Eur Arch Psychiatry Clin Neurosci (2007) 257:104–111 DOI 10.1007/s00406-006-0681-3

ORIGINAL PAPER

Emre Bora · Gulsah Sehitoglu · Mustafa Aslier · Ihsan Atabay · Baybars Veznedaroglu

Theory of mind and unawareness of illness in schizophrenia

Is poor insight a mentalizing deficit?

Received: 16 November 2005 / Accepted: 6 April 2006 / Published online: 14 December 2006

Abstract This study investigates the impact of theory of mind (ToM) deficits on poor insight in schizophrenia. The scale for unawareness of mental disorder (SUMD) was administered to 58 stable outpatients with schizophrenia. First and second order false belief tasks, the Eyes test and a battery of non-ToM cognitive measures were administered. The Second order false belief task was the best predictor of each global insight and symptom attribution scores of the SUMD. ToM tasks explained the substantial amount of the variance (ranging from 22.5% to 29.9%) for the insight scores and classified the significant amount of the patients who were aware of the illness correctly. WCST perseveration scores did not contribute to insight scores beyond that contributed by second order false belief tasks. The Second order ToM tasks seems to have critical importance for the awareness of the disorder. Beyond more direct self-evaluation, the awareness of the disorder and its consequences may also require the ability to evaluate the self from the perspective of others. "Understanding the others' belief about another person" may be conceptually very similar to "understanding the others' belief about self" (instead of another person).

B. Veznedaroglu
Psychiatry Department
Ege University School of Medicine
Izmir, Turkey

G. Sehitoglu · M. Aslier · I. Atabay
Scientificic Research Society (EBAT)
Ege University School of Medicine
Izmir, Turkey

E. Bora, MD (✉)
Psychiatry Department
Melbourne Neuropsychiatry Centre
University of Melbourne
c/o National Neuroscience Facility
161 Barry Street
Carlton South VIC 3053, Australia
E-Mail: emrebora@hotmail.com

Key words schizophrenia · lack of insight · theory of mind · neurocognition · frontal lobe dysfunction

Introduction

The lack of insight is one of the characteristic symptoms of schizophrenia [10]. Owing to its prevalence and potential to disrupt the interpersonal relations and treatment compliance, the lack of insight has become the subject of clinical and scientific attention. Insight in psychosis was previously studied as a categorical concept; the patient may posess or lack insight. However, in the current literature, most of the authors define the insight as a multi-dimensional concept [2, 12, 35]. The dimensions of the insight, which are most frequently mentioned, are awareness of the disorder, the presence of symptoms, effects of treatment and social consequences of the disorder. Furthermore, insight includes the processes of awareness and attribution. While the awareness is the recognition of symptoms of illness, the attribution refers the explanations about the cause or source of these symptoms [3].

A number of etiological models, such as the psychological defence [36], the clinical [15] and the neuropsychological [2], have been proposed to explain the poor insight in schizophrenia. Neuropsychological models of the lack of insight suggest that the lack of insight in psychosis is caused by cognitive deficits, similar to the anosognosia in neurological disorders [2]. Number of previous studies reported a relationship between poor insight and executive dysfunction in psychosis. Some authors suggested that the poor insight may be related to the frontal lobe dysfunction in schizophrenia [17, 31, 40, 44]. However, some other studies did not support this relationship [11, 16]. There are also some contradictory findings about the relation of poor in-

EAPCN 681

sight with the other cognitive functions like memory [19, 27, 38, 42] and attention [38, 42]. Since the predictive power of the neurocognitive tasks for the poor insight seems as somewhat limited, even for the executive dysfunction, investigation for the better cognitive mediators has been continued. For example, some authors hypothesized that a number of metacognitive abilities may contribute to unawareness of illness more than other cognitive skills in schizophrenia [28, 33].

Theory of mind (ToM) is defined as the ability to understand the mental states (like feeling, intentions, beliefs) of others [20]. ToM abilities are permanently impaired in autistic disorder [6]. Recently, research has focused on the possibility that the ToM deficits may be related to some symptoms of schizophrenia [9, 37]. Originally, the ToM deficits were proposed to be present only during acute psychotic episodes [14, 20]. Some evidence suggested that ToM deficits may also persist in outpatients with schizophrenia [23, 25] and even in patients with affective disorders [7, 24]. The researchers generally define the ToM as a unitary skill. However, ToM ability can be divided into different subprocesses. Recently, two different aspects of ToM were proposed: (1) decoding mental states from perceivable social information such as facial expression, tone of voice and body posture (2) reasoning about mental states by integrating the contextual and historical information about a person (attitudes, knowledge, experiences) to understand behavior [39].

