Comprehension of metaphor and irony in schizophrenia during remission: The role of theory of mind and IQ

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Abstract

The study reported herein explored the comprehension of metaphor and irony in schizophrenia during remission, and examined the role of IQ and a theory of mind. Performance of 29 Schizophrenic patients in remission and 22 healthy controls was compared on metaphor and irony comprehension tasks and first- and second-order theory of mind tasks. Participants' IQs were measured using the Wechsler Adult Intelligence Scale-Revised, and the symptoms of individuals with schizophrenia were assessed using the Positive and Negative Syndrome Scale. The results showed that patients with schizophrenia were impaired in their comprehension of metaphor and irony as compared with healthy controls. A theory of mind deficit was found in patients with remitted schizophrenia. The comprehension of metaphor was significantly correlated with second-order false belief understanding and the comprehension of irony was not significantly related to theory of mind. IQ and verbal IQ did not explain the deficit of metaphor and irony comprehension. These findings were not explained by Happé's [Happé, F.G.E., 1993. Communication competence and theory of mind in autism: a test of relevance theory. Cognition 48, 101–119] theory and the shared semantic understanding requirement was discussed.
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1. Introduction

In metaphorical and ironical speech, the actual meaning is not identical to the literal meaning, so the comprehension of non-literal language is different from literal language. For example, the understanding of metaphor and irony requires that interpreters go beyond the literal meaning of words to infer the intended meaning of statements (Sperber and Wilson, 1986, 1998, 2002). In recent years, studies that have included symptomatically acute and remitted patients have investigated their comprehension of metaphor and irony. Research has indicated that patients with schizophrenia have difficulty in the interpretation of metaphor and irony, but study findings have been inconsistent (Mitchley et al., 1998; Langdon and Coltheart, 2004; Herold et al., 2002).

Drury et al. (1998) found that schizophrenic patients who suffered from acute episodes of illness performed metaphor tasks, but not irony tasks, less competently than psychotic and depressed patients. Mitchley et al. (1998) found that patients with schizophrenia who were not in an acute episode of illness during test periods had specific difficulty in the understanding of irony compared with in-patient psychiatric controls. Herold et al. (2002) showed that remitted patients who had earlier suffered from acute paranoid schizophrenia, demonstrated statistically significant impairment in irony tasks, though not in metaphor tasks, as compared with normal control groups. Langdon et al. (2002a,b) investigated disturbed communication in schizophrenia and found that patients' understanding of irony and metaphor was selectively impaired relative to healthy controls. Symptomatic schizophrenic patients demonstrated a deficit in the comprehension of non-literal language, such as metaphor and irony. However, whether or not patients with schizophrenia can improve their understanding of irony and metaphor during remission was unresolved. The current study addresses this issue.

According to Sperber and Wilson's (1986, 1998) 'theory of relevance', the comprehension of non-literal language, such as metaphor and irony, not only involves semantic and syntactical decoding, but also requires non-linguistic inference. The appreciation of other mental states (e.g., knowledge, intention and belief) plays an important role in the understanding of speech content: for example, the understanding of irony requires an inference that a speaker's expressed intention is contrary to the surface meaning of the speech. The ability to infer and attribute mental states to others has been termed "theory of mind" (Premack and Woodruff, 1978) and is often assessed with the performance of first- and second-order false belief tasks (Wimmer and Perner, 1983; Perner et al., 1987). Happé (1993) demonstrated a strong theoretical relationship between theory of mind ability and an understanding of metaphor and irony. The ability to understand metaphor has been linked to a first-order theory of mind and the ability to understand irony has been linked to a second-order theory of mind. As metaphorical interpretation requires only limited understanding of a speaker's intentions, whereas ironical appreciation requires recognition of the speaker's understanding of a thought about the world, the comprehension of ironical speech requires a more sophisticated theory of mind ability than metaphoric speech (Happé, 1993,1995; Langdon et al., 2002a,b). Colston and Gibbs (2003, Exp. 2) revealed that normal

people draw second-order meta-representational inferences about a speaker's intentions and beliefs in the understanding of irony but not of metaphor. Langdon et al. (2002a,b) concluded that a disruption to normal adult mind-reading processes causes selective difficulties with the interpretation of irony in schizophrenic patients and that highly sophisticated normal adult mind-reading processes are not necessary for the interpretation of metaphor. Inhibitory control is required for both theory of mind and for the normal interpretation of metaphor and irony. The role of theory of mind in the understanding of metaphor and irony requires further examination.

