Review

Alejandra Mondragón-Maya[1]
Daniela Ramos-Mastache[1]
Pedro D. Román[2]
Guillermina Yáñez-Téllez[1]

Social Cognition in Schizophrenia, Unaffected Relatives and Ultra-High Risk for Psychosis: What Do We Currently Know?

[1]Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México
[2]West Coast Eye Care

Introduction. Schizophrenia patients show impairments in social cognition (SC), which is a set of cognitive processes that underlie social interactions. The research about SC in schizophrenia has identified four main domains: Theory of mind (ToM), social perception, attributional style and emotional processing. The present review aims to summarize the most recent and consistent findings about SC in patients with schizophrenia, unaffected relatives and ultra-high risk for psychosis individuals (UHR), as well as its association with clinical variables and functional outcome.

Methods. A systematic PsycINFO and Pubmed/Medline databases search was conducted.

Results. ToM impairments have been observed in schizophrenia patients, unaffected relatives and UHR. Emotional processing disturbance has been consistently reported in schizophrenia patients and UHR. ToM and emotional processing have been correlated with symptomatology and functional outcome. However, inconsistencies have been found across studies that assess ToM and emotional processing as predictors of psychosis. Social perception and attributional style are affected in schizophrenia, but the research in at- risk populations is scarce, and their relationship with symptoms or functional outcome is not clear.

Conclusions. All domains of SC are impaired in schizophrenia. Non affected relatives and UHR also display deficits of SC. More research must be conducted to assess the reliability of SC domains as endophenotypes or predictors of conversion to psychosis in at-risk populations.

Keywords: Schizophrenia, Social cognition, Theory of mind, Social perception, Attributional style, Emotional processing

Actas Esp Psiquiatr 2017;45(5):218-26

Cognición Social en Esquizofrenia, Familiares No Afectados e Individuos en Riesgo Ultra-Alto de Psicosis: ¿Qué Sabemos Actualmente?

Introducción. Los pacientes con esquizofrenia presentan alteraciones en cognición social (CS), que es un conjunto de procesos cognitivos que subyace a las interacciones sociales. En la investigación sobre CS en esquizofrenia se identifican cuatro componentes principales: teoría de la mente (TM), percepción social, estilo atributivo y procesamiento emocional. Este trabajo tiene como objetivo resumir los hallazgos más recientes y consistentes sobre la CS en pacientes con esquizofrenia, familiares no afectados e individuos en riesgo ultra-alto de psicosis (RUA), así como su asociación con variables clínicas y funcionalidad del paciente.

Método. Se realizó una búsqueda sistematizada en las bases de datos PsycINFO y Pubmed/Medline.

Resultados. Los déficits en TM se han observado en pacientes con esquizofrenia, familiares no afectados y sujetos en RUA. Se han reportado consistentemente alteraciones de procesamiento emocional en pacientes con esquizofrenia y RUA. La TM y el procesamiento emocional se correlacionan con sintomatología y funcionalidad. Sin embargo, existen inconsistencias en estudios sobre TM y procesamiento emocional como predictores de psicosis. La percepción social y el estilo atributivo están afectados en la esquizofrenia, pero la investigación en poblaciones en riesgo es escasa y su relación con la sintomatología y funcionalidad no es del todo clara.

Conclusiones. Todos los componentes de la CS están alterados en la esquizofrenia. Los familiares no afectados y las personas en RUA también presentan déficits de CS. Se debe realizar más investigación sobre la confiabilidad de los componentes de la CS como endofenotipos o predictores de conversión a psicosis en poblaciones en riesgo.

Palabras clave: Esquizofrenia, Cognición social, Teoría de la mente, Percepción social, Estilo atributivo, Procesamiento emocional

Correspondence:
Alejandra Mondragón-Maya
Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México
Avenida de los Barrios 1, Colonia Los Reyes Iztacala, Tlalnepantla, Estado de México
C.P. 54090, México
E-mail: ale.mondragon@comunidad.unam.mx

INTRODUCTION

Schizophrenia is defined as a chronic psychotic disorder which includes behavioral, affective and cognitive disturbances[1]. It affects approximately 1% of the world population[2]. Schizophrenia symptomatology is classified into positive and negative symptoms. Positive symptoms are defined as those behaviors and cognitions which are not experienced by the general population (i.e., hallucinations, delusions, bizarre behavior). Negative symptoms are those behaviors and cognitions which are present in the general population, but reduced or missing in patients with schizophrenia (i.e. emotional flattening, anhedonia, apathy/indifference). Moreover, it has been consistently reported that schizophrenia patients exhibit cognitive decline, particularly in attention, memory and executive functions (i.e. problem solving, mental flexibility and planning)[3]. It has been reported that the presence and severity of negative symptoms is inversely correlated with neuropsychological performance, while positive symptoms do not show such association[4-6]. Schizophrenia is often related with social dysfunction and poor psychosocial adjustment, which affect different aspects of the patient's life[7].

In recent years, it has been widely reported that schizophrenia patients also exhibit significant deficits in other cognitive processes which involve social interactions. This set of processes known as social cognition (SC), seems to be strongly related with functional outcome and psychosocial adjustment. This review aims to summarize the most consistent findings about the different components of SC in patients with schizophrenia, unaffected relatives and ultra-high risk for psychosis individuals (UHR), as well as the association of SC domains with clinical variables and functional outcome.

