Potential therapeutic avenues to tackle social cognition problems in schizophrenia


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Therapeutic strategies for improving social cognition in patients with schizophrenia have shown much promise in improving social functioning, as well as remediating core psychotic symptoms. However, the efficacy of previous interventions has often been limited by the ambiguity and inconsistency of the categorized subdomains of social cognition, including theory of mind, emotion processing, social perception and attributional bias. Recent research in social and cognitive neuroscience has revealed many new issues that could contribute to the development of more integrated approaches for improving social functioning. The application of such neuroscientific work to a therapeutic and diagnostic context is likely to encourage more effective transference of learned skills to real-world social functioning. This article seeks to provide a comprehensive review of previous social cognitive interventions for schizophrenia, highlight some crucial limitations of these and present the relevance of recent advances in neuroscientific research in possible future treatment strategies. It is emphasized that a more integrated and naturalistic approach for improving social functioning with greater sensitivity for neuroscientific findings related to the psychopathology of schizophrenia is warranted.

**Key words:** emotion processing • learning • metacognition • motivation • schizophrenia • social cognition • social interaction • social neuroscience • theory of mind • treatment outcome

Forty years have passed since the publication of Bandura and Barab’s social learning analyses [1], in which some basic theories of social cognition were described. In the last 10 years, there has been a substantial revival of older questions from social psychology as a result of the advancement of neuroscientific findings regarding social cognition in neuropsychiatric populations. In parallel, new therapeutic strategies to improve pathological social functioning deficits in affected psychiatric and developmental populations have been inspired by the work in social neuroscience. Research from cognitive psychology and neuroscience has consistently identified schizophrenia as a group of clinical syndromes not just composed of positive and negative symptoms, but also riddled with a spectrum of deficits in social cognition in schizophrenia as a group of clinical syndromes not just composed of positive and negative symptoms, but also riddled with a spectrum of deficits in social cognition that translate to impairments in real-world social functioning [2]. The aim of this article is not only to review current therapeutic interventions and their limitations, but also to highlight relevant work in social neuroscience that can potentially be bridged with future therapeutic strategies for improving social cognition in schizophrenia.

**Social cognition in schizophrenia**
Social cognition has been defined as “the ability to construct representations of the relations between oneself and others, and to use those representations flexibly to guide social behaviors” [3]. Social cognition can be considered as the sum of the cognitive processes required for social perception and social interaction. Deficits in social cognition in schizophrenia have a direct impact on rate of relapse and the need for readmission [4]. When asked, the majority of psychotic patients would prioritize the remediation of social skills over the recovery of positive or negative symptoms [5]. However, symptomatic remission with the use of antipsychotic medication appears to have little impact on the remission of social skills [6]. Recent work has revealed that neurocognitive deficits in schizophrenia can successfully explain between 20 and 60% of the overall variance on functioning [7–11], whereas social cognition seems to explain variance beyond that explained by neurocognition [12,13]. Accordingly, in the context of discussing therapeutic interventions, we heretofore focus on the issues related to the deficits in domains of...
social cognition rather than the neurocognitive deficits associated with schizophrenia.

