Social Cognitive Training for Schizophrenia: A Meta-Analytic Investigation of Controlled Research

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A wealth of evidence has revealed that deficits in social cognitive skills (including facial affect recognition (FAR), social cue perception, Theory of Mind (ToM), and attributional style) are evident in schizophrenia and are linked to a variety of domains of functional outcome. In light of these associations, a growing number of studies have attempted to ameliorate these deficits as a means of improving outcome in the disorder through the use of structured behavioral training. This study used quantitative methods of meta-analysis to assess the efficacy of behavioral training programs designed to improve social cognitive function. A total of 19 studies consisting of 692 clients were aggregated from relevant databases. Outcome measures were organized according to whether they were social cognitive tests proximal to the intervention or whether they represented measures of treatment generalization (symptoms, observer-rated community, and institutional function). With respect to social cognitive measures, weighted effect-size analysis revealed that there were moderate-large effects of social cognitive training procedures on FAR (identification, $d = 0.71$ and discrimination, $d = 1.01$) and small-moderate effects of training on ToM ($d = 0.46$), while effects on social cue perception and attributional style were not significant. For measures of generalization, weighted effect-size analysis revealed that there were moderate-large effect on total symptoms ($d = 0.68$) and observer-rated community and institutional function ($d = 0.78$). Effects of social cognitive training programs on positive and negative symptoms of schizophrenia were nonsignificant. Moderating variables and implications for future research and treatment development are discussed.

Key words: social cognitive training/social cognition/schizophrenia

Social cognition is defined as the mental operations involved in understanding, perceiving, and interpreting our social world.[1] There is a wealth of evidence showing that clients with schizophrenia have social cognitive deficits which constitute a stable feature of the disorder, persistent over time,[2–4] and resistant to pharmacological treatment.[5,6] Research suggests that social cognitive deficits are evident prior to diagnosis and can be found in adolescents with high genetic risk for the disorder.[7,8] To date, the vast majority of research on social cognition in schizophrenia has focused on 4 generally accepted domains of social cognition: the interrelated abilities of processing facial emotion (facial affect recognition[FAR]) and interpreting and responding to social cues, such as body language or voice intonation (social perception), the ability to understand that other people may have different mental states than oneself (Theory of Mind [ToM]), and the ability to make appropriate attributions of the causes of events (attributional style). Impairment in each of these domains has been shown to have a significant impact on functional outcome in clients diagnosed with schizophrenia and explains variance in functional outcome beyond that accounted for by elementary neurocognition (as reviewed in Couture, Penn, and Roberts[9]).

For example, impairments in FAR and social perception have been linked to greater supervision in living status and poorer occupational status[10–14] as well as to poor performance on social role-plays[5,15] and inappropriate personal appearance.[5,12] ToM has been found to be correlated with community functioning in outpatients[16] and behavioral problems[17] in both inpatient and outpatient samples. Though attributional style has received less attention in the literature thus far, one study[18] has shown that a tendency to make stable attributions of the causes of life events is linked to a greater number and higher quality of social interactions. Because intact social cognitive skills are vital for negotiating successful interpersonal interactions and are deficient in many individuals with schizophrenia, it is important to identify treatment methods that can effectively remediate impaired social cognition.

Many researchers have begun to develop and implement targeted interventions that attempt to ameliorate deficits in social cognition in clients with schizophrenia. Multiple approaches have been taken in developing these programs that vary across several dimensions—some train clients on aspects of one specific domain of social cognition and are collectively referred to as "targeted" interventions (eg, the FAR training program of Wolwer et al[19]), while others incorporate multiple domains to create more complex, eclectic programs, or "broad-based" interventions, such as the social cognition and interaction training developed by Penn et al[20] and the social cognitive skills training developed by Horan et al,[21] which encompass treatment of emotion perception, attributional style, and ToM. Some interventions are brief, occurring over just 1 or 2 sessions (eg, Combs et al[22]), while others are more sustained, lasting several months (eg, Roberts and Penn[23]).

Three literature reviews have been conducted on this work to date[24–26] and have provided reason for optimism regarding these interventions, showing that all reviewed "targeted" social cognitive training programs produced improvements in the respective domains of social cognition they focused upon. "Broad-based" interventions included in their reviews also reportedly produced improvement on social cognitive measures; however, the authors noted it was difficult to ascertain whether these programs directly affect social cognition due to their multi-faceted natures.

We conducted a meta-analysis of the effectiveness of cognitive and behavioral treatments for social cognitive deficits because in the last several years the number of controlled studies of social cognitive training has increased to permit a quantitative investigation of research findings.

