Naive Theory Impairment in Schizophrenia
Is It Domain-Specific?

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Abstract: The ability to represent mental states of self and others to account for behavior is called *theory of mind* (ToM). This study examined whether ToM deficit in schizophrenia patients is a specific deficit in the cognitive component of interpersonal skills or a more global deficit, involving impaired information processing skills. Schizophrenia inpatients ($N = 41$) were compared with a control group of healthy subjects ($N = 22$) and to nonschizophrenia psychiatric patients (24 with affective disorders, seven with other psychosis) over a range of ToM tasks and another naive theory (theory of biology; ToB). Psychiatric inpatients as a whole showed significant deficit compared with the control group of healthy subjects in ToM tasks. The schizophrenia patients showed significantly larger deficits compared with patients suffering from affective disorder, while the performance of patients with nonschizophrenia psychosis was intermediate. In contrast, no difference was observed in the performance of the different groups on the ToB tasks. The fact that a deficit was found in ToM but not in ToB suggests a specific deficit in a cognitive component of interpersonal skills in schizophrenia rather than a general deficit in information processing skills. Naive theories deficits in schizophrenia seem to be domain-dependent.

Key Words: Theory of mind, theory of biology, schizophrenia, naive theory.

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One of the neuropsychological models for schizophrenia hypothesizes that patients experiencing a psychotic state have significant difficulties in meta-representation; specifically, that they have difficulties in representing mental states, both their own and those of others (Frith, 1994).

The ability to represent mental states of others (or self) including their beliefs, feelings, intentions, or knowledge and to account for their behavior was termed by Premack and Woodruff (1978) a *theory of mind* (ToM).

Several studies in recent years examined ToM in schizophrenia, all reporting ToM deficit in the acute phase of this disorder (Doody et al., 1998; Frith and Corcoran, 1996) but not in remission (Drury et al., 1998), suggesting that this deficit may constitute a state marker of this illness. The deficit was shown not to be accounted for by intelligence or memory on the one hand, and to explain the nature of some symptoms found in schizophrenia (e.g., paranoid delusions) on the other. For recent review of the literature concerning ToM in schizophrenia, see Brune (2005).

A similar deficit was reported in autism, where it is suggested to be permanent (Baron-Cohen, 1995). In this regard, Frith (1992) speculated on the existence of a common cognitive impairment of ToM in both disorders. The difference is that in general, autistic patients never develop a ToM, whereas schizophrenia patients do develop ToM abilities, but these are impaired during the acute phase.

In recent years, three conflicting views about ToM acquisition were discussed: (1) The *theory-theory*, which holds that ToM is mediated via an implicit theory about the structure and functioning of the human mind (Gopnik, 1993; Gopnik and Wellman, 1994; Wellman, 1990); (2) The *simulation approach*, according to which our ability to adopt the perspective of someone else and to imitate their mental activity forms the basis for the ability to perform "mind reading" (Gordon, 1986; Harris, 1991; Heal, 1986); and (3) the *innate module theory*, which maintains that the disposition for developing a ToM is inborn and unfolds through "natural" maturation rather than learning (Fodor, 1987; 1992).

The present study investigates whether the ToM deficit in schizophrenia patients is domain-specific, or the expression of a more global deficit in information processing skills. Theory of biology (ToB) was used as a benchmark, since ToB too is the fruit of conceptual development (Johnson and Carey, 1998), but unlike ToM, does not involve an interpersonal dimension. Further, to determine the specificity of this deficit, we included control groups of patients with affective disorders, nonschizophrenia other psychotics, and a group of healthy individuals.

Beyond the importance of deciding between the two competing approaches (modular versus more global ToM deficits), this study carries a marked clinical significance, due to the central importance of ToM for social adjustment (Charman et al., 2001; Happè and Frith, 1996). In the context of schizophrenia, improved understandings of the nature of the ToM deficit have implications for the diagnosis, treatment, and prognosis of the illness.