A recent National Institute of Mental Health workshop settled on a consensus defining five key domains of social cognition that most commonly and persistently present deficits in schizophrenia [14]. These domains have been listed as: emotion processing, theory of mind, attributional bias, social perception and social knowledge. Emotion processing deficits in schizophrenia encompass multiple impairments, including emotion recognition from facial expression and prosody [15], emotion discrimination, emotion interpretation [16–19] and emotional awareness [20]. In real-world social functioning, recognizing and correctly interpreting facial emotional expressions is a crucial component for social interaction [17]. One study has shown a direct relationship between deficits in emotion recognition and the severity of negative and affective symptoms, as well as poor vocational and global functioning [28]. Recent research has also focused on the impact of the emotional context, particularly verbal and nonverbal clues to integrate the subdomains of emotion processing [16]. Theory of mind refers to the ability to represent other people’s thoughts and intentions [21]. A recent meta-analysis has shown theory of mind deficits in both first-episode and remitted patients, suggesting that these deficits are inherent to the illness [22]. In the past, theory of minds skills were thought to be highly correlated with neurocognitive variables, such as intelligence quotient and verbal memory, although recently some have concluded that deficits in theory of mind may be independent of neurocognitive deficits [23]. It is still not clear as to how or to what extent deficits in theory of mind contribute to dysfunctional social behavior [24], although an impaired ability for mental state attribution has been shown to be the single best predictor of social competency when compared with measures of neurocognitive functioning and psychopathology [25]. Attributional style concerns one’s tendency to ascribe negative or positive events as being caused by oneself or others, which may express self-devaluation or self-inflation, or other-derogation or -idealization [26]. Suggestions of abnormal attribution biases in schizophrenia were pioneered by Bentall et al. in reference to the creation and maintenance of persecutory delusions [27]. They argued that biases in self-representation can be caused by biases in causal attributions, for instance, an over-self-serving attributional bias, which in turn leads to negative events being attributed to external agents and consequently manifesting in paranoid thoughts and delusions. Langdon et al. found that an increased externalizing bias is associated with reduced insight, although interestingly, neither externalizing nor personalizing biases related with theory of mind [28]. In addition, those with misattribution biases appeared to be less flexible in emotion processing. The two other domains of social cognition defined by the National Institute of Mental Health workshop [14], namely social perception and social knowledge, can be considered more as ‘umbrella’ terms that partly overlap with emotion processing, theory of mind and attributional style. Social perception involves the decoding and interpreting of verbal and nonverbal social cues [29]. Social knowledge, also called social schema, overlaps with social perception, but in addition includes the appropriate use of contextual cues in social situations plus the knowledge and awareness of social rules, norms and roles [30]. Poor social perception has shown potential to be correlated with an inability to improve quality of life and also can make it difficult to have trusting relationships, as found in a recent meta-analytic study [31]. Many studies on social perception have attempted to deconstruct this domain to find more specific deficits or subtypes, but most have tended to consistently find general, nonspecific deficits in social perception [32–37]. These semi-independent domains of social cognition are also closely linked to what has been conceptualized as ‘metacognition’, a term introduced to emphasize the necessity to enable patients not only to recognize social information, but to actively use mentalistic information for purposeful problem-solving and coping [38].

Current therapeutic interventions to improve social cognition

The use of social cognition training programs have been shown to indirectly improve positive and negative symptoms, improve vocational prospects and improve quality of life [39–45]. The overall goal for social cognition training is to remediate the specific social cognitive deficits seen in schizophrenia, which are relevant to social functioning, and can be effectively transferred to real-world situations.

