Schizophrenia Research: Cognition 33 (2023) 100287

Contents lists available at ScienceDirect

Schizophrenia Research: Cognition

journal homepage: www.elsevier.com/locate/scog

Research Paper

Social cognition and apathy between two cognitive subtypes of schizophrenia: Are there the same or different profiles?

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ARTICLE INFO

Keywords:
Schizophrenia
Apathy
Social cognition
Neurocognition
Subtypes

ABSTRACT

Objective: Cognitive impairment is an essential feature of schizophrenia, and it involves a broad array of nonsocial and social cognitive domains. This study aimed to examine whether there are the same or different social cognition profiles between two cognitive subtypes of schizophrenia.
Method: There were one hundred and two chronic and institutionalized patients with schizophrenia from two referral tracks. One group is "Cognitively Normal Range" (CNR) (N = 52), and another group is "Below Normal Range" (BNR) (N = 50). We assessed or collected their apathy, emotional perception judgment, facial expression judgment, and empathy by the Apathy Evaluation Scale, the International Affective Picture System, the Japanese and Caucasian Facial Expression of Emotion, and the Interpersonal Reactivity Index, respectively.
Results: We found different impairment profiles depending on the cognitive subtypes of the patient with schizophrenia. Surprisingly, the CNR presented impairments in apathy, emotional perception judgment, facial expression judgment, and empathy and feature impairment in empathy and affective apathy. In contrast, even though the BNR had significant neurocognition impairments, they had almost intact empathy with significantly impaired cognitive apathy. Both groups' global deficit scores (GDSs) were comparable, and all reached at least a mild impairment level.
Conclusions: The CNR and the BNR had similar abilities in emotional perception judgment and facial emotion recognition. They also had differentiable deficits in apathy and empathy. Our findings provide important clinical implications for neuropsychological pathology and treatment in schizophrenia.

1. Introduction

Cognitive impairment is a core and characteristic feature of schizophrenia, and it involves a broad array of nonsocial and social cognitive domains (Green et al., 2019). Most commonly, nonsocial cognitive (neurocognition) impairment includes the speed of processing, verbal learning and memory, visuospatial learning and memory, working memory, attention/vigilance, and reasoning and problem-solving (Nuechterlein et al., 2005). The National Institute of Mental Health (NIMH) workgroup also defined impairments in several areas of social cognition, including emotion perception/processing, mentalizing, social perception (Green et al., 2008), and attributional style (Savla et al., 2013) in schizophrenia. Recently some studies found that the impairments extend to other social cognition domains, such as empathic accuracy (Van Donkersgoed et al., 2019) and self-referential processing (Potvin et al., 2019). A meta-analysis study on deficits in domains of social cognition in schizophrenia showed that patients with schizophrenia appeared to have significant impairments in social perception, theory of mind, emotion perception, and emotion processing (Savla et al., 2013). Green et al. (2015a) found that social cognition of schizophrenia is related to the impairment of their neurocognition, and neither are mutually independent. Longitudinal studies with patients who recently experienced psychotic episodes showed performance on the cognitive task (Rund et al., 2016) or social cognitive task (McCleery et al., 2016) remained stable over time. Some studies used neurocognition functions of schizophrenia to differentiate the cognitive subtypes. For example, Heinrichs et al. (2015) and Chiang et al. (2016) found two cognitive subtypes, Cognitively Normal Range (CNR) and Below Normal Range (BNR). Until now, no study to examine whether the CNR and BNR schizophrenic patients are the same in impaired profiles on their social cognition domains or not.

