7 ± 2.7	26.2 ± 2.7	26.2 ± 2.7	24.7 ± 2.8	25.6 ± 3.0	25 ± 3.5	0.21	0.38	.89	.45
Hinting	16.4 ± 3.3	17.5 ± 3.0	18.0 ± 4.7	16.3 ± 3.4	17.2 ± 3.0	18.3 ± 2.7	0.10	−0.08	.58	.71
AIHQ	181.6 ± 33.5	179.7 ± 42.4	185.5 ± 43.7	185.9 ± 36.6	183.0 ± 46.0	193.3 ± 42.3	−0.07	−0.18	.84	.75
AIHQ-Hostility Bias	27.4 ± 4.9	25.6 ± 4.8	27.4 ± 6.4	26.7 ± 4.9	25.2 ± 5.8	26.9 ± 5.2	0.08	0.07	.92	.91
AIHQ-Intentionality Score	47.1 ± 9.9	45.5 ± 11.0	47.0 ± 11.7	46.7 ± 9.9	44.9 ± 11.7	48.6 ± 10.1	0.05	−0.15	.91	.37
AIHQ-Anger Score	41.3 ± 11.0	41.4 ± 12.8	40.8 ± 12.5	42.9 ± 11.3	44.1 ± 14.2	44.3 ± 14.0	−0.19	−0.27	.78	.56
AIHQ-Blame Score	41.7 ± 11.6	42.8 ± 13.8	44.0 ± 13.5	44.8 ± 11.9	44.6 ± 14.1	48.4 ± 13.7	−0.13	−0.32	.62	.53
AIHQ-Aggression Bias	24.1 ± 5.9	24.5 ± 6.5	26.3 ± 7.7	24.8 ± 6.3	24.2 ± 7.2	25.1 ± 6.1	0.05	0.17	.56	.22

Notes: TAR: Training in Affect Recognition; SCIT: Social Cognition and Interaction Training; SD: standard deviations; d: Cohen's d.
T0: pre-treatment, T1: post-treatment, T3: follow-up.
D1: Cohen's d for TAR-patients vs. SCIT-patients at post-treatment (T1), D2: Cohen's d for TAR-patients vs. SCIT-patients at follow-up (T2).
P1 significance value for TAR-patients vs. SCIT-patients at post-treatment (T1).
P2 significance value for TAR-patients vs. SCIT-patients at follow-up (T2).
p-values come from longitudinal linear mixed models where baseline scale scores are included as covariates and observations are considered clustered within individuals.
ER-40: Penn Emotion Recognition-40 (ER40); FEIT: Face Emotion Identification Task; FEDT: Face Emotion Discrimination Task; Hinting: Hinting Task; AIHQ: Ambiguous Intentions Hostility Questionnaire.

significant predictor of improvement in facial emotion recognition in both SCIT and TAR.

Regarding the positive impact of both interventions on social cognition and functioning, our results support those obtained in previous studies in which patients with schizophrenia showed improvement on several social cognition domains after participating in SCIT (Combs et al., 2009; Penn et al., 2007). Interestingly, improvements in ToM were also evident in the TAR intervention, a program not focused on this domain. However, similar generalization of TAR effects to other social cognition domains were found by Wölwer and Frommann (2011). Therefore, our results are consistent with previous findings demonstrating that different domains of social cognition are related (e.g., Browne et al., 2016), so that targeted training in one domain (e.g., emotion recognition) likely improves other domains (e.g., ToM).

Research on the effectiveness of social cognition training should address the main social cognition domains, through well-validated and standardized measures. In this study, we used two recommended measures from the Social Cognition Psychometric Evaluation (SCOPE) study,

Table 4
Performance in outcome variables (symptomatology, cognition and functioning) in patients treated with TAR vs. SCIT.