Before neuroscientific research began to have some impact on social cognitive training, broad-based interventions were mostly used to improve functioning. Brenner and Hodel’s Integrated Psychological Therapy was the first to be developed for improving functioning and was formed on the basis of a two-type model of the interaction between social and cognitive variables, with two ‘vicious circles’ representing each type [46]. The type 1 section suggests that elementary cognitive dysfunction (e.g., attention and encoding) leads to complex cognitive dysfunction (e.g., concept formation), which in turn perpetuates elementary cognitive dysfunction, and thus creates the first ‘vicious circle’. The type 2 vicious circle is derived from the first and proposes that cognitive deficits that result from the first type of interaction lead to diminished coping skills, which consequently lead to further social stressors and hence a diminished capacity for social functioning, which then contributes to further cognitive deficits. In fact, the majority of the social cognition training frameworks that followed have, although possibly without intention, been developed to break these vicious circles at different points. Elementary cognitive dysfunctions of this model have been targeted by Cognitive Enhancement Therapy [47–50]. Other cognitive remediation therapies that were developed in parallel included Wykes and van der Gaag [51], McGurk and Wykes [52], van der Gaag et al. [53], Kurtz et al. [54] and Penades et al. [55]. Various treatments and strategies have been developed with the aim of specifically improving the type 2 vicious circle, targeting coping skills and social skills in schizophrenia [56,57]. Despite significant efforts, these broad-based techniques only had small effect sizes on the improvement of functioning. However, these results did highlight some possible mediators inbetween elementary and higher-order social cognitive functioning, such as the domains of social cognition mentioned above.
The limitations of broad-based interventions encouraged the later development of more targeted approaches. One of the first social-cognitive interventions was designed to improve affect recognition (training affect recognition [TAR]) [58]. Wolwer and colleagues compared TAR with cognitive remediation training and found that TAR improved working memory and cognitive flexibility in addition to improvement of affect recognition, whereas cognitive remediation training only improved the targeted neurocognitive areas, for instance, attention, working memory and executive function [58]. These results inspired the development of other emotion recognition training programs that included tools to recognize facial micro-expressions [59]. Moritz and Woodward developed the metacognitive training for schizophrenia, which was shown to directly improve cognitive biases [60], in particular jumping to conclusions and attributional biases, and also may have some promise of ameliorating positive symptoms [61]. These positive results then consequently led to the development of more multidimensional social cognition training interventions that aimed to also target other deficits in social cognition. In 2005, Penn et al. made the first attempt to develop a more integrative approach, Social Cognition Interaction Training (SCIT), which not only focused on emotion recognition, but also targeted attributional style and theory of mind [62]. Subsequent studies using SCIT have shown that it has been effective in improving mentalizing, reasoning, empathy, theory of mind, affect recognition, cognitive flexibility and need for closure, although only with a very small effect on attributional bias [39–45]. Interestingly, SCIT appeared to improve the social cognitive domain of theory of mind much more than the social perceptual domain, therefore hinting that each individual domain of social cognition may benefit more from specialized training. A study from Combs et al. showed that the effects of SCIT on measures of emotion processing were still significantly higher than baseline scores after 6 months [40]. A recent study from our group used a variant of SCIT, the family-assisted SCIT (F-SCIT) that had the inclusion of a micro-social environment as part of training, which provided more opportunities for, and therefore better transference of, learned social cognitive skills to real-world social functioning [45]. The application of the F-SCIT seemed to have a greater effect size on measures of social cognition and functioning when compared with other previous SCIT studies, although it needs to be acknowledged that Tas et al. did not directly compare F-SCIT with conventional SCIT [45]. In parallel with the development of SCIT [46], Horan et al. launched their social cognition training using a similar theoretical background but combining TAR with SCIT, with the addition of social coping strategies [41]. This was also shown to be effective in raising scores on tests of social cognition significantly above baseline. In 2011, a study from Horan et al. compared a pure social-cognition trained group, to a group receiving only neurocognitive training, to a hybrid group receiving both, and surprisingly found that having a hybrid group did not have any benefits over training of just social cognitive skills or just neurocognitive skills [62]. Despite the promising results of these aforementioned studies, some have also shown less success, such as that of Sanz et al.’s Social Cognition Training Program, which only produced significant improvement on a small fraction of the measures of social cognition and not others [63].

The benefits of social cognitive training have also been confirmed in a meta-analytic investigation of 19 studies consisting of 692 patients, resulting in a moderate to large effect on facial affect recognition (d = 0.71 for identification and d = 1.01 for discrimination) and a small to moderate effect size on theory of mind (d = 0.46), and more importantly, a moderate to large effect size on generalization effects on total symptoms (d = 0.68), and observer-rated community and institutional function (d = 0.78) [64]. This study is the first to look for predictors of outcomes, which is a crucial step towards achieving feasible and effective social cognition training. However, this meta-analysis may have come too early owing to the relatively small number of studies included in the analysis, and therefore would benefit from replication in the future when more data are made available.

Limitations of current therapeutic interventions

In general, the effect sizes of previous treatments have been less than hoped for. Initially, this points to two main potential conclusions, with the first being that current definitions of social cognitive domains may be insufficient in explaining functioning in real-world social skills completely, and second, that there may also be an inherent lack of integration of these domains in the current therapeutic tools. Impairments in motivation, learning and metacognition as a result of schizophrenia may also contribute to the limited efficacy of previous therapeutic interventions.

Previous studies using factor analysis have shown that there is much overlap between the domains of social cognition [65,66], even though they do appear to largely explain the overall variance in functioning [12,13]. One study found that some domains were not separable, such as attributional biases and jumping to conclusions, although theory of mind did appear to be highly separable [67]. A study using performance-based measures and realistic tasks demonstrated that attributional bias and theory of mind were separable, whereas emotion recognition and social perception seemed highly grouped together [66]. A recent meta-analysis found that theory of mind had the strongest association with functional outcomes when assessed with performance-based scales, whereas emotion processing and social perception had a somewhat weaker association [68].

