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''Theory of Mind'' and Executive Functioning in Forensic Patients with Schizophrenia

ABSTRACT: Previous studies in forensic patients with schizophrenia have shown that delinquent patients may outperform nondelinquent patients with regards to ''theory of mind'' (ToM). Findings were, however, confounded by a lack of control for executive functioning. We examined 33 forensic patients with schizophrenia regarding ToM, intelligence, executive functioning, and psychopathology. Results were compared with a nonforensic schizophrenia sample and a group of healthy controls. Both patient groups performed more poorly on most measures compared with controls. Forensic and nonforensic patients did not differ in task performance. In the forensic group ToM correlated inversely with ''excitement'' and cognitive symptoms. When ''excitement'' was covaried out, forensic patients outperformed nonforensic patients with regards to ToM. This study supports the hypothesis that schizophrenic patients with a criminal record are equally impaired in their ability to infer mental states compared with nonforensic patients, but for different reasons associated with a divergent psychopathological profile.

KEYWORDS: forensic science, theory of mind, schizophrenia, excitement, intelligence, executive functioning

The term ''theory of mind'' (ToM), first introduced by primatologists (1), refers to the cognitive capacity to represent one's own and other persons' mental states in terms of beliefs, desires, intentions, and feelings. Following studies into ToM development in young children (2), abundant research has been dedicated to the question whether or not ToM is impaired in neuropsychiatric disorders (3). It is now widely accepted that patients with schizophrenia have difficulties in appreciating the mental states of others and in awareness of their own mental states (4). For example, misinterpreting other persons' intentions due to an inability to discriminate between reality and subjective representation may cause delusional ideation. Moreover, difficulties in understanding one's own behavior as the result of self-generated intentions may lead to the conviction to be under alien control. Finally, the inability to initiate an action on the basis of one's own intentions may manifest in the form of disorganized behavior (5).

It has repeatedly been demonstrated that impaired ToM in schizophrenia is a pre-eminent predictor of poor social competence (6), including a lack of appreciation of social rules and norms (7). While delinquent behavior reflects a severe violation of social regulations, the association of poor ToM and delinquency is, however, all but straightforward. For example, in nonpsychotic individuals with psychopathy ToM seems at least to be preserved (8,9). In contrast, Asperger's syndrome, a neuropsychiatric condition associated with pronounced ToM deficits, has been shown to be potentially linked with certain types of serial offending, including homicide (10–13). This is counterintuitive if one assumes that such types of delinquent behavior require intact executive planning skills as well as the ability to anticipate the victims' mental states—at least to some degree. In a recent study, Murphy (14) compared three groups of forensic patients with Asperger's syndrome, schizophrenia, and personality disorders (antisocial and/or borderline personality disorder) regarding their ToM task performance. Patients with schizophrenia and those with Asperger's syndrome performed more poorly on ToM tasks compared with forensic patients with personality disorders (14). This suggests that superior ToM skills are neither necessary nor sufficient to explain an individual's propensity of delinquent behavior. Within the diagnostic category of schizophrenia, however, Abu-Akel and Abushua'leh (15) found that violent males with paranoid schizophrenia performed significantly worse on tasks involving empathy or recognition of ''faux pas,'' but outperformed the nonviolent group on higher-level ToM tasks. This finding could lend support to the hypothesis that—within the diagnostic boundaries of a defined phenotype—antisocial behavior is associated with better ToM abilities compared to less antisocial individuals. The above-mentioned studies were, however, to some extent limited in explanatory power due to the relatively small number of participants in each patient group and lack of control for neurocognitive functioning.

We, therefore, sought to examine a larger sample of forensic in-patients with schizophrenia who were treated in a maximum-security psychiatric hospital with regards to ToM performance, premorbid intelligence, executive functioning, and psychopathology, and to compare the results with those of a previously tested nonforensic sample using an identical design (6). Based on the theoretical background outlined above, we hypothesized that forensic patients with schizophrenia would outperform nonforensic patients in their ability to appreciate mental states of others (i.e., ToM).