Social Cognition

Definition and Components

SC can be defined as a set of mental processes which involve the perception, interpretation and generation of a response to the intentions and behaviors of others. Thus, these mental operations underlie social interactions[8-10].

SC is composed of different domains. The research about SC in schizophrenia and psychotic disorders have identified four main components[11]:

1. Theory of mind (ToM). This term was originally introduced by Premack and Woodruff[12] and it refers to the ability to infer the mental states of others, intentions, dispositions or beliefs. According to Bora et al.[13], the most frequently used tasks to assess ToM are: false belief tasks, the hinting task and the eyes test. False belief tasks focus on the subject´s ability to identify other's erroneous interpretation of reality. These tasks may be measured either with verbal stories or with pictures. The hinting task measures the subject's ability to understand figurative language, through ironies, jokes and messages with several meanings depending on the situation. Finally, the eyes test assesses the subject´s ability to identify other's mental states through the picture of their eyes.

2. Social perception. This refers to the ability to identify social roles and rules, as well as social context. This component allows the recognition of social cues (i.e. facial expressions, voice intonations and bodily gestures) which lead to the correct understanding of a given situation. Social perception tasks consist of the participant's processing of verbal and nonverbal cues so they can make inferences about complex social situations.

3. Attributional style. This reflects the way people explain to themselves the occurrence of certain positive or negative events. This component usually is assessed through questionnaires, in which specific situations are described. A set of probable internal or external causes is displayed and the subject is asked to choose one of them.

4. Emotional processing. Mayer, Caruso and Salovey[14] define emotional processing as the ability to perceive emotions and to process the sensations associated with an emotional state. The definition also includes the ability to manage emotions in oneself and in relation to others. The tasks used to assess this component are emotion perception tasks and emotional regulation tests. The emotion perception tasks aim to measure the subject's ability to recognize different emotions through facial or voice expression paradigms. Emotional regulation tests assess the subject´s ability to manage his/her emotions through questionnaires, stories or hypothetical situations.

The particular interest about SC in schizophrenia relies on consistent reports about its association with functional outcome (i.e. social problem solving, social behavior or community function)[15,16]. Some studies have been conducted to test its mediating effect between neurocognition and functional outcome, confirming its role as a mediator variable despite demographic or clinical heterogeneity (i.e. age, duration of illness or presence of perceptual disabilities)[17,18]. Thus, the importance of SC lies on its direct association with the patients' functional outcome, as well as its mediating role with neurocognition. SC target strategies could posi-

tively impact both areas, promoting a better adjustment and higher chances of recovery in these patients[19].

METHODS

Manuscript Search Strategy

To identify recent and relevant manuscripts addressing the main SC components in schizophrenia patients, unaffected relatives and UHR, an exhaustive search of PsycINFO and Pubmed/Medline databases was conducted. In order to address recent literature,we established a time period for publication year between 2005 and 2016. To conduct the database search we entered the following terms: "social cognition", "theory of mind", "social perception", "attributional style", "attributional bias", "emotional processing" "affect recognition" AND "schizophrenia", "unaffected relatives", "ultra-high risk", "clinical high risk". The identified papers were evaluated and included in the present review if they met the following criteria:

- Experimental studies that followed cuantitative and statistical methodology, including meta-analysis.
- Studies which aimed to compare SC domains between clinical and control groups or studies which evaluated correlations between SC domains and clinical variables/ functional outcome in patients.
- Manuscripts written in English.

RESULTS

A total of 76 manuscripts were included in the present review. We decided to divide this section in three main parts: SC in schizophrenia patients, SC in non-affected relatives and SC in ultra-high risk for psychosis individuals. In the following parts we summarize the most consistent findings and point out those inconsistencies that must be explored and clarified in the future.

SC in Schizophrenia

ToM

As mentioned before, a wide variety of tasks has been used to assess ToM in schizophrenia patients. It has been consistently reported that these patients display significant disturbances in ToM independently of the task used. Thus, studies that assessed ToM through false belief tasks, which reflect the ability to detect others' misinterpretation of reality, have found deficits in this clinical population[20]. Studies that used the hinting task to assess the ability to understand jokes or ironies, reported poor performance by schizophrenia patients[21-25]. Studies that assessed ToM through the eyes test, also found deficits of ToM in these patients[25]. Meta-analyses have confirmed these findings[13,26,27].

Several studies have found associations between ToM deficits and clinical variables. Regarding symptomatology, it has been reported that ToM performance is inversely correlated with negative and positive symptoms[25,28-34], although some studies did not find such associations[21,35]. Disorganized symptoms have been associated with poorer performance in ToM tasks[25,35,36]. The meta-analyses from Bora et al.[13], Savla et al.[26] and Sprong et al.[27] have consistently reported that inpatients – presumably presenting acute symptomatology – display greater ToM deficits than outpatients – probably in remission phase. However, remitted patients still exhibit a significant ToM deficit. Nevertheless, a recent study found that remitted first episode patients did not show ToM disturbance when compared to controls[37]. The consistency across most studies has led some authors to propose that ToM impairment should be considered a trait marker of schizophrenia, because it tends to remain stable across the course of the illness[30,34].

Studies that have analyzed the association between ToM and functional outcome in schizophrenia, have reported strong positive correlations with indicators of social adjustment[28,30,33,38]. A meta-analysis performed by Fett et al.[16], has confirmed such findings. The study found that social cognition measures show stronger associations with functional outcome than neurocognitive variables. Specifically, they reported that ToM is the component that seems more related to community functioning, which includes interpersonal relations and work functioning. Bora et al.[28] and Ventura et al.[34] have proposed that ToM performance may be a predictor of functional outcome in this population.