Studies have indicated that patients with schizophrenia may exhibit a theory of mind deficit (Frith, 1992; Doody et al., 1998; Frith and Corcoran, 1996). Mazza et al. (2001) showed that chronic patients with normal IQs performed significantly less competently than normal controls in first- and second-order false belief tasks. Frith and Corcoran (1996) found that patients with schizophrenia in their remission group performed less competently than normal controls in second-order false belief tasks, but as competently as normal controls and psychiatric groups in first-order false belief tasks. They argued that patients with theory of mind deficits may make modest recoveries during remission (Frith and Corcoran, 1996). Pickup and Frith (2001) also found patients with behavioral signs and paranoid symptoms performed less competently than normal controls in first- and second-order theory of mind tasks, but that the remitted patients performed as competently as normal controls. Doody et al. (1998) concluded that an impaired theory of mind in second-order tasks is specific to schizophrenia when compared with mild learning disability and affective disorder control groups. Brüne (2003) found that patients with chronic disorganized schizophrenia were impaired relative to healthy controls in theory of mind tasks (e.g., first-order and second-order false belief tasks). In our study, we not only assessed theory of mind performance in remitted schizophrenia to compare findings with previous studies, but we also explored theory of mind in the comprehension of metaphor and irony in schizophrenia.

The role of IQ in the understanding of metaphor and irony warrants attention. Mitchley et al. (1998) demonstrated that even with Raven's IQ as a covariate, there was a significant difference between schizophrenic and control subjects who performed irony tasks. They argued that general intelligence cannot explain the inability of schizophrenic to understand irony. As patients often suffer from cognitive deficit and intelligence decline, it is difficult to completely match their

IQs with those of normal controls. IQ may also influence a schizophrenic patient's theory of mind performance. For example, Brüne (2003) found that, when controlled for IQ, there was no theory of mind performance difference between patient's with chronic disorganized schizophrenia and healthy controls. Thus, we also examined the relative contribution of IQ to the understanding of metaphor and irony and a theory of mind in patients with remitted schizophrenia.

The purpose of this study was to investigate whether the ability to understand metaphor and irony in remitted schizophrenia among Chinese patients was impaired. It also aimed to examine the role of IQ and theory of mind in the understanding of metaphor and irony. We hypothesize that: (1) patients with schizophrenia are impaired in the comprehension of metaphor and irony as compared with healthy controls; and (2) in accordance with relevance theory and Happé's argument, a first-order theory of mind is correlated with the comprehension of metaphor and a second-order theory of mind is correlated with the comprehension of irony. If there is a specific deficit in a schizophrenic-patient's comprehension of metaphor and irony, then IQ does not significantly influence the comprehension of metaphor and irony.

2. Methods

2.1. Participants

Subjects composed 33 (17 males, 16 females) patients with schizophrenia and 22 (12 males, 10 females) healthy controls. The adults with schizophrenia were in-patients from Beijing's Anding Hospital and were assessed according to DSM-IV criteria (American Psychiatric Association, 1994). The patients determined to be in remission were assessed according to CCMD-3 criteria (Chinese Society of Psychiatry, 2001). Illness symptoms were mild or absent, while patients' scores on positive and negative symptoms subscales were ≤35 (no symptoms had been reported for at least 2 weeks). One patient that did not meet the criterion and two patients with probable intelligence degradation (e.g., IQ scores below 65) were excluded. One patient who had suffered from a probable severe comprehension obstacle (e.g., the scores of all task measures were zero) was excluded from the data analyses. Patients received daily recovery treatment or hospital care. For 2 months, anti-psychotic medication was administered (chlorpromazine-equivalent dose; mean=209.6 mg, S.D.=184.7 mg). Nine patients had been diagnosed with paranoid schizophrenia, four with disorganized schizophrenia and 16 with undif-

Table 1
Clinical and demographic details of participants (mean, S.D.)