Methods

Participants

Thirty-three schizophrenic patients (32 males, 1 female) detained in a high-security forensic psychiatric hospital were compared with a sample of 38 schizophrenic patients (18 males, 20 females) in

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regular psychiatric care, and with a group of 29 healthy controls (10 male, 19 female) recruited from students of psychology, their relatives, and hospital staff.

All patients were diagnosed with schizophrenia according to DSM-IV criteria (16) and gave their written informed consent to participate in the study. All but one forensic patient received antipsychotic medication. In the forensic group, 27 patients (81.8%) showed a history of either drug or alcohol abuse compared with 20 patients in the nonforensic group (52.6%). Among the healthy control group, no such history was evident.

The forensic patients' mean age at onset of the disorder was 21.8 years (12–38 years; SD = 5.2 years) and the mean duration of illness was 9.7 years (1–28 years; SD = 7.4 years). The nonforensic patients' mean age at onset of the disorder was 27.4 years (15–61 years; SD = 11 years), their mean duration of illness was 8.8 years (0–33 years; SD = 8.2 years).

At the time of assessment, forensic patients' mean age was 31.5 years (range 20–50 years), nonforensic patients' mean age was 35.9 years (18–68 years; SD = 11.6 years) and the healthy controls' mean age was 37.0 years (19–65 years; SD = 13.7 years).

The delinquent group showed a heterogeneous pattern of criminal records, varying from repetitive minor offenses [obstructing the police (1), encroachment on traffic (1), drink-driving (1)] to capital crime [theft/robbery (9), arson (3), coercion (1), criminal assault (2), serial sexual offenses (5), (severe) bodily harm (10), and manslaughter (9)]. Six patients were detained while awaiting their trial, 27 were already convicted.

Neuropsychological Tasks

Verbal intelligence was screened using the "Mehrfachwahlwortschatztest" (17), which is similar to the "Spot-The-Word-Test" (18), and practical intelligence was measured using the Picture Completion subtest of the "Hamburg-Wechsler-Intelligenz-Test für Erwachsene" (HAWIE-R; 19). Level of education was determined by the highest grade accomplished at school.

Cognitive flexibility and executive planning skills were examined using (i) a computerized and simplified version of the Wisconsin Card Sorting Test (WCST; 20), and (ii) the first part of the Zoo Map Test taken from the Behavioural Assessment of the Dysexecutive Syndrome (BADS; 21).

ToM abilities were assessed using a computerized series of six picture stories (22). The three story types depicted (i) the cooperation of two characters, (ii) one character deceiving another, and (iii) two characters cooperating to deceive a third. Each story consisted of four pictures, presented in random order. Subjects had to sequence the cartoon stories and to answer a number of questions addressing the mental states of the cartoon characters. The sequencing time was taken for each of the six stories and the way of rating the sequencing task was adopted from Langdon et al. (23). The maximum score for correct sequencing was 36 points (six per cartoon), and 23 points for answering the mental state questions correctly. Thus, the total ToM score was 59 points maximum (for further details, see [6]).

Behavioral Measures

Psychopathology was measured using the Positive and Negative Symptom Scale (PANSS; 24). We used a five-factor model of the PANSS comprising a negative, positive, excitement, cognitive and depression, and anxiety component (25). The patients' psychopathology was rated blind to their performance on the MWT, executive functioning, and ToM tasks.

Statistics

For normally distributed variables, we used parametric tests including Bonferroni-corrected ANOVA for comparisons between healthy controls and the two patient groups, as well as student's *t*-tests for comparisons between forensic and nonforensic patients. For non-normally distributed variables we used the respective nonparametric tests. Statistical analyses were carried out using SPSS 12.0 for Windows.