Social Perception

Research about social perception in schizophrenia patients is less consistent than ToM. Regarding studies addressing social cues through the identification of facial expressions, McIntosh and Park[39] reported that schizophrenia patients showed deficits in identifying negative emotions like fear, anger or sadness. Nevertheless, patients did not differ from healthy controls in making inferences about complex personality features, like attractiveness, trustworthiness or intelligence. Conversely, Bigelow et al.[40] did not find differences in emotion perception abilities between schizophrenia patients and controls. Studies about bodily

gestures have reported consistent impairments in schizophrenia patients regarding the interpretation of gait and ambiguous movements of others[40-42]. Furthermore, Walther et al.[43] reported significant associations between impaired gesture performance, poor nonverbal social perception and gestural knowledge in these patients. The meta-analysis from Savla et al.[26] found medium to large deficits in schizophrenia patients regarding social perception and social knowledge abilities.

Studies that have explored associations between symptomatology and social perception abilites are scarce. McIntosh and Park[39] found that patients with higher levels of positive symptoms were more likely to make positive personality traits judgements about others. No correlations have been found between negative symptoms or social functioning outcome and social perception[22,40,41,43]. The meta-analysis by Savla et al.[26] found that inpatients exhibited a more pronounced impairment than outpatients.

Attributional Style

The assessment of this domain focuses on the subject's choice between two possible explanations (attributions) of certain events: internal or external. Internal attributions refer to the assumption that an event happened as a consequence of oneself's actions (e.g. *"I failed the exam because I did not study enough"*). External attributions refer to the assumption that an event happened as a consequence of others' actions (e.g. *"I failed the exam because the teacher hates me"*). Research in schizophrenia has consistently reported that patients tend to attribute external causes to negative situations. These findings are especially consistent among patients with paranoid delusions[44-49]. Regarding internal attributions, mixed findings have been reported. Some studies have found that schizophrenia patients tend to exacerbate internal attributions to negative events, so they exhibit a self-blaming bias[44,50]. Additionally, Langdon et al.[51] reported that these patients show higher internal attributions for positive events when compared to controls. However, Moritz et al.[52] found a decreased internal attribution bias in these patients for positive and negative events. More research must be conducted to address such inconsistencies.

As mentioned before, several studies have found positive associations between paranoid symptoms and external attributions. Moreover, Mehl et al.[50] reported that patients with persecutory delusions exhibit a pronounced personal bias, in which patients often consider that events happen exclusively to them, eventhough some of these situations may happen to anyone. Most studies have not found significant correlations between attributional style and symptomatology[51,53,54]. However, Mizrahi et al.[55] reported that this domain was associated with positive symptoms. Furthermore, they found that patients with higher rates of symptomatology (negative and positive) tended to exhibit an internal attribution bias. These authors also reported that the external bias observed in schizophrenia patients seems to be sensitive to antipsychotic medication. Only one study explored the association between attributional style and functional outcome, but did not find any correlation between variables[46].

Emotional Processing

This component has been widely studied in schizophrenia and results from different research groups are highly consistent. The most explored emotional processing domain has been emotion recognition. Several studies have reported that schizophrenia patients show significant deficits in the ability to identify emotions in others through their facial expressions[25,56-63] or voice intonation[64-66]. Regarding the ability to manage emotional states, which corresponds to the emotional regulation domain, studies have reported significant impairments in these patients[59,67].

The emotional processing deficits observed in schizophrenia have been associated with a wide variety of clinical variables. It has been consistently reported that an association between this domain and negative symptoms such as affective flattening, avolition, anhedonia and asociality exists[25,31,59,60,62]. Moreover, positive and disorganized symptoms, like bizarre behavior and thought disorder, have been correlated with emotional processing performance[25,59,60], although these findings are less consistent. Correlations with other clinical variables like medication and duration of the illness have been explored. For instance, Kohler et al.[60] reported that unmedicated patients displayed a greater impairment in emotional processing tasks when compared to medicated patients. Additionally, they found that patients under typical antipsychotic treatment showed greater deficits than patients taking atypical medication. Inconsistent findings have been reported regarding duration of the illness. Green et al.[67] explored the emotional processing abilities in three clinical groups: UHR, first- episode psychosis and chronic schizophrenia. Each clinical group had its own control group, matched by demographic variables. Although the clinical groups had a worse performance in comparison to their control groups, no differences were found between them, leading to the conclusion that deficits in emotional processing remain stable through the course of the illness. However, the meta-analysis from Savla et al.[26] and a recent study from Romero-Ferreiro et al.[68] reported that patients with longer duration of the illness had a poorer performance in emotional processing tasks than patients with recent schizophrenia. Such inconsistencies may be due to clinical and methodological differences between studies. Regarding

functional outcome and psychosocial adjustment, a meta-analysis by Irani et al.[69] confirmed a significant relationship between emotional processing abilities and functional outcome variables such as social problem solving, social skills and community functioning.

Social Cognition in Non-Affected Relatives of Schizophrenia Patients

Since the aetiology of schizophrenia includes genetic factors, some studies have explored the role of SC as an endophenotype candidate. Therefore, research has been conducted to assess these abilities in non-affected relatives of schizophrenia patients.

