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Cognitive impairments in schizophrenia

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Document Version
Publisher's PDF, also known as Version of record

Publication date:
2008

Citation for published version (APA):
Pijnenborg, G. H. M. (2008). *Cognitive impairments in schizophrenia: social cognition and cognitive rehabilitation from a clinical perspective.* s.n.

PART II: Social Cognition in Schizophrenia

CHAPTER 3

Social Cognition in Schizophrenia: an introduction

3.1 SOCIAL COGNITION: DEFINITION AND TERMINOLOGY

Social cognition is, like executive functioning, an umbrella term that encompasses several cognitive processes. A very broad definition of social cognition is provided by Fiske and Taylor (1991, p.1): "social cognition is the way in which people make sense of other people and themselves". Others define social cognition in terms of underlying mental operations, for example as "mental operations underlying social interactions, which include the human ability and capacity to perceive the intentions and dispositions of others" (Brothers, 1990, p. 28). Finally, some definitions link social cognition directly to behaviour, including that of Adolphs (2002, p.12), who defined social cognition as: "the ability to construct representations of the relationship between oneself and others and to use those representations flexibly to guide social behaviour".

Social cognition can be differentiated from non-social cognition (Penn et al. 1997). Frith and Happé (1994), for example, describe individuals with autism whose performance in social situations is very poor, in contrast to a very good academic performance. Several mental processes are involved in social cognition. These processes can be divided into lower order processes (basic emotion perception) and more complex or higher order processes relating to the interpretation of the perceived information (Green, 2005). According to Green (2005) higher order cognition in schizophrenia can be divided into social perception, social knowledge, "Theory of Mind" and attributional style.

Social perception is similar to emotion perception, but involves the ability to assess more complex social rules and roles. Social knowledge (or social schemata)

refers to the adoption[1] of roles, rules, and goals that characterise social situations and guide social interactions, for example the script of a customer who is talking to a waiter in a restaurant (Green et al., 2005). In addition, patients with schizophrenia are impaired in the ability to make complex social judgements from facial expression. This impairment can not be accounted for by a general impairment in facial processing (Hall et al., 2004). Theory of Mind (ToM) refers to the ability to interpret mental states of others (desires and beliefs).

Being able to attribute mental states to others and understanding them as causes of behaviour means, in part, that one must be able to conceive of the mind as a "generator of representations" (Courtin, 2000; Courtin & Melot, 2005) and to understand that others' mental representations of the world do not necessarily reflect reality and can be different from one's own. ToM was first described in 1978 by Premack and Woodruff in a paper on mentalizing abilities of chimpanzees. Premack and Woodruff defined ToM as the ability to ascribe mental states to oneself and to others. The ability to ascribe these mental states was called a 'theory' because mental states are not observable. ToM develops gradually in several distinct stages. At age 3-4 children understand that another person may hold a belief that is mistaken (first order ToM). Between age 6 and 7 children begin to understand that others have "beliefs about beliefs" (second order ToM). Thus, first order false beliefs refer to the ability to understand that someone holds a false belief about the world, whereas second order false beliefs are defined as the ability to understand that someone holds a false belief about another person's belief (Wimmer & Perner, 1983). Cognitive ToM, or knowledge about other peoples believes, has been distinguished from affective ToM, or empathic apprecation of a listerer's state (Shamay-Tsoory et al., 2005).

Attributional style is how one explains causes for positive and negative outcomes and how the attribution of causaility leads to the interpretation of an event.
Yager and Ehman (2006) distinguish social cognition from social skills.
Social skills are defined on the ICF level of acivities and are applied in social functioning. Social skills are defined as the cognitive, verbal and non-verbal behaviours necessary to engage in positive social interactions (Smith et al., 1996). Examples of social skills are making eye contact or taking turns in a conversation.

Social functioning refers to overall social performance in multiple domains of daily life, such as independent living and employment. According to Yager and Ehman (2006) "social functioning" is a broad term also comprising social cognition and social skills. According to them, social functioning is the most global term,

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[1] **note:** In his original text Green uses the term awareness; this terminology may be confusing because it suggests that schema application is a conscious process. Therefore "awareness of roles…" has been replaced with "adoption of roles…".

while the other two terms are increasingly molecular in nature. In terms of the ICF classification, impaired social cognition is an impairment, while impaired social skills are activity limitations and impaired social functioning might be described as a participation restriction.

