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Theory of mind and the role of IQ in chronic disorganized schizophrenia

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Abstract

Background: Several studies have suggested a theory of mind (ToM) deficit in schizophrenic disorders. However, the role of interfering variables such as IQ, attention, memory, and severity of the disorder has remained ambiguous. *Methods*: A theory of mind picture story comprising a sequencing task, a first and a second order false belief test, and a tactical deception test was given to a group of 23 patients with chronic disorganized schizophrenia and to 12 healthy control persons. In addition, a nonsocial picture story had to be sequenced. Severity of the psychopathology was measured by using the brief psychiatric rating scale (BPRS), IQ was estimated using the 'Mehrfachwahlwortschatztest' (MWT, multiple choice verbal comprehension test). *Results*: The schizophrenic group was impaired relative to controls on the theory of mind task, but not on the sequencing task of the nonsocial picture story. However, when controlled for IQ, no such difference was found. These findings were neither related to severity, duration, nor age at onset of the disorder. *Conclusions*: Theory of mind deficits in schizophrenia may be related to domain general impairments, e.g., intelligence and working memory load, rather than reflecting a 'genuine' compromised mental state attribution similar to autistic spectrum disorders. Schizophrenic patients may, however, rather be impaired in how and when to apply strategic social reasoning. Further studies to investigate the nature of social deficiency in schizophrenia are warranted.

Keywords: Disorganized schizophrenia; Theory of mind; Strategic social reasoning

1. Introduction

Theory of mind is defined as the ability to infer mental states, e.g., intentions and dispositions of other individuals. From an evolutionary perspective, theory of mind has been suggested to represent an essential component of social intelligence that evolved in primates to solve problems of an increasingly complex social environment (Brothers, 1990; Whiten, 2000). The acquisition of mental state representations, including understanding false beliefs and deception, thereafter, has been considered crucial to actively manipulate other people's behavior in order to improve one's own social (and reproductive) success. In support of this assumption, it has been demonstrated that the volume of the nonvisual neocortex in primates is correlated with the group size of the respective species as a measure of social complexity, labeled as 'social brain hypothesis' (Dunbar, 1998).

With respect to psychopathology, it may be hypothesized that the specialization of the human brain on

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information processing from the social environment may have contributed to an enhanced susceptibility to dysfunction as the evolutionary 'cost' of the development of advanced 'mind reading' capacities (Brüne, 2001). Likewise, Frith and Frith (1999) propose that specific impairments of theory of mind abilities may occur in both developmental and acquired psychiatric disorders with characteristic lesions in a dedicated brain system which is probably located in the prefrontal and temporal cortex (see also Russell et al., 2000; Stuss et al., 2001). However, whereas there is good empirical evidence of theory of mind impairments in autistic spectrum disorders (e.g., Baron-Cohen, 1995), the present data are far more ambiguous with respect to schizophrenic disorders. Clinically, it is obvious that patients with schizophrenia have deficits in social skills. In addition, the classic Schneiderian first rank symptoms, such as thought insertion, thought withdrawal, and thought broadcasting as well as delusions of control and reference, intuitively suggest a compromised theory of mind (Sarfati, 2000). As early as 1958, Conrad outlined in his Gestalt-theoretical monograph ''Die beginnende Schizophrenie'' (the beginning schizophrenia) that the inability to change mental perspectives comprises the core feature of the very earliest stage of schizophrenic disorders (Conrad, 1979). On the contrary, however, Walston et al. (2000) have recently argued that an *intact* theory of mind mechanism may be essential for developing persecutory delusions, at least in 'pure' delusional disorders, since so-called ''theory of mind'' delusions may only occur if the capacity to make inferences about intentions of other persons is preserved. Similarly, Abu-Akel and Bailey (2000) suggest that schizophrenic patients with positive symptoms may even have a 'hyper-theory of mind'.

To date, several studies have systematically addressed theory of mind abilities in schizophrenia. However, some difficulties remain on how to interpret their results, for instance, due to methodological problems such as interference with intelligence and general information processing capacity which may, among other factors, depend on the acuteness and the chronicity of the disorder (Brüne, 2001). Furthermore, the majority of the samples assessed in the available studies were either relatively small or diagnostically heterogeneous, and hence limiting their comparability.