To date, social cognitive interventions have focused primarily on improving the domains of social cognition, while possible confounders, such as motivation [69–71], metacognition [72–75] and learning [76] have been largely ignored. Therefore, expecting a significant positive outcome from cognitive training may be optimistic when there are known deficits in such cognitive factors that are not directly related to the skills being taught. During training, poor motivation will inevitably reduce task engagement and also result in a low learning potential [10,69,76]. Studies addressing specific aspects of metacognition in the abovementioned meaning [38,77] have shown that deficits in metacognition, specifically ‘mastery’, which is defined as the ability to actively use mentalistic information for problem-solving and coping, can lead to a weaker

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therapeutic alliance [78]. This can consequently reduce the ability to detect social clues, and therefore, people with poor metacognition will inevitably lose some social information. Deficits in motivation, learning potential and metacognition are also likely to lead to poorer engagement in social interactions, an impaired ability to learn new social skills, and consequently prevent social knowledge from being learnt through observation [73,74,77]. In addition, these deficits are likely to also further act to prevent learned social cognitive skills from being applied to real-world social situations.

The success reflected from previous studies on social cognition training has relied upon improved scores on specific measures of social cognition by targeting particular social cognitive domains with training, but have not always resulted in comparable functional improvements [39–45]. One possible explanation for this comes from studies highlighting the limited psychometric properties of current assessments of social cognition [14,79]. For example, the lack of improvement in attributional biases after training could be due to the limitations of assessment strategies that rely only on self-reports and observations of others’ social situations [61,79]. This, therefore, suggests that we need measures of social cognition that correlate more with real-world social functioning and are specialized for the neurocognitive profile of people with schizophrenia. Many of the scales assessing social cognitive domains have been standardized with either autistic or healthy populations, which may lead to scaling problems, such as ceiling effects, scoring dilemmas and difficulties in interpreting scores [14]. This also highlights an important consideration in terms of the expected outcomes of social cognition training that may be aimed at working towards ‘normal’ levels on assessment scales, where ‘normal’ levels are likely to be inappropriate and unrealistic for people with schizophrenia. The heterogeneity of symptoms and cognitive deficits in schizophrenia also further adds to this problem. It is also important to appreciate that the dissociation of domains and subdomains of social cognitive deficits appropriate for an autistic or healthy population may not be suitable for a population with schizophrenia. Illustrative of this is the finding that attributional biases of a certain degree do not necessarily reflect a pathological difference because healthy individuals can also experience misattributions to the same degree as paranoid patients with schizophrenia in ambiguous situations [80,81]. To date, we do not have a cutoff level to define pathological boundaries on scales measuring social cognitive domains.

Studies assessing the effects of social cognitive training have often used specific tasks to demonstrate specific outcomes, and may have therefore missed the generalized effects of the training on other areas of social cognition and psychotic symptoms. Therefore, this body of research may not provide a comprehensive view of the efficacy of existing therapeutic interventions. For example, an intervention for improving emotion processing shows improvement in emotion recognition tasks, but it has also been shown to improve theory of mind skills and reduce misattributions, while obtaining more reliable social clues [58]. Recently, standardized general neurocognitive test batteries have been developed that include a wider range of social cognitive tasks [82,83], but a standardized and validated test battery specifically focused on assessing social cognition is still missing.

In summary, the main issues of current research investigating therapeutic interventions for improving social cognition in schizophrenia ultimately boil down to problems of the dissociations between the social cognitive domains used for assessment and training, and the problem of a lack of transference to real-life social functioning. To tackle these problems, the boundaries and the fundamental relationships between social cognitive deficits and real-world social dysfunction need to be first clarified, and neuroscience-based research is likely to be particularly relevant for this.