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METHODS

Subjects

Ninety-six participants, 42 women and 54 men (mean age = 32 years; *SD* = 11 years) from Beer-Sheva Mental Health Center in Israel, participated in the study. The study group included 23 patients with schizophrenia and 18 patients with schizoaffective disorder, diagnosed according to DSM-IV criteria (American Psychiatric Association, 1994). All patients were inpatients treated by psychotropic medications administered by an independent psychiatrist not involved in the study. The median duration of the illness in the sample was 5 years (range, 1–44 years). We defined two patient populations, one with 5 or more years of illness ($N = 22$, mean illness duration for this subgroup = 9.7; $SD = 8$) and the other with less than 5 years of illness ($N = 19$, mean duration = 1.0; $SD = 1.2$).

The study included three control groups:

- Twenty-two healthy subjects recruited from the Beer-Sheva Mental Health Center staff.
- Twenty-four patients suffering from affective disorders: 10 with bipolar disorder—manic type, eight with bipolar disorder—depressive type, four with major depression, one with cyclothymic disorder, and one with nonspecific mood disorder.
- Seven patients diagnosed by DSM-IV as suffering from psychotic disorder not otherwise specified.

Table 1 portrays the demographic and illness related data of the study and control groups. The study and the control groups were of substantially the same age. The healthy subjects had a statistically significantly higher intelligence score as compared with the other study and control groups ($F[3,92] = 10.5$; $p < 0.0001$). Accordingly, intelligence was introduced as a covariant in the analyses. There were no differences between the study and the patient control groups as to age of illness onset.

Instruments

ToM Assessment

ToM Verbal Stories

Six ToM stories (Frith and Corcoran, 1996) were used. These stories test the ability of subjects to appreciate trickery and first-order and second-order false beliefs (beliefs about beliefs). After each story was read out, two questions were asked. The first was the ToM question that could only be answered if the mental state of the character in the story is inferred. The second question was a memory question and served as a control and depended on the subjects' cooperation, understanding, and memory of the plot. To answer it, only general characteristics of the situation had to be understood, but ToM was not involved.

ToM Cartoon Stories

To control for difficulties with linguistically encoded information, we also used a set of cartoon stories. This task consists of 32 short comic strips (Sarfati et al., 1997). Four strips served for practice, and are followed by two sets of 14 strips each, of comparable difficulty. Each strip consists of three drawings that depict a character engaged in some activity, and whose mental state can readily be derived. After the subjects have seen these pictures, they are asked to select as quickly as they can the most appropriate picture from three given alternatives that continue the story. Only one of these pictures concludes the story in a way that fits the mental state of the character. One of the alternatives shows the character performing some common everyday activity, while the other is superficially similar to the last picture presented. This paradigm allows the identification of the compensatory strategy used by the subject.

ToB Assessment

The items in this questionnaire were taken from the study by Johnson and Carey (1998), who devised two batteries based on the distinction of (1) general knowledge consistent with the conceptual repertoire of normally developing preschool children (the T1 battery) and (2) folk biological concepts normally acquired between 6 and 12 years that require conceptual change for their construction (life, death, people-as-one-animal-among-many, species kind as determined by origin of the animal; the T2 battery). Johnson and Carey (1998) provide normative data for the performance of both adults and children on these tasks.

Intelligence Assessment: Vocabulary and Block Design Subscales of the WISC-R

This combination is one of the best and most common ways to evaluate intelligence on the basis of a short test (Groth-Marant, 1999). Correlation with overall intelligence

TABLE 1. Demographic and Illness-Related Data of the Study Subjects

	Schizophrenia (1) (N = 41)				Affective Disorders (2) (N = 24)		NOS-Psychosis (3) (N = 7)		Healthy Control (4) (N = 22)				
	<5 y of Illness (N = 19)		≥5 y of Illness (N = 22)										
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	ANOVA	*p*	LSD
Age (y)	38.6	10	28.0	10	27.7	13	26.9	11	34.8	9	$F(3,92) = 2.48$	NS	
Sex (M:F)	10:9		17:5		15:11		6:1		7:15				
IQ	93.4	12	94.7	14	100.5	13	98.0	22	113.3	10	$F(3,92) = 1.5$	<0.001	4 > 1,2,3
Onset of illness	25.7	11	24.9	10	24.0	13	31.0	14			$F(2,72) = 1.33$	NS	
Duration of illness	1.2	0.4	9.7	8	2.2	2	1.0	0			$F(2,72) = 7.72$	<0.001	