In emotion perception or processing domains, standardized facial

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https://doi.org/10.1016/j.scog.2023.100287
Received 11 October 2022; Received in revised form 30 April 2023; Accepted 4 May 2023

expressions such as in Japanese and Caucasian Facial Expression of Emotion (JACFEE) or a set of pictures such as in the International Affective Picture System (IAPS) were often used as study stimuli. Some studies using facial expressions of emotion, such as JACFEE, found that patients with schizophrenia have more difficulty recognizing negative emotional facial expressions, such as fear and anger (Leppänen et al., 2006; Kohler et al., 2010; Ku and Lin, 2020). Some studies use emotional, evocative scenes, such as IAPS, to assess emotional functioning in schizophrenia and found inconsistent results. For example, Herbener et al. (2008) found that schizophrenia patients and healthy report similar emotional valence and elicited arousal when viewing IAPS images. However, Peterman et al. (2015) found that patients with schizophrenia were more positive in their valence rating than healthy control, but self-reported arousal was similar in both groups.

Empathy is a complex construct with multiple components, often measured in cognitive and affective domains (Bonfils et al., 2017). Research on empathy in people with schizophrenia has revealed deficits in both commonly measured empathic components (Bonfils et al., 2016; Savla et al., 2013). Davis (1980) developed a multidimensional individual-difference measure of empathy called the Interpersonal Reactivity Index (IRI) from the interpersonal relationship views. The IRI consists of four 7-item scales measuring two types of empathy: cognitive empathy and affective empathy (Davis, 1980; Rankin et al., 2006). Cognitive empathy describes one's capacity to adopt another person's psychological point of view (Davis, 1994). Two scales measure it: the Fantasy scale measures the tendency to imaginatively identify with the feelings and actions of fictitious characters in movies, books, and plays; the Perspective Taking scale assesses the tendency to adopt the psychological viewpoint of others spontaneously. Affective empathy is the ability to react emotionally to the observed experiences of others. Two scales also measure it: the Empathic Concern scale measures 'other-oriented' feelings of sympathy and concern for unfortunate others; the Personal Distress scale assesses self-oriented feelings of unease and personal anxiety in tense interpersonal settings (Davis, 1980). Some studies in behavioral, developmental, and social neuroscience also clarify the nature of empathy and narrow its scope by delineating dissociable facets that are not totally overlapping in functions and mechanisms yet interact to support interpersonal relationships, including affective sharing, empathetic concern, and perspective taking (Batson, 2012; Decety and Svetlova, 2012; Schnell et al., 2011). Several studies have shown a crucial role of motivation in modulating empathetic experiences (Cameron et al., 2017; Cameron et al., 2019; Lockwood et al., 2017; Zaki, 2014).

Apathy is defined as a lack of motivation not attributable to a diminished level of consciousness, cognitive impairment, or emotional distress (Marin, 1991). Marin et al. (1991) developed the Apathy Evaluation Scale (AES) to measure apathy. Operationally, the AES treats apathy as a psychological dimension defined by simultaneous deficits in the overt behavioral, cognitive, and emotional concomitants of goal-directed behavior. Njomboro and Deb (2014) found that affective apathy of the AES was associated with emotion perception deficits and cognitive apathy of the AES was associated with executive deficits in patients with acquired brain damage. They suggested that treating apathy as a multidimensional syndrome may show important correlates to apathy symptoms. AES was widely used to measure the apathy of patients with schizophrenia (Kiang et al., 2003; Faerden et al., 2008; Chiang, 2009; Minyaycheva et al., 2017).

The current study examined whether there were different performances in apathy, emotional perception judgment, facial expression judgment, and empathy between the CNR and the BNR of schizophrenia. We hypothesized that the CNR performs better than the BNR on these dependent variables.

