



Clinical subtypes of schizophrenia based on the discrepancies between objective performance on social cognition tasks and subjective difficulties in social cognition

Takashi Uchino ^{1,2}, Hisashi Akiyama ^{3,4}, Ryo Okubo ^{4,5}, Izumi Wada¹, Akiko Aoki¹, Mariko Nohara⁴, Hiroki Okano ⁶, Ryotaro Kubota ⁷, Yuji Yamada ⁸, Atsuhito Toyomaki ⁴, Naoki Hashimoto ⁴, Satoru Ikezawa ⁸ and Takahiro Nemoto ^{1,2}✉

Intervention for social cognition could be key to improving social functioning in patients with schizophrenia. A first step towards its clinical implementation involves interviewing patients about their subjective difficulties with social cognition as they experience them in the real world. The present study focused on the clinical subtypes classified by the discrepancies between the subjective difficulties in social cognition and actual cognitive impairment. A total of 131 outpatients with schizophrenia and 68 healthy controls were included. Objective measurement of social cognition was performed using a test battery covering four representative domains, and subjective difficulties were determined by a questionnaire covering the same domains. A two-step cluster analysis explored the potential classification of social cognition in patients with schizophrenia. There was little correlation between the objective performance on social cognition tasks and subjective difficulties in social cognition. The analysis yielded three clusters: the low-impact group (low objective impairment and low subjective difficulties), the unaware group (high objective impairment but low subjective difficulties), and the perceptive group (moderate objective impairment and high subjective difficulties). Positive, negative, and general symptoms were more severe in the two groups that showed impaired performance on the social cognition tasks (i.e., the unaware and perceptive groups) than those in the low-impact group. Neurocognition and functional capacity were the lowest in the unaware group, and social functioning was the lowest in the perceptive group. Awareness about the clinical subtypes of social cognition could serve as a guidepost for providing individualized, targeted interventions.

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INTRODUCTION

Impaired social cognition is widely observed in patients with schizophrenia and contributes strongly to a decline in social functioning as a mediator between neurocognition and social functioning^{1,2}. Therefore, improvement of social cognition is an essential therapeutic target in the treatment of schizophrenia and could represent the key to clinical recovery in these patients^{3,4}. Social cognition refers to “mental operations that underlie social interactions, including perceiving, interpreting, and generating responses to the intentions, dispositions, and behaviors of others” and has a critical role in social interaction and participation⁵. Four core domains of social cognition have been identified: theory of mind, social perception and knowledge, attributional style/bias, and emotion processing⁶. Measures of and interventions for social cognition have been developed mainly based on these core domains. Reliable and validated measures have been developed, also taking into account cultural and linguistic differences^{7–10}. Interventions have been divided into pharmacotherapy and psychosocial therapy. In regard to pharmacotherapy, mainly the efficacy of oxytocin has been examined, and further evidence is expected to be accumulated^{11–14}. In regard to psychosocial therapy, several programs have been developed, for example, Social Cognition and Interaction Training¹⁵. Many studies

regarding those programs have been accumulated on improving social cognition and even social functioning^{16–18}.

However, according to a previous online survey, only a few patients with schizophrenia actually received examinations or treatment related to social cognition¹⁹; the survey revealed that only 3.9% of patients with schizophrenia received treatments to improve social cognition, and a large proportion of the patients were still unfamiliar with the term or concept of social cognition in the first place. Given these findings, it would be very unlikely for patients with schizophrenia to voluntarily request treatment for social cognition in the current clinical settings. Thus, it could be said that there is an unmet need in relation to treatment of patients with schizophrenia in that while effective interventions have been developed, they have not been provided to the patients. A first step towards clinical implementation of intervention for social cognition is for the medical workers to interview the patient to determine the presence and degree of difficulties the patients experience in their real lives in relation to social cognition, i.e., the subjective difficulties^{20–22}. In the previous study referred to above, patients with schizophrenia, while not being aware of the term social cognition, perceived strong subjective difficulties when presented with specific situations in their lives that required social cognition¹⁹; this was the case for all four domains of social cognition. Furthermore, the degree of subjective difficulties itself