ToM deficits may have the potential to be related with the poor insight in schizophrenia. There may be several possible explanations for this relationship. First, the impaired theory of mind may contribute to the unawareness of the illness through inappropriate attribution of the threatening thoughts, intentions or behaviors to others [18]. Another explanation may be the possible relationship between the ToM abilities and self-perspective. Some recent neuroimaging findings demonstrated that the ability of mindreading (ToM) and self-perspective may rely on a partially common neural mechanisms [41]. Right prefrontal activation can be critical for both of the abilities. Awareness of mental disorder may be related to more general concept of the self-awareness. Perspective taking does not only help the observer to understand underlying motives of the others, it can also have an essential importance for understanding the beliefs of others about the observer's self. Taking account of the others' beliefs towards the self can have a critical importance for objective self-evaluation. As a natural extension of this argument, the awareness of the disorder and its consequences may require the ability to evaluate the self from the perspective of the others.

To our knowledge, the relation of ToM abilities with poor insight has not been studied adequately. Gambini et al. [21] reported that some patients with schizophrenia gain insight about their mental state when perspective was shifted from first person to third person. They suggested that first person-third person shifting procedure can be similar to ToM tasks. Drake and Lewis [17] investigated and could not find a significant relationship between poor insight and a measure of ToM in acute sample schizophrenia.

The primary aim of this study was to investigate impact of two different kinds of ToM abilities (mental state reasoning and decoding) on poor insight in shizophrenia. We hypothesized that ToM deficits would significantly predict poor insight in schizophrenia. A secondary aim was to examine the impact of other cognitive variables on poor insight in schizophrenia.

Method

Participants

A total of 58 patients with schizophrenia according to DSM-IV criteria participated in the present study. All of the patients were recruited from the outpatient clinic of Psychotic Disorders Unit of Ege University Psychiatry Department between November 2004 and June 2005. Forty-one were males, 17 were females, their mean age was 32.58 (S.D. = 8.3). The mean duration of education of the patients was 11.52 (S.D = 2.85) years. All of the patients were clinically stable and have had no history of acute psychotic exacerbation for at least 1 month (only two patients had a psychotic exacerbation in last 4 months). The patients who had disorders that could have influence on cognitive function (significant neurological and physical illnesses, substance abuse or dependence in the last year, electroconvulsive therapy in the preceding year or cerebral trauma history) were excluded. The patients were evaluated by a psychiatrist using the Structured Clinical Interview for Diagnostic Symptoms (SCID, DSM-V) [13] and Positive and negative symptoms scale (PANSS) [4]. About 39 of the patients were classified as schizophrenia, paranoid type, other patients were classified as following; 13 of them were undifferentiated, 6 were residual type. All of the patients were receiving antipsychotic medication. The participants were individually briefed on the nature of the study and signed an informed consent form in accordance with declaration of Helsinki.

Assessment of insight

The Scale of unawareness to mental disorders (SUMD) [3] was used to assess the level of insight of the patients. Interclass correlation coefficients for the Turkish version of the scale were little higher than the results reported by Amador et al. [2]. Interclass correlation coefficients for the three general items were between 0.85 and 0.93 [8]. Three general items and selected symptoms (Hallucinations, delusions, alogia, flat affect, avolition, anhedonia) were rated for both current and past time periods. We reported six global items of SUMD (1) current (c) and past (p) awareness of having a mental disorder (SUMD1) (2) current and past unawareness of the response to medication (SUMD3) (3) current and past awareness of the social consequences of the disorder (SUMD3). Also for the purpose of this study, we calculated two total SUMD score by adding these three ratings for current and past time. We also defined four pairs of scores (for past and current) from subscales of awareness and attribution for symptoms: (1) unawareness of negative symptoms (average of items 13–16) (UNAWARE neg) (2) attribution for negative symptoms (MISATRR neg) (3) unawareness of positive symptoms (average of item 4 and 5, most recent psychotic episode) (UNAWARE pos)

(4) attribution for positive symptoms (MISATTR pos). Only the positive and negative symptoms that were present during the most recent episode (based on chart reviews and family interview) were rated. Insights for negative symptoms were assessed for the subjects who have at least three points on corresponding items on PANSS scale. For the purpose of the study, participants were divided into two groups (patients with poor insight and patients with good insight). The seperation of the groups were based on the SUMD total score. We defined good insight as having a level of awareness more than partial (item score 1 or 2). Since the SUMD total score consisted of three items, the threshold for the level of insight was accepted as six (mean of three items = 2). Patients who scored 7 or above on the SUMD total were accepted as having poor insight.