2. Materials and methods

2.1. Participants

The sample came from two studies. In the current study [the Social Cognitive Function study], 60 participants were Han Chinese ethnicity schizophrenic patients. They were chronically institutionalized patients. The criteria were as follows: 1. They had a schizophrenia diagnosis according to DSM5. 2. Their age ranged from 20 to 65 years old. 3. Their psychiatric symptoms were stable, and their treatment had not changed for two years. 4. Their Mini-Mental State Examination (MMSE) score was higher than or equal to 20. The rationale for selecting this cut-off score of 20 in this study is mainly based on Ong et al.'s (2016) study. Ong et al. examined the performance of MMSE in long-stay patients with schizophrenia in a psychiatric institute. They found that patients' severity of cognitive impairment could be classified into three levels: 24–30 = no cognitive impairment, 18–23 = mild cognitive impairment, and 0–17 = severe cognitive impairment. For grouping CNR and BNR from the participants, this cut-off score of 20 should be reasonable. In contrast, we excluded patients with one of the following criteria. 1. They had other diagnoses, such as traumatic brain impairment, substance abuse, or neurodevelopmental disorders. 2. According to Taiwan's law, a judge judged them incapacitated or of limited capacity. Forty-two participants were recruited from a previous study [the Cognitive Function study]. The criteria of inclusion and exclusion of the participants and used assessment tests were the same in both studies. Finally, one hundred and two schizophrenic patients of Han Chinese ethnicity participated in this study.

2.2. Procedures

The Social Cognitive Function study began in September 2017 and was completed in December 2020. The study was approved by the Institutional Review Board of Yuli Hospital (Approved number: YLH-IRB-10617). The study procedures were as follows. All referred participants were screened and verified as meeting the study criteria by the first author (CSK, Ph.D., certified clinical psychologist) and third author (HTM, M.D., certified psychiatrist). Then one of the researchers interpreted the content of the study for these patients. The willing patients with MMSE scores above or equal to 20 were given the informed consent procedure. Two licensed clinical psychologists (LSM and CTT, both M. Sc.) administered the assessment tests.

The Cognitive Function study began in September 2013 and was completed in August 2015. The study was approved by the Institutional Review Board of Kai-Syuan Psychiatric Hospital (Approved number: KSPH-2012-05). The Institutional Review Board of Yuli Hospital approved using the previous primary data. The first author (CSK, Ph.D., certified clinical psychologist) connected the de-identification data (only appearing as a case number) to patients' other demographic variables. The first and third authors (HTM, M.D., certified psychiatrist) crossly checked and verified no repeated patient in both studies.

2.3. Materials

2.3.1. Neurocognition tests

This study took the same tests and cognition impairment criteria for differentiating CNR and BNR subtypes of schizophrenia as in a previous study (Chiang et al., 2016). These tests included the Digit Symbol Substitution (DSS) subscale and Working Memory Index (WMI) of the Wechsler Adult Intelligence Scale Third Version (WAIS-III) (Chen and Chen, 2002), Logic Memory (LM) subscale, and Visual Reproduction (VR) subscale of Wechsler Memory Scale Third Version (WMS-III) (Hua et al., 2005), Modified Card Sorting test (MCST) (Nelson, 1976), Trail Making test, A form (TMT-A) (Lezak et al., 2004), Semantic Association Verbal Fluency test (SAVFT) (Hua, 1999), and a Blyler's short form of four subscales (Information; Block Design; Digit Span; Digit Symbol

Substitution) of WAIS-III. The equation is as follows: estimated FSIQ = 2.22 * Information + 1.6 * Block Design + 0.86 * Digit Span + 1.33 * Digit Symbol Substitution + 37.97 (Chiang et al., 2007).

2.3.2. Rating of neurocognition impairment

We adopted the Global Deficit Score (GDS) to reflect participants' impairment and severity of neurocognitive functioning (Leung et al., 2008). We compared participants' scores to Taiwanese adult norms of these instruments, including neurocognition tests, AES, IAPS, C-IRI, and JACFEE.

The GDS method begins by converting *T* scores to deficit scores that reflect the presence and severity of impairment. *T* scores above 40 represented no impairment (deficit score = 0). In contrast, a deficit score of 1 reflects mild impairment (*T* scores = 39 to 35), a deficit score of 2 reflects mild to moderate impairment (*T* scores = 34 to 30), a deficit score of 3 reflects moderate impairment (*T* scores = 29 to 25), a deficit score of 4 reflects moderate to severe impairment (*T* scores = 24 to 20), and a deficit score of 5 reflects severe impairment (*T* scores <20). Deficit scores on all tests were then averaged to create the GDS. The GDS score ranges from 0 to 5—a Score of 0 means within the normal range. Score 1 means mild impairment. Score 2 means between mild and moderate impairment. A score of 3 means moderate impairment. A score of 4 means between moderate and severe impairment. A score of 5 means severe impairment.