**Summary of recent work in social neuroscience in schizophrenia**

‘Social neuroscience’ [84], refers to the investigation of underlying neural mechanisms behind cognitive processes related to social functioning, mostly with the use of modern neuroimaging methods, such as functional MRI and EEG. Substantial work has been carried out to look for neural correlates of deficits in neurocognition and the domains of social cognition in schizophrenia, and many have attempted to forge a link between them, although with little consensus. There are still many unanswered questions that have been highlighted by work in social neuroscience; for example, we are still not sure as to what degree deficits in social cognition can be explained by structural and functional brain abnormalities, and therefore, it is also unclear as to whether structural or functional abnormalities in schizophrenia may limit the effects of psychosocial interventions for remediating social cognitive deficits. Furthermore, if schizophrenia, or syndromal subtypes, is considered to be a neurodevelopmental disease, rather than neurodegenerative [85], then this would suggest that we need extra psychopharmaceutical augmentation strategies specifically targeted at either improving neurocognition, social cognition or both, in addition to social cognition training. Numerous neuroimaging studies have shown both gross and localized structural brain abnormalities in people with schizophrenia that relate to deficits in social cognition. One research group has consistently seen reduced gray matter volumes in areas thought to be critical for emotion attribution and theory of mind [86–88]. Numerous studies have also found abnormal connectivity in patients with schizophrenia, and in particular, a reduction in white matter integrity, therefore supporting the disconnection hypothesis [89,90]. The disconnection hypothesis proposes altered global structural and functional brain connectivity as an underlying pathophysiological explanation for the cause of schizophrenia [91] and more emphasis is now being put on abnormal connectivity in brain networks and psychopathologies, rather than abnormal activity in localized areas. This hypothesis will also have substantial implications if the domains of social cognition, used in social cognitive training for schizophrenia, are defined on the basis of social brain networks in healthy people.

More specific localized structural and functional differences have been found in patients with schizophrenia. These areas may also represent a disruption across ‘an integrated social cognitive
Reduced volumes and activation levels have been found in areas related to emotion processing in patients with schizophrenia, particularly in the amygdala, but also in a network of other areas. A wide network of areas has been implicated in previous neuroimaging studies of theory of mind, including the anterior and posterior cingulate cortices, the medial prefrontal cortex, the middle temporal lobes, superior temporal sulcus and temporal parietal junction (Figure 1). Activity in this theory of mind network has been shown to be significantly abnormal and disorganized in patients with schizophrenia and, it is possible that these functional differences may have a direct relationship with the course and progression of the illness. This raises another important issue concerning the use of neuroimaging studies to inform future training tools for social cognition. If the differences in functional brain activity related to neurocognitive and social cognitive impairments relate to the course and progression of the illness, whereby deviations from ‘normal’ activity become greater as symptoms worsen, then training tools, assessment criteria and the goals for treatment outcomes should be appropriately adjusted to appreciate these differences. A few studies in subjects at high risk of developing schizophrenia have shown that abnormal activations in particular brain areas can have some power in predicting illness onset. Some have also suggested that functional and structural differences in brain areas related to social cognitive functioning may be used in addition to behavioral deficit measures for a multilevel evaluation to inform remediation strategies and predict treatment outcome. This is particularly salient if we consider that abnormalities in brain function may limit the efficacy of cognitive remediation strategies. Neuroimaging data could be used to support behavioral data to define individual baseline scores and treatment target goals depending upon the degree of cognitive deficit at both a behavioral and neurological level. With our current state of knowledge, however, we are still far away from being able to use neuroimaging data for this purpose.

As previously mentioned, a number of other cognitive deficits common in schizophrenia are likely to confound the efficacy of current social cognition training interventions. Deficits in learning are well known in schizophrenia and the neuroscientific literature suggests that this may partly be caused by a deficit in the representation of reward. Therefore, traditional reward-based learning techniques are likely to have a much lower efficacy with patients with schizophrenia. This also directly impacts on the deficits in motivation in schizophrenia, and therefore also on the efficacy of social cognitive training strategies. With this in mind, future interventions for social cognitive training would benefit from the addition of some element of motivational training. Another important confounder in social cognition training is metacognition, which is associated with self-monitoring, reflexive thinking and error correction, and therefore has an influence on the ability to apply learned skills to real social situations. Neuroimaging studies have found that brain areas associated with metacognition overlap with theory of mind-related areas, and even though recent specific approaches to improve metacognition in schizophrenia have promising results, as previously mentioned, there has been little effort to integrate metacognitive training with specialized social cognition training.
Neurobiological interventions to improve social functioning