	TAR			SCIT						
	T0	T1	T2	T0	T1	T2	D1	D2	P1	P2
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD				
N	49	46	42	55	39	39				
PANSS	26.4 ± 11.5	25.0 ± 10.2	24.0 ± 9.5	25.1 ± 11.6	22.8 ± 10.8	23.0 ± 10.6	0.21	0.11	.37	.94
PANSS-PS	12.1 ± 4.4	10.7 ± 4.1	10.5 ± 4.1	11.7 ± 4.3	10.9 ± 3.5	10.6 ± 3.5	−0.05	−0.03	.39	.63
PANSS-NS	16.2 ± 6.6	13.9 ± 5.8	13.4 ± 5.2	15.8 ± 7.0	13.9 ± 6.7	13.7 ± 6.7	0.01	−0.07	.48	.37
PANSS-C	−2.5 ± 8.4	−2.6 ± 7.5	−1.7 ± 7.5	−1.9 ± 9.9	−1.9 ± 9.3	−1.4 ± 8.9	−0.17	−0.04	.76	.42
Hamilton	9.2 ± 6.6	6.1 ± 5.6	6.1 ± 6.0	7.5 ± 5.6	6.0 ± 5.0	5.9 ± 4.4	0.02	0.02	.19	.27
PSP Global	67.4 ± 12.3	68.6 ± 15.4	68.5 ± 14.0	65.8 ± 12.2	68.3 ± 14.3	70.6 ± 13.7	0.02	−0.13	.73	.19
PSP Self Care	1.9 ± 1.0	1.8 ± 0.8	1.8 ± 0.8	1.8 ± 0.9	1.7 ± 1.0	1.6 ± 0.9	0.16	0.19	.97	.78
PSP Interpersonal	2.7 ± 1.1	2.4 ± 1.0	2.4 ± 1.0	2.8 ± 1.0	2.4 ± 1.0	2.3 ± 0.9	−0.05	0.15	.97	.20
PSP Social Activities	2.7 ± 1.1	2.6 ± 1.3	2.6 ± 1.2	2.8 ± 1.0	2.6 ± 1.1	2.5 ± 1.2	−0.02	0.13	.84	.24
PSP Aggression	1.2 ± 0.6	1.1 ± 0.3	1.1 ± 0.3	1.2 ± 0.5	1.2 ± 0.6	1.1 ± 0.4	−0.29	0.16	.26	.57
FAS Total	27.5 ± 10.0	29.1 ± 9.2	31.7 ± 10.4	28.9 ± 9.6	29.9 ± 9.3	31.8 ± 8.1	−0.08	−0.02	.98	.65
LNS	9.5 ± 5.5	8.4 ± 2.5	8.6 ± 3.0	8.1 ± 2.2	8.6 ± 2.2	8.9 ± 2.5	−0.08	−0.11	.36	.33
TMTA	45.0 ± 17.9	45.0 ± 20.6	43.6 ± 29.6	48.5 ± 26.6	42.2 ± 19.4	41.4 ± 19.8	0.14	0.09	.28	.23
TMTB	107.9 ± 63.8	96.4 ± 52.9	90.9 ± 55.0	111.5 ± 65.5	109.3 ± 74.0	93.8 ± 60.5	−0.20	−0.05	.76	.47
Benton	39.3 ± 9.5	40.4 ± 9.9	40.1 ± 9.3	36.7 ± 11.0	38.1 ± 10.3	39.1 ± 10.6	0.23	0.10	.40	.80

Note: TAR: Training in Affect Recognition; SCIT: Social Cognition and Interaction Training; SD: standard deviations; d: Cohen's d.
T0: pre-treatment, T1: post-treatment, T3: follow-up.
D1: Cohen's d for TAR-patients vs. SCIT-patients at post-treatment (T1), D2: Cohen's d for TAR-patients vs. SCIT-patients at follow-up (T2).
P1 significance value for TAR-patients vs. SCIT-patients at post-treatment (T1).
P2 significance value for TAR-patients vs. SCIT-patients at follow-up (T2).
P-values come from longitudinal linear mixed models where baseline scale scores are included as covariates and observations are considered clustered within individuals.
PANSS: Positive and Negative Syndrome Scale; PANSS-PS: Positive Scale; PANSS-NS: Negative Scale; PANSS-C: Composite scale; Hamilton: Hamilton Depression Rating Scale; PSP: Personal and Social Performance Scale; FAS: Controlled verbal fluency task; LNS: Numbers and letters sequence; TMTA: Trail Making Test–Part A; TMTB: Trail Making Test–Part B; Benton: Benton Facial Recognition Test.

the ER-40 (emotion recognition) and the Hinting task (ToM) (Pinkham et al., 2014, 2018). We also used the AIHQ, which is a promising and psychometrically sound instrument assessing attributional style in schizophrenia (Bordon et al., 2017; Lahera et al., 2015). Since affect recognition difficulties in schizophrenia have demonstrated responsiveness to psychological interventions designed to improve them, we included two measures of emotion recognition in the present study (FEDT and FEIT). Unfortunately, there is, to date, a lack of consensus on social perception measures with acceptable psychometric properties (Pinkham et al., 2018), so the present study did not assess this domain.

