Social Cognition in Schizophrenia

Subjects: Psychology, Psychoanalysis
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Schizophrenia (SZ) is a major psychiatric disorder. It is characterized by the disruption of various mental processes, including the perception of reality, emotions and cognition. Cognitive impairment, especially social cognition (SC), is gaining attention and is considered by some psychiatrists as the core feature of SZ. Cognition has two branches: neurocognition (NC) and SC. NC includes mental abilities such as working memory, learning and memory, attention, processing speed, reasoning and problem solving. SC refers broadly to the high mental processes involved with perception, storage and the use of social information that helps everyone to make sense of themselves and others. Increasing evidence highlights that SC is also a direct predictor of functional outcomes, particularly of community and social functioning such as to fulfil basic social roles and being involved in social relationships. NC and SC are interlinked. Indeed, SC may act as a mediator between basic neurocognition and daily life functioning.

Keywords: social cognition ; schizophrenia

1. Social Cognition

SC refers to psychological processes involved in the perception of social signals and in the connection of such perception to motivation, emotion and adaptive behaviour. It allows people to recognize, manipulate and behave with respect to socially relevant information. According to Adolphs [1] “Social cognition guides both automatic and volitional behaviour by participating in a variety of processes that modulate behavioural response: memory, decision-making, attention, motivation and emotion are all prominently recruited when socially relevant stimuli elicit behaviour.”

At the National Institute of Mental Health workshop in 2006 [2] it was stated that SC includes five principal domains: Theory of Mind, emotional processing, social knowledge, social perception and attribution bias.

- Theory of Mind (ToM): ToM is the ability to attribute mental states, such as desires, intentions and beliefs, to others and to understand that others have beliefs that are different from one’s own [3]. Skills that help to understand the intentions of others, such as non-verbal communications and sarcasm, are included in ToM [4]. Deficits in ToM may cause misreading of intentions, emotions or cues from others, with consequent difficulties in social communication and limited expression of empathy toward others. Later, the study of ToM has been extended to SZ patients based on evidence that alterations in SC may play a key role in the pattern of their clinical symptoms [5]. In the early 1990s, studies conducted by Frith and colleagues [6][7] and by Corcoran [8] supposed that the deficit of people with SZ in the understanding of oneself and the mental states of others underlying overt behaviour (i.e., ToM or mentalization deficit) resulted in the inability in creating metarepresentations that correctly attribute thoughts to others. According to these authors, this difficulty would represent a core feature in the genesis of psychotic symptoms, therefore ascribing mentalization processes a key role in the psychopathology of SZ [9][10].
- Emotional processing: Emotional processing is the ability to perceive and use emotions. It defines the emotional intelligence of an individual and includes the capacity to identify, understand and manage emotions [11].
- Social knowledge: Social knowledge is the awareness of the rules that define interpersonal relationships in society [12]. It is fundamental for people to reach adequate social competence [13], defined as the capacity to solve interpersonal problems through verbal and non-verbal communication [14].
- Social perception: Social perception is the ability to identify, understand and employ social cues, roles and rules to make inferences about context, relationship and social situations using verbal and non-verbal communication [15]. It allows people to form impressions of others from elements of social interaction [16].
- Attribution bias: According to Kelley [17], human behaviour can be usually attributed to internal factors, such as one’s will and intentions; or to external factors, such as situations. Using causal attribution human beings judge or infer reasons for the behaviour or social situations of others. An attribution bias is an error in attributing a cause to internal or

external factors.

2. Assessment of Social Cognition in SZ

In 2003, the National Institute of Mental Health (NIMH) established the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) initiative to clarify the main concepts and evaluation criteria associated with NC and SC relative to people living with SZ. The goal of the MATRICS consensus conference (MCC) was two-fold: First, to identify cognitive domains worthy of attention in a consensus cognitive battery; second, to establish criteria for selections of the battery tests [18]. SC was included as one of the seven domains represented in the MCC Battery (MCCB) for clinical trials in SZ and the Managing Emotions component of the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT) was selected [2][19].