Previous studies' results showed that a GDS greater than or equal to 0.5 has accurately predicted the expert clinical rating of overall impairment (Carey et al., 2004; Heaton et al., 2004). We follow the criteria of our previous study: The GDS's mean of the BNR is higher or equal to 0.5; the GDS's mean of the BNR is lower than 0.5 (Chiang et al., 2016).

2.3.3. Tests for evaluating participants' social cognition domains and apathy

2.3.3.1. International Affective Picture System (IAPS). This study used the IAPS (Lang et al., 2005) to evaluate participants' valence and arousal to pictures about emotional perception under social context. We used 64 pictures of the IAPS, including positive and negative$_1$. These pictures had suitable psychometric properties in the previous study (Chiang et al., 2012). We used SAM to collect participants' responses by following the standardized procedure of the IAPS.

Negative pictures: *3063*, *3069*, *6415*, *9500*, *3000*, *3053*, *3180*, *3215*, *9008*, *9290*, *9300*, *9341*, *3016*, *9911*, *9921*, *9925*, *2455*, *2700*, *2703*, *2800*, *2683*, *2691*, *6243*, *6821*, *1302*, *1525*, *1930*, *1932*, *2491*, *2661*, *6311*, *9432*; positive pictures: *8033*, *8040*, *8050*, *8220*, *1603*, *1947*, *5611*, *5811*, *8178*, *8179*, *8341*, *8490*, *2005*, *4534*, *4542*, *4574*, *4002*, *4004*, *4235*, *4255*, *7284*, *7340*, *7286*, *7475*, *4607*, *4608*, *4659*, *4669*, *2154*, *2299*, *2395*, *2360*.

2.3.3.2. Japanese and Caucasian Facial Expression of Emotion (JACFEE). Matsumoto and Ekman (1988) developed the JACFEE using the Facial Action Coding System. This system includes seven facial expressions: anger, contempt, disgust, fear, happiness, sadness, and surprise. In this study, we followed Chiang's (2009) study to use twenty-four pictures of JACFEE, including six facial expressions but not contempt, and four pictures for each facial expression. We calculated the accuracy rate of the judgment of each facial expression category. A higher accuracy rate means a better recognition ability of facial expressions.

2.3.3.3. Interpersonal Reactivity Index (IRI). Davis (1980) developed the IRI, and it included four subscales, Fantasy (FS), Perspective Taking (PT), Empathic Concern (EC), and Personal Distress (PD). Combining FS and PT can calculate a participant's cognitive empathy. Combining EC and PD can calculate a participant's affective empathy. Chiang et al. (2014) developed a Chinese version of the IRI (C-IRI) with good psychometric properties. This study used C-IRI to measure participants' empathy. A higher score means better performance on total empathy and its compositions of components.

2.3.3.4. Apathy Evaluation Scale (AES). Marin (1991) developed the Apathy Evaluation Scale. Yang (2003) developed a Chinese version of AES (C-AES) with good psychometric properties. Chiang (2009) found C-AES had three cognitive, affective, and behavioral factors, which are appropriate for patients with schizophrenia. This study used C-AES to assess participants' apathy. A higher score means a worse performance on apathy and its components.