The ultimate goal for all behavioral social cognition training is to indirectly remediate abnormal brain function. To achieve this target, the development of psychopharmaceutical strategies has recently shown promising potential. Oxytocin is a prosocial neuropeptide produced in the pituitary gland, and its effects are mediated by complex emotional and social behavior. Studies have shown a relationship between low basal oxytocin levels and low social competence and high symptom severity in schizophrenia patients [108]. The administration of intranasal oxytocin can increase trustworthiness, improve social interaction, and improve coping strategies under stress in both healthy populations and various psychiatric populations that have known deficits in social cognition [109]. However, it is still unclear whether oxytocin regulation in the brain correlates with the psychopathology and the course of the illness, although a recent review has convincingly assigned oxytocin a role in the pathophysiology of schizophrenia [110]. In fact, one study demonstrated that peripheral serum levels of oxytocin were inversely correlated with symptoms severity [108], and an intervention study using intranasal oxytocin administered over a 6-week period revealed an improvement of positive, but not negative, symptoms [111]. In regards to social cognition in schizophrenia, Pedersen et al. reported an increase in theory of mind skills in a small sample of schizophrenia patients compared with a placebo group [112]. There is not currently any work demonstrating the use of oxytocin administration as augmentation to social cognition training.

Expert commentary

Recent work in social neuroscience has opened up the potential for many new therapeutic avenues, and has also raised a number of critical issues, some of which have already been highlighted in this article. To take further advantage of this body of work, this needs to be put into the context of schizophrenia before it can be applied to any operational therapeutic structure.

One major issue in the research and training in social cognition is the lack of coherence between currently used social cognitive domains and the multidimensional nature of real-world social functioning. Relying on dissociated and independent constructs puts us at risk of disregarding the complexity and integrated structure of real social interaction. Therefore, both research and therapy will profit from the use of more naturalistic and integrated tasks and constructs, to improve the relevance and transference to real-world social functioning. The assessment of social cognition will benefit from having more multidimensional criteria, using naturalistic tasks that allow for a more accurate reflection of performance in real-world social functioning. In terms of the development of new treatment strategies, transference to real-world social functioning is likely to be encouraged by more realistic and naturalistic training tools to facilitate the application of learned skills into real social situations. Zaki and Ochsner have argued for the need for naturalistic paradigms in the study of social cognition [113], and some have already taken steps towards this [114]. This is still a very young and burgeoning area that is anticipated to have essential relevance to future developments in new therapeutic interventions for schizophrenia.

From the perspective of the clinician, objective treatment outcome criteria and predictors have crucial importance in standardization of effect sizes across patients who receive social cognitive therapy. Therefore, we suggest greater utilization of neuroimaging data and neurobiological markers of social cognition (e.g., BDNF and oxytocin) to inform expectations for treatment outcome.

Individual social experiences are undoubtedly driven by the micro- and macro-social environment [45], which can directly influence the development of social skills, including social perception and social knowledge. Some efforts have been made to move towards more integrated approaches, such as that of Beauchamp and Anderson, which utilizes a developmental biopsychosocial model with a framework integrating the biological sociocognitive skills foundations of social functioning and the internal and external environmental factors that mediate these [115]. However, this is a general framework that could be further developed to cater for the social cognitive deficits specifically seen in schizophrenia.

Moreover, social cognition can mediate the development of other cognitive skills via the transference and application in real-world social functioning. Improving social functioning through social cognitive interventions may also help to prevent the deterioration of psychotic symptoms [44]. Despite the ongoing discussion regarding the cost–effectiveness of early intervention programs [116], we believe that the impact of an early intervention to improve social functioning may be more effective and generalizable to other symptoms as opposed to early interventions only targeting psychotic symptoms.

To summarize and expand on some of the previously mentioned issues, one possible suggestion is the use of individualized assessment and training programs to meet the specific needs of individual pathological social cognitive profiles. We also suggest that performance levels of metacognition, motivation and learning should contribute to the individualization of treatment programs, and in addition, treatment programs should include some elements of training aimed to improve these.