¹Department of Neuropsychiatry, Toho University Faculty of Medicine, Ota, Tokyo, Japan. ²Department of Psychiatry and Implementation Science, Toho University Faculty of Medicine, Ota, Tokyo, Japan. ³Department of Psychiatry, Iwamizawa Municipal General Hospital, Iwamizawa, Hokkaido, Japan. ⁴Department of Psychiatry, Hokkaido University Graduate School of Medicine, Sapporo, Hokkaido, Japan. ⁵Department of Clinical Epidemiology, Translational Medical Center, National Center of Neurology and Psychiatry, Kodaira, Tokyo, Japan. ⁶Department of Behavioral Medicine, National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Tokyo, Japan. ⁷Department of Forensic Psychiatry, National Center of Neurology and Psychiatry, Kodaira, Tokyo, Japan. ⁸Department of Psychiatry, National Center Hospital, National Center of Neurology and Psychiatry, Kodaira, Tokyo, Japan. ✉email: takahiro.nemoto@med.toho-u.ac.jp

was related to the level of social functioning²³. These findings suggest that measures of subjective difficulties can be important indicators that could be efficiently utilized and provide much information in clinical settings.

While subjective difficulties could have an important clinical role, it remains under question if they simply reflect the actual level of impairments of cognitive performance as measured objectively. In general, patients with schizophrenia have impaired insight^{24,25}. One cause is impaired metacognition, and it is not uncommon to find a discrepancy between a patient's subjective perceptions and the results of objective assessments of their symptoms²⁶. Such discrepancy is often observed not only in psychopathological symptoms but also in cognitive functions²⁷. In particular, the degree of discrepancy between subjective perception of one's own cognitive function and objective assessment of cognitive performance has been defined as "introspective accuracy"²⁸. Introspective accuracy has often been assessed by measuring the confidence in a cognitive task²⁹. In patients with schizophrenia, diverse patterns have been noted, such as underestimation, agreement, or overestimation³⁰. In general, patients with schizophrenia tend to be overconfident as compared with healthy controls in regard to their performance and functioning, which was associated with various clinical variables, such as higher interpersonal difficulties and delusional symptoms^{31–33}. In addition, there are also several reports of schizophrenia patients exhibiting overconfidence about their social cognition. Overconfidence regarding social cognition affected the performance in patients with schizophrenia^{34,35}. Similar to the diverse patterns of introspective accuracy in patients with schizophrenia, a variety of patterns would also be expected in the discrepancies/agreements between subjective difficulties and objective assessment of social cognition, and their clarification could have clinical implications. In fact, a study indicated that the subjective difficulties with social cognition measured by the Observable Social Cognition Rating Scale were not strongly correlated with the objective performance in patients with schizophrenia as a whole, and further detailed examination of this discrepancy is warranted²².

This study was aimed at determining the degree of agreement between objective performance in tasks of social cognition and subjective difficulties in social cognition in patients with schizophrenia, measured for four representative domains. Based on the results, patients with schizophrenia were exploratively classified into groups according to their objective performance and subjective difficulties in social cognition, and the clinical characteristics of these groups were comparatively assessed.

METHODS

Study design and participants

This study had a cross-sectional design, and outpatients with schizophrenia and healthy controls were recruited from the National Center of Neurology and Psychiatry, Hokkaido University Hospital and Toho University Omori Medical Center. A total of 131 patients with schizophrenia and 68 healthy controls were included in the study. Participants were aged between 20 and 59 years. The diagnosis of schizophrenia or absence of psychiatric disorders was confirmed using the Mini-International Neuropsychiatric Interview, for use of which we had obtained a license^{36,37}. The patients with schizophrenia had not undergone hospitalization in the previous two months, their prescriptions had not changed in the previous six weeks, and there had been no changes in the prescribed dosages in the previous two weeks. The participants were from a part of our previous study, the Evaluation Study for Social Cognition Measures in Japan, and the detailed study protocol and primary outcome of which have been described elsewhere^{38,39}.