In this study, we investigated the effects of programs of social cognitive training and programs that combined cognitive and social cognitive training (as long as a majority of the training was focused on social cognition, eg, Cognitive Enhancement Therapy[27] and Integrated Psychological Therapy [IPT][28]) on social cognitive outcome measures, symptoms, and function and assessed the influence of demographic, clinical, and treatment characteristics (eg, training of one vs multiple social cognitive domains, duration and intensity of treatment). More specifically, we hypothesized that relative to a control condition (1) those clients who participate in social cognition training programs will show improvement on social cognitive outcome measures as these measures assess outcomes directly targeted by social cognitive treatments, (2) those clients who participate in social cognition training programs will show improvements in positive, negative, and total symptoms. While not directly targeted by social cognitive interventions, in light of the stress-vulnerability model of symptoms in schizophrenia, we hypothesized that clients equipped with enhanced social cognitive skills will show better coping strategies and will be better able to marshal social support; and thus will be less sensitive to the effects of stress in their environment and consequently less likely to show symptoms,[29] and (3) those clients who participate in social cognition training programs will show improvements in observer-rated psychosocial functioning outcome measures. This domain, while not directly targeted by social cognitive interventions, would also be expected to improve more indirectly as participants are better able to negotiate their social environment, reducing impairments in overall social functioning. Secondary hypotheses were that interventions of longer duration and higher intensity, and interventions that incorporate multiple social cognitive treatment domains would produce larger effects on social cognitive outcome measures.

Methods

Search Strategy

Articles included in the meta-analysis were identified through a computer-based search of SciVerse ScienceDirect, PubMed, and PsychInfo from 1980 to 2010 using combinations of the following key words: social cogn*, training, rehabilitation, remediation, and schizophrenia. The reference sections of articles located from all searches were studied for relevant citations. Nineteen eighty was selected as the cut-off in light of the introduction of the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition*, (DSM-III) for more reliable diagnostic criteria for schizophrenia.

Inclusion Criteria

For the purposes of this review, social cognitive training was defined as interventions which provided clients with training exercises designed to ameliorate one or more areas of social cognition, used social cognitive stimuli for this training, and used at least one social cognitive outcome measure from the four most commonly studied domains of social cognition—facial affect perception (eg, the Face Emotion Identification Test; FEIT[30]), social cue perception (eg, the Picture Arrangement subtest of the Wechsler Adult Intelligence Scale; WAIS[31]), ToM (eg, the Hinting Task[32]), and/or attributional style, (eg, the Ambiguous Intentions Hostility Questionnaire; AIHQ[33]). To be included in this review studies must have (1) included a sample with at least a majority of clients with a diagnosis of schizophrenia or schizoaffective disorder, (2) conducted some type of social cognition training as defined above, (3) been published in the English language, (4) included a client control group, (5) if combined with training in neurocognition,[27,34] must have provided a majority (more than 50% of sessions) of training in social cognitive skills, and (6) provided sufficient statistical detail to compute a *d*-value. Criteria 5 was

implemented as the goal of the study was to evaluate the effects of social cognitive training on proximal social cognitive outcome measures along with more distal outcome measures. We elected to exclude studies that studied interventions that included less than 50% of training sessions devoted to social cognitive training as we reasoned that effects of social cognitive training on social cognitive measures and more distal outcome measures (symptoms, functioning) could be made only tentatively when a minority of the training program was devoted to social cognitive training. We elected to include studies that consisted of 50% or more of total training devoted to social cognitive activities as we hypothesized that links between outcome and social cognitive training could be made with some confidence in this setting. For the purposes of this review, interventions that included social skills training (eg, Bellack et al[35]) as a component of training were excluded from the review as the effects of this intervention have been assessed in previous, recent meta-analyses[36,37] and the goal of the study was to evaluate the effects of social cognitive training specifically as a novel treatment modality for the social cognitive deficits found in schizophrenia. These procedures resulted in a final sample of 19 studies.

Study Outcome Measures

Outcome measures from the studies are grouped in table 1 and consist of proximal measures of social cognitive skills and generalization measures of symptoms and community and institutional function. In the absence of factor analytic studies of social cognitive tests in schizophrenia to guide groupings of measures, we relied on conventions in the literature. Consistent with previous meta-analyses,[59] we combined different measures of facial affect identification and discrimination, in light of the presumed similarity between tasks that involved assigning descriptive labels to faces of different emotions, or distinguishing expressions of emotions from two different faces, respectively.

Statistical Analysis

Analyses were conducted according to procedures suggested by Rosenthal[60] and Hedges and Olkin.[61] DSTAT *v. 1.11*[62] was used to calculate effect sizes and to carry out subsequent homogeneity and moderator variable analyses. The dependent measures were organized into 3 categories to assess proximal effects and generalization of training to other illness features: (1) measures of social cognitive skills (proximal), (2) measures of positive, negative, and total symptoms (generalization), and (3) observer-rated measures of community and institutional function (generalization).