2. Brief review of theory of mind assessment in schizophrenia and rationale for the present explorative study

So far, the majority of studies of theory of mind (ToM) in schizophrenia have adopted short stories and picture sequences comprising first and second order false belief tasks similar to the methodology of ToM assessment in autism. Previous studies in schizophrenia have revealed differences in ToM comprehension according to symptom subgroups proposed by Frith (1992). It has been predicted, thereafter, that the performance of schizophrenic disorders on ToM tasks would be hierarchically formed such that schizophrenics with positive or negative behavioral symptoms, e.g., avolition, poverty of speech, flattened affect, or incoherent speech, were expected to perform worst on theory of mind tasks, followed by paranoid schizophrenic patients. By contrast, patients with passivity symptoms, such as delusions of control or thought insertion, or patients in remission were predicted to be relatively unimpaired in mental state representation compared to clinical and nonclinical controls (for an updated overview, see Pickup and Frith, 2001). Corcoran et al. (1995) found schizophrenic patients with predominant negative symptoms and incoherence performing significantly worse on theory of mind tasks compared to controls. In addition, patients with paranoid features performed more poorly than patients with passivity symptoms and those in remission. In a subsequent study, these findings remained significant even when IQ differences were covaried out (Corcoran et al., 1997). However, although the poorer performance on theory of mind tasks of schizophrenic samples appeared to be associated with positive, negative, and general psychopathology, no such correlation was found in other clinical groups, e.g., in patients with affective disorders. Moreover, schizophrenic patients with comorbid learning disability performed worst, suggesting a cumulative effect of lowered IQ and psychopathology (Doody et al., 1998). Using a modified study design, Pickup and Frith (2001) have recently shown, however, that IQ, severity of psychopathology, and duration of illness do not fully account for the divergent performance of ToM tasks between the symptom subgroups. Furthermore, regression analysis revealed that the severity of positive and negative behavioral symptomatology predicted impaired ToM

comprehension in this study (Pickup and Frith, 2001). Only in paranoid schizophrenics the difficulties in understanding ToM tasks were associated with lower IQ. The authors concluded that paranoid patients with higher IQ could possibly compensate ToM deficits by solving the tasks using domain general capacities (Pickup and Frith, 2001). The study group of Sarfati et al. investigated ToM in schizophrenia putting emphasis on patients with disorganization symptoms compared to patients with affective disorders and normal controls. A series of studies of ToM (Sarfati et al., 1997a,b, 1999) revealed that disorganized schizophrenics performed significantly poorer on pictorial and verbal ToM tasks than other schizophrenic subgroups and patients with affective disorders (Sarfati and Hardy-Baylé, 1999). Verbalization may play an important role in ToM comprehension since many schizophrenic patients improved their ToM performance after the introduction of verbal material. A subgroup of schizophrenic patients who did not improve had a significantly longer duration of their illness compared to the patients with remediated ToM performance (Sarfati et al., 2000). These differences between the groups appeared not to be related to the severity of psychopathology. However, in this study, the impact of IQ remained ambiguous since the good performers had a significantly higher IQ compared to the remediable and the poor performers. In addition, Mazza et al. (2001) recently found differences in ToM performance between schizophrenic patients with reality distortion, psychomotor poverty, and disorganization. Schizophrenics with psychomotor retardation performed significantly poorer on first order false belief tasks than the other groups which, however, may partly reflect attentional deficits or impaired memory load (Mazza et al., 2001).

In addition to interference of ToM tasks with IQ and information processing capacity, it has been suggested that theory of mind deficits in schizophrenic disorders may represent a state rather than a trait condition (Frith and Corcoran, 1996). This assumption has been buttressed by a study addressing the question as to whether theory of mind abilities differ during acute episodes of psychosis from recovery (Drury et al., 1998) which revealed differences in ToM performance only in the acute stage of the disorder but not after recovery. Moreover, there was no difference between the non-schizophrenic group with persecutory delusions even during the acute phase compared to nondeluded subjects except for memory, suggesting that theory of mind deficits are not related to persecutory delusions per se. The authors hypothesized that cognitive plasticity may deteriorate with the chronicity of the disorder, and hence inhibits regaining theory of mind abilities (Drury et al., 1998).