There are other tests used to assess the specific domain of SC, such as difficulty in recognizing facial emotion. For example, Facial Emotion Discrimination test, Facial Emotion Identification Test (FEIT) [20] and Penn Emotion Recognition Test (ER-40) [21]. The ER-40 is considered a promising tool to evaluate emotion identification and response in SZ [22]. In addition, the Bell Lysaker Emotion Recognition Task (BLERT) evaluates emotion processing through the recognition of seven emotional states [23].

The Awareness of Social Inference Test (TASIT) is a ToM test designed with seven scales: positive emotions, negative emotions, sincere, simple sarcasm, paradoxical sarcasm, sarcasm enriched and lie. The scales are organized into three sections: emotion recognition, social inference minimal and enriched [24].

Mental state attribution can also be investigated through the Reading the Mind in the Eyes Test (Eyes) and the Hinting Task. Eyes focuses on the capacity of understanding the mental states of others from expressions in the eye region of the face [25]. Hinting Task focuses on the ability to infer the true intent of indirect speech [8].

The Social Cognition Screening Questionnaire (SCSQ) is designed to assess multiple domains of SC, especially ToM, metacognition and hostility bias. The SCSQ presents interpersonal vignettes that describe ambiguous interpersonal situations and the subject is requested to answer yes/no questions. Moreover, the SCSQ can assess non-SC as schematic inference and verbal memory [26][27].

The Intentional Bias Task (IBT) evaluates the tendency to attribute intentionality to the actions of others. Patients are asked to define action as occurred “on purpose” or “by accident” [28].

The Mini Profile of Nonverbal Sensitivity (MiniPONS) and The Social Attribution Task-Multiple Choice version (SAT-MC) are used to assess social perception by decoding interpersonal cues [29][30].

Even though these tools are currently used to evaluate SC in SZ, it can be argued that it is still missing a strong validation of measures to assess SC and this represents a significant limitation for clinical trials [31]. The Social Cognition Psychometric Evaluation (SCOPE) study was designed to reduce this limitation [31][32] by systematically evaluating the psychometric properties of promising measures. It was a five-phase project that ultimately focused on the following tasks: BLERT, ER-40, Eyes, TASIT, Hinting Task, MiniPONS, SAT-MC and IBT. According to its results, the BLERT, Hinting Task and ER-40 are recommended for use in trials as they possessed the strongest psychometric properties; Eyes, IBT and TASIT require further study as they possessed weaker psychometric properties; and MiniPOS and SAT-MC have poorer psychometric properties.

3. Social Cognition Deficit in Schizophrenia

SZ patients show meaningful deficits in different dimensions of SC [33]. These deficits are considered core features of SZ and seem to be present throughout the course of the disease from the prodromal phase in high-risk subjects, in the first stages of the illness and during symptom remission. They were also demonstrated in first-degree relatives of SZ patients [34][35][36][37][38]. These findings suggest that SC deficits are unlikely to be an undesirable effect of taking psychoactive medication [39].

Recently, a comprehensive review of SC in first episode psychosis (FEP) examined 48 relevant studies and showed consistent SC deficits in individuals who experienced a FEP, particularly in emotional processing and ToM [40]. Furthermore, SC deficits appear to be stable over time in FEP samples and comparable with SZ clinical groups.

According to Galderisi and colleagues [41] and previous studies [42][43], the impairment of SC in patients with SZ could be a mediator of the relationship between NC and functioning. Furthermore, according to the meta-analysis of Fett and colleagues [34], SC, as compared to NC, could have a stronger connection to functional outcome.

Recently, Rocca and colleagues [44] conducted a study that stratified the functional outcomes of patients with SZ on the basis of their impairment in SC. They used a large patient sample recruited in the context of the Italian Network for Research on Psychoses (NIRP). A total of 809 patients with SZ completed the SC assessments that included MSCEIT, TASIT and FEIT. It also evaluated NC, psychopathology, real life functioning and the milestones reached. With cross-sectional data, they identified three clusters based on SC: unimpaired (42%), impaired (50.4%) and very impaired (7.5%). Their findings showed that real life functioning worsened significantly from the unimpaired to the impaired and very impaired cluster, denoting a strong correlation between SC and functioning.