score is around 0.9 (Brooker and Cyr, 1986; Hoffman and Nelson, 1988; Silverstein, 1982). The administration of the subtests and their scoring was based on the scoring guide and the norms of the Hebrew version of the WISC-R. We used the children's version for several reasons. First, this version is easier for most schizophrenia patients, and a larger variance of scores is obtained. Support for the use of this version with adults with cognitive impairment is found in Lawson and Inglis (1989) and Feingold (1985). Second, Israeli norms have been established for the children's version, but none are available for the adults version. Lastly, we wanted to use the vocabulary subscale, as it is known to provide robust and valid information. Since there is no valid and reliable vocabulary test in the adult version in Israel, we were driven to use one developed for children.

Positive and Negative Syndromes Scale

The Positive and Negative Syndromes Scale (PANSS; Kay et al., 1987) is a reliable and validated semistructured interview for measuring positive and negative symptoms and their relation to general psychopathology. Thirty items are scored between 30 (no symptoms) to 210 (most severe symptoms). The score of the first 7 items is referred to as the Positive syndrome subscale score; the score of items 8 to 15 forms the Negative syndrome subscale score, and that of items 15 to 30 the General psychopathology subscale score. The score of all items (1–30) is referred to as the total PANSS score. The scale is composed of five subscales (thought disorders, paranoia, depression, activation, and energy). A score above 60 is considered clinically significant (Keck et al., 1998).

Hamilton Depression Rating Scale

The Hamilton Depression Rating Scale (HDRS; 17 items; Hamilton, 1967, 1982) is scored by clinicians. Eight items range from 0 (not having the symptom) to 4 (severe presentation of the symptom). In 9 items, symptoms are either present or absent. Interrater reliability is about 0.9, and reported correlations with general assessment of depression are 0.84 and above (Hamilton, 1982).

Young Mania Rating Scale

The Young Mania Rating Scale (YMRS; Young et al., 1978) is an 11-item questionnaire that measures severity of manic symptoms during the last 48 hours. Total score range is between 0 and 60 points. A score above 12 is clinically significant (Keck et al., 1998).

Procedure

All subjects signed a consent form following a detailed explanation of the study procedure. All candidates were diagnosed according to DSM-IV criteria. Study scales were administered by research psychologists well experienced with these scales.

The experimental tasks were administered in the following order: (1) six ToM stories, (2) 14 ToM comic strips, (3) the ToB questionnaire, and (4) the intelligence test. All subjects were allowed to perform the tasks in two sessions held in the morning hours (9–12 AM) within a 48-hour period.

RESULTS

Demographic and illness-related data of the study subjects, including assessment of symptomatology of the patients' study groups, are presented in Table 1. Table 2 summarizes the psychopathology in the patient study groups. Schizophrenia patients and nonspecific psychotic disorders were assessed by the PANSS. Affective disorders patients demonstrating manic episodes were assessed by YMRS, and bipolar depressed patients and major depressive patients were assessed by HDRS.

ToM Assessment

Each story was followed by two questions, a ToM question and a control question testing memory. A subject score on a set of three ToM questions (either first-order or second-order) was the proportion of correct ToM answers out of the total ToM questions. Separate scores were given for the set of first-order and the second-order ToM questions. Whenever a subject failed to answer a memory question, the corresponding ToM question was removed from analysis. Subjects who failed all three memory questions of a given set were removed from the analysis. Two schizophrenia patients were removed from analysis due to a failure in the first-order question set and one due to a failure in the second-order set. ANOVA test was then applied with intelligence taken as a covariant. The results are summarized in Figure 1.