Written informed consent was obtained from the participants prior to the start of the survey, and the participants were informed

that they could opt out of the survey at any point. This study was conducted with the approval of the Ethics Committee of the National Center of Neurology and Psychiatry (B2020-107) and the Independent Clinical Research Review Committee of Hokkaido University Hospital (022-0137). The protocol is registered in the UMIN-Clinical Trials Registry (UMIN000043777). This study was performed in accordance with the principles in the latest version of the Declaration of Helsinki.

Measures

Each of the four representative domains of social cognition was assessed using the corresponding task. Specifically, emotion processing was assessed by the Facial Emotion Selection Test (FEST)⁴⁰, theory of mind by the Hinting⁴¹, attributional bias by the Ambiguous Intentions and Hostility Questionnaire (AIHQ)^{42,43}, and social perception and knowledge by the Social Attribution Task-Multiple Choice⁴⁴. Higher scores indicated higher levels of functioning, except in the AIHQ. For the AIHQ, a reversed score was used to adapt to the other scales. The total score on each of the scales was used. The psychometric properties of the four scales have been examined in the Social Cognition and Psychometric study^{6,45,46}. In addition, they have been recommended for use considering their reliability and validity in Japanese³⁹. Subjective difficulties in social cognition were evaluated using the Self-Assessment of Social Cognition Impairment questionnaire (ACSo)^{19,20}. The ACSo is a self-administered 12-item questionnaire to determine the patients' subjective difficulties with the four domains of social cognition mentioned above. Higher scores indicated higher degrees of subjective difficulties.

The scores for the four domains were standardized using data from the healthy controls, and composite Z-scores for subjective difficulties and objective performance were calculated, respectively.

The other variables assessed in the present study were psychopathology, assessed by the Positive and Negative Syndrome Scale (PANSS)^{47,48}, neurocognition, assessed by the Brief Assessment of Cognition for Schizophrenia, Japanese Version^{49,50}, functional capacity, assessed by the University of California, San Diego Performance-based Skill Assessment-Brief (UPSA-B)^{51,52}, and social functioning, assessed by the Specific Levels of Functioning Scale (SLOF) with interviewer ratings^{53,54}. Except for the case of PANSS, the total score on each scale was used.

Data analysis

First, the demographics, objective performance in tasks of social cognition, and subjective difficulties in social cognition were compared between the patients with schizophrenia and healthy controls. The t-test was used for comparing continuous variables, and the chi-squared test for comparing categorical variables. Next, using the data from healthy controls, the objective performance and subjective difficulties in the four domains of the patients with schizophrenia were standardized, and the composite Z-scores for objective performance and subjective difficulties were calculated, respectively. To assess the relationship between objective performance and subjective difficulties in patients with schizophrenia, as well as their relationships with other clinical characteristics, correlation analyses were performed. Then, to identify potential clusters of patients with schizophrenia based on agreement or discrepancy between the levels of objective performance and subjective difficulties in social cognition, the two-step cluster analysis was performed using the Z-scores for objective performance and subjective difficulties by the log-likelihood method and Bayesian Information Criterion (BIC). The two-step cluster analysis is an approach for exploring empirical groups of individuals with similar characteristics and has the advantage of allowing automatic calculation of the optimal number of clusters⁵⁵. This is a hybrid approach that first uses a

distance measure (the log-likelihood method in the present study) to separate groups and then a probabilistic approach to choose the optimal subgroup model⁵⁶. The number of clusters is determined by selecting the best-fitting (i.e., the lowest BIC value) model among the clustering candidates. Furthermore, the silhouette coefficient, calculated from degrees of internal cohesion and external separation, is checked, and a value of 0.5 or greater is considered as being indicative good clustering.