4. Neuroanatomical Substrates of Social Cognition in Healty Subjects and in Peolple with SZ

About thirty years ago, Brothers was the first to define the existence of a “social brain”. He sustained that the network by which social knowledge operates is different from that of other types of knowledge [45]. Studying primates, he suggested that the “social brain” consists of three regions: the amygdala, the orbitofrontal cortex and the temporal cortex. Thanks to functional neuroimaging, particularly functional magnetic resonance imaging (fMRI), more brain areas were added to the “social brain”: the medial prefrontal cortex (MPFC), the inferior frontal gyrus (IFG), the interparietal sulcus, the inferior parietal lobule (IPL), the anterior insula (AI), the anterior cingulate cortex (ACC), the posterior cingulate cortex/precuneus (PCC/PC) and the amygdala (Amy) [5][46][47][48]. Furthermore, specific areas of the temporal cortex were found to be involved in fMRI SC tasks: the temporoparietal junction (TPJ), the posterior superior temporal sulcus (p-STS) and the fusiform gyrus (FFG). In addition to these areas, the mirror neuron system (MNS) is considered part of the “social brain” [49] and is embedded in the IFG, in the ventral and dorsal premotor areas, in the supplementary motor area, in the STS, in the primary motor cortex, in the primary somatosensory cortex, in the posterior middle temporal gyrus (p-MTG), in the fusiform face area (FFA), in the IPL, in the middle temporal area (MTG) and in the AI [47][50][51][52].

Individually, these areas play a role that cannot be considered as purely social; however, together they shape the complexity of our social interactions. Among a wide range of skills, the “social brain” is responsible for the ability to assign emotional value to faces, to interpret expressions as fear and distrust, to process empathy-related stimuli and to understand the point of view of others in complicated social situations. In particular, some socio-cognitive tasks used in functional magnetic resonance imaging (fMRI) activate mostly cerebral areas involved in neuro-cognitive processes, while other tasks are associated with a higher involvement of brain area activated by affective stimuli and still others exhibit an intermediate pattern of activations [53]. In any case, a strong activation of language-related motor areas containing mirror neurons was found in all kinds of tasks suggesting that motor/mirror processes take place in most experimental paradigms assessing SC [53]. Moreover, when focusing on different fMRI tasks designed to study different domains of SC, some specificity of activated brain areas was found: ToM tasks were associated with the activation of the TPJ, MPFC, PCC/PC and of the anterior temporal lobe (ATL); social perception tasks with OFC, FFG and Amy activation; and social action observation with mental imitation tasks with IPL and IFG activation. The posterior superior temporal sulcus (pSTS) was involved in all different tasks [49]. Focusing on brain networks activation during SC fMRI task, two main types of cross-network interactions were reported: A negative coupling (segregation) between the Default Mode Network and the Control Network (composed by Ventral Attention, Frontoparietal and Dorsal Attention Networks) and a positive coupling (integration) between these two networks [54] according to the type of SC fMRI task proposed.

Focusing on neural correlates of SC in SZ, many studies have been conducted on people with SZ engaged in SC tasks while performing fMRI. This imaging was compared with that of healthy controls (HC) performing the same SC task in order to assess differences attributable to the mental disorder. From these kind of studies, PFC, FFG, right Amy, visual processing areas, ACC, IPL and STS altered activations were found in emotion recognition, processing and attribution tasks [55][56][57][58]; left posterior TPJ and STS were hypoactivated during ToM tasks [57][59][60], while altered activation where found in both types of SC fMRI tasks in the bilateral AI, in the right TPJ and in the left Amy [57]. In general, during SC fMRI tasks, people living with SZ showed hyperactivation of brain areas not directly involved in SC and hypoactivation of brain regions belonging to the social brain. This altered activation could be interpreted as a possible functional neural correlate of SC deficits observed in SZ. To confirm this speculation, further meta-analytic studies are needed to integrate this information about brain activations with a deeper knowledge of the role of functional networks interactions in SZ patients during standardized SC fMRI tasks exploring all the domains of SC.

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