Most studies of SC in non-affected relatives have focused on ToM. Consistent findings have been reported about ToM deficits in relatives of schizophrenia patients when compared to controls[70-75]. Furthermore, two different meta-analyses have reported modest to moderate effects of ToM disturbances in non-affected relatives[76,77].

Social perception and attributional style studies in non-affected relatives of schizophrenia patients are scarce and insconsistent. While Cella et al.[70] and the meta-analysis of Lavoie et al.[77] reported moderate deficits in social perception, Lavoie et al.[74] found that parents of schizophrenia patients showed better performance than controls in a social perception task. Regarding attributional style, Rodríguez et al.[78] reported no deficits in non-affected relatives of schizophrenia patients.

Studies about emotional processing in non-affected relatives of schizophrenia patients have been inconsistent. Some studies have reported worse performance to identify emotions in this population when compared to controls[71,79,80]. The meta-analysis by Lavoie et al.[77] reported a moderate effect of emotional processing deficits in non-affected relatives, especially in emotion identification tasks. However, other studies have failed to find such impairments[70,74,78]. The inconsistencies found in this population may be due to the heterogeneity of the samples. Moreover, it must be noted that the studies included in this review explored emotion identification abilities, rather than other components of emotional processing (i.e. emotion regulation). More research is needed to address these issues.

SC in Ultra-High Risk Individuals

The term "ultra-high risk" (UHR) is used to describe individuals who display symptoms that may correspond to a prodromal phase of schizophrenia or another psychotic disorder[81]. In recent years, research on SC and UHR have consistently reported subtle deficits in different domains.

A meta-analysis by Bora and Pantelis[76] showed modest ToM deficits in UHR when compared to healthy controls. Healey et al.[82] compared ToM scores of UHR who converted to psychosis with UHR who did not convert. They found that converters achieved significantly lower scores than non converters. In addition, statistical analyses showed that baseline ToM performance predicted conversion to psychosis. They also found significant correlations between ToM and negative and disorganized symptoms. Consistent with these findings, Zhang et al.[83] reported a greater ToM impairment in converters than non converters. However, a recent report from the North American Prodrome Longitudinal Study (NAPLS 2), found no differences between converters and non converters in ToM abilities[84]. More longitudinal studies must be conducted to test the reliability of ToM as a cognitive marker of psychosis conversion.

Social perception and attributional style studies are scarce and inconsistent. Recent meta-analyses have reported social perception impairments in UHR, although the effect size of such deficits is small[85,86]. No correlations between social perception and clinical or functional variables in UHR have been reported. Regarding attributional style, An et al.[87] found that UHR individuals tend to perceive higher levels of hostility, leading them to blame others for negative or ambiguous situations. They also found correlations between blame bias and positive symptoms (i.e. suspiciousness and persecution ideas) in UHR. Thompson et al.[88] reported that UHR individuals obtained significant higher scores on external bias when compared to controls. They also found correlations between external bias and negative and paranoid symptoms. However, DeVylder et al.[89] reported no differences between UHR and controls in attributional style and found no associations with symptomatology.

Most studies have reported significant impairment in emotional processing abilities among UHR. Such deficits correspond to emotion recognition tasks through facial gestures or voice intonation[90-93]. The meta-analysis by Lee et al.[86] showed medium effect sizes for this domain. Addington et al.[91] compared affect recognition abilities between UHR converters and non converters. Although deficits were found in both UHR groups, no statistical differences were reported between them. Similar results were reported by the NAPLS 2 study[84]. Conversely, Allot et al.[94] found that the ability to identify facial gestures with no emotional content (i.e. neutral faces) as well as those expressing fear were predictive of psychosis onset. More longitudinal studies must be conducted to address such inconsistencies. No correlations between emotional processing and symptomatology have been reported.

Conclusions and future directions

SC deficits in schizophrenia have been widely reported. The main SC components that have been studied in schizophrenia research are: ToM, social perception, attributional style and emotional processing.

ToM is affected in schizophrenia patients. Most studies have found correlations between ToM and symptomatology (positive and negative symptoms). Moreover, ToM seems to be related with functional outcome. Research on the social perception domain is less consistent than ToM. The most consistent evidence shows that patients exhibit deficits in the interpretation of gait and ambiguous movements. No correlations between social perception and symptomatology or functional outcome have been reported. The evidence about attributional style has pointed that patients with schizophrenia, especially those with paranoid symptomatology, tend to exhibit an external attribution bias. No other associations between attributional style and symptoms or functional outcome have been found. Emotional processing deficits have been consistently reported in schizophrenia patients. This domain has been associated with negative symptoms and functional outcome.

Regarding SC in non-affected relatives of schizophrenia patients, ToM impairment has been consistently reported. Studies of social perception and attributional style are scarce and inconsistent. Emotional processing has been widely studied in this population using emotion identification tasks. Such studies have reported conflicting results. More research must be conducted to assess the reliability of SC domains as endophenotypes.

Evidence about SC in UHR has pointed that ToM is affected in this population. However, conflicting results have been reported regarding ToM impairment in converters and non converters. Studies about social perception are scarce, although some meta-analyses have reported subtle deficits in this population. Regarding attributional style, most studies have found an external bias in UHR, which tends to be correlated with paranoid symptomatology. Finally, the emotional processing domain is impaired in UHR. Most research have studied their ability to identify emotions, which is affected. As in ToM, there are inconsistencies regarding its reliability as a conversion predictor.