	Schizophrenia	Controls	χ^2/t-value	P-value
Participant (male/female)	29 (15/14)	22 (12/10)	0.197	0.657
Age (years)	43.07 (8.83)	39.73 (10.13)	1.256	0.215
Education level (years)	10.52 (2.68)	12.23 (3.15)	1.715	0.11
IQ overall	90.38 (12.85)	109.68 (7.81)	21.6	<0.001
Verbal IQ	90.80 (14.27)	109.55 (9.39)	18.47	<0.001
Duration of illness (years)	19.34 (7.82)			
Onset of illness (years)	25.00 (6.03)			
PANSS sum	52.10 (11.93)			
PANSS negative	12.93 (5.35)			
PANSS positive	12.79 (4.29)			
PANSS general	26.38 (4.87)			

ferentiated schizophrenia. Healthy control participants were recruited from the hospital staff and reported no prior history of psychiatric illness, drug abuse or alcohol abuse. All participants gave their informed consent. The psychopathology of the patient group was assessed using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) and participants' IQs were measured using the Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981; Gong et al., 1986). Table 1 summarizes the demographic details of the patient and control groups. No significant differences in gender, age and educational level were found between the two groups. The IQ and verbal IQ scores of patients were significantly less than those of controls.

2.2. Measures

2.2.1. Metaphor and irony tasks

The participants' understanding of metaphor and irony was assessed through the performance of two story tasks (following the procedures of Drury et al., 1998; Herold et al., 2002). The story and questions were slightly modified in Chinese. The stories were narrated with the appropriate prosodic information to the participants, and questions on metaphor and irony were asked. To demonstrate the participants' ability to comprehend and apprehend story details, the participants were asked to retell the stories. Questions on the narratives' metaphorical and ironical content were asked, and when necessary, one forced choice question was presented. The order of the metaphor and irony questions was balanced. Participants obtained 1 point for each correct answer. Scores for understanding of

metaphor and irony each ranged from 0 to 2 for both story tasks.

One of the scenarios was as follows:

Xiao Zhang could never make up his mind about anything. One day when Li Qi and Wang Li asked him if he would like to go to the cinema, Xiao Zhang could not decide. It took him so long to make up his mind that by the time he did, they had already missed the first half of the film.

Li Qi said: 'Xiao Zhang, you are a ship without a captain!' The metaphorical question was asked, 'What does Li Qi mean? Does he mean Xiao Zhang is good or not good at making decisions!'

Wang Li said to Xiao Zhang, 'You really are so good at making decisions!' Then, the ironical question was asked, 'What does Wang Li mean? Does he mean Xiao Zhang is good or not good at making up his mind?'

2.2.2. Theory of mind tasks

The theory of mind tasks included first- and second-order false beliefs using modified 'Sally-Anne' (Baron-Cohen et al., 1985) and 'Ice-Cream Van Test' story tasks (Perner and Wimmer, 1985; used by Doody et al., 1998). The first-order false belief task examined the ability to represent a character's false belief state, and the second-order false belief required participants to understand second representations about a character's belief. Participants were presented with cartoon illustrations of the story while the story was being narrated. At the end of the story, participants were asked a first- or second-order false belief question and two control questions.

The first-order false belief task was presented in the following scenario:

A boy and a girl were playing ball in a room. After a while, the boy put his ball into a box and went to play outside. After the boy left the room, the girl took the ball from the box and put it into a basket. A little while later, the boy came back into the room and wanted to play with his ball again.

The false belief question was "Where will the boy look for his ball—in the box or in the basket?" The control questions were "Where is the ball now?" and "Where did the boy put the ball before he left the room?"