Results

Between-group Differences

Patients with a forensic background did not differ from nonforensic patients or controls regarding age. However, both forensic and nonforensic schizophrenia patients performed more poorly, relative to controls, on measures of verbal intelligence, executive functioning, and ToM. The three groups also differed significantly in terms of gender distribution (for details, see Table 1). Specifically, males were over-represented in the forensic group relative to the two other groups (forensic–controls: MD = 0.62; SE = 0.11; $p < 0.001$; forensic–nonforensic: MD = 0.50; SE = 0.10; $p < 0.001$), with equal gender distribution between the nonforensic schizophrenia group and controls (MD = 0.13; SE = 0.10; $p = 0.645$). Thus, to control for gender effects, we performed separate analyses in which we included only male patients. As no differences emerged compared to whole-group comparisons, we continue to report group statistics for the mixed-gender groups.

Comparisons of demographic variables between forensic and nonforensic schizophrenia patients revealed that both groups did not differ regarding the duration of the schizophrenic illness ($t = -0.470$; df = 68; $p = 1.0$) or level of education (MD = 0.67; SE = 0.35; $p = 0.175$). However, forensic patients were significantly younger at the onset of the disorder compared with nonforensic schizophrenia patients (MD = 5.64; SE = 1.77; $p = 0.006$). Moreover, forensic patients had significantly more often a history of drug or alcohol abuse compared with the nonforensic schizophrenia patients ($chi^2 = 8.803$; df = 1; $p = 0.003$) (Table 2).

With regards to neuropsychological performance, the two patient groups showed no significant differences regarding verbal IQ as measured using the MWT (MD = 6.59; SE = 3.13; $p = 0.115$) or practical IQ as measured using the picture-completion task taken from the HAWIE (MD = 1.06; SE = 0.89; $p = 0.705$). By contrast, forensic patients made significantly more errors in the WCST (MD = −4.06; SE = 1.19; $p = 0.003$), while the two patient groups showed no significant differences concerning the number of perseverative errors (Mann–Whitney $U = 513.0$; $Z = -1.158$; $p = 0.247$). The performance on the Zoo Map Test (MD = −0.98; SE = 1.02; $p = 1.0$) did not differ significantly between the groups.

We found significant differences between the forensic and the nonforensic schizophrenia groups with regards to the ToM questionnaire (which was not normally distributed, thus: Mann–Whitney $U = 386.5$; $Z = -2.828$; $p = 0.005$), but no differences regarding the sequencing task (MD = 1.50; SE = 1.33; $p = 0.793$) or ToM total score (MD = 0.58; SE = 1.76; $p = 1.0$) (Table 3).

With respect to psychopathology, we found no significant differences between the groups concerning the PANSS-positive (MD = −1.29; SE = 0.96; $p = 0.549$), negative (MD = −2.24; SE = 1.36; $p = 0.311$), or the depression and anxiety components (MD = 1.73; SE = 0.73; $p = 0.058$). However, forensic patients showed significantly more excitement (MD = −3.03; SE = 0.46; $p < 0.001$) and cognitive symptoms (MD = −2.13; SE = 0.80; $p = 0.027$), relative to nonforensic schizophrenia patients.

TABLE 1—*Comparison of executive functioning, intelligence, psychopathology, and theory of mind of forensic and nonforensic patients with healthy controls (Bonferroni-corrected).*