2.4. Statistics

We used IBM SPSS Statistics 20.0 to analyze the collected data. We applied a descriptive statistic to present the participant's demographic characteristics and transform their cognitive performances into GDS scores for dividing into CNR or BNR. For examining the homogeneity of the demographic variables of the two groups, we used the independent sample *t*-test analysis to compare differences in age, academic years, first onset age, and illness years, and Chi-Square analysis for comparing the difference in gender between CNR and BNR. Ong et al. (2016) found that age, gender, and level of education were associated with cognitive functioning measured by MMSE. After adjusting these socio-demographic correlates, the length of hospital stay was independently associated with cognitive functioning. Based on this evidence, we used ANCOVA to control the covariable to compare differences in cognitive domains between CNR and BNR. We also used regression analysis to examine the relationships between demographic variables, apathy, and social cognition functions. Then we applied ANCOVA to compare the differences between the two groups.

3. Results

3.1. Demographic data

Table 1 showed no significant differences between the two groups in gender, age, academic years, and first onset age. Illness years of BNR are significantly longer than CNR's.

3.2. Neurocognition functions of the two groups

Because BNR was significantly longer than CNR in the illness years, we applied ANCOVA to control the illness years and compare differences in cognitive domains between the two groups. In addition, we took the adjusted *p*-value (.05/11 = .0045) for multiple comparisons. Except for MCST-P and TMT-A, Table 2 shows that the CNR performs significantly better on other cognitive indexes than the BNR. Fig. 1 shows the profile of GDS of the cognitive indexes for the two groups. The GDS = 0.5 is the cut-off point of cognitive impairment. The mean of the GDS of the CNR and the BNR are 0.15 and 1.55, respectively. According to the criteria of the GDS score on levels of impairment, a score of 0 means within the normal range, a score of 1 means mild impairment, and a score of 2 means between mild and moderate impairment, respectively. In

Table 1
Comparison of the two group's demographic data.

	CNR (n = 52) *M* (*SD*)	BNR (n = 50) *M* (*SD*)	t/χ^2	*p*
Age	46.82 (10.58)	46.73 (7.73)	0.051	.96
Education years	10.85 (2.97)	9.92 (3.11)	0.547	.127
First onset	21.66 (5.06)	19.96 (4.51)	1.62	.108
Illness years	21.88 (9.68)	26.77 (8.17)	−2.52	<.05
Male	35	31	0.31	.68
Female	17	19		

Table 2
The ANCOVA test of two groups on different cognitive domains.

Cognitive domain	Index	Subtype	M	SD	*F*	*p*
Verbal Fluency	SAVFT	CNR	42.50	9.65	15.87	.000
		BNR	26.50	9.10		
Processing Speed	DSS	CNR	9.50	1.43	13.13	.000
		BNR	5.48	2.72		
Working Memory	WMI	CNR	82.90	7.67	22.22	.000
		BNR	65.24	7.57		
Verbal Immediate Memory	LGI	CNR	8.90	3.03	8.29	.001
		BNR	5.50	2.60		
Verbal Delayed Memory	LGII	CNR	9.00	3.27	7.55	.001
		BNR	5.62	2.92		
Visual Immediate Memory	VRI	CNR	9.60	2.07	13.82	.000
		BNR	5.48	2.63		
Visual Delayed Memory	VRII	CNR	8.90	2.64	13.61	.000
		BNR	5.44	2.40		
Reasoning and Problem-Solving	MCST-C	CNR	5.90	1.45	13.75	.000
		BNR	2.56	1.97		
	MCST-P	CNR	2.20	2.74	4.86	.01
		BNR	16.46	14.44		
Executive Function	TMT-A	CNR	56.10	23.58	5.33	.008
		BNR	104.80	67.37		
Full-Scale IQ	FSIQ	CNR	102.45	15.11	15.11	.000
		BNR	80.27	11.55		