The second-order false belief task was presented in the following scenario:

One day, Zhang Ming and Li Hong were in the park. They met a man selling ice cream. Zhang Ming wanted to eat ice cream, but he had no money. The ice cream man said, "You can go home to get some money, and I will wait here." Zhang Ming went home to get some money. After a while, the ice cream man wanted to go to a school where he could sell more ice cream. Li Hong asked the ice cream man, "Where will you go?" The ice cream man said, "I will go to a school where I can sell ice cream more quickly." Then Li Hong went home. When she went past Zhang Ming' home, she asked Zhang Ming's mother if Zhang Ming was in. Zhang Ming's mother said Zhang Ming had gone to buy ice cream.

The false belief question is, "Where does Li Hong think Zhang Ming has gone to buy ice cream—to the park or to the school?" The two control questions were, "Where was the ice cream man before Zhang Ming went home to get money?" and "Where is the ice cream man now?"

If participants could not correctly answer the control questions, their data were excluded from the analyses. Participants obtained one point if they correctly answered the false belief question. Participants were tested individually in a quiet room in the hospital.

3. Results

3.1. Performance on metaphor and irony tasks and theory of mind tasks

The descriptive data of participants' performance in all tasks are presented in Table 2. All participants gave correct answers to the control questions in the theory of mind tasks. Eighty-three and seventy-six percent of the patients gave correct responses in each of the first- and second-order false belief tasks. In the metaphor and irony tasks, the patients and the controls were able to retell the stories. Chi-square or t-test results showed that there were significant differences in the first-order false belief task and the second-order false belief task, and the metaphor and irony tasks between the patient group and the control group.

Table 2
Theory of mind, metaphor and irony performances of the patient and control groups

	Schizophrenias	Controls	χ^2/t-values	P-values
First-order false belief task (%)	83	100	$\chi^2(1, 51)=$ 4.205	$P<0.05$
Second-order false belief task (%)	76	95	$\chi^2(1, 51)=$ 3.631	$P=0.057$
Metaphor (M, S.D.)	1.24 (0.73)	1.95 (0.21)	$t(49)=$ −4.378	$P<0.001$
Irony (M, S.D.)	1.17 (0.71)	1.95 (0.21)	$t(49)=$ −4.985	$P<0.001$

3.2. Group differences

A repeated measured-analysis of covariance (ANCOVA) was conducted to examine the performance of patients with schizophrenia and healthy controls: metaphor and irony were dependent variables, group was a between-group variable, and IQ was a covariant variable. The results showed that there was no significant difference performance for metaphor and irony comprehension tasks [$F(1,48)=0.023$, $P=0.879$]. A significant main effect of the group factor was found [$F(1,48)=13.91$, $P=0.001$]: the patients performed significantly less competently than the controls in the metaphor and irony tasks. There were deficits in the understanding of metaphor and irony in patients with schizophrenia during remission. No significant interaction was found.

Significant differences in performance on theory of mind tasks were found between schizophrenic patients and healthy controls. Fewer participants with schizophrenia passed the first-order false belief task [$\chi^2(1,51)=4.205$, $P<0.05$] and the second-order false belief task [$\chi^2(1,51)=3.631$, $P=0.057$] than did healthy controls. Due to IQ differences between the two groups, two subgroups with matching IQs were compared. There were no significant IQ differences between the patient subgroup ($n=13$) and the healthy control subgroup ($n=17$) [$F(1,28)=2.934$, $P=0.098$]. There were still significant differences between the subgroups in the false-order false belief task [$\chi^2(1,30)=4.359$, $P<0.05$] and in the second-order false belief task [$\chi^2(1,30)=6.036$, $P=0.014$].