The unit of analysis in a meta-analysis is the effect size (*d*). For purposes of the present study, the *d* score was defined as the difference between intervention type (ie,

Table 1. Outcome Measures Selected for the Meta-Analysis

Measures Included	
Proximal Social Cognitive Measures	
Emotion perception	Bell-Lysaker Emotion Recognition Test (BLERT),[38] Emotion Identification Task,[39] Emotion Labeling Task,[40] Emotion Matching Task,[40] Emotion Perception Test,[41] emotion recognition assessment,[42] Emotion Recognition Task (ERT),[43] Emotion Recognition Test (ERT),[44] Face Emotion Discrimination Test (FEDT),[30] Face Emotion Identification Test (FEIT),[30] Facial Emotion Identification Test,[21] Pictures of Facial Affect (PFA),[19] Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT)[45] (Perceiving Emotions subtest)
Social perception	Cue Recognition Test (CRT),[46] Half-Profile of Nonverbal Sensitivity (PONS),[47] Social Behavior Sequencing Task (SBST),[48] Social Perception Scale (SPS),[28] Wechsler Adult Intelligence Scale-Picture Arrangement (WAIS-PA)[31]
Theory of Mind (ToM)	Attribution of Intention errors,[49] Advanced ToM Scale,[50] Hinting Task,[32] The Awareness of Social Inference Test (TASIT),[51] ToM stories[52]
Attributional style	Ambiguous Intentions Hostility Questionnaire (AIHQ)[33]
Measures of generalization of treatment effects	
Symptoms	Positive and Negative Syndrome Scale (PANSS),[53] Brief Psychiatric Rating Scale (BPRS)[54]
Social functioning	Nurses' Observation Scale for Inpatient Evaluation (NOSIE),[55] Personal and Social Performance Scale (PSP),[50] Social Adjustment Scale (SAS),[56] Social Behavioral Scale (SBS),[57] World Health Organization Disability Assessment Schedule (WHODAS)[58]

treatment vs control) at termination of training expressed in SD units ($M_{post\ exp}M_{post\ control}/SD_{pooled\ across\ groups}$) Study statistics were converted to *d* using formulas provided by Glass.[63] We used the pooled SD using the formula of Rosenthal.[64] Because of the potential for inflated within-group effects relative to between-group comparisons,[65] we did not compare within-group pre to posttreatment change. As we predicted beneficial effects of social cognitive training on outcome measures in this article, for studies with multiple measures in either the same social cognitive domain (FAR, social cue perception, ToM, or attributional style), symptom (positive, negative, or total symptoms), or observer-rated community or institutional status, we conservatively selected the measure within that domain with the smallest effect. Nonsignificant results lacking supporting statistical information

were coded as an effect size of zero.[66] By expressing effect size in SD units, we were able to make a direct comparison of outcomes across studies. Effects were categorized as small ($d < 0.5$), moderate-large ($d = 0.5–0.8$), or large ($d > 0.8$ or greater).[67] All effect sizes were expressed in a way such that positive values indicated improvement as a result of social cognitive interventions. We note that by focusing our analysis on posttreatment effects, we did not account for any baseline differences in reported findings. For the 19 selected studies, only three reported baseline differences on measures selected for our analysis and in only one case[48] was there evidence that social cognitive test performance was stronger in social cognitively trained participants at baseline.

Each analysis was conducted in several steps. First, Hedges g was derived for each study using raw means and SD, t, F, or p statistics reported in the individual study.[61,64] Although Hedges g is an estimate of effect size, the g-statistic is known to overestimate the population effect size when sample sizes are small.[64] In order to correct for this bias, Hedges g was subsequently transformed into an unbiased measure of effect size, Cohen's d.[61,68] Individual values of d were thereafter combined across studies and weighted according to their variance. Potential differences in effect size between studies were analyzed using the method of Hedges and Olkin.[61] This procedure computes mean weighted effect sizes and 95% CI for each variable and allows for the testing of the influence of each individual factor on the overall results using the Q statistic. The test for heterogeneity Q_T is based on the sum of squares of the individual effect sizes around the mean when each square is weighted by the inverse of the estimated variance of the effect size. Q has an asymptotic χ^2-square distribution and is analogous to the ANOVA. Studies were evaluated for within-group differences (Q_W) and between-group differences (Q_B) following the same model.

To partially address the "file-drawer" problem in meta-analytic investigations in which null results in a research area are collected but not reported in the literature, we calculated a fail-safe N for each class of outcome variable by the method of Orwin.[69] This measure provides an estimate of the number of studies with null results that would be needed to render the effect size nonsignificant. In the absence of a universally accepted significance level for effect sizes, an effect size of 0.20 was considered nonsignificant.[69]