			MD	SE	Significance
Age	forensic (31.8 ± 7.4)	control (36.7 ± 13.4)	−4.9	2.90	$p = 0.283$, n.s.
	nonforensic (35.4 ± 11.6)	control (36.7 ± 13.4)	−1.29	2.84	$p = 1.0$
Level of education	forensic (1.77 ± 1.56)	control (3.04 ± 0.85)	−1.26	0.37	$p = 0.003$
	nonforensic (2.44 ± 1.58)	control (3.04 ± 0.85)	−0.60	0.36	$p = 0.308$
IQ	forensic (95.9 ± 11.3)	control (111.1 ± 13.4)	−15.1	3.32	$p < 0.001$
	nonforensic (102.5 ± 13.3)	control (111.1 ± 13.4)	−3.3	3.25	$p = 0.030$
Picture completion	forensic (10.7 ± 4.2)	control (13.7 ± 2.3)	−3.0	0.94	$p = 0.005$
	nonforensic (11.7 ± 3.8)	control (13.7 ± 2.3)	−2.0	0.92	$p = 0.705$, n.s.
WCST errors	forensic (12.2 ± 6.8)	control (5.6 ± 3.0)	6.7	1.27	$p < 0.001$
	nonforensic (8.2 ± 3.7)	control (5.6 ± 3.0)	2.7	1.24	$p = 0.100$, n.s.
WCST pers. errors*	forensic (5.0 ± 6.6)	control (0.9 ± 1.4)	$U = 165.5$	$Z = -4.39$	$p < 0.001$
	nonforensic (3.0 ± 3.0)	control (0.9 ± 1.4)	$U = 234.5$	$Z = -3.86$	$p < 0.001$
Zoo Map Test	forensic (1.0 ± 5.1)	control (4.4 ± 3.6)	−3.3	1.08	$p = 0.008$
	nonforensic (0.1 ± 3.4)	control (4.4 ± 3.6)	−4.3	1.06	$p < 0.001$
ToM overall (max. 59 pts.)	forensic (49.1 ± 8.8)	control (55.9 ± 3.5)	−6.8	1.87	$p = 0.001$
	nonforensic (49.7 ± 7.4)	control (55.9 ± 3.5)	−6.2	1.83	$p = 0.003$

ToM, theory of mind; WCST, Wisconsin Card Sorting Test; MD, mean difference; SE, standard error.
*Compared using nonparametric Kruskal–Wallis tests.

TABLE 2—*Demographic characteristics (incl. standard deviations) for forensic and nonforensic patients with schizophrenia.*

	Forensic	Nonforensic	*p*-values
N	33	38	
Sex ratio (m:f)	32:1	18:20	$p < 0.001$
Index age (years)	31.8 (±7.4)	35.4 (±11.6)	$p = 0.571$, n.s.
Age at onset (years)	21.8 (±5.2)	27.4 (±11.0)	$p = 0.006$
Duration of illness (years)*	9.7 (±7.4)	8.8 (±8.2)	$p = 0.640$, n.s.
History of drug or alcohol abuse	27 (81.8%)	20 (52.6%)	$p = 0.003$

*Compared using student's *t*-test

TABLE 3—*Comparison of neurocognitive functioning, theory of mind task performance, and psychopathology scores (incl. standard deviations) between forensic and nonforensic patients with schizophrenia (Bonferroni-corrected).*

	Forensic	Nonforensic	*p*-Values
IQ (MWT score)	95.9 (±11.0)	102.5 (±13.3)	$p = 0.115$, n.s.
WCST errors	12.3 (±6.8)	8.2 (±3.7)	$p = 0.003$
WCST perseverative errors*	5.0 (±6.6)	3.0 (±3.0)	$p = 247$, n.s.
Zoo Map Test	1.1 (±5.1)	0.1 (±3.4)	$p = 1.0$, n.s.
Picture completion	10.7 (±4.2)	11.7 (±3.8)	$p = 0.705$, n.s.
ToM Sequencing task (max. 36 pts.)	28.4 (±6.6)	29.9 (±5.8)	$p = 0.793$, n.s.
ToM Questionnaire (max. 23 pts.)*	20.9 (±3.4)	19.2 (±3.5)	$p = 0.005$
ToM overall (max. 59 pts.)	49.1 (±8.8)	49.7 (±7.4)	$p = 1.0$, n.s.
PANSS Excitement Component	10.3 (±2.3)	7.3 (±1.9)	$p < 0.001$
PANSS Positive Component	11.6 (±4.2)	10.3 (±4.9)	$p = 0.549$, n.s.
PANSS Negative Component	18.4 (±4.9)	16.2 (±7.6)	$p = 0.311$, n.s.
PANSS Cognitive Component	13.5 (±3.6)	11.4 (±3.7)	$p = 0.027$
PANSS Depr/Anx Component	10.7 (±2.9)	12.4 (±3.2)	$p = 0.058$, n.s.