3.2 Neurobiology of Social Cognition

Recent brain imaging studies have described brain systems that are involved in social cognition. Brothers (1990) proposed a neural system of emotion that was composed of the orbitofrontal cortex, the superior temporal sulcus and the amygdala. His ideas have been confirmed by many other studies. In a review of fMRI studies of social cognition, Grady and Keightley (2002) describe the brain functions that are involved in social cognition. Their definition of social cognition encompasses executive processes as well, leading to the involvement of more brain regions than in Brothers' model. The regions they describe mediate face perception, emotion processing (perception of emotional information and mood regulation), Theory of Mind, self reference and working memory, and are indispensable for adequate behaviour in social situations. A number of brain regions are consistently associated with these processes: the fusiform gyrus (perception of facial affect), the amygdala (critical for emotion processing), the anterior cingulate gyrus (autonomic processes, reward, monitoring and selecting among competing responses), the superior temporal sulcus (gaze direction of another person's eyes), the ventrolateral prefrontal cortex (reward), the orbitofrontal cortex (decision making in the context of emotional situations), the dorsolateral prefrontal cortex (executive functioning and working memory) , and the dorsomedial prefrontal cortex (self-reference/ internal versus external focus). Several neuroimaging studies have shown that the frontal lobes play a crucial role in social cognitive processes, especially in mentalising or ToM abilities. A dissociation of performance within the frontal lobes appears to exist. Medial right ventral frontal lesions impair the detection of deception, while the entire frontal cortex, and in particular the right frontal lobe, is thought to be involved in visual perspective taking (Stuss et al. 2001). Attributing mental states to cartoons is associated with activation of the left medial frontal lobe (Fletcher et al., 1995), temporal lobe, and cerebellum (Brunet et al., 2000, Völlm et al., 2006), whereas mental state word recognition is associated with increased activity in the right orbitofrontal cortex, but decreased activity in the left frontal-polar region (Baron-Cohen et al., 1994). There is evidence that affective ToM is mediated by circumscribed areas in the ventromedial prefrontal cortex, while cognitive ToM is associated with widespreas activation the dorsolateral and ventromedial prefrontal cortex (Shamay-Tsoory et al., 2007).

In schizophrenia the brain areas involved in social cognition are essentially the same as in healthy controls (see for a review: Pinkham et al., 2003). Functional abnormalities in brain areas involved in social cognition have been demonstrated in schizophrenia. Imaging studies have demonstrated that people with schizophrenia show less activation than healthy controls in the VLPFC during the perception of angry faces and ToM tasks (Philips et al., 1999; Russell et al., 2000) and less activation in the amygdala during the perception of fearful and sad faces (Philips et al., 1999; Schneider et al., 1998). Moreover, amygdala activation during the judgement of emotional intensity in faces is increased in schizophrenia, as compared to healthy controls (Kosaka et al., 2002). Furthermore, structural brain changes are also observed: a meta-analyses reveals that on average amygdala volume in schizophrenia is only 94% of that of healthy controls (Wright et al., 2000). The medial prefrontal cortex and the fusiform gyrus also show abnormal volumes in schizophrenia (Pinkham et al, 2003).

3.3 Tests of Social Cognition

Together with the increased interest in social cognition, several neuropsychological tests of this construct have been developed in recent years. Moreover, a number of tests that have been used in the assessment of people with autism have been applied in schizophrenia research. Some of the most widely-used tests are discussed in the following section.