Neurocognitive measures

A battery of neuropsychological tests was administered to assess cognitive skills of the patients. The Wisconsin Cart Sorting Test (WCST) was administered to assess the executive functions [22]. Two scores of the test, perseverative responses and categories achieved, were used. The WAIS-R forward and backward digit span tests were also administered. While the forward digit span task is a measure of attention, the backward digit span is also a measure of working memory ability [43]. To assess working memory, the letter to number test was also used [30]. A measure of verbal fluency (Letters KAS in Turkish) was also administered. The WAIS-R information test was used to estimate the verbal IQ capacities of the participants [43]. The experimenters were blind to the insight scores of the patients.

Theory of mind tasks

The Eyes test was used as a measure of mental state decoding. The Eyes test is not just a simple measure of affect decoding, although it is clearly associated with facial recognition skills [7]. It measures the ability to identify mental states requiring inferences about other's intentions and beliefs (like curious, guilty, desire). It comprises 36 photographs of people with facial expressions, showing only the eye region. Participants are asked to choose the appropriate response among four words, which gives the best definition of the mental state of the person [6]. The task was first developed as an advanced ToM test to detect subtle ToM deficits in autistic spectrum patients who passed easier tasks. Patients with schizophrenia reported to have deficits in the Eyes test before [26].

To assess mental state reasoning abilities a battery of first order and second order false belief ToM stories was composed from the tasks used in previous studies [1, 25, 34]. The ability of a person to understand that others may hold false beliefs that do not match his or her own knowledge is commonly referred as first order false belief ("Mary believes that the marble is in the basket although its place was changed"). The ability to understand that someone else thinks that a third person believes something is a second order ToM task. The battery was consisted of three stories of first order false belief tasks (TOM1) and three stories of second order false belief tasks (TOM2). For each of the true responses one point was given. There were also control questions to assess the comprehension of the tasks in false belief tasks. First, all of the stories were read aloud two times by the examiner. After that, to ensure the comprehension, the patient read the same story from a written text.

Data analysis

Since the insight scores were skewed, the Spearman correlation analyses were performed to investigate the relationships between clinical, neurocognitive, ToM and insight measures. The normality of the variables was checked with Shapiro-Wilk test and necessary transformations for several variables were performed. Since the SUMD total scores were only mildly skewed compared to the individual global SUMD items, we only used the normalized SUMD total scores for further analysis. Series of linear regression analyses were carried out to examine several questions. (1) To examine the relative roles of neurocognitive tasks on the SUMD total and misattribution ratings of insight. Since the scores of unawareness to the symptoms were extremely skewed and could not be normalized, they were excluded from these analyses. (2) A logistic regression analysis was carried out to evaluate the predictive power of the ToM2 score for discriminating the patients who have poor and good insight.

Table 1 Mean values of clinical and neurocognitive variables

	Mean	SD
Clinical variables		
Duration of illness (years)	10.24	7.50
Age at onset (years)	22.08	5.68
PANSS positive	9.84	3.11
PANSS negative	17.81	6.29
PANSS depression	1.50	0.81
PANSS general	25.8	11.5
Neurocognition		
WAIS information	10.11	2.77
Digit span forward	6.81	2.61
Digit span backward	5.26	1.98
Letter to number	3.28	2.30
Verbal fluency	27.28	12.98
WCST perseverative	37.36	28.27
WCST category	3.07	2.26
ToM total	3.76	1.70
ToM1	2.22	1.01
ToM2	1.53	1.02
Eyes	18.16	4.68

Results

Clinical, insight and neurocognitive variables

The clinical characteristics of the patients are summarized in table 1. The patients had very low level of psychotic symptoms (PANSS positive subscale = 9.84 ± 3.11). Table 2 presents the mean scores of the insight ratings. About 28 of the 58 subjects (48%) had full awareness (one point on SUMD) of the current disorder; 29 (50%) were fully aware of the current effects of their medications and 25 (43%) of them fully understood the current social consequences of the disorder. Only a minority of the patients was unaware of their positive and negative symptoms. The patients had a tendency to have better insight for the most recent psychotic period. The three global SUMD items and Unawareness items were highly skewed.