TABLE 2. Assessment of Psychopathology in the Patient Study Groups

	Schizophrenia (N = 41)							Affective Disorders (n=24)							
	<5 y of Illness (N = 19)		≥5 y of Illness (N = 22)		NOS-Psychosis (N = 7)			Bipolar Disorders: Manic Type (N = 10)		Bipolar Disorders: Depressive Type (N = 8)		Major Depression (N = 4)		Other Mood Disorder (N = 2)	
PANSS Subscales	Mean Score	*SD*	Mean Score	*SD*	Mean Score	*SD*		Mean Score	*SD*	Mean Score	*SD*	Mean Score	*SD*	Mean Score	*SD*
PANSS Positive	20	7	19	8	10	2	YMRS	25	7						
PANSS Negative	15	7	12	4	10	7	HDRS			17	4	17	4	13	2
PANSS General psychopathology	35	6	32	7	23	7									
PANSS total	70	15	63	15	43	15									

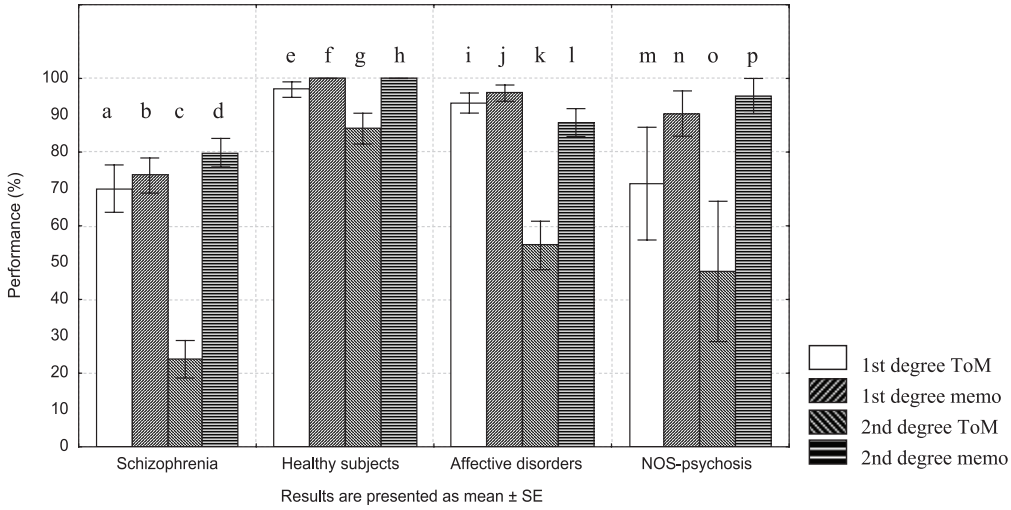

FIGURE 1. Performance on ToM questions by group.

First-Order ToM Stories

Memory (Control) Questions

The control questions score were calculated as the proportion of correct answers of each set of three questions. One-way ANCOVA revealed a significant difference between the schizophrenia group and the three control groups ($F[3,85] = 3.63$; $p < 0.0162$). A post hoc LSD test showed that the scores for schizophrenia patients were lower than those of both the normal control subjects ($p < 0.00001$) and the patients with affective disorders ($p < 0.0002$).

ToM Questions

ANCOVA with ToM score as a dependent variable, grouping as independent variable, and intelligence as a covariate showed no significant main effect between the study groups ($F[3,83] = 2.19$; NS).

Second-Order ToM Stories

Memory (Control) Questions

A one-way ANCOVA with intelligence as covariant failed to reveal a significant difference between study and control groups ($F[3,85] = 2.2$; NS).

ToM Questions

ANCOVA with ToM as dependent variable, grouping as independent variable, and intelligence as covariate revealed a significant effect ($F[3,84] = 5.84$; $p < 0.001$). A post hoc LSD test showed that the scores of schizophrenia patients were lower than those of the affective disorders patients. All three patient groups fared worse than the healthy control group.