Finally, the clinical characteristics of the identified clusters were assessed by analysis of variance and Tukey's post hoc test.

Patients with missing values were excluded from each analysis. In all the analyses, the proportions of those with missing values were less than 5%, suggesting that their exclusion had negligible effects on the results⁵⁷. Statistical differences were determined using two-tailed tests and the significance level was set at $p < 0.05$. Data analyses were performed using SPSS, version 26.0.

RESULTS

Demographics and objective and subjective social cognition performance in patients with schizophrenia and healthy controls

As shown in Table 1, there were no significant differences in the age or sex distribution between the patients with schizophrenia and healthy controls. The scores on all four domains of social cognition in the objective assessment were significantly lower in the patients with schizophrenia. The scores in all four domains of social cognition in the subjective assessment by the patients were significantly higher in the patients with schizophrenia.

Correlations between objective measures and subjective perception of social cognition

The composite Z-scores of the objective performance and subjective difficulties were -1.60 (standard deviation 1.76) and

0.74 (standard deviation 1.51), respectively. As shown in Table 2, there was a small, but significant correlation between the Z-scores of objective performance and subjective difficulties. There were significant/some degrees of correlations of the objective performance scores with the psychiatric symptoms (PANSS), neurocognition (BACS), functional capacity (UPSA-B), and social functioning (SLOF). There were also significant and weak correlations between the subjective difficulty scores and each of the aforementioned variables, except for negative symptoms and neurocognition.

Clusters by objective and subjective social cognition in patients with schizophrenia

The two-step cluster analysis yielded three clusters that fit well with the silhouette coefficient. The BIC values for one, two, three, and four clusters were 200.1, 170.5, 155.6, and 160.3, respectively. The value was the lowest for three clusters, i.e., it was the optimal model. As shown in Fig. 1, Cluster 1 (the low-impact group) comprised 65 patients (49.6%) who showed very little impairment of objective performance in the social cognition tasks and also very few subjective difficulties. Cluster 2 (the unaware group) comprised 43 patients (32.8%) who showed severely impaired objective performance on the social cognition tasks, but scarce subjective difficulties. Cluster 3 (the perceptive group) comprised 23 patients (17.6%) who showed moderately impaired objective performance and reported the highest level of subjective difficulties.

As shown in Table 3, there were no differences in the age, sex distribution, or duration of illness among the three groups. As for the psychiatric symptoms, the scores for positive, negative, and general symptoms were higher in the two groups showing impaired performance on the social cognition tasks (i.e., the unaware and perceptive groups) as compared with those in the low-impact group. Neurocognition and functional capacity were lowest in the unaware group, and social functioning was the lowest in the perceptive group. The results of the post hoc analysis are shown in Table 4.

DISCUSSION

In the present study, we investigated the discrepancies between the objective performance on tasks of social cognition and subjective difficulties in social cognition across the four representative domains of social cognition in patients with schizophrenia. We exploratively classified the patients, based on the agreements and discrepancies between the two. The participants in the present study were patients with stable and chronic schizophrenia. Overall, the patients with schizophrenia showed poorer objective performance on the tasks of social cognition and higher subjective difficulties in social cognition than the healthy controls, consistent with previous reports^{1,2}. Consistent results were obtained across all four domains of social cognition⁵⁸. Next, there was only a small correlation between the objective performance on social cognition tasks and subjective difficulties in social cognition, indicating that interpreting subjective difficulties as representing the actual level of social cognition should be done cautiously. On the other hand, the results of the cluster analysis, with three clusters classified according to the objective performance on social cognition tasks and subjective difficulties in social cognition, provided clinically helpful insights. The three groups consisted of those with no impairment in objective performance and no subjective difficulties, those with impaired objective performance, but no perceived difficulties, and those with impaired objective performance as well as perceived difficulties in social cognition. About half of the patients from a previous study which classified schizophrenia patients into subgroups based on the results of performance on the tasks of emotion processing and theory of mind were classified into the

Table 1. Comparisons of the demographics, subjective difficulties in social cognition, and objective performance on social cognition tasks.