The mean values of cognitive tasks are reported in table 1. The number of the patients who passed comprehension tasks of all the questions of ToM1 (95%) and ToM2 (88%) was high. ToM scores of these patients were excluded from further correlational analyses.

Table 2 SUMD (Scale to assess unawareness of mental disorders) scores of the patients

	Mean	SD	Median	Level of insight (% patients)	
				None-low partial[a]	High partial-full[b]
SUMD1 Curr	2.09	1.33	2	32.8	67.2
SUMD1 Past	1.85	1.14	1	24.1	75.9
SUMD2 Curr	2.07	1.35	1.5	31.0	69.0
SUMD2 Past	1.93	1.25	1	27.5	72.5
SUMD3 Curr	2.33	1.49	2	42.4	57.6
SUMD3 Past	2.10	1.34	2	34.5	65.5
UNAWARE neg (C)	1.73	1.20	1	26.5	73.5
UNAWARE neg (P)	1.65	1.15	1	22.4	77.6
UNAWARE pos (C)	1.45	1.24	1	10.3	89.7
UNAWARE pos (P)	1.43	1.09	1	12.1	87.9
MISATTR neg (C)	3.06	1.38	3	65.3	34.7
MISATTR neg (P)	3.00	1.32	3	65.3	34.7
MISATTR pos (C)	3.03	1.57	3	65.5	34.5
MISATTR pos (P)	2.64	1.56	3	51.7	48.3

[a]SUMD score ≥ 3, [b]SUMD score < 3, pos = positive, neg = negative
UNAWARE = Unawareness of ..... symptoms
MISSATTR = Misattribution of ..... symptoms

The correlations of insight scores with symptom and neurocognitive variables

The Spearman correlation coefficients between the seven insight variables and all of the clinical and neurocognitive variables were calculated (Table 3). The positive symptoms were associated with the current and past SUMD total scores and misattribution of the positive symptoms. There were no correlations between the WAIS information score and poor insight. Among nonToM cognitive tests, only task, which have some significant correlations with insight were the WCST scores. The WCST perseverative responses score was only significantly associated with the misattribution of past positive symptoms. The WCST category score was inversely associated with the current and past SUMD total scores and unawareness of the current positive symptoms. Both of the false belief tasks were inversely correlated with the current and global insight scores. They were also associated with the misattribution to negative (past and current) and positive (only past) symptoms. The correlations between the ToM2 and insight scores were stronger compared to the ToM1.

The correlations of the ToM scores with other neurocognitive variables

The verbal IQ estimate was mildly associated with ToM1. It was not significantly associated with the ToM2 and the Eyes test. There was a significant correlation between the ToM2 task and the Eyes test (Table 4).

The first and second order false belief tasks had correlations with the digit span forward and letter to number test. The second order false belief task was also mildly correlated with the WCST scores. The Eyes test had significant correlations with the attention tasks, which have a significant working memory load (Letter to Number and digit span backwards).

Table 3 Spearman correlation coefficients for insight, symptom and neurocognitive variables

	SUMD tot		UNAWARE pos		UNAWARE neg		MISATTR pos		MISATTR neg	
Clinical variables	Curr (58)	Past (58)	Curr (29)	Past (58)	Curr (43)	Past (43)	Curr (29)	Past (58)	Curr (43)	Past (43)
PANSS positive	**0.40**[b]	**0.41**	0.03	0.03	0.18	0.16	−0.06	0.27	0.32[a]	0.37[b]
PANSS negative	0.27	0.28	0.09	0.15	0.05	0.05	0.01	0.22	0.25	0.27
PANSS depression	−0.07	−0.09	−0.16	−0.26	−0.34[a]	−0.32	0.17	0.01	−0.17	−0.14
Neurocognition										
WAIS information	−0.04	0.08	−0.03	−0.06	−0.17	−0.06	0.12	0.07	−0.04	0.03
Digit span forward	−0.17	−0.13	−0.15	−0.06	−0.03	−0.05	0.01	−0.15	−0.09	−0.11
Digit span backward	0.01	0.06	0.21	0.13	−0.03	0.01	0.14	0.08	−0.02	0.01
Letter to number	−0.19	−0.15	0.01	0.01	−0.02	0.03	0.13	−0.17	−0.14	−0.12
Verbal fluency	−0.10	−0.02	0.15	−0.01	−0.01	0.02	0.15	0.03	−0.09	0.05
WCST per	0.20	0.26	−0.02	0.01	0.15	0.11	0.34	0.29[a]	0.24	0.22
WCST category	−0.27[a]	−0.29[a]	−0.22	−0.03	−0.02	0.01	−0.37[a]	−0.22	−0.20	−0.20
ToM1	**−0.42**[b]	**−0.45**[b]	−0.08	−0.14	−0.26	−0.20	−0.23	−0.37[a]	−0.36[a]	−0.32[a]
ToM2	**−0.55**[b]	**−0.54**[b]	−0.30	−0.34[a]	−0.26	−0.29	−0.34	**−0.44**[b]	**−0.43**[b]	**−0.48**[b]
Eyes	−0.10	−0.16	−0.16	−0.16	−0.22	−0.21	0.06	0.01	−0.18	−0.18