ToM Stories in Participants Without Memory Deficit

In this analysis, we include only those subjects who gave correct answers to all the control questions of the first-order and second-order sets of questions. In first-order ToM stories, the sample was reduced to 22 schizophrenia patients, four NOS psychotic patients, and 22 normal control subjects. An ANOVA did not indicate any difference between the groups ($F[3,61] = 1.73$; NS). Regarding second-order ToM stories, the sample was reduced to 23 schizophrenia patients, 17 affective disorders patients, six NOS psychotic patients, and 22 normal control subjects. This time, an ANOVA demonstrated a significant difference between the subjects' groups ($F[3,56]=5.48$; $p < 0.0023$). The means and *SE* scores for second-order ToM stories are shown in Figure 2. A LSD post hoc test established the following differences between the groups: schizophrenia patients showed lower scores compared with healthy control group ($p < 0.00001$) and affective disorders group ($p < 0.0163$); the affective disorders group itself scored lower than the normal control group ($p < 0.0018$), and the same was true of the NOS psychotic group ($p < 0.013$).

These findings point to a significant impairment of second-order ToM skills in the patient groups, which seems to be unrelated to intelligence or memory. Schizophrenia patients present the greatest impairment compared with the other patient groups. Affective disorders patients also exhibit impairment but seem to perform better than schizophrenia patients, while NOS psychotic patients hold an intermediate position among the three patient groups.

ToM Nonverbal Task (Comic strip)

The number of times the subject selected the correct card was taken as the dependent variable. One-way ANOVA showed a significant effect of study group ($F[3,88] = 10.22$; $p < 0.0000$), which, however, disappeared when intelligence was introduced into the analysis as a covariate ($F[3,84] = 1.49$; NS).

ToB Assessment

A repeated-measures ANOVA for the three T1-level questions taken together failed to indicate a difference between the groups ($F[6,168] = 1.77$; NS). One-way ANOVAs for individual questions also did not demonstrate differences between the groups.

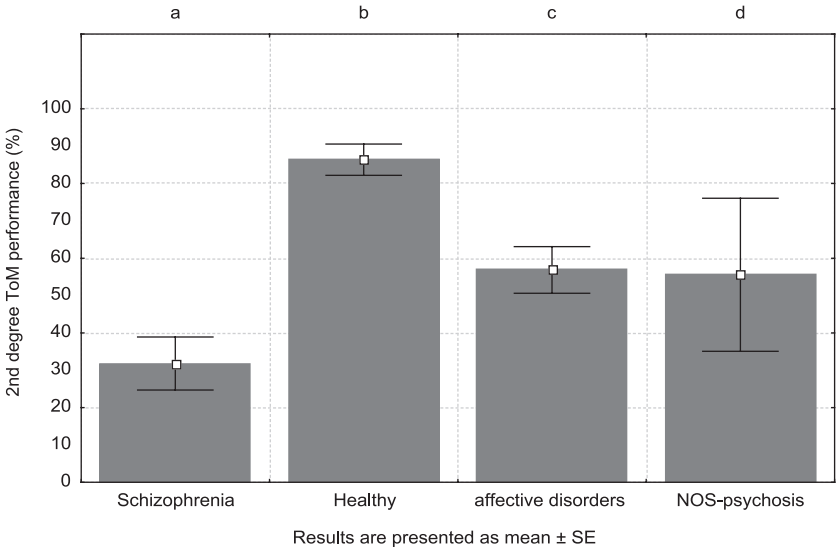

FIGURE 2. Performance on second-order ToM stories in subjects with intact memory by group.

The possible scores for the five questions testing advanced ToB (T2 battery) are correct/incorrect. One point was scored whenever the subject answered a question correctly, and these points where then summed for each subject. This procedure yields an ordinal variable, with a range of 0 to 5 points, which was taken as the dependent variable in the use of ANOVA. A one-way ANOVA showed no difference for any of the T1 or T2 ToB scores between the groups (Table 3).

Relationship of ToM With Clinical Features

No significant correlation was found between any of the ToM measures and the symptoms' presentation as measured by the PANSS (total, Positive, Negative, and General psychopathology subscores), YMRS, and HDRS. We also looked for the contribution of demographic and illness related factors to ToM differences between the schizophrenia and control groups, including age, gender, and duration of illness, and onset of illness variables. Regression equations did not show significant relationship between age and first-degree and second-degree ToM performance ($\beta = -.12$; $R^2 = .01$, NS; $\beta = -.08$; $R^2 = .01$, NS respectively), and the same holds for memory questions ($\beta = -.07$; $R^2 = .00$; NS) and comic strips ($\beta = -.10$; $R^2 = .01$; NS).