PANSS, Positive and Negative Symptom Scale; ToM, theory of mind; WCST, Wisconsin Card Sorting Test.
*Compared using nonparametric Mann–Whitney *U*-tests.

A subsequent ANCOVA revealed significant differences between forensic and nonforensic schizophrenia patients in the overall ToM results when "excitement" was controlled for ($F = 5.152$; df = 67; $p = 0.026$), with forensic patients outperforming the nonforensic group after covarying out the "excitement" factor of the PANSS. No difference in ToM task performance emerged when the PANSS cognitive component ($F = 1.978$; df = 1; $p = 0.164$), verbal IQ ($F = 1.117$; df = 1; $p = 0.294$), or executive functioning as measured using the number of errors in the WCST ($F = 1.250$; df = 1; $p = 0.268$) were covaried out.

Correlations Within the Two Patient Groups

Parametric correlation analyses in the forensic group revealed that ToM task performance correlated with patients' practical intelligence as measured using the picture completion task ($r = 0.494$, $p = 0.003$), inversely with the amount of WCST perseverative errors ($r = -0.598$, $p < 0.001$) and with the performance on the Zoo Map Test ($r = 0.346$, $p = 0.048$). We found, using Spearman-Rho correlations, inverse relationships of ToM task performance with the excitement component (rho = −0.419, $p = 0.019$), and cognitive component (rho = −0.439, $p = 0.014$) of the PANSS. No correlation was found regarding ToM with patients' verbal IQ, level of education, duration of illness, age at onset of the disorder, or duration of illness.

Similarly, in the nonforensic group the overall ToM performance correlated with patients' performance on the picture completion task ($r = 0.412$, $p = 0.013$), inversely with the number of errors ($r = -0.457$, $p = 0.004$) and perseverative errors in the WCST ($r = -0.490$, $p = 0.002$), and with executive planning skills (Zoo Map Test: $r = 0.487$, $p = 0.002$). In contrast to the forensic patient group, in the nonforensic group ToM performance correlated inversely with the negative component (rho = −0.334, $p = 0.040$), and, similar to the forensic group, with the cognitive component of the PANSS (rho = −0.527, $p = 0.001$), but with none of the other PANSS subscales.

Discussion

The present study was carried out to explore the comprehension of the mental states of story characters (i.e., ToM) in schizophrenic patients with a history of delinquent behavior compared with nonforensic patients and healthy controls. We were further interested in the question as to whether ToM task performance was confounded by intelligence, executive functioning, or psychopathology. In a previous study, our research group revealed significant interactions between ToM task performance, executive functioning, and disorganization in schizophrenia (26), as well as strong correlations between ToM task performance and patients' social skills (6,7).

Previous studies comparing ToM skills in individuals with psychopathy (8,9), Asperger's syndrome, personality disorders and paranoid schizophrenia (14), and a study examining ToM differences between violent and nonviolent patients with schizophrenia in high-security forensic psychiatric care (15) revealed overall ToM deficits in forensic schizophrenic patients, but perhaps to a lesser degree compared to nonforensic patients. Similar deficits were found in Asperger's syndrome (14), but not in individuals with psychopathy (8,9). Even though a direct comparison between forensic and nonforensic patients with Asperger's syndrome or individuals with psychopathy with and without a criminal record are lacking, these findings can tentatively be interpreted in a way that suggests that antisociality is associated with superior ToM skills within a defined psychopathological phenotype. However, the above-mentioned studies did not explore putative effects of neurocognitive functioning and psychopathology on ToM task performance that may account for differences in task performance to other psychiatric patients.

Based on previous work, we hypothesized that schizophrenic patients with a history of delinquent behavior would outperform nonforensic patients with schizophrenia regarding their ability to appreciate other persons' mental states. In line with our hypothesis the forensic patients performed better in the ToM questionnaire subtest compared to nonforensic patients with schizophrenia. No differences emerged with regards to the sequencing task (as a measure of basic understanding of the social interaction depicted) or total score of both sequencing and questionnaire component. Forensic and nonforensic schizophrenia patients did not differ with respect to premorbid intelligence or executive functioning, except for the number of errors in the WCST.