$X^a = P < 0.05$, $X^b = P < 0.01$

Table 4 Spearman correlations between ToM and neurocognitive variables

	ToM1	ToM2	Eyes	WAIS information
Digit span forward	0.28	0.44**	0.32*	0.50**
Digit span backward	0.12	0.25	0.41**	0.37**
Letter to number	0.40**	0.36**	0.44**	0.40**
Verbal fluency	0.15	0.29	0.09	0.37**
WCST perseveration	−0.20	0.34*	−0.07	−0.31*
WCST category	0.22	−0.29*	0.05	0.40**
ToM1		0.38**	0.24	0.30*
ToM2			0.40**	0.24
Eyes				0.09

*$P < 0.05$, **$P < 0.01$

Table 5 Linear regression equation predicting the impact of neurocognitive variables on SUMD

	F	*df*	Model *P* <	r^2	Predictors	Beta	Predictor *P* <
SUMD tot (C)	7.67	3,54	0.001	0.299	ToM2	−0.41	0.003
SUMD tot (P)	7.57	3,54	0.001	0.296	ToM2	−0.35	0.01
					ToM1	−0.26	0.04
MISATTR neg (C)	4.99	3,39	0.004	0.250	ToM2	−0.35	0.02
MISATTR neg (P)	5.61		0.002	0.272	ToM2	−0.43	0.006
MISATTR pos (C)	2.29		0.10				
MISATTR pos (P)	5.23	3,54	0.002	0.225	ToM2	0.27	0.05

The regression analyses

Several regresssion analyses were carried out for further examining several questions. (1) To examine the relative roles of individual ToM tasks on ratings of insight. Six linear regression equations were created for the current and past total SUMD scores and the symptom misattribution scores. Independent variables were the ones most significantly correlated with the individual insight scores ($P < 0.2$). To avoid multicollinearity only the WCST variables that were more significantly associated with individual insight items were chosen. The ToM1, the ToM2, the letter to number test and one of the WCST items were entered to each equation. The Eyes task was entered to SUMD total past and MISATTR neg scores. All of the regression models except for the one to misattribution of current positive symptoms were significant. Significant amount of the variance were explained by these models (22.5–29.9%). The ToM2 score was a significant predictor of the each of the significant equation (Table 5). Multicollinearity did not seem to be a particular problem according to VIF and tolerance values. Furthermore, two regression analyses for the current total SUMD score were repeated with ToM2 and WCST category score as sole independent variables, respectively. While ToM2 score explained the 22.7% of the variance ($F = 12.6$, $P = 0.001$), WCST category score explained the only 7% of the variance ($F = 3.29$, $P = 0.08$).

(2) A logistic regression analysis was carried out to evaluate the predictive power of the ToM2 for discriminating the patients who have poor and good insight. The dependent variable was the level of insight (SUMDtotal ≤6 good insight, >6 poor insight) and the ToM2 score was the predictor. The model was significant ($\chi^2 = 20.904$, $P < 0.001$, Nagelkerke $R^2 = 0.502$) and classified the 90.6% of the patients who had good insight and 77.0% of the patients who have poor insight correctly.

Discussion

The previous studies investigating the neurocognitive basis for unawareness of having schizophrenia have implicated the executive functioning, memory and other cognitive deficits, but the relationship of the ToM deficits with poor insight has not been adequately studied. The results of this study supported our primary hypothesis. The failure on second order ToM dysfunction was a prominent predictor of global insight deficits and symptom misattribution. The second order ToM deficits explained the substantial proportion of the variance of the insight ratings (ranging from 22.2% to 29.9%) and the ToM2 score classified the 90% of the patients who had good insight correctly.