Two subtests of the Mayer-Salovey Caruse Emotional IntelligenceTest* (MSCEIT: Mayer et al., 2003) are recommended by the MATRICS committee: perceiving emotions and managing emotions. The MSCEIT is a 141-item test battery, composed of four aspects of social cognition: perceiving emotions, using emotions to facilitate thought (defined by the authors as the ability to employ ones feelings to enhance the cognitive system), understanding emotions, and managing emotions. Perceiving emotions is measured with pictures of faces with an emotional expression; facilitating thought is measured by generating emotions and matching sensations to them and judging the moods that best accompany a given cognitive task. Understanding emotions is measured by identifying emotions that could be combined emotions (for example that rage is combined from annoyance and irritation) and managing emotions consist of the judgement of the actions that are most effective for one person to use in the management of another person's feelings.

Most tests of social cognition can be placed into one of two categories: tests that measure lower order (or perceptual) functions and tests that measure higher order (or information processing) functions (Green et al., 2005). Most measures

of perceptual processes are focused on the recognition of facial affect, very often using the black and white photographs of emotional faces developed by Ekman and Friesen (1976); subjects have to judge the emotional expression of the face in the picture. Examples of this kind of test of facial affect perception are the Face Emotion Identification Test (Kerr & Neale, 1993), the Facial Expression of Emotion: Stimuli and Tests (FEEST; Young et al., 2002), and the Face Emotion Discrimination Test (Kerr & Neale, 1993). Others have tried to develop more ecologically valid tests of social perception, for example by using videotaped affect instead of photographs. Examples of the latter are the Videotaped Affect Perception Test (Bellack et al., 1996) and the TASIT (McDonald et al., 2003). Other tests of lower order social cognition are aimed at the perception of emotional prosody, although standardised measures in this field are few. In tests of emotional prosody, stimuli usually consist of sentences neutral in verbal content, that convey information about a speaker's emotional state by pitch, amplitude, and duration contours of speech.

Higher order social cognition encompasses Theory of Mind (ToM), social knowledge, attributions, social problem solving, and social perception. Different stages of ToM can be measured with neuropsychological tests of increasing difficulty: first order false beliefs tasks require the participant to infer another individual's mental state related to an external event. In second order ToM tasks the participant infers an individual's thought about another individual's thought about an event. Even more sophisticated cognitive capacities relating to ToM are required for complex higher order false beliefs tasks, the understanding of hints and the detection of a faux pas (Brüne, 2005a). Historically, ToM test were developed for use with children with autism.Very often, ToM tasks used in studies with adults are modified versions of these tests. Recently, tests have been developed specifically for adults. Examples of these tests are the Faux Pas Test, (Baron-Cohen et al., 1999), the Strange Story Test (Happé, 1994), the Hinting Task (Corcoran, 2001), the Joke Appreciation Task (Corcoran et al., 1997), Cartoon Picture stories (Brüne, 2003), the Reading the Mind in the Eyes (Baron-Cohen et al., 2001). The Faux Pas Test requires subjects to detect a faux pas in stories on social interactions. A faux pas is defined as when a speaker says something without considering if, or knowing that, what he says is something that the listener might not want to hear. The Strange Story Test is test of complex ToM abilities, in which subjects are required to provide context-appropriate mental state explanations for the story character's non-literal utterances. The Hinting Task, is comprised of stories and requires participants to infer what one character intends when he/ she provides verbal hints to another character. In the Cartoon Picture stories participants are asked to order cards in a logical sequence of events. This task encompasses three kinds of scenarios: a scenario in which characters are co-

operating, a scenario where one character deceives another character, and a scenario where two characters are co-operating to deceive a third. Finally, in the Reading the Mind in the Eyes Test, subjects have to infer complex mental states from 36 pictures of eyes. Response categories are presented in a multiple choice format.

Tests that explore social schemata are for example the Situational Feature Recognition Test (Corrigan, et al., 1996) and the Schema Component Sequencing Task- Revised (Corrigan & Addis, 1995). The Situational Feature Recognition Test assesses recognition of key components in social situations. The test includes abstract situational features, like goals, and more concrete features, like actions. Ten situations are presented to the subjects, while subjects are given a list of actions and goals and are required to mark every feature they think would fit the situation. The Schema Component Sequencing Task consists of short and long sequencing actions that describe social situations. The test consist of twelve situations, six short sequences with six component actions and six longer sequences with nine component actions. Subjects are asked to order a list of component actions. Some tests encompass intentions, aspects of personality and interpersonal style, like the Social Cue Recognition test (Corrigan, 1994) and the Interpersonal Perception Task (Archer & Costanzo, 1988). The Social Cue Recognition Test encompasses eight videotaped vignettes of approximately two minutes, and a set of 36 "true or false" items for each vignette. The Interpersonal Perception Task contains 15 brief, real-life scenes on videotape. Subjects are required to answer questions about relationships and deception in the vignettes.