Correlation analyses in the two patient groups revealed quite similar interactions of ToM task performance with IQ and executive functioning, with some notable differences regarding the interaction of ToM performance with psychopathology. In the forensic sample, ToM showed a significant interaction with the excitement and cognitive scores of the PANSS, whereas in the nonforensic sample significant interactions of ToM task performance emerged regarding the negative and the cognitive component. Most interestingly, when taking into account these group differences in psychopathological profiles, we found that forensic patients showed a significantly better performance in total ToM task performance when the excitement factor of the PANSS was covaried out, whereas no such interaction was found with respect to the cognitive component. This finding may underscore the assumption that symptoms such as excitement, hostility, tension, and poor impulse control (comprising the ''excitement component'' in the five-factor model) may negatively influence mental state comprehension, in both experimental test situations and perhaps also in ''real life'' during social interaction.

The finding that forensic patients with schizophrenia are similarly impaired in understanding mental states as nonforensic patients, albeit for different reasons, may also support endeavors to develop social cognitive training modules for schizophrenia. In a recent study Combs et al. (27) could demonstrate that social cognitive training (including emotion recognition) of forensic in-patients with schizophrenia significantly reduced patients' hostility and aggression and improved the quality of their social relationships. This promising data should be the basis for further exploration and needs to be replicated in a larger sample.

As a shortcoming of the present study, we were unable to determine differences in task performance according to the nature of the criminal offense. Patients showed a heterogeneous pattern of offenses, including violent acts against others with and without sexual connotation, property offenses including arson, and minor offenses like encroachment on traffic or obstructing the police. Thus, due to the small number of patients in each subgroup a meaningful statistical comparison with regards to ToM performance and executive functioning was not feasible. Moreover, since forensic patients were detained in high-security wards, a comparison of the association of ToM with social competence between the schizophrenia groups was impracticable, because the majority of items of the Social Behaviour Scale (28) used in previous studies pertains to behaviors outside a clinical context. Finally, we failed to examine antisocial personality traits or psychopathy in patient samples.

In summary, we were able to show that forensic schizophrenia patients in a maximum-security psychiatric hospital are impaired in their understanding of mental states of others, but perhaps for different reasons associated with their psychopathological profile as compared with nonforensic patients. This finding may have implications for routine assessment during detention, as well as treatment. Criminal behaviors by schizophrenic patients are perhaps not so much the consequence of impaired ToM but more closely linked to deficits in empathetic perspective-taking, an issue that was not specifically addressed in the present study. Nevertheless, social cognitive training embracing ToM, emotion recognition, and empathetic perspective-taking may serve as an additional tool to improve outcome and rehabilitation.