Moderator Variable Analysis

Sample characteristics of age, sex, gender distribution, duration of illness, in vs outpatient status, education, and neuroleptic dosage (chlorpromazine [CPZ] equivalent), study characteristics of intensity and duration of social cognitive skills treatment in sessions per week and total hours, respectively, one vs multiple areas of social cognition trained, type of social cognitive outcome measure selected, and design characteristics of active vs treatment-as-usual (TAU) control conditions, were evaluated as potential moderators of effect size when significant heterogeneity in effect sizes was evident. We also differentiated design quality of selected studies on the basis of ratings of 4 elements that related to the validity of each study: (1) random assignment of participants to experimental groups, (2) use of raters blind to the condition of the participants, (3) establishment of inter-rater reliability on outcome measures, and (4) formal measures of treatment fidelity. Each study received a score of "1" (included none of these aspects of design quality), "2" (included 1 of these aspects of design quality), "3" (included 2 of these aspects of design quality), "4" (included 3 of these aspects of design quality), or "5" (included 4 of these aspects of design quality). All study characteristics were coded independently by two raters (C.L.R. and M.M.K.) in a subsample of 20% of studies to ensure reliability of extraction of study characteristics. Interrater concordance for coding was calculated to be 95%. Continuous data (eg, age, duration of illness, and hours of training) were analyzed with a continuous model[61] with a z-test for significance of model fit. Group comparisons were made for categorical moderator variables (eg, inpatient vs outpatient). In these comparisons, ANOVA-type summary values were estimated for the group effect. Given the high number of analyses and corresponding inflation in risk for alpha error we used a reduced alpha level of .01. All statistical tests were two-tailed.

Results

Study Characteristics

A total of 19 studies involving 692 participants were included in the analysis (see table 2), with all 19 studies reporting average age of participants ($M = 36.54$ years, $SD = 6.17$ years) and 18 of 19 studies reporting gender ($M = 69\%$ male, $SD = 15\%$). Thirteen studies reported average years of education ($M = 12.28$, $SD = 1.07$), 10 studies reported average duration of illness ($M = 13.29$ years, $SD = 4.63$), and 7 studies reported CPZ equivalent neuroleptic dosages ($M = 562.6$, $SD = 209.87$). Eighteen studies exclusively included participants with a diagnosis of schizophrenia or schizoaffective disorder, while one study also included participants with a diagnosis of psychosis not otherwise specified.[70] Six studies (31.6%) worked with inpatient samples, 9 (47.4%) worked with outpatient samples, and 4 (21.1%) worked with samples consisting of a mixture of inpatients and outpatients.

Total duration of social cognition training ranged from 1 to 93 hours, with the number of sessions ranging from 1 session to 62 weeks of sessions. In terms of areas of training, 6 studies (31.6%) utilized programs which trained primarily on the domain of emotion perception. Three studies (15.8%) utilized broader social perception training programs while one study (5.3%) trained exclusively on ToM. Nine studies (47.4%) included training programs

Table 2. Studies of Social Cognitive Training in Schizophrenia Included in the Meta-Analysis ($n = 19$)

Study	Sample	Social Cognition Training Intervention	Control Condition	Age	Gender (% Male)	Duration of Illness (Years)	Intensity of Training	Methodological Quality Ratings (1–5)	Social Cognition Outcome Measures	Major Findings
Choi and Kwon[48]	34 inpatients with schizophrenia-spectrum diagnoses	Social Cognition Enhancement Training (SCET)	Treatment-as-usual (TAU)	32	56	11	Two 1.5-h sessions per wk for 24 wk	Study quality rating of 2: participants randomized to condition	Picture Arrangement (PA), Social Behavioral Sequencing Task (SBST), Emotion Recognition Test (ERT)	SCET participants improved on PA test, but not on SBST or ERT.
Combs et al[71]	28 inpatients with schizophrenia-spectrum diagnoses	Social Cognition and Interaction Training (SCIT)	Coping skills group noted as part of routine treatment	42	75	19	One 1-h session per wk for 18 wk	Study quality rating of 3: raters blind to condition, establishment of interrater reliability	Face Emotion Identification Test (FEIT), Face Emotion Discrimination Test (FEDT), Social Perception Scale (SPS)	SCIT participants improved in all social cognitive domains relative to controls.
Combs et al[22]	60 inpatients with schizophrenia	Attentional-shaping	Repeated practice with emotion perception measures	39	65	15	1 session of unspecified duration	Study quality rating of 4: participants randomized to condition, raters blind to condition, establishment of interrater reliability	FEIT, Bell-Lysaker Emotion Recognition Test (BLERT)	Participants in the attentional-shaping condition performed better on facial affect recognition (FAR) outcome measures than did those in the monetary reinforcement and repeated practice conditions.
Corrigan et al[46]	40 patients with schizophrenia-spectrum diagnoses of whom 35% were inpatients at the time of study	Vigilance-plus-memory training	Vigilance training alone	35	45	NR	One 1-h session	Study quality rating of 5: participants randomized to condition, raters blind to condition, establishment of interrater reliability, assessment of fidelity to treatment model	Cue Recognition Test (CRT), Social Cue Recognition Test (SCRT)	Participants in the vigilance-plus-memory condition performed better on SCRT and CRT than control group.
Eack et al[27]	58 outpatients with schizophrenia	Cognitive Enhancement Therapy (CET)	Enriched Supportive Therapy (EST) group	26	69	3	One 1.5-h session of social cognition training per wk for 62 wk	Study quality rating of 4: participants randomized to condition, establishment of interrater reliability, assessment of fidelity to treatment model	Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT)	Participants who received CET showed improvement on social cognition measures relative to a control condition.
García et al[28]	20 outpatients with schizophrenia	Social Perception subprogram of Integrated Psychological Therapy (IPT)	NR	39	70	18	30-min sessions for the first five sessions, 1-h sessions for the next 16 sessions, two sessions per wk for 12 wk	Study quality rating of 2: participants randomized to condition	Social Perception Scale (EPS, Escala Percepción Social)	Participants who received training improved in the perception and interpretation of social situations relative to controls.