	Patients with schizophrenia <i>N</i> = 131 mean (SD)	Healthy Controls <i>N</i> = 68 mean (SD)	<i>p</i> value
Age (years)	39.24 (10.67)	39.61 (11.24)	0.77
Sex (Male/Female)	68/63	31/37	0.77
Duration of illness (years)	13.53 (8.92)	-	
FEST	14.66 (2.81)	16.21 (2.12)	<0.001
Hinting	12.56 (3.80)	15.18 (2.40)	<0.001
AIHQ	-6.94 (2.03)	-6.22 (1.56)	0.011
SAT-MC	13.65 (4.71)	16.47 (2.91)	<0.001
ACSo total score	15.02 (8.38)	10.91 (5.56)	<0.001
ACSo emotional processes	3.56 (2.44)	2.60 (1.69)	0.001
ACSo theory of mind	4.48 (2.37)	3.49 (1.61)	0.001
ACSo attributional bias	3.36 (2.40)	2.25 (1.57)	<0.001
ACSo social perception and knowledge	3.63 (2.32)	2.57 (1.54)	<0.001

ACSo the self-assessment of social cognition impairments, AIHQ the Ambiguous Intentions and Hostility Questionnaire, FEST the Facial Emotion Selection Test, SAT-MC the Social Attribution Task-Multiple Choice, SD standard deviation.

Table 2. Correlations of subjective difficulties in social cognition and objective performance on social cognition tasks with the clinical characteristics.

	Mean (SD)	Objective performance	Subjective difficulties
Objective performance (z-score)	-1.60 (1.76)	-	-0.17*
Subjective difficulties (z-score)	0.74 (1.51)	-0.17*	-
PANSS positive	16.08 (5.14)	-0.30**	0.25**
PANSS negative	18.86 (4.74)	-0.30**	0.14
PANSS general psychopathology	36.53 (7.60)	-0.25**	0.29**
BACS-J	-1.87 (1.77)	0.44**	0.27
UPSA-B	76.38 (12.46)	0.32**	0.21*
SLOF	95.48 (12.59)	0.25**	-0.24**

BACS-J the Brief Assessment of Cognition for Schizophrenia, Japanese Version, PANSS the Positive and Negative Syndrome Scale, SD standard deviation, SLOF the Specific Levels of Functioning Scale, UPSA-B the University of California, San Diego Performance-based Skill Assessment-Brief.

* $p < 0.05$, ** $p < 0.01$. Objective performance and subjective difficulties are composite score of the four domains standardized by the data from healthy controls.

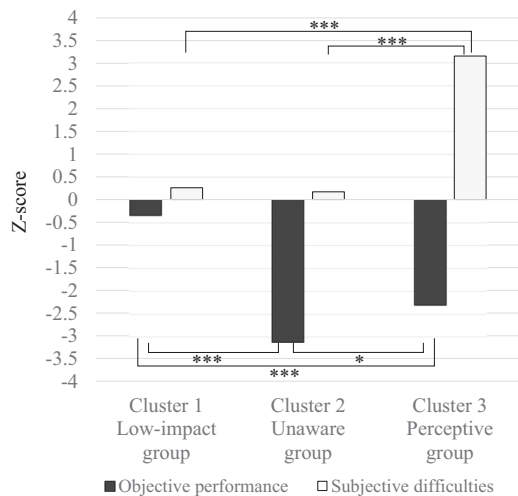


Fig. 1 Characteristics of the three clusters of schizophrenia. Patients were classified according to their objective performance on social cognition tasks and subjective difficulties in social cognition. * $p < 0.05$, *** $p < 0.001$.

unimpaired group in this study⁵⁵. Similar to the proportion in this previous study, the low-impact group, with little impairment in objective performance on social cognitive tasks, accounted for 49.6% of all the participants in the present study. The fact that there were no demographic differences among the groups but differences in the clinical characteristics suggests that the present classification might be reasonable and valid as a classification of clinical subtypes based on the social cognition in patients with schizophrenia.