Although a wide variety of studies have explored SC in schizophrenia, there still are issues that must be addressed. Social perception and attributional style studies are markedly scarce when compared to ToM or emotional processing. More research on these domains may clarify their relationship with schizophrenia. The research of SC in non-affected relatives and UHR is recent and fairly consistent. Subtle deficits have been identified, especially in ToM and emotional processing. However, there are inconsistencies across studies when both domains have been tested as predictors of psychosis. Since these populations seem to display subtle deficits, such inconsistencies may be due to the variety of tasks used to assess ToM or emotional processing. Most of them differ in complexity or cognitive demand, so it is posible that some tasks may be more sensitive than others. Another issue regarding at-risk populations is their clinical heterogeneity. More research must be conducted to test the reliability of SC domains as cognitive predictors of conversion to psychosis.

ACKNOWLEDGEMENTS

This work was supported by Programa UNAM-DGAPA-PAPIIT under grant IA205516.

CONFLICT OF INTEREST

No conflict of interest is reported by the authors of this manuscript.

REFERENCES

1. American Psychiatric Association. Manual Diagnóstico y Estadístico de los Trastornos Mentales. 5ª ed. Madrid: Panamericana; 2013.
2. Ritsner MS, Gottesman II. The schizophrenia construct after 100 years of challenges. In: Ritsner MS, editor. Handbook of schizophrenia spectrum disorders vol. 1. London: Springer; 2011. p. 1-44.
3. Mesholam-Gately R, Giuliano A, Goff K, Faraone S, Seidman L. Neurocognition in first-episode schizophrenia: A meta-analytic review. Neuropsychology. 2009;23(3):315-36.
4. Milev P, Ho B, Arndt S, Andreasen N. Predictive values of neurocognition and negative symptoms on functional outcome in schizophrenia: A longitudinal first-episode study with 7-year follow-up. Am J Psychiat. 2005;162(3):495-506.
5. Ojeda N, Sánchez, Elizagárate E, Yöller A, Ezcurra J, Ramírez I. Evolución de los síntomas cognitivos en esquizofrenia: Una revisión de la literatura. Actas Esp Psiquiatr. 2007;35(4):363-70.
6. Zanello A, Curtis L, Badan Ba M, Merlo M. Working memory impairments in first-episode psychosis and chronic schizophrenia. Psychiat Res. 2009;165(1-2):10-8.
7. Knapp M, Mangalore R, Simon J. The global costs of schizophrenia. Schizophr Bull. 2004;30(2):279-93.
8. Brothers L. The social brain: A project for integrating primate behavior and neurophysiology in new domain. Concept Neurosci. 1990;1:27-61.
9. Green M, Penn D, Bentall R, Carpenter W, Gaebel W, Gur S, et al. Social cognition in schizophrenia: An NIMH workshop on definitions, assessment, and research opportunities. Schizophr Bull. 2008;34(6):1211-20.
10. Ruiz-Ruiz J, García-Ferrer S, Fuentes-Durá I. La relevancia de la cognición social en la esquizofrenia. Apunt Psicol. 2006;24(1-3):137-55.
11. Couture SM, Penn DL, Roberts DL. The functional significance of social cognition in schizophrenia: a review. Schizophrenia Bull. 2006;32(S1):S44-S63.