Finally, attributions are often measured by questionnaires (Green 2005), such as the Internal, Personal, and Situational Attributions Questionnaire (IPSAQ, Kinderman & Bentall, 1996).

3.4 Impaired Social Cognition in Schizophrenia

Edwards, Jackson, and Pattison (2002) reviewed the literature on emotion perception in schizophrenia. The visual modality, especially the perception (encoding and identification) of facial affect, has received most attention. In many studies it was found that people with schizophrenia are impaired in the perception of emotional expression. Impaired perception of facial affect is a consistent finding, although varying degrees of impairment have been reported, probably due to methodological differences. People with schizophrenia appear to be in particular impaired in the perception of negative emotional stimuli, especially fear (e.g. Mandal et al., 1998; Edwards et al., 2001). Also, the processing of threat-related facial affect is delayed in delusion-prone individuals (Green et al., 2001). There is some evidence of a negative

bias in the perception of facial affect: patients tend to misidentify neutral faces as negatively valenced (Kohler et al. 2003), although this finding was not confirmed in a study by Kee et al. (2006). People with schizophrenia tend to perceive boundaries between emotional categories less sharply than healthy controls; they are less sharp in their categorisations of ambiguous emotions (Kee et al., 2006). Perception of facial affect has been reported to be associated with measures of intelligence (Borod, et al., 1993), level of education (Van der Gaag & Haenen, 1990) and attention (Addington & Addington, 1998; Bellack et al., 1992). Impaired facial affect perception is relatively stable over time and shows minimal response to antipsychotic medication (Herbener et al., 2005), although some evidence suggests that remitted patients perform better on emotion recognition than patients in the acute phase of the disease (Cutting, 1981). Besides impaired perception of facial affect, people with schizophrenia have difficulties in judging the direction of eye gaze (Philips and David, 1997).

Auditory decoding of affect (or emotional prosody) has received considerably less attention. Emotional prosody conveys information about a speaker's emotional state from pitch, amplitude, and duration contours of speech (Luks, et al., 1998). People with schizophrenia are especially impaired in the perception of fearful and sad prosody (Edwards et al. 2002). Although most studies (eg. Murphy and Cutting, 1990) demonstrate a specific deficit in the perception of affective prosody, others found a generalized deficit in analyzing vocal cues (Kerr and Nealy, 1993). No relationship was found between positive and negative symptoms and the ability to encode emotional prosody (Fricchione, et al., 1986, Edwards et al., 2001, Shaw et al., 1999, Bozikas, et al., 2004). It has been argued that impairments in other cognitive abilities underlie impaired affect perception, but results with regard to general cognitive functioning and prosody recognition are not consistent. Bozikas et al. (2004) found prosody recognition to be associated with attention and executive functioning; others (Whittaker, et al. 1994), however, did not find such associations. In conclusion: there is evidence of a deficit in the decoding of emotional prosody, but the exact nature of the relationship with general cognitive abilities remains unclear. Furthermore, the difference between emotional categories in prosody perception has not been adequately studied.

Finally, a recent study showed that deficits in basic affect categorisation of socially relevant stimuli extends beyond the perception of facial and prosodic features and also includes emotion recognition of human postures and perhaps body motion (Bigelow et al, 2006).

The Theory of Mind (ToM) Model also has been associated with schizophrenia. ToM deficits are reported often in patients. The work of Frith (1992) is helpful with respect to understanding the role of ToM in schizophrenia. He hypothesises that

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schizophrenia may be understood as a disorder of the representations of mental states and proposes a model in which specific symptoms of schizophrenia reflect different meta-representational dysfunctions. That is, in his view, meta-representations that allow humans to represent their own and other's mental states are the cause the behavioural symptoms of schizophrenia. For example, passivity phenomena like delusions of control, thought insertion, thought withdrawal or auditory hallucinations are thought to result from the patients failure to monitor his intentions or acts and false interferences about the intentions of others may lead to paranoid delusions (Frith & Done, 1989).