Table 2. Continued.

Study	Sample	Social Cognition Training Intervention	Control Condition	Age	Gender (% Male)	Duration of Illness (Years)	Intensity of Training	Methodological Quality Ratings (1–5)	Social Cognition Outcome Measures	Major Findings
Gil Sanz et al[42]	14 outpatients with schizophrenia	Social Cognition Training Program (SCTP)	TAU	37	50	17	Two 45-min sessions per wk for 10 wk	Study quality rating of 2: participants randomized to condition	Facial emotion recognition task, EPS	Participants who received training with the SCTP improved on two aspects of the EPS—interpretation of social situations and allocation of an appropriate title for the scene—relative to controls. No significant difference was found between the two conditions on the facial emotion recognition task.
Habel et al[39]	A total of 30 individuals–20 patients with schizophrenia (a mixture of inpatients and outpatients) and 10 healthy controls	Training of Affect Recognition (TAR)	TAU	33	100	NR	Two 45-min sessions per wk for 6 wk	Study quality rating of 2: participants randomized to condition	Emotion discrimination task	Participants who completed the TAR programs showed improvement on the emotion discrimination task relative to both impaired controls who received TAU and healthy controls.
Hodel et al[72]	22 inpatients with schizophrenia who were diagnosed as treatment-resistant	Emotion Management Therapy (EMT)	Problem-solving group	36	NR	NR	Two 45-min sessions per wk for 12 wk	Study quality rating of 2: raters blind to condition	Emotion Perception Test	EMT participants showed improvement on emotion perception test immediately following training, but not at a 4-month follow-up.
Horan et al[21]	34 outpatients with schizophrenia-spectrum diagnoses	Social Cognitive Intervention based on SCIT	Time-matched illness self-management and relapse prevention skills training group	48	94	NR	Two 1-h sessions per wk for 6 wk	Study quality rating of 4: participants randomized to condition, raters blind to condition, establishment of interrater reliability	Facial Emotion Identification Test, The Half-Profile of Nonverbal Sensitivity (PONS), Ambiguous Intentions Hostility Questionnaire (AIHQ), The Awareness of Social Inference Test (TASIT)	Participants in experimental condition improved on facial affect perception test, but not on other social cognition measures.

Table 2. Continued.

Study	Sample	Social Cognition Training Intervention	Control Condition	Age	Gender (% Male)	Duration of Illness (Years)	Intensity of Training	Methodological Quality Ratings (1–5)	Social Cognition Outcome Measures	Major Findings
Horan et al[70]	68 outpatients with schizophrenia, schizoaffective disorder, delusional disorder or psychosis not otherwise specified	Social Cognitive Skills Training (SCST)	Time- and format-matched illness management skills training group	48	88	NR	Two 1-h sessions per wk for 12 wk	Study quality rating of 4: participants randomized to condition, raters blind to condition, establishment of interrater reliability	Facial Emotion Identification Test, PONS, AIHQ, TASIT	Participants in SCST condition improved on social cognition outcome measures relative to control groups. No effects were found for neurocognition or clinical symptoms.
Kayser et al[49]	14 patients with schizophrenia (13 outpatient, 1 inpatient)	Training analysis of mental states and intentions of characters in video scenes	TAU	35	78	12	Two 1-h sessions per wk for 1 wk	Study quality rating of 2: participants randomized to condition	Number of errors in attribution of intentions	Participants who completed Theory of Mind (ToM) training showed an improvement on disorganization measures from pretest to posttest as well as relative to controls.
Mazza et al[50]	33 outpatients with schizophrenia	Emotion and ToM Imitation Training (ETIT)	Problem-solving group	25	59	NR	Two 50-min sessions per wk for 12 wk	Study quality rating of 3: participants randomized to condition, establishment of interrater reliability	Advanced ToM Scale, Emotion Attribution Task	ETIT subjects not only improved on all social cognitive measures, but also showed improvement in social and behavioral functioning relative to control subjects.
Penn and Combs[73]	40 inpatients with schizophrenia-spectrum diagnoses	Imitation of a target face	Repeated practice with emotion perception measures	40	58	14	One session of unspecified duration	Study quality rating of 3: participants randomized to condition, establishment of interrater reliability	FEIT, FEDT	Participants in the experimental condition improved on the FEIT, however, treatment effects did not generalize to FEDT.
Roberts and Penn[23]	31 outpatients with schizophrenia-spectrum diagnoses	SCIT	TAU	38	58	NR	One 1-h session per wk for 20 wk	Study quality rating of 3: raters blind to condition, establishment of interrater reliability	FEIT, Hinting Task, AIHQ, BLERT, TASIT	SCIT participants improved on emotion perception measures relative to controls.
Roncone et al[52]	20 inpatients with schizophrenia	Meta-cognitive rehabilitation program	TAU	34	65	14	One 1-h session per wk for 22 wk	Study quality rating of 3: participants randomized to condition, raters blind to condition	ToM (first level), ToM (second level), Emotion Recognition test	Participants in the experimental condition improved on ToM and Emotion Recognition measures relative to controls and continued to show improvement on these measures at a 6-month follow-up.