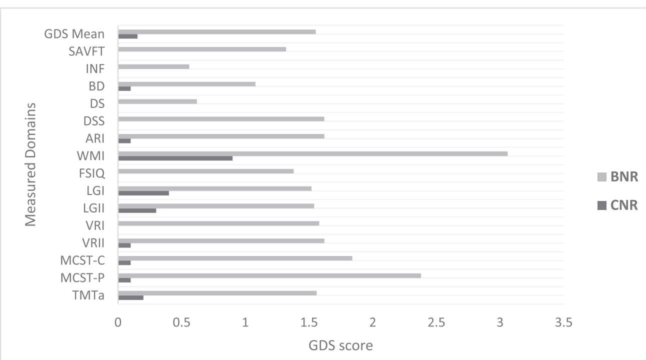

Fig. 1. The profile of GDS of all cognitive indexes of the two groups.
Note: GDS: Global Deficit Score; SAVFT: Semantic Association Verbal Fluency Test; INF: Information Subtest; BD: Block Design Subtest; DS: Digit Span Subtest; DSS: Digit Symbol Substitution Subtest; ARI: Arithmetic Subtest; WMI: Working Memory Index; FSIQ: Full-Scaled Intelligence Quotient; LGI: Logical Memory-Immediate; LGII: Logical Memory Delayed; VRI: Visual Reproduction Immediate; VRII: Visual Reproduction Delayed; MCST-C: Modified Card Sorting test-Category; MSCT-P: Modified Card Sorting test-Perseveration; TMTa: Trail Making test, A form.

summary, The CNR of the current study only had very mild impairment; in contrast, the BNR closely had mild to moderate impairment.

3.3. Apathy and social cognition functions of the two groups

We used the demographic variables to predict the indexes of apathy and social functions to examine the associations between predictive and predicted variables for all participants by a stepwise regression method. Table 3 appeared the results.

We used the ANCOVA or t-test analysis to compare the differences in apathy and social cognition functions between the two groups depending on the regression analysis results. For multiple comparisons, we took the adjusted *p*-value (.05/4 = .0125) for apathy components.

Table 4 shows that the CNR was significantly better than the BNR on AES's cognitive and total apathy. There were no significant differences in AES's affective and behavioral apathy.

For multiple comparisons, we took the adjusted *p*-value (.05/8 = .00625) for affective dimensions. Table 5 showed no significant differences between the CNR and BNR groups.

For multiple comparisons, we took the adjusted *p*-value (.05/6 = .0083) for facial expression categories. Table 6 showed no significant differences in the accurate judgment rate of six facial expressions between the CNR and the BNR.

For multiple comparisons, we took the adjusted *p*-value (.05/7 = .0071) for empathy dimensions.

Table 7 showed the BNR group was significantly better than the CNR group on all subscales of C-IRI.

Fig. 2 shows the profiles of the GDS scores of the social cognition domains and apathy. Overall, the means of the GDS of both groups are 1.19 and 1.10, respectively. However, there were three deficit conditions across all domains and two groups. First, both groups were within the normal range in Fantasy and Personal Distress of the C-IRI; Disgust, Surprise, Anger, and Happy of the JACFEE; arousal of both positive and negative pictures of the IAPS. Second, both groups were defective in Empathic Concerns of the C-IRI, Fear and Sad of the JACFEE, the valence of both positive and negative pictures of the IAPS, and behavioral and

Table 3
The results of the regression analysis of apathy and social cognition domains.

Domains	Predicted variables	Predictive variables	Adjusted R^2
Apathy	Cognitive Apathy	Illness years	0.087
	Affective Apathy	Nil	–
	Behavioral Apathy	Illness years	0.046
	Total Apathy	Illness years	0.073
Affective Dimension	Total Pictures Pleasure	Education years/Gender	0.093
	Total Pictures Arousal	Nil	–
	Negative Pictures Pleasure	Education years	0.046
	Negative Pictures Arousal	Nil	–
	Neutral Pictures Pleasure	Gender/Education years	0.143
	Neutral Pictures Arousal	Nil	–
	Positive Pictures Pleasure	Education years/Gender/First onset	0.136
	Positive Pictures Arousal	Nil	–
Facial Expression	Happiness	Nil	–
	Fear	Nil	–
	Sad	Nil	–
	Anger	Illness years	0.059
	Surprise	Nil	–
	Disgust	Nil	–
Empathy Dimension	Fantasy	Age	0.044
	Perspective Taking	Age	0.045
	Empathy Concern	Nil	–
	Personal Distress	Age	0.089
	Cognitive Empathy	Age	0.054
	Affective Empathy	Illness years	0.085
	Total Empathy	Illness years	0.091

Table 4
The ANCOVA or *t*-test of the two groups on the AES and its components.