Due to the problems with interfering variables which pose the difficulty to reliably distinguish between a compromised information processing capacity, IQ, and a genuine theory of mind impairment, some study groups have suggested to construct novel theory of mind tasks comprising low information processing demands and higher theory of mind demands (Frith and Corcoran, 1996; Drury et al., 1998).

The rationale of the present study, therefore, is twofold: firstly, to provide a task which depicts 'online' different levels of intentionality, including tactical deception in a single setting to approximate 'real-life' situations and to facilitate perspective taking of the characters involved with minimal interference with attention, and memory load. In short, in order to assess ToM in schizophrenia uncontaminated, one has to keep it simple. Secondly, since schizophrenia does not probably represent a diagnostic entity, the study sample ought to be as homogenous as possible. Disorganized schizophrenia (DSM-IV criteria) as assessed here represents a subtype of chronic schizophrenia that is characterized by early onset, severely compromised social behavior, and poor outcome. Furthermore, psychiatrists have recognized already decades ago that patients with disorganized schizophrenia often suffer a remarkable cognitive decline with 'concretistic' thinking and impaired understanding of proverbs or metaphor (e.g., Kleist, 1934). Therefore, taking into account previous studies, ToM deficits are expected to be the most prominent in chronic disorganized schizophrenia which most closely resembles the behavioral symptoms subgroup in Frith's model (see also Sarfati et al., 1999, 2000; Pickup and Frith, 2001).

3. Methods

3.1. Subjects and tasks

Twenty-three patients (17 males, 6 females) who met the DSM-IV (American Psychiatric Association,

1994) criteria for disorganized schizophrenia were included. Acute exacerbation stages were excluded. The subjects were compared to 12 nonpsychiatric healthy controls (7 males, 5 females). IQ was estimated using the ''Mehrfachwahlwortschatztest'' (MWT, Lehrl, 1976; which may be best translated as 'multiple verbal comprehension test'). Psychopathology was assessed using the brief psychiatric rating scale (BPRS; Overall and Gorham, 1962). The participants were tested individually. Prior to theory of mind assessment, the subjects were asked to sequence a 'physical' picture story depicting a nonsocial action (house construction, adopted from WAIS-R, a forth picture being added). Basic theory of mind tasks were pretested in the schizophrenic group using an easy practical test (modified 'Smarties-Test', Perner et al., 1989) for first order false belief assessment and a short text passage (the 'burglar story', obtained from Happé et al., 1998) comprising a second order false belief task. The subjects were asked to read the text aloud. The subjects were then asked a second order false belief question ('why did the burglar raise his hands?') as well as the reality question ('did the policeman know the man was a burglar?'). Scores were rated 0 if subjects either failed to answer the theory of mind question or the reality question correctly, and 1 if passing both questions.

Theory of mind was then assessed in both the schizophrenic and the control group using a cartoon picture story consisting of four pictures (obtained from Wilhelm Busch, a famous 19th century German caricaturist), comprising a first order false belief, a second order false belief, and a tactical deception. Distracting details were removed from the original pictures. The subjects were asked to sequence the four pictures, which were presented in the same order (4–1–2–3). If they failed to sequence the picture story correctly, a correction was made by the experimenter (M.B.) and the picture story was continuously presented in the right order for subsequent theory of mind testing. The subjects were orally given a description of each picture as follows. A maid captures a bee in a paper bag (first picture). She presents the paper bag to the monkey (second picture). The monkey curiously grabs into the paper bag (third picture). The monkey is stung by the bee (fourth picture). After the description of the action (without allusion to the mental states of the actors, of course), the subjects were asked to answer the first order false belief question ('what does the monkey think is in the paper bag?' Correct answers, for example, sweets, nuts, etc.) and, subsequently, the reality question ('what is really in the paper bag?'). The subjects were then asked the second order false belief question ('what does the monkey think the maid intends?' Correct answers, for example, to feed him, to give him sweets, etc.). After that, the subjects were asked the reality question again ('what is in the paper bag?'). Finally, the subjects were asked to answer the tactical deception question ('what does the maid intend?'). Scores were rated in the same manner as in the orally given theory of mind task. The maximum sum score of the cartoon theory of mind task was 4 points (for correct sequencing, and correct answering of the theory of mind tasks, including the reality questions).