Because of the significant verbal IQ difference between the patient group and the control group, further subgroup matching of verbal IQs between the two groups was used in the metaphor and irony comprehension and theory of mind tasks. There was no significant difference in verbal IQs between the remaining patient subgroup ($n=9$, mean verbal IQ=103.78 ± 7.17) and the healthy control subgroup ($n=15$, mean verbal IQ=107.20 ± 6.84) [$F(1,22)=1.360$, $P=0.256$]. There was no significant difference in age [$F(1,22)=2.662$, $P=0.117$] and educational level [$F(1,22)=0.077$, $P=0.784$] between the two subgroups. There was no significant difference between the two subgroups in the first-order false belief task [$\chi^2(1,24)=1.739$, $P=0.187$], but there was a significant difference in the second-order false belief task [$\chi^2(1,24)=3.636$, $P=0.057$]. Due to significant differences between the subgroups in the amount of variance in the metaphor and irony task, a nonparametric Kruskal–Wallis test was conducted. The results revealed that patients still performed less competently than did controls in the metaphor [$\chi^2(1,24)=7.00$, $P=0.008$] and irony comprehension tasks [$\chi^2(1,24)=12.26$, $P<0.001$].

3.3. Correlation analysis within the schizophrenic group

A simple Pearson correlation analysis was carried out to reveal the relationship between performance in metaphor and irony comprehension, theory of mind task, educational level, IQ and verbal IQ, and medication dosage in the patient group. Table 3 showed the results of the correlation analysis. The performance of metaphor comprehension significantly correlated with the performance of the second-order false belief task ($r=0.409$, $df=29$, $P=0.028$) and with educational level ($r=0.439$, $df=29$, $P=0.017$). The performance of irony comprehension was related to metaphor comprehension ($r=0.73$, $df=29$, $P<0.001$). No significant correlations between the performance of irony comprehension and theory of mind tasks were found.

Partial correlation analysis revealed that there was a significant correlation between the performance of

Table 3
Correlations of task measures for patients

	Education	Medicine dose	IQ	Verbal IQ	First-order false belief	Second-order false belief	Metaphor	Irony
Educational level		−0.216	0.502**	0.581**	0.124	−0.012	0.439*	0.270
Medicine dose			−0.031	−0.167	0.049	0.149	−0.325	−0.194
IQ				0.941***	−0.022	−0.187	−0.044	−0.035
Verbal IQ					−0.058	−0.179	0.024	0.070
First-order false belief						−0.257	0.026	−0.149
Second-order false belief							0.409*	0.255
Metaphor								0.734***

*$P<0.05$, **$P<0.01$, ***$P<0.001$ (two-tailed).

metaphor and second-order false belief understanding ($r=0.414$, $df=29$, $P=0.036$) when educational level, IQ, verbal IQ and medication dosage were controlled for.

3.4. Regression analyses

To examine the relative contribution of theory of mind and IQ to metaphor and irony comprehension, a linear stepwise regression analysis was conducted. In a stepwise regression with the performance of metaphor as a dependent variable, and group variable, IQ, first- and second-order false belief performances in the regression equation as predictors, we found that the group variable was a significant predictor of the participants' performance in metaphor comprehension [adjusted $R^2=0.267$, R^2 change $=0.281$, $F(1,49)=$ 19.168, $P<0.001$]. This indicated that the group variable can account for 28.1% of the variance of metaphor comprehension performance. The second-order theory of mind performance can account for 10.5% of the variance of metaphor comprehension performance [adjusted $R^2=0.334$, $F(1,46)=7.917$, $P=0.007$] independent of group effect. IQ and first-order theory of mind cannot account for any variance of metaphor comprehension. A similar regression analysis with the performance of irony comprehension as a dependent variable and using the same set as independent variables was carried out. The result of regression showed that only the group variable was a significant predictor of irony comprehension [adjusted $R^2=0.323$, R^2 change $=0.336$, $F(1,49)=24.84$, $P<0.001$]. IQ cannot account for any variance of irony comprehension, and first-order theory of mind and second-order theory of mind only account for 1.4% and 2.6% of irony comprehension performance.

When the group variable, IQ, and first-order and second-order theory of mind were entered into the regression equation, the full model with metaphor as dependent variable was significant [adjusted $R^2=0.334$, R^2 change $=0.387$, $F(4,46)=7.266$, $P<0.001$] and the full model with irony comprehension performance as dependent variable was significant [adjusted $R^2=0.322$, R^2 change $=0.376$, $F(4,46)=8.924$, $P<0.001$].