TAR, a 12-session computer-assisted intervention targeting emotion recognition, demonstrated a greater improvement in this specific domain of social cognition, compared with SCIT. This intervention-specific improvement in emotion recognition was observed on the ER-40, but not on the FEIT and FEDT (both tasks of identification and visual discrimination of facial emotions). This finding supports previous research suggesting the ER-40 is the most discriminative measure of emotion recognition, well suited for use in clinical trials (Pinkham et al., 2018). Results of this study may have clinical implications in that patients with schizophrenia with pronounced deficits in emotion recognition may benefit more from a "targeted" psychosocial intervention than a broad-based intervention. The TAR intervention is based on errorless learning, information processing strategies, positive feedback and feature abstraction (Wolwer and Frommann, 2011). Earlier studies demonstrated improvements in facial and prosodic affect recognition and an increased gaze fixation to salient facial features (Drusch et al., 2014; Habel et al., 2010; Tan et al., 2016). Since psychopharmacological therapies, including oxytocin and certain antipsychotics, have been shown to have equivocal or limited impact on this aspect of social cognition, these psychosocial strategies appear especially promising (Javed and Charles, 2018).

The efficacy of both SCIT and TAR interventions on the symptomatology and functioning of stable outpatients with schizophrenia is impressive. Overall, a significant improvement was observed on both the positive and negative subscales of the PANSS. In addition, both groups demonstrated a reduction in depressive symptoms. Due to the absence of a non-active control group, these effects may be due to generic factors of psychosocial interventions. However, improvements in social cognition, symptomatology and functioning of patients in both interventions is a compelling demonstration that these domains can be substantially improved through psychosocial intervention in patients with schizophrenia.

A potential limitation of this study is the small sample size ($N = 100$) to detect differences between two active interventions. However, significant differences in the improvement of emotion recognition were observed and effect sizes for all results were provided to address this limitation. Another limitation is the comparison between two psychosocial interventions with important structural differences (e.g., intervention duration, number of participants and therapists, group setting, homework, computer assistance, etc.). The TAR intervention, with session attendees composed of one therapist and two patients and with a duration of 12 sessions showed a lower drop-out rate than SCIT (session attendees include two therapists, six to 12 patients, and a duration of 20–24 sessions), suggesting differences in drop-out rate may be attributed to structural characteristics rather than intervention content. Lastly, this study did not include a control group with a placebo treatment. Thus, improvements in social cognition, symptoms, and functioning may be considered general, non-specific, improvements, rather than true treatment effects of TAR or SCIT.

The present study was designed as a first step to detect potential differences in treatment efficacy between two social cognition interventions (i.e., TAR and SCIT). Future directions to compare interventions targeting social cognition are to identify the mechanisms of change or specific processes included in these interventions that lead to therapeutic change and improvements in social cognition in schizophrenia (following the definition of *change process research*; Greenberg, 1986). This is one of the first studies to include a direct "head-to-head" study design comparing the efficacy of two interventions targeting social cognition in schizophrenia. Another strength of the present study is the three-month follow-up assessment to assess the durability of intervention improvements with a retention rate of 77% of the baseline sample. Results of this study demonstrate, for the first time, that both TAR and

SCIT lead to improvements in social cognition, reductions in symptoms, and improvements in functioning in individuals with schizophrenia. Furthermore, these observed improvements were similar between SCIT and TAR and persisted beyond the intervention, although there was some advantage for TAR (e.g., improvements in facial affect recognition).

Declaration of competing interest

Dr. Wolwer and Nicole Fromman developed the TAR. David Penn developed the SCIT.

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The rest of authors declare no conflict of interests.

Abbreviations

TAR	Training in Affect Recognition
SCIT	Social Cognition and Interaction Training
SD	standard deviation
PANSS	Positive and Negative Syndrome Scale
Hamilton	Hamilton Depression Rating Scale
PSP	Personal and Social Performance Scale
FAS	Controlled verbal fluency task
ER-40	Penn Emotion Recognition-40
FEIT	Face Emotion Identification Task
FEDT	Face Emotion Discrimination Task
Hinting	Hinting Task
AIHQ	Ambiguous Intentions Hostility Questionnaire;
LNS	Numbers and letters sequence
TMTA	Trail Making Test–Part A
TMTB	Trail Making Test–Part B
Benton	Benton Facial Recognition Test

Declarations

Ethics approval and consent to participate: This study was reviewed and approved by the Institutional Ethics and Clinical Trials Committee of the Instituto Aragonés de Ciencias Sociales, Zaragoza (PI 13/00119), Fundació Unio Catalana Hospitals, Barcelona (15/22) and Hospital Universitario Ramón y Cajal (March 30, 2015).

This study was pre-registered at ClinicalTrials.gov (NCT03446703).

Authors' contributions

GL and AR designed the study and wrote the protocol. AR, AV, CV, VL, PF and ME recruited the patients. GM-A advised on the statistical analyses. WW and DP contributed to study design and data interpretation. GL, AR and TH managed the manuscript preparation. GL and TH wrote the first draft of the manuscript. All authors contributed to and approved the final version of the manuscript.

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