12. Premack D, Woodruff G. Does the chimpanzee has a theory of mind? Behav Brain Sci. 1978;1:515-26.
13. Bora, E, Yucel M, Pantelis C. Theory of mind impairment in schizophrenia: Meta-analysis. Schizophr Res. 2009;109:1-9.
14. Mayer J, Caruso D, Salovey P. Emotional intelligence meets traditional standards for an intelligence. Intelligence. 2000; 27(4):267-98.
15. Couture SM, Penn DL, Roberts DL. The functional significance of social cognition in schizophrenia: A review. Schizophr Bull. 2006;32(S1):S44-S63.
16. Fett A, Viechtbauer W, Dominguez M, Penn D, van Os J, Krabbendam L. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: A meta-analysis. Neurosci Biobehav Rev. 2011;35:573-88.
17. Horton HK, Silverstein SM. Social cognition as a mediator of cognition and outcome among deaf and hearing people with schizophrenia. Schizophr Res. 2008,105:125-137.
18. Schmidt SJ, Mueller DR, Roder V. Social cognition as a mediator variable between neurocognition and functional outcome in schizophrenia: Empirical review and new results by structural equation modeling. Schizophr Bull. 2011,37(S2):S41-S54.
19. Mas-Expósito L, Amador-Campos JA, Lalucat-Jo L, Villegas-Miranda F. Social cognition interventions for persons with schizophrenia: evidence and clinical practice guidelines. Actas Esp Psiquiatr. 2016 Jan-Feb;44(1):30-43.
20. Wang Y, Shi J, Roberts D, Jiang X, Shen Z, Wang Y, et al. Theory-of-mind used in remitted schizophrenia patients: The role of inhibition and perspective-switching. Psychiat Res. 2015;229:332-9.
21. Blisked V, Fagerlund B, Weed E, Frith C, Videbech P. Social cognition and neurocognitive deficits in first-episode schizophrenia. Schizophr Res. 2014;153:9-17.
22. Champagne-Lavau M, Charest A. Theory of mind and context processing in schizophrenia: the role of social knowledge. Front Psychiatry. 2015;6:98. Available from: doi:10.3389/fpsyt.2015.00098
23. Fiszdon J, Fanning J, Johannesen J, Bell M. Social cognitive deficits in schizophrenia and their relationship to clinical and functional status. Psychiat Res. 2013;205:25-9.
24. Langdon R, Still M, Connors M, Ward P, Catts S. Theory of mind in early psychosis. Early Interv Psychiatry. 2014;8:286-90.
25. Vohs J, LysaKer P, Francis M, Hamm J, Buck K, Olesek K, et al. Metacognition, social cognition, and symptoms in patients with first episode and prolonged psychoses. Schizophr Res. 2014;153:54-9.
26. Savla G, Vella L, Armstrong C, Penn D, Twamley E. Deficits in domains of social cognition in schizophrenia: A meta-analysis of the empirical evidence. Schizophr Bull. 2013;39(5):979-92.
27. Sprong M, Schothorst P, Vos E, Hox J, van Engeland H. Theory of mind in schizophrenia. Brit J Psychiat. 2007;191:5-13.
28. Bora E, Eryavuz A, Kayahan B, Sungu G, Veznedaroglu B. Social functioning, theory of mind and neurocognition in outpatients with schizophrenia; mental state decoding may be a better predictor of social functioning than mental state reasoning. Psychiat Res. 2006;145:95-103.
29. Koelkebeck K, Pedersen A, Suslow T, Kueppers K, Arolt V, Ohrmann P. Theory of Mind in first-episode schizophrenia patients: correlations with cognition and personality traits. Schizophr Res. 2010;119:115-23.
30. Mazza M, Pollice R, Pacitti F, Pino M, Mariano M, Tripaldi S, et al. New evidence in theory of mind deficits in subjects with chronic schizophrenia and first episode: correlation with symptoms, neurocognition and social function. Riv Psichiatr. 2012;47(4):327-36.
31. Mehta U, Thirthalli J, Kumar C, Kumar J, Keshavan M, Gangadhar B. Schizophrenia patients experience substancial social cognition deficits across multiple domains in remission. Asian J Psychiatr. 2013;6:324-9.
32. Shamay-Tsoory S, Shur S, Barcai-Goodman L, Medlovich S, Harari H, Levkovitz Y. Dissociation of cognitive from affective components of theory of mind in schizophrenia. Psychiat Res. 2007;149:11-23.
33. Sttrata P, Bustini M, Daneluzzo E, Riccardi I, D'Arcangelo M, Rossi A. Deconstructing theory of mind in schizophrenia. Psychiat Res. 2011;190:32-6.
34. Ventura J, Ered A, Gretchen-Doorly D, Subotnik K, Horan W, Hellemann G, et al. Theory of mind in the early course of schizophrenia: stability, symptom neurocognitive correlates, and relationship with functioning. Psychol Med. 2015;2031-43.
35. Abdel-Hamid M, Lehmkämper C, Sonntag C, Juckel G, Daum I, Brüne M. Theory of mind in schizophrenia: the role of clinical symptomatology and neurocognition in understanding other people's thoughts and intentions. Psychiat Res. 2009;165:19-26.
36. Fretland RA, Andersson S, Sundet K, Andreassen OA, Melle I, Vaskinn A. Theory of mind in schizophrenia: Error types and associations with symptoms. Schizophr Res. 2015;162:42-6.
37. Caldiroli A, Buoli M, Serati M, Cahn W, Altamura AC. General and social cognition in remitted first-episode schizophrenia patients: a comparative study. Eur Arch Psychiatry Clin Neurosci. 2016; 1-9. Available from: doi: 10.1007/s00406-016-0701-x
38. Sullivan S, Herzig D, Mohr C, Lewis G, Corcoran R, Drake R, et al. Theory of mind and social functioning in first episode psychosis. Cogn Neuropsychiatry. 2013;18(3):219-42.
39. McIntosh L, Park S. Social trait judgement and affect recognition from static faces and video vignettes in schizophrenia. Schizophr Res. 2014;158:170-5.
40. Bigelow N, Paradiso S, Adolphs R, Moser D, Arndt S, Heberlein A, et al. Perception of socially relevant stilmuli in schizophrenia. Schizophr Res. 2006;83:257-67.
41. Peterman J, Borgan F, Giese M, Park S. Extraction of social information from gait in schizophrenia. Psychol Med. 2014; 44(5):987-96.
42. White T, Borgan F, Ralley O, Shergill S. You looking at me?: Interpreting social cues in schizophrenia. Psychol Med. 2015; 46(1):149-60.
43. Walther S, Stegmayer K, Sulzbacher J, Vanbelligen T, Müri R, Strik W, et al. Nonverbal social communication and gesture control in schizophrenia. Schizophr Bull. 2015;41(2):338-45.
44. Aakre J, Seghers J, St-Hilaire A, Docherty N. Attributional style in delusional patients: A comparison of remitted paranoid, remitted non paranoid, and current paranoid patients with non psychiatric controls. Schizophr Bull. 2009;35(5):994-1002.
45. Jolley S, Garety P, Bebbington P, Dunn G, Freeman D, Kuipers E, et al. Attributional style in psychosis - The role of affect and belief type. Behav Res Ther. 2006;44:1597-607.
46. Lahera G, Herrera S, Reinares M, Benito A, Rullas M, González-Cases J, et al. Hostile attributions in bipolar disorder and schizophrenia contribute to poor social functioning. Acta Psychiat Scand. 2015;131:472-82.
47. Langdon R, Corner T, McLaren J, Ward P, Coltheart M. Externalizing and personalizing biases in persecutory delusions: the relationship with poor insight and theory-of-mind. Behav Res Ther. 2006;44:699-713.
48. Lincoln T, Mehl S, Exner C, Lindenmeyer J, Rief W. Attributional style and persecutory delusions. Evidence for an event independent and state specific external-personal attribution bias for social situations. Cognitive Ther Res. 2010;34:297-302.
49. Pinkham AE, Harvey PD, Penn DL. Paranoid individuals with