Table 2. Continued.

Study	Sample	Social Cognition Training Intervention	Control Condition	Age	Gender (% Male)	Duration of Illness (Years)	Intensity of Training	Methodological Quality Ratings (1–5)	Social Cognition Outcome Measures	Major Findings
Russell et al[43]	40 outpatients with schizophrenia-spectrum diagnoses	Micro-Expression Training Tool (METT)	Repeated exposure to stimuli	41	68	NR	One session lasting 3 h	Study quality rating of 2: participants randomized to condition	Emotion Recognition Task	Participants in the METT group showed improved emotion recognition relative to controls and effects were present at a 1-wk follow-up.
van der Gaag et al[40]	42 inpatients with schizophrenia	Cognitive retraining program in which 12/22 sessions are specifically related to elements of social cognition	Time-matched group which participated in leisure activities such as board games	31	64	10	Two 20-min sessions per wk for approximately 12 wk	Study quality rating of 2: participants randomized to condition	Emotion Matching Test, Emotion Labeling Test	Experimental group improved in the domain of perception relative to the control group.
Wölwer et al[19]	77 schizophrenia patients who were either inpatients (n = 58) or outpatients (n = 19)	TAR	TAU	34	78	NR	Two 45-min sessions per wk for 6 wk	Study quality rating of 2: participants randomized to condition	Pictures of Facial Affect (PFA), PA	TAR ameliorated FAR deficits in schizophrenia patients relative to a control condition.

which incorporated more than one and as many as all four domains of social cognition.

Control groups were active (n = 7, 36.8%) or passive (n = 11, 57.9%), with one study not reporting control group activity. Active controls consisted of problem solving, supportive therapy, or illness management groups, while passive controls participated in TAU.

Four studies (21%) included interventions that were comprised of both cognitive and social cognitive training. Two of these studies (11%) included both elements of training, while 2 studies (11%) included just the social cognitive training portion of the larger protocol.

Effects of Social Cognitive Training on Facial Affect Identification and Discrimination

The results of the meta-analysis are presented in table 3. Of the 19 controlled trials identified, 15 provided data on facial affect identification tasks that involved assigning descriptive labels to faces of different emotions.[19,21–23,27,39,40,42,43,48,50,70–73] The weighted mean effect size was moderate-large ($d = 0.71$) with a 95% CI of 0.52–0.90. Because this CI does not include 0, it can be considered to be significant. There was also significant heterogeneity in overall effect sizes across studies, suggesting that these studies did not share a common effect. Moderator analyses revealed that illness duration was related to treatment effects ($Z = 2.58$; $P = .01$).

Three studies provided data on facial affect discrimination in which faces are compared and a judgment is made regarding which face is expressing a greater degree of emotion.[40,71,73] The weighted mean effect size was large ($d = 1.01$) with a 95% CI of 0.56–1.47. There was also significant heterogeneity in overall effect sizes between studies, suggesting that these studies did not share a common effect. No moderator analyses were significant.

Effects of Social Cognitive Training on Social Cue Perception

Eight studies provided data on social cue perception.[19,21,28,40,42,46,48,70] These measures all used social stimuli in which the participant was required to identify the nature of social interactions between people by verbal description or sequencing of stimuli. The weighted mean effect size for these studies was not significantly different from 0.

Effects of Social Cognitive Training on ToM

Seven studies included data on ToM measures.[21,23,49,50,52,70,71] These measures all included an assessment of a participant's ability to attribute accurate intentions, knowledge, and emotions of individuals in a specific social situation. The weighted mean effect size for these studies was small-moderate ($d = 0.46$; 95% CI: 0.15–0.78). There was also significant heterogeneity in overall effect sizes between studies, suggesting

Table 3. Mean Effect Sizes for Controlled Studies of Social Cognitive Training for Schizophrenia Organized by Measured Area of Outcome and Whether the Measure is a Proximal Outcome or a Measure of Generalization

	k	N	ES	95% CI	Z	Q_w	N_{fs}
Proximal measures of social cognition							
Emotion perception							
Facial affect recognition	15	488	0.71	0.52, 0.90	7.4*	34.9*	38
Facial sffect discrimination	3	89	1.01	0.56, 1.47	4.38*	5.61*	12
Social Perception	8	261	0.13	−0.12, 0.38	1.05	24.74	
Theory of Mind	7	186	0.46	0.15, 0.78	2.94*	40.31*	9
Attributional style							
Aggression bias	4	119	0.25	−0.12, 0.62	1.33	4.42	
Hostility bias	4	119	0.15	−0.24, 0.53	0.75	23.95	
Blame bias	4	119	0.07	−0.3, 0.45	0.39	11.08	
Measures of generalization							
Symptoms							
Negative symptoms	10	306	0.15	−0.08, 0.38	1.30	16.37	
Positive symptoms	8	258	0.26	−0.01, 0.52	1.92	60.31	
Total symptoms	7	166	0.68	0.33, 1.02	3.80*	58.36*	17
Psychosocial functioning	6	187	0.78	0.45, 1.11	4.61*	73.65*	17