3.5. Additional analysis within the patient group

To explore the potential influence of different symptoms of schizophrenia subtypes on the understanding of metaphor and irony and on mind in participants with schizophrenia, we crudely compared participants with diagnosed paranoid schizophrenia ($n=9$) with two other subtypes (4 disorganized and 16 undifferentiated, $n=20$). A t-test showed no significant differences in the PANSS scores for age, educational level, medication dosage, duration of illness, onset of illness age, IQ and verbal IQ, except for the positive and general scale scores. There was a significant difference between patients with paranoid schizophrenia and with disorganized or undifferentiated schizophrenia in irony comprehension ($t=-2.129$, $df=27$, $P=0.043$). No significant differences were found between patients with paranoid schizophrenia and other non-paranoid schizophrenia in the first-order false belief task [$\chi^2(1,29)=3.44$, $P=0.558$], the second-order false belief task [$\chi^2(1,29)=0.026$, $P=0.872$] and the metaphor comprehension task ($t=-1.788$, $df=27$, $P=0.085$). The small sample size requires further examination of the results.

4. Discussion

This study examined the comprehension of metaphor and irony in remitted schizophrenia as well as the role of theory of mind and IQ. The results showed that the comprehension of metaphor and irony in patients with remitted schizophrenia was impaired relative to healthy controls, and the impairment remained when IQ and verbal IQ were controlled for. This study also showed theory of mind deficits in schizophrenic patients during remission. The findings indicated that the comprehension of metaphor in patients with schizophrenia was significantly related to second-order theory of mind and that metaphors significantly contribute to a deficit in the comprehension of metaphor in remitted schizophrenic patients. IQ does not explain the significantly high levels of impairment of comprehension of metaphor and irony.

There is consistency with previous study findings that remitted paranoid schizophrenic patients suffer from impairment in irony but not metaphor comprehension, relative to normal controls (Herold et al., 2002). Our findings indicated the individuals have difficulty in comprehension of irony, but also in metaphor comprehension. This may reflect different subtypes of schizophrenia in the studies. In the Herold et al. (2002) study, the participants only included a paranoid subtype, but our study also included disorganized and undifferentiated schizophrenia. We found there was a significant difference in the comprehension of metaphor between paranoid and non-paranoid schizophrenia. Our findings are consistent with the findings of Mitchley et al. (1998), who found participants that did not suffer from acute symptoms had

impaired comprehension of irony. Our Mandarin findings provide evidence for further investigation of non-literal language comprehension (e.g., metaphor and irony) in individuals with schizophrenia, in terms of our knowledge. If people with schizophrenia had been able to understand metaphor and irony before they developed symptoms of schizophrenia, then they may now suffer from comprehension impairment of non-literal language due to psychotic symptoms. The results of the between-group difference and regression analyses provided strong evidence for deficits in comprehension of metaphor and irony in remitted schizophrenia. Our findings and those of previous studies indicated that the ability to understand metaphor and irony in schizo-phrenic patients during remission demonstrated a moderate deficiency, compared with healthy controls.

Given the theory of mind deficit found in previous studies, our study showed participants with remitted schizophrenia performed less competently than healthy controls on theory of mind tasks. This partial consis-tency with the results of Frith and Corcoran (1996) suggests that patients in remission still have difficulty with the attribution of complicated mental states to others. However, our findings are not consistent with those of Pickup and Frith (2001), where remitted schizophrenic patients performed as competently as controls in first- and second-order theory of mind tasks. Our findings indicated that a theory of mind deficit existed in patients with remitted schizophrenia to some degree. Whether theory of mind ability would improve after the disappearance of symptoms of schizophrenia (Frith and Corcoran, 1996) was not the focus of this study. Further research may address this issue.