schizophrenia show greater cognitive bias and worse social functioning than non-paranoid individuals with schizophrenia. Schizophr Res Cogn. 2016;3:33-8.
50. Mehl S, Landsberg M, Schmidt A, Cabanis M, Bechdolf A, Herrlich J, et al. Why do bad things happen to me? Attributional style, depressed mood, and persecutory delusions in patients with schizophrenia. Schizophr Bull. 2014;40(6):1338-46.
51. Langdon R, Still M, Connors M, Ward P, Catts S. Attributional biases, paranoia, and depression in early psychosis. Brit J Clin Psychol. 2013;52,408-23.
52. Moritz S, Woodward T, Burlon M, Braus D, Andresen B. Attributional style in schizophrenia: evidence for a decreased sense of self-causation in currently paranoid patients. Cognitive Ther Res. 2007;31:371-83.
53. Fraguas D, Mena A, Franco C, Martín-Blas M, Nugent K, Rodríguez-Solano J. Attributional style, symptomatology and awareness of illness in schizophrenia. Psychiat Res. 2008;158:316-23.
54. McKay R, Langdon R, Coltheart M. Paranoia, persecutory delusions and attributional biases. Psychiat Res. 2005;136:233-45.
55. Mizrahi R, Addington J, Remington G, Kapur S. Attribution style as a factor in psychosis and symptom resolution. Schizophr Res. 2008;104:220-7.
56. Brüne M. Emotion recognition, "theory of mind", and social behavior in schizophrenia. Psychiat Res. 2005;133:135-47.
57. Comparelli A, Corigliano V, De Carolis A, Mancinelli I, Trovini G, Ottavi G, et al. Emotion recognition impairment is present early and is stable through the course of schizophrenia. Schizophr Res. 2013;143:65-9.
58. Gur R, Kohler C, Ragland J, Siegel S, Lesko K, Bilker W, et al. Flat affect in schizophrenia: Relation to emotion processing and neurocognitive measures. Schizophr Bull. 2006;32(2):279-87.
59. Kee K, Horan W, Salovey P, Kern R, Sergi M, Fiske A, et al. Emotional intelligence in schizophrenia. Schizophr Res. 2009; 107:61-8.
60. Kohler C, Walker J, Martin E, Healey K, Moberg P. Facial emotion perception in schizophrenia: a meta-analytic review. Schizophr Bull. 2009;36(5):1-11.
61. Schneider F, Gur R, Koch K, Backes V, Amunts K, Shah N, et al. Impairment in the specificity of emotion processing in schizophrenia. Am J Psychiat. 2006;163:442-7.
62. Turetsky B, Kohler C, Indersmitten T, Bhati M, Charbonnier D, Gur R. Facial emotion recognition in schizophrenia: When and why does it go awry? Schizophr Res. 2007;94:253-63.
63. van't Wout M, Aleman A, Kessels R, Cahn W, de Hann E, Kahn R. Exploring the nature of facial affect processing deficits in schizophrenia. Psychiat Res. 2007;150:227-35.
64. Bell M, Tsang H, Creig T, Bryson G. Neurocognition, social cognition, perceived social discomfort and vocational outcomes in schizophrenia. Schizophr Res. 2009;35(4):738-47.
65. Kucharska-Pietura K, David A, Masiak M, Phillips M. Perception of facial and vocal affect by people with schizophrenia in early and late stages of illness. Brit J Psychiat. 2005;187:523-8.
66. Meyer M, Kurtz M. Elementary neurocognitive function, facial affect recognition and social-skills in schizophrenia. Schizophr Res. 2009;110(1-3):173-9.
67. Green M, Bearden C, Cannon T, Fiske A, Hellemann G, Horan W, et al. Social cognition in schizophrenia, part 1: Performance across phase of illness. Schizophr Bull. 2011;38(4):854-64.
68. Romero-Ferreiro MV, Aguado L, Rodríguez-Torresano J, Palomo T, Rodríguez-Jiménez R, Pedreira-Massa JL. Facial affect recognition in early and late-stage schizophrenia patients. Schizophr Res. 2016;172:177-83.
69. Irani F, Seligman S, Kamath V, Kohler C, Gur R. A meta-analysis of emotion perception and functional outcomes in schizophrenia. Schizophr Res. 2012;137:203-11.
70. Cella M, Hamid S, Butt K, Wykes T. Cognition and social cognition in non-psychotic siblings of patients. Cogn Neuropsychiatry. 2015;20(3):232-42.
71. de Achával D, Costanzo E, Villareal M, Jáuregui I, Chiodi A, Castro M, et al. Emotion processing and theory of mind in schizophrenia patients and their unaffected first-degree relatives. Neuropsychologia. 2010;48:1209-15.
72. Ho K, Lui S, Hung K, Wang Y, Li Z, Cheung E, et al. Theory of mind impairments in patients with first-episode schizophrenia and their unaffected siblings. Schizophr Res. 2015;166:1-8.
73. Irani F, Platek S, Panyavin I, Calkins M, Kohler C, Siegel S, et al. Self-face recognition and theory of mind in patients with schizophrenia and first-degree relatives. Schizophr Res. 2006; 88:151-60.
74. Lavoie M, Plana I, Jackson P, Godmaire-Duhaime F, Lacroix J, Achim A. Performance in multiple domains of social cognition in parents of patients with schizophrenia. Psychiat Res. 2014; 220:118-24.
75. Montag C, Neuhaus K, Lehmann A, Krüger K, Dziobek I, Heekeren H, et al. Subtle deficits of cognitive theory of mind in unaffected first-degree relatives of schizophrenia patients. Eur Arch Psy Clin N. 2012;262:217-26.
76. Bora E, Pantelis C. Theory of mind impairments in first-episode psychosis, individuals at ultra-high risk for psychosis and in first-degree relatives of schizophrenia: systematic review and meta-analysis. Schizophr Res. 2013;144:31-6.
77. Lavoie M, Plana I, Lacroix J, Godmaire-Duhaime F, Jackson P, Achim A. Social cognition in first-degree relatives of people with schizophrenia: A meta-analysis. Psychiat Res. 2013;209:129-35.
78. Rodríguez J, Gil H, Trujillo A, Winter M, León P, Guerra L, et al. Social cognition in patients with schizophrenia, their unaffected first-degree relatives and healthy controls. Comparison between groups and analysis of associated clinical and sociodemographic variables. Rev Psiquiat Salud Ment. 2013;6(4):160-7.
79. Allot K, Rice S, Bartholomeusz C, Klier C, Schlögelhofer M, Schäfer M, et al. Emotion recognition in unaffected first-degree relatives of individuals with first-episode schizophrenia. Schizophr Res. 2015;161:322-8.
80. Albacete A, Bosque C, Custal N, Crespo JM, Gilabert E, Albiach A. Emotional intelligence in non-psychotic first-degree relatives of people with schizophrenia. Schizophr Res. 2016 Aug;175(1-3):103-8.
81. Fusar-Poli P, Borgwardt S, Bechdolf A, Addington J, Riecher-Rössler A, Schultze-Lutter F, et al. The psychosis high-risk state: a comprehensive state-of-the-art review. JAMA Psychiatry. 2013;70(1):107-20.
82. Healey K, Penn D, Perkins D, Woods S, Addington J. Theory of mind and social judgements in people at clinical high risk of psychosis. Schizophr Res. 2013;150:498-504.
83. Zhang TH, Yi ZH, Li HJ, Cui HR, Tang YY, Lu X, et al. Faux pas recognition performance in help-seeking population at clinical high risk for psychosis. Eur Arch Psychiatry Clin Neurosci. 2016;266:71-8.
84. Piskulic D, Liu L, Cadenhead KS, Cannon TD, Cornblatt B, McGlashan TH, et al. Social cognition over time in individuals at clinical high risk for psychosis: findings from the NAPLS-2 cohort. Schizophr Res. 2016;171:176-81.
85. van Donkersgoed R, Wunderink L, Nieboer R, Aleman A, Pijnenborg M. Social cognition in individuals at ultra-high risk for psychosis: a meta-analysis. PLoS One. 2015;10(10):1-16.
86. Lee T, Hong S, Shin N, Kwon J. Social cognitive functioning in prodromal psychosis: a meta-analysis. Schizophr Res. 2015;