The patients were impaired in the false belief tasks. The patients gave correct answers to 74% of the ToM1 and 52% of the ToM2 questions. Since same patients performed well on the comprehension scores for these tasks, this result was reflecting the ToM dysfunction in the patients with poor insight. The ratios of the subjects who gave correct responses to the two of the second order tasks used in this study (ice cream and burglar) were 40% for the patients and 97% for the control group in the study of Mazza et al. [34]. The

false belief tasks, which are among the ToM tasks that can be conceptualized as the mental state reasoning tasks seemed to have critical importance for the insight scores. The second order false belief tasks were better predictors for poor insight than first order tasks. If our conceptualization of the insight as an extension of the ability to understand self from the perspective of the others is correct, this result is not suprising. According to this view, "Understanding the others' belief about another person" is conceptually very similar to "understanding the others' belief about the self" (instead of another person). To be aware of our disease, we need to imagine ourselves, as a person in the others' situation and try to understand what will he think about us. This kind of mentalizing ability is conceptually similar to the simulation theory of ToM [29]. This idea may also be associated with the findings of Lysaker et al. [32] who examined the relationship between insight and interpersonal function and theorized that an inability to take the perspective of others underlies both impaired insight and poor social functioning.

In our study, relationship between a mental state decoding task, the Eyes test and poor insight was not significant compared to mental state reasoning tasks. Decoding the mental states is an automatic and even subconscious process. Rather than relying on inferences about the knowledge of others, decoding of mental states rely on the immediately available information. The ability of someone to understand that he or she has a mental disorder seems to be based on judging and reasoning about the situation. Since the concept of mental disorder and normal behavior is essentially defined in reference to cultural norms rather than recognition of physical or objective universal signs, this result is not suprising.

Our results seemingly contradict the findings of Drake and Lewis [17] who did not find a significant relationship between poor insight and ToM in schizophrenia. We think that this study had several limitations. The study was conducted in an acute sample and the sample size was relatively moderate. The authors only used a visual joke comprehension task as a ToM task, which is a more indirect measure of mentalizing ability. Further studies needed to answer which dimensions of ToM are critical for poor insight in schizophrenia.

Unlike symptom misattribution and global insight scores unawareness of current negative and past positive symptoms were not significantly associated with the false belief tasks. This result may be related to the high awareness levels of the current study sample. Since there were very few patients who were unaware of their past and current symptoms, the statistical power of the current analyses were low. Alternatively, the symptom misattribution and global insight ratings may be selectively associated with poor insight. Understanding "others belief about a person or yourself" could be essential to grasp that people think or would think you are ill; but identifying symptoms may need a different form of judgement unrelated to beliefs about people or minds.

Many of the previous studies have examined the relationship of the insight deficits and the WCST performance. Some of these studies have found a relationship with the WCST perseverative responses and poor insight [12]. The WCST assesses flexibility in abstract thought [30]. The lack of the capacity of flexibility in abstract thought can interfere in the development of an awareness of something as complex as mental disorder. WCST perseveration scores were not correlated with poor insight as strongly as false belief tasks and did not significantly contributed to prediction of insight scores. WCST perseverative responses score was correlated with second order false belief tasks. Since WCST perseverative responses did not enter the regression equations, the relationship between WCST and insight shares common variance with the relationship between insight and ToM measure. Previous findings also reported a relationship between the WCST dysfunction and ToM deficits [7]. This finding could have important implications for the literature on WCST performance and insight. The relationship between executive function and insight may be in fact reflecting the relationship between ToM and insight. This could, potentially, explain the inconsistent findings in the previous studies regarding the relationship of executive function and insight. This possibility requires further study.

Another point is the nature of the relationship between the mental state reasoning and insight. There may be a casual relationship between these two measures or alternatively this association may be a manifestation of another common underlying deficit like metacognition. Like second order false belief tasks, metacognitive scores of an adapted version of WCST were much more strongly associated with insight than conventional WCST scores [28]. We think that both direct self evaluation (related to metacognition) and evaluation of self-form the perspective of others (more closely associated with ToM) are essential abilities for the awareness of mental disorder. From this perspective, mindreading may make at least partially independent contributions compared to other metacognitive abilities in explaining insight but this question can not be answered adquately with the data presented and should be investigated in future studies.