The three groups in this study had some interesting clinical features. First, the low-impact group showed fewer subjective difficulties in social cognition, higher objective performance on the social cognition tasks, and the highest level of social functioning. It is worth noting that nearly half of the participants had very little cognitive impairment and showed the highest level of social functioning. This is consistent with the numerous reports suggesting that cognition is a strong contributor to social functioning in patients with schizophrenia^{59–61}. This group of patients could evaluate themselves reasonably accurately. These results were consistent with previous reports suggesting that a high introspective accuracy contributes to a high level of social functioning^{62,63}. This group also had the mildest positive, negative, and general psychopathological symptoms and would be one group with a relatively good prognosis among patients with schizophrenia with a diverse course. Next, the unaware group

showed impaired objective performance on the tasks of social cognition but reported few subjective difficulties in social cognition. The unaware group showed the most impaired social cognition, as well as the most impaired neurocognition and functional capacity. In addition, these patients showed more severe positive, negative, and general psychopathological symptoms than the low-impact group. This group of patients may be unaware of their impaired social cognition due to impairment of other aspects of cognition, such as metacognition, which causes a lack of insight of these patients into their symptoms and illness. It could also be considered as overestimation of the actual level of social cognition by these patients. The characteristics of the unaware group are consistent with those of patients exhibiting overconfidence, with poor functioning and worse psychiatric symptoms^{34,64,65}. Finally, the perceptive group exhibited impaired objective performance on social cognition tasks, had serious subjective difficulties in social cognition, and had severe positive, negative, and general psychopathological symptoms. Furthermore, the perceptive group showed poorer social functioning than the unaware group, which showed the most severe cognitive impairment. As discussed so far, cognitive impairment and low introspective accuracy, such as overconfidence, have been noted as strong contributors to low functioning, which would be a contradictory result for the perceptive group. In this type of high introspective accuracy group, i.e., patients with both high impairments and difficulties, social functioning may be more likely to be influenced by other factors not determined solely by cognitive impairments. For example, depressive symptoms can increase subjective difficulties in social cognition and decrease social functioning^{2,66}. Although the duration of illness was not significantly different among the present groups, the stage of illness could have had an impact. Impairments of social cognition are found in first-episode psychosis and further at-risk states^{67,68}, but the proportion of people who perceive that social cognition is related to their social life increases as the duration of illness increases¹⁹. This may be due in part to the fact that the longer the disease duration, the more difficulties the patients face in interpersonal situations related to social cognition and the greater negative attitudes they experience from others. Other psychosocial factors, such as internal stigma or lack of service engagement with social services, could have similar effects^{61,69}. The social factors may have particularly influenced the clustering in the present study, since difficulties perceived in social life were used for the analyses rather than the degree of confidence in performing the task.

The findings of the present study have significant implications, especially in clinical settings. Interviewing patients to determine their subjective difficulties in social cognition is simple to do in clinical settings. It should also be an essential conversation among patients,

Table 3. Comparisons of the clinical characteristics among the three groups.