Mazza et. al. (2001) linked ToM deficits to symptom dimensions. They found that people with schizophrenia with psychomotor poverty performed more poorly than patients with reality distortion and disorganisation on a first order false beliefs task. The psychomotor poverty group were also worse on a second order false belief task, but the other two groups showed impaired performance as compared to the shorter and less complex first order false belief task. Formal thought disorder was associated with performance on a false belief picture sequencing task in a study by Langdon et al. (2002).

Deteriorated performance in schizophrenia is also described on tasks requiring the understanding of hints (Corcoran et al., 1995), conversational maxims (=guidelines for successful communications, for example "be relevant" (Corcoran & Frith, 1996), first and second order false beliefs and deception (Frith & Corcoran, 1996) and jokes (Corcoran et al., 1997; Frith & Corcoran, 1996). These impairments were found to be linked to behavioural and paranoid symptoms of schizophrenia (Frith, 1992). Drury et al. (1998) showed that Theory of Mind problems disappeared in a remitted state. Within the domain of psychotic disorders, ToM impairment is specific to schizophrenia (Doody et al., 1998). These studies all point in the direction of a state dependent deficit, although relatives of people with schizophrenia show impaired performance on ToM tasks as well (Janssen et al., 2003; Marjoram, 2006) suggesting a more trait-based hypothesis. In sum, although some studies that tested Frith's model showed negative results, ToM impairments have been found to be associated with schizophrenia in most studies.

In relation to <u>attributional style</u>, or how one explains the causes for positive and negative outcomes and how the meaning of events is based on ones attribution of their cause (Green et al., 2005), it is thought that mentalizing errors may contribute to the development and maintenance of persecutory delusions. Martin and Penn (2002) showed evidence of a self-serving bias for subjects with persecutory delusions. Subjects with persecutory delusions tended to show a stronger bias toward blaming others rather than situations for negative outcomes, and there was a linear association

between persecutory ideation and a self-serving attributional style.

Impaired social perception (Toomey et al., 2002; Sergi & Green, 2003) and social knowledge (Corrigan & Green, 1993; Corrigan, Wallace & Green, 1992) have also been documented in schizophrenia.

3.5 Relationship between cognitive impairments and activity limitations/ participation restrictions in schizophrenia

Cognitive impairments are considered to be rate-limiting factors in schizophrenia (Mueser, 2000); that is, they prevent the patient from achieving optimal adaptation. The cognitive impairments that accompany the disease may decrease an individual's potential to cope with the consequences of schizophrenia. Cognitive impairments severely hamper daily functioning and are thus associated with activity limitations and participation restrictions (e.g. Green, et al., 2000).

With regard to activity limitations and participation restrictions, individuals with schizophrenia experience difficulties in multiple areas of social functioning. Moreover, work and personal achievement, finances, and self-care are affected in many individuals (Corrigan and Penn, 2001). In the past decade, many efforts have been made to predict poor social functioning by measures of cognitive functioning, like attention, verbal memory, and executive functioning. Green (1996) reviewed and analysed 37 publications on cognition and social functioning. According to this meta-analysis, daily community functioning is predicted by measures of cognition, with verbal memory, card sorting and verbal fluency as the best predictors. This publication was followed by a series of studies examining the relationship between social functioning and cognition. Unfortunately, results of these replications were inconsistent; variance in outcome accounted for was only modest. Therefore, several authors have concluded that the relationship between cognition and social functioning is weak, due to large error-variances, and unreliable and invalid methods (Van Beilen, 2004; Holthausen, 2003. In conclusion, the clinical relevance of cognitive testing in order to predict social functioning is still questionable (Van Beilen, 2002).