An ANOVA with second-order ToM as dependent variable and gender and study group as independent variables showed a significant main effect both for the study group (schizophrenia vs. healthy: $F[1,59] = 51.91$; $p < 0.0001$) and for gender ($F[1,59] = 4.15$; $p < 0.05$), with males performing better then females. However, the absence of an interaction between group and gender implies that this difference is not specific for schizophrenia. Interestingly, when intelligence is introduced as a covariate, the above difference in ToM performance between male and female disappears ($F[1,56] = 2.47$; NS).

Next, we examined the effect of the duration of illness for schizophrenia patients (up to 5 years/more or equal to 5 years) on ToM deficits, using ANOVA. Two variables, memory questions and comic strip, were found to be affected by duration of illness. Memory questions showed differential results: while the performance of chronic patients did not differ from that of healthy controls ($F[1,20] = .76$; NS), that of patients with shorter duration of illness (up to 5 years of illness) was impaired compared with the healthy controls ($F[1,34] = 22.25$; $p < 0.0001$) even when intelligence was used as a covariate ($F[1,40] = 10.31$; $p < 0.003$). Comic strips showed impaired performance for both schizophrenia groups (up to 5 years of illness: $F[1,42] = 19.91$; $p < 0.0001$, more or equal to 5 years of illness: $F[1,39] = 98.92$; $p < 0.0001$). Comparison of the two schizophrenia patient groups

TABLE 3. Performance in ToB Tasks by Group (Mean ± *SD*)

	Schizophrenia (1) (*N* = 41)		Affective Disorders (2) (*N* = 24)		NOS-Psychosis (3) (*N* = 7)		Healthy Control (4) (*N* = 22)			
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***	**ANOVA**	***p***
T1										
Properties	94	16	96	12	93	19	97	11	$F(3,84) = .13$	NS
Worm	16	37	26	50	14	56	49	36	$F(3,84) = .75$	NS
"Chiffonic membrane"	34	38	40	38	61	54	45	47	$F(3,83) = .75$	NS
T2	3.19	1.40	3.36	1.59	3.47	1.68	2.57	1.27	$F(3,87) = .68$	NS

demonstrated a significant difference ($F[1,39] = 5.67$; $p < 0.022$), with the more chronic patients performing more poorly. The difference remained significant after intelligence was taken as a covariate ($F[1,37] = 6.67$; $p < 0.014$).

To examine the effect of onset of illness, we divided the schizophrenia patients into three subgroups: onset before age 20 ($N = 14$), onset between 20 and 30 ($N = 18$), and onset after the age of 30 ($N = 9$). Using onset of illness as independent variable in ANOVA, significant effects were found for first-order memory questions ($F[2,40] = 4.85$; $p < 0.01$). LSD post hoc test showed that late onset (after age 30) performed worse then the two groups with earlier onset ($p < 0.04$). A significant effect was also found for onset and first-order ToM questions ($F[2,36] = 3.82$; $p < 0.03$): the later the onset of illness, the more impaired the ToM performance. No effect was found for age of onset on second-order ToM performance.

DISCUSSION

Modularity and ToM

We found that all patient groups exhibited a significant deficit in second-order verbal and nonverbal ToM skills in comparison to healthy subjects, and this deficit cannot be accounted for by intelligence or memory. Schizophrenia patients were more affected than the two other groups of patients. Nonschizophrenia psychotic patients were more affected than patients suffering from affective disorders.