3.2. Data analysis

Data analysis was carried out using SPSS for Windows Version 10.0.

4. Results

4.1. Clinical and demographic characteristics

The age and sex distribution of the schizophrenic subjects and the control group are shown in Table 1. The groups did not differ with respect to age ($F = 0.093$; $p = 0.762$). In the schizophrenic group, the mean age at onset of the disorder was 18.8 years (S.D. = 3.48) and the mean duration of illness was 10 years (S.D. = 7.04). As expected, the schizophrenic

Table 1
Clinical and sociodemographic characteristics of the study samples

Variable	Schizophrenic patients	Controls	Statistical significance
n (female/male)	23 (6:17)	12 (5:7)	
Age (years)	29.2 (7.03)	30 (8.6)	0.762, n.s.
MWT score	22 (7.86)	29.8 (3.6)	$p = 0.003$
IQ equivalents	92	107	
Onset of illness (years)	18.8 (3.48)		
Duration of illness (years)	10 (7.04)		
Total BPRS score	46.9 (10.68)	18 (0.0)	$p < 0.001$

group scored significantly higher on the BPRS compared to the nonpsychiatric group ($F = 86.457$; $p < 0.001$). Most significantly, there was a marked statistical difference in the level of IQ as estimated by the MWT ($F = 10.404$; $p = 0.003$).

4.2. Performance on sorting and theory of mind tasks

In the pretest, 22 out of 23 schizophrenic patients (96%) passed the 'Smarties Test' (first order false belief). Moreover, 17 schizophrenic patients (74%) passed the theory of mind 'burglar story' (second order false belief).

No difference between the schizophrenic group and the controls was found in the performance of the sorting task of the physical story (see Table 2 for statistical details). By contrast, there was a difference in sequencing the theory of mind cartoon. Whereas only 14 of the schizophrenic group (61%) sequenced the cartoon story correctly, the number was much higher in the control group (92%). However, the difference was slightly above the 5% significance level. About 91% of the schizophrenic subjects and 100% of the controls passed the first order false belief task. No statistical significance was found ($p = 0.293$). As expected, there was a high correlation in performance on the Smarties Test and the first order false belief test of the cartoon picture story ($r = 0.691$; $p < 0.001$). A significant difference could be found in performance on the second order false belief question of the cartoon story. Whereas 16 schizophrenic patients (70%) answered the theory of mind and the reality question correctly, all healthy subjects passed the task ($p = 0.033$). The correlation between the 'burglar story' and the second order false belief task of the cartoon story was moderate ($r = 0.468$; $p = 0.024$). No significant difference between the groups was found with respect to the tactical deception task. Nineteen schizophrenic subjects (83%) performed well compared to 100% of the controls ($p = 0.125$). However, if summarizing the scores with a maximum of 4 points for correct sequencing and correct answering of the theory of mind questions, the schizophrenic group differed significantly from the control group ($F = 5.858$; $p = 0.021$). The duration of the illness correlated negatively with the performance in the sorting task of the 'physical' story ($r = -0.415$; $p = 0.049$), with the performance on the second order false belief question of the cartoon story ($r = -0.526$; $p = 0.01$), and with the sum score of the cartoon story ($r = -0.532$; $p = 0.009$) but neither with the performance on the 'Smarties Test', the 'burglar story', nor with the sequencing of the cartoon story alone. No such correlation was found between the onset of the illness and one of the theory of mind tasks.