Since the amount of variance in social outcome that is explained by general cognitive functioning is relatively small, it has been suggested that other variables might mediate this connection (e.g. Green & Nuechterlein, 1999). To enhance the ecological validity of neuropsychological assessment, it is suggested that measures of social cognition be added to standard neuropsychological assessment. The use of these tests is currently not common in clinical settings, but may improve the prediction of social outcome. Although social cognition has been consistently associated with both general cognition (Lancaster et al, 2003) and functional status/

role functioning in schizophrenia, its role as a potential mediator between to two has been studied less often.

Emotion perception was most often operationally defined as the perception of facial affect. Other studies in this area used measures of prosody perception, or combined measures of affect perception. Community functioning (work, social functioning, and social behaviour (Brekke, 2005), occupational functioning, communication social functioning (Hooker & Park, 2002), non-verbal social skills, social mixing, and personal appearance (Mueser et al., 1996) were all associated with perception of facial affect. Results with regard to independent living are mixed. Brekke (2005) did not find a relationship between facial affect perception and independent living, while Kee et al. (2003) found a moderately strong correlation between measures of these constructs. Facial affect perception was associated with family or other relationships, and community/ recreational functioning (Brekke, 2005), social skills in a role play test (Cohen et al., 2006), inappropriate behaviour and personal appearance (Mueser et al., 1996), independent living, family or other relationships, and community/ recreational functioning (Hooker & Park, 2002). The perception of affect (using videotaped stimuli) was not related to daily functioning, while perception of auditory affect predicted occupational success (Brekke, 2005; Hooker & Park, 2002). Quality of life, interpersonal relations, and community participation were predicted by a composite measure of facial and vocal affect recognition, while this measure did not predict vocation in a study by Poole et al. (2000). Kee et al. (2003) did not find an association between social functioning, family relationships and a composite measure of facial and vocal affect recognition.

Studies of social perception or the ability to use social cues to understand interpersonal situations and interactions, linked early visual processing ability to social and vocational functioning (Sergi et al., 2006) and social problem solving (Toomey et al, 1997). Furthermore, subtests of the WAIS-R (respectively Picture Arrangement and Comprehension) were associated with social behaviour in milieu in a hospital setting (Appelo et al., 1992), and with community status (Revheim & Medalia, 2004), but not with social skills (Appelo et al., 1992). Social problem solving performance was predicted by the Social Cue Recognition test (Addington et al., 2006; Corrigan and Toomey, 1995). Performance on the Social Cue Recognition Test and the Schema Component Sequencing Task-Revised predicted quality of life (Addington et al., 2006), while the Schema Component Sequencing Task-revised also predicted social competence in milieu and social interest (Penn et al., 2002). Also, patients who were aware of the impact of their behaviour on other people had better social skills than patients with low self-monitoring skills (Penn et al. , 1999). Vauth et al. (2004) found that social cue recognition and sequencing mediated the association

between general cognitive variables and occupational outcome. The impact of social cognition on vocational functioning was greater than the direct impact of other cognitive functions, and the combined impact of social cognition and other cognitive functions was greater than the impact of both social cognition and general cognition alone. Finally, performance on a biological motion task (a task requiring recognition of familiar actions, while the actor is invisible apart from a couple of lights attached his head and major limb joints) predicted community functioning, as measured with the Zigler Social Competence Scale (Kim et al., 2005). Associations between social perception and outcome were moderate, with Pearson's correlation coefficients ranging from .3 to .5. In summary, social perception is consistently associated with most functional outcome measures, but effect sizes vary over a large range. Social perception is probably more relevant for some social behaviours than for others (Couture et al., 2006).

Five recent studies examined the relationship between <u>functional outcome,ToM and attributional style</u>. Group differences in ToM abilities were associated with pre-morbid social functioning (Schenkel et al., 2005). This is consistent with the work of Pollice et al. (2002) and Brüne et al. (2007), who found that a second order Theory of Mind task was a better predictor of community functioning than other measures of cognition in schizophrenia. Making a greater number of stable attributions predicted a small amount of variance in interpersonal and community functioning (Lysaker et al., 2004), while a hostile attributional style was associated with frequency of violence in daily life (Waldheter et al., 2005). However, studies are too few to draw reliable conclusions on the relationship between and ToM or attributional style and social functioning.