164:28-34.
87. An S, Kang J, Park J, Kim K, Lee S, Lee E. Attribution bias in ultra-high risk for psychosis and first-episode schizophrenia. Schizophr Res. 2010;118:54-61.
88. Thompson A, Papas A, Bartholomeusz C, Nelson B, Yung A. Externalized attributional bias in the Ultra High Risk (UHR) for psychosis population. Psychiat Res. 2013;206(2-3):200-5.
89. DeVylder J, Ben-David S, Kimhy D, Corcoran C. Attributional style among youth at clinical risk for psychosis. Early Interv Psychiatry. 2013;7:84-8.
90. Addington J, Penn D, Woods S, Addington D, Perkins D. Facial affect recognition in individuals at clinical high risk for psychosis. Brit J Psychiat. 2008;192:67-8.
91. Addington J, Piskulic D, Perkins D, Woods SW, Liu L, Penn DL Affect recognition in people at clinical high risk of psychosis. Schizophr Res. 2012;140:87-92.
92. Amminger G, Schäfer M, Klier C, Schlögelhofer M, Mossaheb N, Thompson A, et al. Facial and vocal affect perception in people at ultra-high risk of psychosis, first-episode schizophrenia and healthy controls. Early Interv Psychiatry. 2012:6:450-4.
93. Kohler C, Richard J, Brensinger C, Borgmann-Winter K, Conroy C, Moberg P, et al. Facial emotion perception differs in young persons at genetic and clinical high-risk for psychosis. Psychiat Res. 2014;216:206-12.
94. Allot KA, Schäfer MR, Thompson A, Nelson A, Bendall S, Bartholomeusz CF, et al. Emotion recognition as a predictor of transition to a psychotic disorder in ultra-high risk participants. Schizophr Res. 2014;153:25-31.