Note: k, number of studies; N, number of clients; Z, significance test within the group; Q_w, homogeneity statistic; N_{fs}, indicates the number of null findings that would be needed to reduce the effect size to 0.20.
*$P < .01$.

that these studies did not share a common effect. Moderator analyses showed that duration of illness was positively related to treatment effects ($Z = 3.79$; $P < .001$), while education was negatively related to treatment effects ($Z = −2.63$; $P < .01$). There was also an effect of test type, with static measures of ToM showing larger effects than dynamic measures ($Q_B[1] = 12.97$ $P < .001$; $d_1 = 1.02$ vs $d_2 = −0.13$).

Effects of Social Cognitive Training on Attributional Style

Four studies investigated the effects of social cognitive training on attributional style in people with schizophrenia, all using the AIHQ, in which participants read a series of vignettes describing social situations and answered questions about the intentions of the characters and how they themselves would respond to the situation.[21,23,70,71] Weighted mean effect sizes for aggression, hostility, and blame bias scores were not significantly different from 0.

Effects of Social Cognitive Training on Positive, Negative, and Total Symptoms

Eight studies presented data on positive symptoms,[19,21,27,28,42,49,50,70] 7 studies provided data on total symptoms,[28,42,49,50,52,70,71] while 10 studies described findings regarding negative symptoms.[19,21,27,28,42,49,50,52,70,71] Social cognitive training produced moderate-large effect-size improvement in measures of overall psychiatric symptoms ($d = 0.68$; 95% CI:0.33–1.02) but did not influence positive or negative symptoms ($Ps > .05$).

Heterogeneity measures suggested that the overall mean weighted effect size for overall symptoms was not stable.

Moderator analyses of total symptoms revealed that as sample age increased, treatment effects decreased ($Z = −6.03$; $P < .0001$), as duration of treatment increased, effects increased ($Z = 3.65$; $P < .0005$), and as dose of antipsychotic medication in CPZ equivalents increased, treatment effects increased ($Z = 5.44$; $P < .0001$). Studies with active control conditions produced larger effects than those with passive controls ($Q_B[1] = 8.91$, $P < .005$; $d_1 = 1.05$ vs $d_2 = −0.29$).

Effects of Social Cognitive Training on Measures of Observer-Rated Community and Institutional Functioning

Six studies provided data for observer-rated community and institutional functioning measures.[22,27,28,42,50,72] The weighted mean effect size for these studies was large ($d = 0.78$; CI 0.45–1.11). Heterogeneity measures suggested that the overall mean weighted effect size for function measures was not stable. Moderator analyses revealed that as sample age and education level increased, treatment effects decreased ($Z = −7.28$; $P < .001$ and $Z = −8.24$; $P < .001$, respectively). As dosage of medication in CPZ equivalents increased, so did treatment effects ($Z = 8.82$, $P < .001$). Inpatient samples showed larger treatment effects than outpatient samples ($Q_B[1] = 10.35$, $P < .001$, $d_1 = 1.54$ vs $d_2 = 0.39$). Paradoxically, as intervention duration and intensity increased, treatment effects decreased ($Z = −3.42$; $P < .001$ and $Z = −4.05$; $P < .001$).

Fail-Safe N Results

The fail-safe N results reveal that for FAR, 38 more studies than those identified in the literature, all reporting negative findings, would be necessary to reduce this

finding to a null effect. For facial affect discrimination, 12 studies beyond those reported in the literature, all reporting negative findings would be necessary to reduce this finding to a null effect. For ToM, 9 studies, all reporting negative findings would be necessary to reduce this finding to a null effect. For total symptom measures and community and institutional functioning measures, 17 studies beyond those identified in the literature, all reporting negative findings would be necessary to reduce this finding to a null effect.

Discussion

This is the first study, to our knowledge, to meta-analyze controlled studies of social cognitive training in schizophrenia. The results of the meta-analysis were consistent with the hypothesis that social cognitive training programs produced improvement on FAR in the moderate-large range (identification, $d = 0.71$ and discrimination, $d = 1.01$), while producing a smaller but significant effect on ToM ($d = 0.46$). While findings regarding training effects on facial affect perception are well-replicated (see Kohler and Martin[74]), the finding of effects of social cognitive training programs on ToM tasks is of considerable significance because it suggests that even the complex cognitive operations involved in appreciating mental states other than one's own, which are a core component of successful performance on all ToM tasks, are amenable to structured training. Findings regarding other social cognitive domains did not support our hypotheses: social cognitive training did not produce significant changes in attributional style (aggression, hostility, and blame biases) or social perception measures.