Finally, another five studies were conducted on the functional significance of multiple measures of social cognition. Emotion perception was found to be independent of ToM abilities. Mild to severe behavioural problems were associated with a ToM questionnaire (23 questions referring to the mental states of the characters in the Cartoon Picture story task), but not with the Cartoon Picture stories task itself or with emotion recognition (Brüne, 2005b). Ihnen et al. (1998) studied the predictive significance of emotional perception and social perception for social skills, and found that only the perception of facial affect was associated with social skills. Neatness was also associated with emotion perception in a study by Penn et al. (1996); social interest and social competence were not predicted by social or emotional perception in this study. Pinkham and Penn (2006) examined the relationship between social cognition, general cognition, and interpersonal skill in schizophrenia. They operationalised social cognition as a multidimensional construct and used a combined measure, encompassing emotion perception, social

knowledge and ToM. In their study, social cognition contributed unique variance to the prediction of social skill beyond that of general cognition: social cognition predicted almost twice as much variance in social skills than general cognition. In particular, performance on a ToM task predicted social functioning in schizophrenia, whereas social cognition did not contribute to the prediction of social skill in a non-clinical control sample. Finally, Zhu et al. (2007) found an association between ToM and community functioning, while eye gaze discrimination was not related to outcome.

3.6 Future Directions

Despite the increasing body of studies on social cognition, literature on social cognition is still fragmented. This fragmentation concerns both patient samples (e.g. schizophrenia, autism) and the level at which the study is aiming (e.g. brain functioning/ structure, neuropsychological assessment, functioning in daily life), making it difficult to form a coherent picture of the nature and consequences of social cognition deficits in schizophrenia.

In future, information from different patient samples and on different levels of functioning needs to be integrated. One example of this integrative approach is the "Mirror Study", which is the result of a collaboration between the Neuroimaging Centre of the University of Groningen, Autism Team North Netherlands, Groningen, and the Department of Psychotic Disorders of GGZ Drenthe. This study aims to collect information on social functioning on the level of brain functioning by using modern neuroimaging (fMRI), on a test level (neuropsychological assessment) and on the level of daily functioning (structured observation) in people with schizophrenia, people with autism and healthy controls.

A subsample of the data from this project is presented in Chapter VI of this thesis on the functional significance of social cognition. The fMRI paradigm that is used in this study focuses on a specific aspect of social cognition: empathy or the ability to understand another's thought, feelings or beliefs and focuses on a brain system that is thought to be involved in experiencing empathy ('the mirror neuron circuit'). Gallese et al. (1996) first discovered "mirror neurons", while they were studying goal-directed hand and mouth movements in macaque monkeys. They describe a set of neurons in the rostral part of inferior area 6 (area F5), that became active when a monkey performed a given action and when it observed a similar action performed by the experimenter. In order to be visually triggered, these mirror neurons required an interaction between the agent and the object of an action.
Gallese and Goldman (1998) hypothesised that mirror neurons are not only involved

in goal-directed behaviour in monkeys, but are also involved in social interactions in humans. More specific, they suggest that mirror neurons play an important role in mentalising abilities. Indeed, mirror neurons in the left anterior insula are found to be activated in both the imitation and experience of disgust in humans (Wicke et al., 2003). Thus, during the experience of disgust, brain systems are activated that are also active during the imitation of disgust displayed by others. Apparently, a person experiences what another person is experiencing, by observing his or her behaviour. In other words, the neuron 'mirrors' the behaviour of another person, as though the observer were himself performing the action. In humans, 'shared circuits' that are possibly involved in both the experience and observation of emotions are thought to be located in the premotor cortex, the posterior parietal lobe, and the superior temporal sulcus (Keysers & Perrett, 2004). Recently, hypoactivation of mirror neurons during observation and imititation of facial affect has been found in children with autism as compared to healthy controls. Furthermore, hypoactivation of mirror neurons is associated with the severity of autistic symptoms (Dapretto, 2006). Research on mirror neurons and schizophrenia is still in it's infancy, but it has been suggested that deficits in the mirror neuron system are also underlying some of the social cognitive deficits in people with schizophrenia (Burns , 2006, Gallese, 2003), especially in those with flat affect (Fahim et al., 2004).