The view above assumes the cognitive deficit in schizophrenia is focused—and thus affects specific modules, possibly higher cognitive functions. Alternatively, schizophrenia may be an illness that has wide-ranging effects at lower levels, such as basic neurological functioning. Phillips and Silverstein (2003) show how specific deficits found in schizophrenia (impaired perception, preattentive sensory gating, selective attention, working memory, long-term memory, and other deficits related to context processing) may all be accounted for with reference to a failure in cognitive coordination. Such coordination processes are complementary to local specialized functions. The authors point to the role of failure of coordination mechanisms in psychotic states, especially in disorganized schizophrenia. It is possible, from that point of view, that the failure in ToM does not prove the existence of a ToM module, but rather arises from the loading of the tasks used to assess ToM on cognitive coordination (Leiser and Bonshtein, 2003). Those tasks may require the coordination of several pieces of information, which constitutes a specific source of cognitive complexity (Astington et al., 2002; Halford et al., 1998; Waltz et al., 1998; 1999). Specifically, in the false belief task, subjects must maintain in memory and logically coordinate the belief about the actual state of affairs, the belief of the first character about that state of affairs, and the beliefs of the second character about those of the first one. The comic strip task throws some light on precisely this issue. Selecting the correct picture in that task reflects the construction of a context to the activity of the character, which relies on the coordination between the successive frames in the story. Failure on the task takes place in an alternate context, in which the subject relies on a well-known everyday activity to endow the comic strip with meaning, or with even more impoverished contexts, subjects rely on the last picture of the series to provide a context of selection (see also Sarfati and Hardy-Balyle, 1999; Sarfati et al., 1997, 2000).

Psychosis, then, whether schizophrenia or affective, may lead to the construction of a context based on past experience in general, not on the specifics of the event at hand. This finding may be interpreted in two ways: as just one case of failure of coordination, or as a deficit in the interpersonal component, required for understanding the specific context required by the story.

A closer comparison of the performance on the two forms of ToM tasks (verbal and nonverbal) may shed some additional light on this issue. While the comic strip task is heavily loaded on the context factor, the same is not true of the verbal task (especially of second-order). This can also be seen from the loading of the comic strip and first-order ToM tasks on intelligence, which is absent from the second-order ToM stories. Our interpretation is that there is a certain effect of coordination, but that there is a specific deficit in ToM, over and beyond the effect of impairment in processing context.

Moreover, the fact that no differences were found in ToB tasks between any of the patient groups and the healthy control group, or among the three patient groups, supports our interpretation. The deficit exhibited by the schizophrenia patients appears to be specific to ToM, rather than a consequence of a general difficulty with deploying a naive theory. Since ToM is but one of a variety of naive theoretical constructions to be found in humans, our results lend support to the modularity view rather than to the "theory theory" view of ToM.

Relation Between Clinical Features and ToM Deficits in the Acute Phase of Schizophrenia

Duration of Illness

Subjects with illness duration up to 5 years scored more poorly in memory questions than healthy subjects, whereas, somewhat surprisingly, chronic patients did not differ from controls. These results are compatible with the course of schizophrenia, in which later episodes are relatively more moderate than the first ones (Buchanan and Carpenter, 2000). It is possible that the better memory performance of chronic patients indicates a better adjustment of the patients to their illness and familiarity with hospitalization and treatment.

Comic strips performance was impaired in the two subgroups of schizophrenia patients compared with controls, but chronic schizophrenia patients performed worse than patients with illness of up to 5 years in duration. These results suggest that while memory abilities as indicated by the control questions are less impaired in chronic patients compared with those with shorter illness duration, chronic schizophrenia patients' performance is more impaired on the nonverbal ToM tasks. The two groups did not differ in their ToM performance.

A possible interpretation of these findings may be attempted with reference to a dynamic process related to the illness course. Prolonged periods of illness come with more negative signs and fewer positive ones. Memory tasks may be

related to positive symptoms, while comic strip capacities are more related to negative symptoms.

Illness onset was found to be related to performance on both memory tasks and first-order ToM tasks: patients with later onset were more impaired in the acute phase. This is curious, since those tasks are easy, and even children with autism perform successfully. Further, as TOM scores and the PANSS (total and subscale) scores are uncorrelated, the severity of the symptoms does not account for this finding. The issue deserves attention in the future.

CONCLUSION

The present study adds to the developing understanding of ToM deficit in schizophrenia. Its findings support the modular theory of ToM, suggesting a selective impairment of the module or modules mediating ToM functions, and weaken the alternative interpretation that ToM impairment is but one manifestation of a broader deficit. The ability to maintain a naive theory in general (like the biological naive theory) seems not to be affected by the illness.

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