Analyses of the role of theory of mind in the comprehension of metaphor and irony produced interest-ing results. The understanding of metaphor was signifi-cantly correlated with a more complicated second-order theory of mind and was predicted by a second-order theory of mind. The understanding of irony was not significantly related to theory of mind. The general results supported the relevance theory of Sperber and Wilson (1986, 1998) and indicated that non-literal speech comprehension may be related to an understanding of mental states that are assessed in the performance of false belief tasks. However, the findings could not be explained by Happé's (1993) theory that a complicated theory of mind is related to irony, but that metaphor comprehension requires a first-order theory of mind ability. In contrast, we found that metaphor comprehension was predicted by a second-order theory of mind. First, a theory of mind deficit in schizophrenia may be different from that in autism, as schizophrenia is a psychosis that develops in late adolescence or early adulthood, whereas autism is often congenital. More specifically, some patients with schizophrenia may suffer from application and perfor-mance deficits, where they demonstrate an awareness of other mental states but fail to apply that knowledge because of processing constraints (e.g., general cognitive deficit) (see reviews of Abu-Akel, 2003; Langdon et al., 2002a,b). Hypotheses drawn from normal people and those with autism are hardly in accordance with the situation of patients with schizophrenia. Second, theory of mind deficits in schizophrenia may reflect a general cognitive impairment, such as deficits of semantic networks or inhibitory control (Paulsen et al., 1996; Brüne, 2005; Langdon et al., 2002a,b). The second-order false belief task was more complicated than the first-order false belief task not only because it involved twofold embedded-thought, but also because it required more complicated semantic understanding (Perner and Wim-mer, 1985). According to a case report (Vanderzeypen et al., 2003), schizophrenia is a heterogeneous disease with a large variety of cognitive dysfunctions, where some symptoms are similar to fronto-temporal dementia, which often includes semantic dementia deficits. Langdon et al. (2002a,b) concluded that a poor understanding of metaphors was better explained by abnormal semantics, and Langdon and Coltheart (2004) also proposed that the poor recognition of metaphors may reflect degraded semantics. Hence, the correlation between metaphor comprehension and a second-order theory of mind might reflect shared semantic requirements. Third, the findings did not support the argument that insensitivity to irony in patients with schizophrenia was associated with a poor theory of mind (Langdon and Coltheart, 2004). However, we are not able to explain the poor under-standing of irony in schizophrenic participants in this study. Irony comprehension was more impaired than metaphor comprehension, but not at a significant level, perhaps because the patient participants could interpret irony by using the information on prosody and non-literal tone. Another reason for the deficit in non-literal speech interpretation in schizophrenic people may be impairment in strategic social reasoning (Mazza et al., 2003) and severe social-behavioral abnormalities in understanding social scenarios (Brüne, 2005). However, the mechanism that underlies deficits in irony comprehension among people with schizophrenia needs to be further studied.

As schizophrenic patients often suffer declines in IQ, it is difficult to select an appropriate control group (David et al., 1997). In our study, when IQ was controlled for, the schizophrenic participants still performed more poorly in the metaphor and irony comprehension tasks than did the healthy controls. Regression analysis also showed that IQ

cannot explain any variance of metaphor or irony comprehension independent of group membership. This result was similar to that of Mitchley et al. (1998), who showed that deficits in irony comprehension were specific to people with schizophrenia when IQ was controlled for. These results indicated that the comprehension of metaphor and irony may be relatively independent of IQ. When comparing the patient subgroup matched for IQ with the healthy control subgroup, we found that the patient participants still had theory of mind deficits. Yet when matched by verbal IQ, the two subgroups still showed significant differences in the second-order false belief, but not in the first-order false belief task. This was similar to the hypothesis of Herold et al. (2002), who stated that people with schizophrenia in remission would pass simple theory of mind tasks, but would fail tasks that made higher demands. However, due to the small size of our subgroups ($n=9$), statistical power needs to be considered, and these findings should be examined further.

Some limitations of this study should be considered. The small patient sample size may influence the statistical power. If other groups such as schizophrenic patients with acute symptom episodes were included in samples, many problem areas could be explored, such as whether theory of mind deficits improve after symptom elimination. Although first- and second-order false belief tasks have often been administered to adult participants with schizophrenia (Herold et al., 2002; Mazza et al., 2001; Pickup and Frith, 2001), if other tasks that assessed theory of mind were used, it would help us to examine the likelihood of different results from different tasks.

Acknowledgements

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