In the 'mirror study' activity in shared circuits during perception and experience of disgust in people with schizophrenia with primarily negative symptoms will be compared to people with autism and healthy controls. We expect to find less activation in both patient samples. Furthermore, the amount of brain activity during the imaging part of the study will be associated with neuropsychological assessment and observation of social with daily functioning will be studied, to learn more about processes that underlie impaired functioning in daily life. We hypothesize that a performance on Theory of Mind Task will be associated with activity in shared circuits during our fMRI experiment. Also, less activity in shared circuits is expected to be predictive of poorer social functioning in daily life.

Preliminary results (Bastiaansen et al., 2008) of the study show that contrary to previous expectations no hypo-activity was observed in the mirror system during emotion perception (disgust) in people with an autism spectrum disorder. Instead, hyperactivity was observed. According to the authors this may because participants were over-aroused by social stimuli, or alternatively the hyperactivation may reflect a compensation effect. Data of the people with schizophrenia have not been analysed yet.

3.7 SUMMARY AND CONCLUSION

Research in the area of social cognition in schizophrenia has accumulated during the past decade. Social cognition refers to mental functions that underlie social interactions and can be divided into basic perceptual functions (emotion processing) and higher order functions (social perception, social knowledge, Theory of Mind and attributional style).

The neural substrate of social cognition includes the orbitofrontal cortex, the superior temporal sulcus, the fusiform gyrus, and the amygdala. The dorsomedial prefrontal cortex, the dorsolateral prefrontal cortex, the ventrolateral prefrontal cortex and the anterior cingulate gyrus have been linked to social cognition as well. In schizophrenia, both structural and functional abnormalities have been found in many of these areas. These neural abnormalities are also revealed in impaired performance on neuropsychological assessment: a series of studies on social cognition in schizophrenia demonstrate that both emotion perception and higher order social cognition are impaired. A relationship between social cognition, activity limitations and participation restrictions in daily life (social and community functioning) has been demonstrated in several studies, but the exact nature of the association is still not clear.

Although an impressive series of studies on social cognition and schizophrenia has been published in recent years, a number of questions remain unanswered. In this thesis two of these aspects of social cognition in schizophrenia will be addressed. First, while many studies have focussed on the perception of facial affect, perception of emotional prosody has not been studied systematically. There is evidence that people with schizophrenia have difficulties in decoding auditory affect, but literature is inconsistent with regard to the relationship between emotional prosody and other cognitive functions. Moreover, there is evidence that in the case of facial expressions, the perception of negative emotions is specifically impaired in schizophrenia, but it is not clear whether this is also the case with emotional prosody. These issues will be addressed in Chapter 4 of the thesis.

Second, the fact that people with schizophrenia are impaired in the perception of emotions as well as in perceiving their mental states will hamper the search for relevant (social) stimuli. Incorrect social inferences are expected to lead to the selection of incorrect schemata and if one is not able to extract adequate social cues from a complex environment, social interactions are likely to fail. It is therefore expected that a multidimensional measure of social cognition (emotion perception and ToM) will be a good predictor of social community functioning in schizophrenia. However, a number of important issues with regard to exact nature of the relationship between

social cognition and community functioning in schizophrenia are yet unresolved. These will be addressed in Chapter 5 of the thesis. In this Chapter, the predictive value of emotion perception and ToM for community functioning is compared to that of general cognition and psychiatric symptoms. Morever, will examine the unique contributions of emotion perception and ToM for the prediction of social outcome. As community functioning itself is also multidimensional concept, it will be also examined whether social cognition is linked to specific dimensions of community functioning. Finally, we will examine the specificity of the relationship between social cognition and community functioning for schizophrenia, by looking at this association in healthy controls . In the discussion of Chapter 5 a number a guidelines for assessing social cognition in schizophrenia are provided.

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