Table 2
Performance on 'physical' and theory of mind tasks in schizophrenic and control groups

Variable (correct answers)	Schizophrenic patients	Controls	Statistical significance
Sequencing of 'physical story'	87%	100%	$\chi^2 = 1.712$, $p = 0.191$, n.s.
First order false belief ('Smarties test')	96%		
Second order false belief ('burglar story')	74%		
Sequencing of theory of mind cartoon	61%	92%	$\chi^2 = 3.665$, $p = 0.056$
First order false belief (theory of mind cartoon)	91%	100%	$\chi^2 = 1.107$, $p = 0.293$, n.s.
Second order false belief (theory of mind cartoon)	70%	100%	$\chi^2 = 4.565$, $p = 0.033$
Tactical deception (theory of mind cartoon)	83%	100%	$\chi^2 = 2.356$, $p = 0.125$, n.s.
Sum score (theory of mind cartoon)	3.04	3.92	$F = 5.858$, $p = 0.021$

Due to the disparate IQ levels between the groups, a subsequent statistical analysis was carried out after correction for IQ. Therefore, patients who scored lower than 22 points on the MWT (equivalent to IQ = 92) were excluded, such that all remaining subjects (patients and controls) had at least normal IQ. The remaining 12 schizophrenic patients (3 females, 9 males) did not differ from the controls with respect to the estimated IQ (mean MWT score = 28.1, S.D. = 3.58, equivalent to IQ = 101; $F = 1.295$; $p = 0.267$). The subgroup with disorganized schizophrenia matched for IQ did not differ from the entire schizophrenic group with respect to age (28.33 years; S.D. = 5.77), age at onset of the disorder (18.58 years; S.D. = 3.23), and duration of illness (8.92 years; S.D. = 4.72). The BPRS score of the IQ-matched schizophrenic group was even slightly higher (49.67) compared to the entire group. All 12 schizophrenic subjects passed the 'Smarties Test', 10 (83%) performed well on the 'burglar story'. All patients of the subgroup passed the sorting task of the

'physical' story, 10 schizophrenic patients (83%) sequenced the cartoon story correctly. No difference was found compared to the nonpsychiatric controls ($\chi^2 = 0.381$; $p = 0.537$, n.s.). Moreover, all subjects of the schizophrenic group performed well on the first order false belief task of the cartoon story and 11 (92%) answered the second order false belief question as well as the reality question of the cartoon story correctly. There was no difference to the healthy controls ($\chi^2 = 1.043$; $p = 0.307$). An identical result was found in the tactical deception task. When controlled for IQ, the sum score of the cartoon story did not reveal any significant differences compared to the control group (mean score of 3.67 in the matched schizophrenic group; $F = 2.302$; $p = 0.143$, n.s.).

5. Discussion

It is still a matter of debate as to what extent theory of mind is impaired in schizophrenia, although clinical intuition and the available studies clearly indicate that understanding other minds may be compromised, depending on the acuteness and the duration of the disorder (Drury et al., 1998; Sarfati et al., 2000). Furthermore, recent studies suggest that ToM impairments appear to be related to the level of disorganization and psychomotor retardation (Sarfati et al., 1999; Sarfati and Hardy-Baylé, 1999; Mazza et al., 2001). Nevertheless, ambiguities of the results remain as to how far performance on ToM tasks is associated with a 'purely' deficient ToM mechanism or, rather, reflects a dysfunction of other cognitive capacities such as attention, memory, and general intelligence (Frith and Corcoran, 1996; Doody et al., 1998; Pickup and Frith, 2001). Another problem is that many of the available ToM tasks do not sufficiently resemble 'real-life' situations (Simpson et al., 1998). The present study reveals, in some respect contradictory to previous results, that ToM in chronic disorganized schizophrenia may be less impaired than other studies suggest. In the pretests, the schizophrenic subjects performed better on the second order false belief task compared to schizophrenic patients in previous studies (Frith and Corcoran, 1996; Mazza et al., 2001) which may be explained by the exclusion of acute stages of the disorder in this study. The ToM cartoon story revealed significantly poorer performance of the disorganized schizophrenic group on the second order false belief task and a lower sum score which included the sequencing of the picture story compared to healthy controls. The sequencing of the cartoon story was included into the rating as it may point to the correct understanding of the entire action which requires already mental state attribution *prior* to the introduction of verbal material. To investigate whether this depends on executive functioning rather than ToM, the sequencing task was compared to sequencing a 'physical' picture story. As patients performed more poorly on sequencing the ToM cartoon story than on sequencing the 'physical' story correctly, this result suggests that it may be rather related to a ToM deficit, although the difficulty of the sequencing tasks was not clearly matched. Moreover, ToM performance of the entire schizophrenic group was negatively associated with the duration of the illness which is in line with previous studies (Drury et al., 1998; Sarfati et al., 2000).