	Cluster 1 Low-impact group <i>n</i> = 65 mean (SD)	Cluster 2 Unaware group <i>n</i> = 43 mean (SD)	Cluster 3 Perceptive group <i>n</i> = 23 mean (SD)	F/X2 (df)	<i>p</i>	Summary of post-hoc
Objective performance	−0.34 (0.73)	−3.12 (1.18)	−2.31 (2.08)	73.21 (2, 128)	<0.01	2 < 3 < 1
Subjective difficulties	0.26 (1.04)	0.17 (1.06)	3.16 (0.85)	79.34 (2, 128)	<0.01	1 = 2 < 3
Age (years)	37.14 (10.67)	40.23 (10.42)	42.78 (10.32)	2.78 (2, 128)	0.07	-
Sex (M/F, %)	33/32 50.8%/49.2%	17/26 39.5%/60.5%	13/10 56.5%/43.5%	2.10 (2)	0.35	-
Duration of illness (years)	11.73 (7.79)	14.74 (9.12)	16.35 (10.66)	2.95 (2, 128)	0.06	-
PANSS positive	14.60 (4.52)	17.41 (5.63)	17.83 (4.87)	5.61 (2, 121)	0.01	1 < 2 = 3
PANSS negative	16.87 (4.42)	20.67 (4.64)	21.17 (3.43)	13.22 (2, 121)	<0.01	1 < 2 = 3
PANSS general psychopathology	33.97 (7.08)	38.05 (7.42)	40.87 (6.81)	9.13 (2, 121)	<0.01	1 < 2 = 3
BACS	−1.48 (1.65)	−2.33 (1.84)	−2.07 (1.78)	3.27 (2, 127)	0.04	2 < 1
UPSA-B	78.19 (9.94)	71.21 (16.00)	81.00 (7.36)	6.47 (2, 127)	<0.01	2 < 1 = 3
SLOF	98.62 (12.01)	93.47 (13.09)	90.39 (11.21)	4.70 (2, 128)	0.01	3 < 1

Objective performance and subjective difficulties are composite scores of the four domains standardized by the data from healthy controls. *BACS-J* the Brief Assessment of Cognition for Schizophrenia, Japanese Version, *PANSS* the Positive and Negative Syndrome Scale; *SD* standard deviation, *SLOF* the Specific Levels of Functioning Scale, *UPSA-B* the University of California, San Diego Performance-based Skill Assessment-Brief.

Table 4. Post-hoc analysis of the comparisons of the three groups.

Variables	Cluster 1 Low-impact group/ Cluster 2 Unaware group		Cluster 1 Low-impact group/ Cluster 3 Perceptive group		Cluster 2 Unaware group/ Cluster 3 Perceptive group	
	Mean difference	<i>p</i>	Mean difference	<i>p</i>	Mean difference	<i>p</i>
Objective performance	2.78	<0.01	1.97	<0.01	−0.82	0.03
Subjective difficulties	0.08	0.91	−2.90	<0.01	−2.98	<0.01
PANSS positive	−2.81	0.02	−3.23	0.02	−0.42	0.95
PANSS negative	−3.80	<0.01	−4.30	<0.01	−0.51	0.90
PANSS general psychopathology	−4.08	0.02	−6.90	<0.01	−2.82	0.29
BACS	0.85	0.04	0.59	0.34	−0.25	0.84
UPSA-B	6.98	0.01	−2.81	0.60	−9.79	<0.01
SLOF	5.15	0.86	8.22	0.02	3.07	0.60

Objective performance and subjective difficulties are composite scores of the four domains standardized by the data from healthy controls. *BACS-J* the Brief Assessment of Cognition for Schizophrenia, Japanese Version, *PANSS* the Positive and Negative Syndrome Scale, *SLOF* the Specific Levels of Functioning Scale, *UPSA-B* the University of California, San Diego Performance-based Skill Assessment-Brief.