We think that the second order ToM deficits could be among the possible predictors of poor insight in schizophrenia. Beyond more direct self-evaluation, the awareness of the disorder and its consequences may also require the ability to evaluate the self from the perspective of others. The current study-support this idea in stable outpatients with schizophrenia. The mental state reasoning tests explained the substantial proportion of the variance of the insight scores. Some

authors proposed that the neurocognitive factors are more important predictors of insight for clinically stable patients than acute psychotic patients. The defensive denial of the illness can be more strongly associated with poor insight in acute psychotic episodes. However, the mental state reasoning dysfunction can still be a prominent predictor of poor insight even in psychotic patients since ToM deficits are also more severe in psychotic episodes. Future studies should be considered to confirm the relationship between mental sate reasoning type of ToM deficits and insight impairments in both stable and psychotic patients. Also studies investigating the relative importance of ToM dysfunction, psychological defensiveness and other cognitive skills are needed.

References

1. Abu-Akel A, Abushualeh K (2003) Theory of mind in violent and nonviolent patients with paranoid schizophrenia. Schizophr Res 69:45–53
2. Amador XF, Strauss DH, Yale SA, Gorman JM (1991) Awareness of illness in schizophrenia. Schizophr Bull 17:113–132
3. Amador XF, Strauss DH, Yale SA, Flaum MM, Endicott J, Gorman JM (1993) Assessment of insight in psychosis. Am J Psychiatry 150:873–879
4. Anil AE, Batur S, Tiryaki A, Gogus A (1999) Reliability of Turkish version of Positive and Negative Symptoms Scale. J Turk Psychol 14:23–32
5. Baron-Cohen S, Leslie AM, Frith U (1985) Does the autistic child have a theory of mind? Cognition 21:37–46
6. Baron-Cohen S, Wheelwright S, Hill J, Raste Y, Plumb I (2001) The "Reading the mind in the eyes" test revised version: a study with normal adults, and adults with asperger syndrome or high functioning autism. J Child Psychol Psychiatry 42:241–251
7. Bora E, Vahip S, Gonul AS, Akdeniz F, Alkan M, Ogut M, Eryavuz A (2005) Evidence for theory of mind deficits in euthymic patients with bipolar disorder. ACTA Psychiatr Scand 112:110–116
8. Bora E, Ozdemir F, Ozaskinli S (2006) The reliability and validity of the abbreviated version scale of unawareness to mental disorder. Psychiatry in Turkiye 8:74–80 (Turkish)
9. Brune M (2005) Theory of mind in schizophrenia: a review of the literature. Schizophr Bull 31:21–42
10. Carpenter WT, Strauss JS, Barttko JJ (1973) Flexible systems for the diagnosis of schizophrenia: report from the who international pilot study of schizophrenia. Science 182:1275–1278
11. Collins AA, Remington GJ, Coulter K, Birkett K (1997) Insight, neurocognitive function and symptom clusters in chronic schizophrenia. Schizophr Res 27:37–44
12. Cooke MA, Peters ER, Kuipers E, Kumari V (2005) Disease, deficit or denial? Models of poor insight in psychosis. ACTA Psychiatr Scand:1–14
13. Corapcioglu A, Aydemir O, Yildiz M (1999) Reliability of Turkish version of structured clinical assessment according to DSM-4 axis 1 mental disorders. Journal of Drug Treatment 12:33–36 (Turkish)
14. Corcoran R, Mercer G, Frith CD (1995) Schizophrenia, symptomatology and social inference: investigating "theory of mind" in people with schizophrenia. Schizophr Res 17:5–13
15. Cuesta MJ, Peralta V (1994) Lack of insight in schizophrenia. Schizophr Bull 20:359–366
16. Cuesta MJ, Peralta V, Caro F, Leon J (1995) Is poor insight in psychotic disorders associated with poor performance on the Wisconsin Card Sorting Test? Am J Psychiatry 152:1380–1382
17. Drake RJ, Lewis SW (2003) Insight and neurocognition in schizophrenia. Schizophr Res 62:165–173
18. Flashman L, Roth RM (2004) Neural correlates of unawareness of illness in psychosis. Insight and psychosis. Eds Amador X, David A, OUP, Oxford