References

1. Premack D, Woodruff G. Does the chimpanzee have a ''theory of mind''? Behav Brain Sci 1978;4:515–26.
2. Leslie AM. Pretense and representation: the origins of ''theory of mind.'' Psychol Rev 1987;94:412–26.
3. Brüne M, Brüne-Cohrs U. Theory of mind—evolution, ontogeny, brain mechanisms and psychopathology. Neurosci Biobehav Rev 2006;30:437–55.
4. Frith CD. Schizophrenia and theory of mind. Psychol Med 2004;34:385–9.
5. Frith CD. The cognitive neuropsychology of schizophrenia. Hove: Lawrence Erlbaum Associates, 1992.
6. Brüne M, Abdel-Hamid M, Lehmkämper C, Sonntag C. Mental state attribution, neurocognitive functioning, and psychopathology: what predicts poor social competence in schizophrenia best? Schizophr Res 2007;92(1-3):151–9.
7. Brüne M. ''Theory of mind'' in schizophrenia: a review of the literature. Schizophr Bull 2005;31:21–42.
8. Blair J, Sellars C, Strickland I, Clark F, Williams A, Smith M, et al. Theory of mind in the psychopath. J Forens Psychiat Psychol 1996;7(1):15–25.
9. Richell RA, Mitchell DGV, Newman C, Leonard A, Baron-Cohen S, Blair RJR. Theory of mind and psychopathy: can psychopathic individuals read the ''language of the eyes''? Neuropsychologia 2003;41:523–6.
10. Silva JA, Ferrari MM, Leong GB. The case of Jeffrey Dahmer: sexual serial homicide from a neuropsychiatric developmental perspective. J Forensic Sci 2002;47:1347–59.
11. Silva JA, Ferrari MM, Leong GB. Asperger's disorder and the origins of the Unabomber. Am J Forens Psychiat 2003;24(2):5–43.
12. Silva JA, Leong GB, Ferrari MM. Paraphilic psychopathology in a case of autism spectrum disorder. Am J Forens Psychiat 2003;24(3):5–20.
13. Silva JA, Leong GB, Ferrari MM. A neuropsychiatric developmental model of serial homicidal behavior. Behav Sci Law 2004;22:787–99.
14. Murphy D. Theory of mind in Asperger's syndrome, schizophrenia and personality disordered forensic patients. Cogn Neuropsychiat 2006;11:99–111.
15. Abu-Akel A, Abushua'leh K. ''Theory of mind'' in violent and non-violent patients with paranoid schizophrenia. Schizophr Res 2004;69:45–53.
16. American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: American Psychiatric Association, 1994.
17. Lehrl S, Triebig G, Fischer B. Multiple choice vocabulary test MWT as a valid and short test to estimate premorbid intelligence. Acta Neurol Scand 1995;91:335–45.

18. Baddeley A, Emslie H, Nimmo-Smith I. The Spot-The-Word Test: a robust estimate of verbal intelligence on lexical decision. Br J Clin Psychol 1993;32:55–65.
19. Tewes U Hamburg-Wechsler-Intelligenz-Test für Erwachsene, Revised 2nd ed. Göttingen: Hogrefe, 1991.
20. Nelson HE. A modified card sorting test sensitive to frontal lobe defects. Cortex 1976;12:313–24.
21. Wilson BA, Alderman N, Burgess P, Emslie H, Evans JJ. Behavioural Assessment of the Dysexecutive Syndrome (BADS). Bury, St. Edmunds: Thames Valley Test, 1996.
22. Brüne M. Social cognition and behaviour in schizophrenia. In: Brüne M, Ribbert H, Schiefenhövel W, editors. The social brain. Evolution and pathology. Chichester, U.K.: Wiley and Sons, 2003;277–313.
23. Langdon R, Michie PT, Ward PB, McConaghy N, Catts S, Coltheart M. Defective self and/or other mentalising in schizophrenia: a cognitive neuropsychological approach. Cogn Neuropsychiat 1997;2:167–93.
24. Kay SR, Opler LA, Lindenmayer JP. The Positive and Negative Symptom Scale (PANSS): rationale and standardisation. Br J Psychiatry 1989;7(Suppl.):59–67.
25. Lindenmayer JP, Bernstein- Hyman R, Grochowski S. A new five-factor model of schizophrenia. Psychiat Quart 1994;65:299–322.
26. Abdel-Hamid M, Lehmkämper C, Sonntag C, Juckel G, Daum I, Brüne M. Theory of mind in schizophrenia: the role of clinical symptomatology and neurocognition in understanding other people's thoughts and intentions. Psychiat Res 2009;165:19–26.
27. Combs DR, Adams SD, Penn DL, Roberts D, Tiegreen J, Stem P. Social Cognition and Interaction Training (SCIT) for inpatients with schizophrenia spectrum disorders: preliminary findings. Schizophr Res 2007;91:122–6.
28. Wykes T, Sturt E. The measurement of social behaviour in psychiatric patients: an assessment of the reliability and validity of the SBS schedule. Br J Psychiatry 1986;48:1–11.

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