Five-year view

It is evident that the area of social neuroscience has become an increasingly popular field of research that has wide implications for both normal and abnormal pathological social behavior. Consequently, future treatments for improving or enhancing social functioning are likely to become more ‘neurocentric’, with treatments aimed at improving brain function in measurable ways through cognitive training strategies and neurobiological interventions. In addition to this, we are likely to see more work invested in exploring the potential for psychopharmaceutical cognitive enhancers to improve both neurocognitive and social cognitive deficits [112,117].

Ultimately, the aim of social cognitive training is to make significant subjective changes in patients’ real life and to contribute to outcome. Therefore, relying on the improvement of neuropsychological test scores as an indicator of treatment efficacy is an abstract construct that is still quite distant from real-world
functioning and real social interaction. In light of the main issues discussed in this article, it seems clear that the implementation of more integrated and naturalistic approaches in therapy and research in social cognition will be at the forefront of the newest and most progressive developments. One example of this is by the use of virtual reality to simulate more realistic social situations and environments that are more relevant to real-world social functioning [18,119]. Virtual reality systems provide immersive training environments that also allow for more interactive approaches to social cognition remediation, as opposed to the observational tasks currently used for the assessment and training of social cognitions. Other computer-based social remediation tools could also be used to complement traditional psychological therapies with an experienced therapist, therefore without neglecting the impact of a therapeutic alliance.

In addition to these methodological questions, it will be necessary to disentangle which patients benefit from social cognitive training and which do not. Several studies and meta-analyses have shown that social cognitive abilities vary greatly within the spectrum of schizophrenia phenotypes. In particular, patients with profound conceptual disorganization and patients with negative symptoms seem to perform poorly on a range of tasks tapping into the social cognitive domain [120,121]. It is, therefore, plausible to assume that differential effects also occur with regard to training effects in this domain.

Impairments in social functioning are also a common occurrence in people considered at high risk of developing schizophrenia [122], and in family members of those suffering from schizophrenia [123]. With the increased efforts for early interventions in psychosis, we also propose a substantial integration of social cognition training in early intervention programs to prevent further worsening of social cognitive impairment and to remediate impairments already present in people at high risk. Again, this will require refining the definition of clinical phenotypes in order to better identify those who are likely to benefit from social cognitive training and tailor alternative treatment methods for individuals who are less likely to improve upon social cognitive training. Whether or not social cognitive training in schizophrenia and at-risk stages of the disorder can be buttressed by concomitant pharmacological intervention, such as oxytocin administration, will certainly also be a matter of investigation. Finally, in light of the growing literature on childhood adversity in patients with schizophrenia, psychotherapeutic approaches, including ones that specifically promote social cognitive or metacognitive elements that go beyond standardized social cognitive training, will play an important role in schizophrenia therapy [38].

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Key issues

- People with schizophrenia demonstrate deficits in social cognitions, including theory of mind, attributional style and emotion processing that can translate to severe impairments in real-world social functioning.
- Social cognition training can remediate both deficits in social cognition and core psychotic symptoms, as well as improving quality of life.
- More recent social cognition training strategies have used more integrative approaches, but still appear to have some crucial limitations.
- Other confounding factors, such as deficits in motivation, learning and metacognition, may be restricting the transference of learned skills to real-world functioning.
- Neuroimaging research has revealed both global and localized structural and functional abnormalities related to social cognition in patients with schizophrenia.
- Neuroimaging and neurobiological markers may be used as diagnostic tools to predict treatment outcome.
- Assessment criteria, performance baselines and expectations for treatment outcomes should be catered for the specific neurocognitive and social cognitive deficits seen in schizophrenia.
- Future social cognitive therapeutic interventions would benefit from the development of more naturalistic and integrated approaches that do not just rely on training social cognitive domains, but also appreciate other neurocognitive deficits in schizophrenia.

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- of interest
- of considerable interest


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•• Review on the use of neuroimaging as a predictive tool for treatment outcome in schizophrenia.


Potential therapeutic avenues to tackle social cognition problems in schizophrenia

- Important study using oxytocin administration as a potential treatment to improve social cognition in schizophrenia.
- Innovative study looking at the potential for virtual reality environments with patients with schizophrenia.