Regarding measures of generalization of training effects, there was no support for our hypothesis that social cognitive training effects would produce improvements in positive and negative symptoms specific to schizophrenia. The limited effects of social cognitive training on positive and negative symptoms may reflect the multi-determined nature of these disease domains, including effects of medication nonadherence[75] and emotionally charged family relationships.[76] These training procedures did produce moderate size effects on general symptom levels ($d = 0.68$), suggesting these training programs may be effectively influencing more general psychiatric symptoms such as depression and anxiety.

Possibly the most important finding from the current study is that moderate-large effect size improvements were evident on observer-rated measures of community function for outpatients and institutional function for inpatients ($d = 0.78$). These findings provide strong evidence for the generalization of training effects on social cognitive measures for improving indices of functioning in clients' everyday environments and suggest little reduction of treatment effects to more distal outcome measures. Regarding secondary hypotheses, there was no evidence that training

programs of longer duration or higher intensity, or programs that treat multiple domains of social cognition, rather than a single domain, produce larger effects on social cognitive measures.

In terms of moderator analyses, for social cognitive outcome measures, longer mean sample duration of illness predicted greater responses to social cognitive training as measured by FAR and ToM measures. Thus, clients with a longer history of living with the illness seem better prepared to take advantage of these social cognitive interventions. For generalization measures, moderator analyses revealed that the effects of social cognitive training were most likely to generalize to general symptoms in samples with a younger mean age, and when treatment was of longer duration and prescribed sample medication levels were higher. Moderator analyses also revealed that effects of social cognitive training on observer-rated community and institutional function were strongest in young samples, samples with higher mean education, and samples that were hospitalized and treated with high dosages of antipsychotic medications. One possible interpretation of these findings is that the effects of social cognitive training are more evident on measures of institutional function administered to highly-medicated inpatient samples, as these functioning measures are less affected by the complex social and individual forces influencing outpatient measures of functioning (eg, current employment market, access to potential social encounters, individual differences in medication compliance, etc.). The findings regarding an advantage for younger clients for generalization of treatment effects to functioning are consistent with generalization effects for symptoms.

Several caveats to the current findings should be noted. First, the overall sample of 19 controlled studies was small, and the number of studies for each of the outcome domains was even smaller. Thus, as the number of controlled trials of social cognitive training grows in the future, the findings of this meta-analysis will need to be replicated. Second, some of the moderator analyses included a very small number of studies making the power to detect some relationships limited. Third, as is common to all meta-analyses, it is unknown the degree to which our findings may represent publication bias. Inclusion of unpublished negative findings would affect our overall results, and their absence may have led us to overestimate our reported effect sizes. Fourth, failure to report crucial sample information, such as age-of-illness onset (3 out of 19 studies reported this information) limited the number of variables that could be investigated in this analysis and suggests that some variables that may have an impact on social cognitive training remain to be explored. Fifth, the psychometric characteristics of many of the commonly selected social cognitive measures that were analyzed in this report are not well understood. Sixth, the inclusion of studies that included both cognitive and social cognitive training may have biased our results (relative

to studies using only social cognitive training), as effects of combined training on social cognitive, symptom, and functioning outcome measures may have been influenced by this surplus of treatment. Lastly, 2 studies used only 1 subprogram of the IPT, administering social cognitive training in the absence of other rehabilitation activities prescribed by this intervention, and thus the effects of this specific treatment may have been underestimated in our study.

The results of this meta-analysis suggest several avenues for future study. First, many of the studies in this meta-analysis include outcome measures from only 1 or 2 social cognitive and other functional domains. Including measures from a variety of outcome domains, both within the larger domain of social cognition, as well as more distal measures of symptoms and community or institutional measures of psychosocial function, will provide greater clarity in understanding the effects of these interventions on different aspects of social cognition (and their interrelationships) as well as the ability of these interventions to generalize to other important domains of illness in schizophrenia. Second, the types of interventions used in these studies were heterogeneous in terms of method and content and ranged methodologically from simple behavioral shaping procedures to complex group exercises that involved careful increases in task difficulty, and thematically from training in FAR alone, to treatment in multiple social cognitive domains including attribution of intentions and training in the understanding of sarcasm and humor. More research will be necessary to identify what methodologic and thematic components of these myriad treatments are most active in addressing social cognitive deficits, as well as associated functional impairments. Third, it remains unclear to what degree impairments in elementary neurocognition that are estimated to be evident in 70% of clients with schizophrenia or more[77,78] impact the ability to benefit from training of more complex social cognitive skills. We note one study by Horan et al[21] that controlled for elementary neurocognitive skill and found that it did not have an impact on improvements in facial affect perception as a function of social cognitive training. Last, the number of studies investigating durability of social cognitive training effects was too small to compute meaningful effect sizes. Given the time and effort-intensive nature of social cognitive training, understanding the durability of treatment effects and the potential necessity of booster sessions will be crucial for maximizing its benefit.

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