However, the overall impression is quite different when controlling the results for IQ. The IQ-matched schizophrenic group differed from control subjects neither in sequencing the 'physical' cartoon story nor in any of the ToM tasks. Furthermore, the schizophrenic subgroup did not differ from the entire schizophrenic group with respect to duration of illness, age at onset, and psychopathology, suggesting that performance on ToM tasks was independent from duration of illness and psychopathology in this sample. However, these conclusions have to be tentatively drawn, as the sample size was relatively small, though the group of schizophrenic patients was more homogeneous with regards to the subtyping as compared to previous studies. Moreover, the test used for estimating IQ (MWT) exclusively relies on verbal material, thus, a bias due to verbal capacities of the matched group cannot be ruled out. This finding, however, would confirm that verbalization possibly plays an important role in remediating theory of mind deficits in disorganized schizophrenia (Sarfati et al., 1999, 2000). Furthermore, due to the explorative nature of the study, ToM comprehension was assessed using a single set of tasks. Therefore, it cannot be ruled out that the applied ToM cartoon was not discriminating enough to detect group differences, and hence, ceiling effects may account for the statistically small differences between the groups. However, the inclusion of a

first and a second order false belief and a tactical deception in a single setting possibly resembles more closely real-life social *interaction* of two characters in the literal sense, with action and reaction than previously used tasks.

Despite phenomenological similarities between negative symptoms in schizophrenia and autism, the present study suggests that ToM is unlikely impaired in the same way in these disorders. The findings of the present study would rather be consistent with the notion of Walston et al. (2000) that an intact ToM mechanism is essential for developing persecutory delusions and may, therefore, be preserved in many schizophrenic patients. Yet, social behavior and perspective taking are unequivocally compromised in chronic schizophrenia. According to the hypothesis of a hierarchically organized 'social module' (Gigerenzer, 1997), it is conceivable that the ability of *how* and *when* to apply cooperative or deceptive social strategies, referred to as 'procedural rules' (Schmitt and Grammer, 1997), may be impaired rather than mental state attribution per se in patients with schizophrenia (for an overview, see, Brüne, 2001). A recent study addressing 'Machiavellian Intelligence' suggests that schizophrenic patients apply strategic social reasoning to a lesser degree than control persons, with schizophrenic men scoring lowest on the Mach IV scale (Sullivan and Allen, 1999). Moreover, as emotions decisively influence cognitive processes, for example, via so-called 'somatic markers' by recollecting previous emotional experiences (Damasio, 1996; Walston et al., 2000), empathy may be indispensable for mental perspective taking in 'real-life' situations. In patients with chronic schizophrenia, affective flattening and other negative symptoms may, therefore, likely be involved in social neglect (Grossberg, 2000). Finally, given that mental state attribution requires the integration of perceptual, emotional, and cognitive input, ToM impairment in schizophrenia may also reflect an overload of working memory capacity.

In summary, ToM abilities in schizophrenia remain a controversial topic. However, more sophisticated ToM tests should, for example, include comprehension of multiple ToM picture stories, understanding of proverbs that combine metaphor and mental state attribution, and strategic social thinking (Machiavellian Intelligence) controlled for IQ, psychopathology, and taking into account the onset and the duration of the disorder. Behavioral observation addressing the question as to whether schizophrenic patients make use of strategic social reasoning, e.g., whether and how often they intentionally deceive and cooperate, may also be fruitful to improve our understanding of social skills in schizophrenic disorders. Likewise, to date, the question as to how far possible sex differences in social reasoning may play a role has not systematically been assessed. From a therapeutic perspective, it is important to further study social cognition in psychiatric populations since patients may possibly benefit from cognitive training in this domain (Sarfati et al., 2000).

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