families, and healthcare providers when implementing examinations and treatments for social cognition. If a patient expresses serious difficulties in social cognition during the interview, he/she may be assumed to belong to the perceptive group and his/her objective performance could be declining. This group is characterized by the lowest social functioning. Thus, these patients should be actively encouraged to receive treatments to improve their social cognition and, consequently, their social functioning, although providing motivation for treatment to these patients is often a challenge^{70,71}. On the other hand, careful observation is required in patients who report fewer difficulties. While some of these patients may actually have little impairment of social cognition, there is also a certain subset of these patients who belong to the unaware groups, i.e., those with a high degree of impairment in objective performance. These patients may be better served by provision of metacognitive training to improve their insight into their own disease before they receive

treatment for social cognition^{72,73}. Examination of the level of social cognition using objective measures is also helpful in this group, as that would contribute to confirming the patient's actual degree of functional impairment and defining the treatment goals. In addition to the questionnaire for measuring the subjective difficulties used in the present study, obtaining information from the patient's relatives who are close to the patient is also essential²². As an example, a scale for disability caused by cognitive impairments has been developed, including the perspectives of patients' relatives⁷⁴, and further research in this area is warranted. Furthermore, it has been suggested that cognitive impairments may be an endophenotype that extends across a variety of psychiatric illnesses, including depression and bipolar disorder^{75,76}. Therefore, the clinical subtypes identified in the present study may not be specific to patients with schizophrenia alone.

The present study had some limitations. Although we used a recommended test battery covering all four representative domains of social cognition in this study, it was difficult to collect a large sample size. While this sample size was considered acceptable for cluster analysis, a larger sample size would be desirable for more detailed analyses, such as investigations pertaining to each domain of social cognition. The characteristics were only compared among the groups, and no intra-group variations in the characteristics were investigated. In addition, in the present cluster analysis, only objective performance on social cognition tasks and subjective difficulties in social cognition were entered as variables, and other factors that could potentially be used for classification of the patients into clusters were not examined. Depressive symptoms and comorbidities were not adequately assessed in the present study. In particular, the presence of very few depressive symptoms leads to an overestimation in self-assessment, while moderate depressive symptoms could lead to an accurate assessment^{77,78}. Furthermore, severe depressive symptoms could worsen subjective difficulties in social cognition, although they may have little impact on the performance⁶⁶. Therefore, these may affect the results of cluster analysis, and the results of the present study should be interpreted with caution. An additional limitation was the asymmetry between the measures of subjective difficulties and objective performance that were entered in the cluster analysis. Indeed, the objective performance in some patients with schizophrenia was better than that of healthy controls, but the subjective difficulties measure did not adequately detect this superiority over the healthy controls. This could have affected the results of the cluster analysis.

CONCLUSION

As in previous studies, a certain number of patients with low cognitive impairment exhibited high social functioning in the present study, reinforcing the importance of focusing on cognitive impairment in the treatment of schizophrenia. The present study also revealed clinical subtypes derived by measuring subjective and objective cognition simultaneously. As in previous studies, the group with a discrepancy, i.e., overestimation, showed worse symptoms and levels of functioning. On the other hand, the group with no discrepancies, but with both high impairments and difficulties showed the lowest levels of functioning. Focusing on these subtypes classified on the basis of such clinical discrepancies could allow rational approaches to be adopted to resolve some unmet needs in the treatment of schizophrenia in the real world^{79–81}. Future studies should include a detailed examination of patients with different clinical subtypes of schizophrenia rather than schizophrenia patients as a whole. The present results could contribute to a more precise assessment of the actual impairments of social cognition and could serve as a guidepost for providing individualized, targeted interventions. Intervention in social cognition can be a key to achieving functional recovery in patients with schizophrenia, and the first step in implementing this would be to listen to the patient.

DATA AVAILABILITY

The data that support the findings of this study are available upon reasonable request to the corresponding author.

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AUTHOR CONTRIBUTIONS

T.U., R.O., N.H., and T.N. designed the study and wrote the protocol. H.A., I.W., A.A., M.N., H.O., R.K., Y.Y., A.T., and S.I. were involved in the conceptualization of the study. T.U., H.A., A.A., and I.W. collected the data. T.U. undertook the statistical analysis and wrote the first draft of the manuscript. All the authors contributed to and approved the final manuscript.

COMPETING INTERESTS

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ADDITIONAL INFORMATION

Correspondence and requests for materials should be addressed to Takahiro Nemoto.

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