19. Freudenreich O, Deckersbach T, Goff DC (2004) Insight into current symptoms of schizophrenia. Association with frontal cortical function and affect. ACTA Psychiatr Scand 110:14–20
20. Frith CD (1992) The cognitive neuropsychology of schizophrenia. Hove: Lawrence Erbaum Associates
21. Gambini O, Barbieri V, Scarone S (2004) Theory of Mind in schizophrenia: First person vs third person perspective. Consciousness and Cognition 13:39–46
22. Heaton RK (1981) Wisconsin Card Sorting Test. Odessa, FL: Psychological assessment resources
23. Herold R, Tenyi T, Lenard K, Trixler M (2002) Theory of mind deficit in people with schizophrenia during remission. Psychol Med 32:1125–1129
24. Inoue Y, Tonooka Y, Kazua Y, Shigenobu K (2004) Deficiency of theory of mind in patients with with remitted mood disorder. J Affect Disord 82:403–409
25. Janssen I, Krabbendam L, Jolles J, Van OS J (2003) Alterations in theory of mind in patients with schizophrenia and non-psychotic relatives. Acta Psychiatr Scand 108:110–117
26. Kelemen O, Keri S, Must A, Benedek G, Janka Z (2004) No evidence for impaired theory of mind in unaffected first-degree relatives of schizophrenia patients. ACTA Psychiatr Scand 110:146–149
27. Keshavan MS, Rabinowitz J, Desmedt G, Harvey PD, Schooler N (2004) Correlates of insight in first episode psychosis. Schizophr Res 70:187–194
28. Koren D, Seidman LJ, Poyurovsky M, et al. (2004) The neuropsychological basis of insight in first episode schizophrenia: a pilot metacognitive study. Schizophr Res 70:195–202
29. Langdon R, Colhearth M (2001) Visual perspective taking and schizotypy: evidence of simulation based account of mentalising in normal adults. Cognition 82:1–26
30. Lezak MD (2004) Neuropsychological assessment. Oxford University Press, 4th edition
31. Lysaker P, Bell M (1995) Work rehabilitation and improvements in insight in schizophrenia. J Nerv Ment Dis 183:103–106
32. Lysaker P, Bell MD, Bryson GJ, Kaplan E (1998) Insight and interpersonal function in schizophrenia. J Nerv Ment Dis 186:432–436
33. Lysaker PH, Carcione A, Dimaggio G, Johannesen JK, Nicolo G, Procacci M, Semerari A (2005) Metacognition amidst narratives of self and illness in schizophrenia: Association with neurocognition, symptoms, insight and quality of life. ACTA Psychiatr Scand 112:64–71
34. Mazza M, De Risio A, Surian L, Roncone R, Casacchia M (2001) Selective impairments of theory of mind in people with schizophrenia. Schizophr Res 47:299–308
35. Mintz AR, Dobson KS, Romney DM (2003) Insight in schizophrenia: a metaanalysis. Schizophr Res 61:75–88
36. Moore O, Cassidy E, Carr A, O'Callaghan E (1999) Unawareness of illness and its relationship with depression and self-deception in schizophrenia. Eur Psychiatry 14:264–269
37. Pinkham AE, Penn DL, Perkins DO, Liebermann J (2003) Implications for the neural basis of social cognition for the study of schizophrenia. Am J Psychiatry 160:815–824
38. Rossell SL, Coakes J, Shapleske J, Woodruff PW, David AS (2003) Insight: its relationship with cognitive function, brain volume and symptoms in schizophrenia. Psychol Med 33:111–119
39. Sabbagh MA (2004) Understanding the theory of mind contributions to theory of mind reasoning: implications for autism. Brain Cog 55:209–219
40. Smith TE, Hull JW, Israel LM, Willson DF (2000) Insight, Symptoms and Neurocognition in Schizophrenia and Schizoaffective Disorder. Schizophr Bull 26:193–200

41. Vogeley K, Bussfeld P, Newen A (2001) Mind reading neural mechanisms of theory of mind and self perspective. Neuroimage 14:170–181
42. Voruganti L, Heslegrave RJ, Awad AG (1997) Neurocognitive correlates of negative and positive syndromes in schizophrenia. Can J Psychiatry 42:1066–1071
43. Wechsler D (1981) WAIS-R manual. New York: Psychological Corporation
44. Young DA, Davilla R, Scher H (1993) Unawareness of illness and neuropsychological performance in chronic schizophrenia. Schizophr Res 10:117–124