Apathy components	Subtype	N	*M*	*SD*	*t/F*	*p*
Cognitive Apathy	CNR	52	14.06	9.72	30.35	.000[b]
	BNR	50	29.88	5.90		
Affective Apathy	CNR	52	13.56	3.36	1.82	.072[a]
	BNR	50	12.50	2.41		
Behavioral Apathy	CNR	52	16.75	4.90	4.59	0.013[b]
	BNR	50	18.84	4.51		
Total Apathy	CNR	52	44.37	14.72	16.54	0.000[b]
	BNR	50	61.22	10.37		

[a] Using t-test analysis.
[b] Using ANCOVA analysis.

Table 5
The ANCOVA or *t*-test of two groups on the valence and arousal of the IAPS pictures.

Affective Dimension	Subtype	N	*M*	*SD*	*t/F*	*p*
Total Pictures Pleasure	CNR	52	4.87	0.98	2.79	.044[b]
	BNR	50	4.96	1.10		
Total Pictures Arousal	CNR	52	5.63	1.24	1.53	.129[a]
	BNR	50	5.26	1.18		
Negative Pictures Pleasure	CNR	52	4.73	1.00	2.88	.061[b]
	BNR	50	4.71	1.17		
Negative Pictures Arousal	CNR	52	5.84	1.40	2.08	.040[a]
	BNR	50	5.30	1.24		
Neutral Pictures Pleasure	CNR	52	6.09	1.30	3.34	.022[b]
	BNR	50	6.33	1.46		
Neutral Pictures Arousal	CNR	52	5.13	1.65	−1.23	.223[a]
	BNR	50	5.52	1.55		
Positive Pictures Pleasure	CNR	52	4.78	1.03	4.20	.004[b]
	BNR	50	4.93	1.08		
Positive Pictures Arousal	CNR	52	5.74	1.28	1.78	.078[a]
	BNR	50	5.30	1.24		

[a] Using *t*-test analysis.
[b] Using ANCOVA analysis.

Table 6
The ANCOVA or *t*-test of the accurate judgment rate of JACFEE between the two groups.

Facial Expression	Subtype	N	*M*	*SD*	*t*	*p*
Happiness	CNR	52	98.08	8.35	−1.26	.214[a]
	BNR	50	94.50	18.41		
Fear	CNR	52	24.04	24.23	1.45	.149[a]
	BNR	50	31.50	27.58		
Sad	CNR	52	47.60	27.68	1.53	.129[a]
	BNR	50	56.50	31.06		
Anger	CNR	52	69.23	28.70	3.20	.046[b]
	BNR	50	70.50	33.00		
Surprise	CNR	52	81.25	28.81	−1.08	.281[a]
	BNR	50	75.00	29.45		
Disgust	CNR	52	47.60	32.18	−0.18	.854[a]
	BNR	50	46.50	27.67		

[a] Using t-test analysis.
[b] Using ANCOVA analysis.

Table 7
The *t*-test of the C-IRI between the two groups.

Empathy Dimension	Subtype	N	*M*	*SD*	*t/F*	*p*
Fantasy	CNR	52	12.25	4.95	26.95	.000[b]
	BNR	50	19.18	4.52		
Perspective Taking	CNR	52	15.13	5.79	10.02	.000[b]
	BNR	50	20.28	6.00		
Empathy Concern	CNR	52	14.50	4.62	4.41	.000[a]
	BNR	50	18.72	5.04		
Personal Distress	CNR	52	12.60	4.87	17.85	.000[b]
	BNR	50	18.32	5.30		
Cognitive Empathy	CNR	52	27.38	9.53	20.26	.000[b]
	BNR	50	39.46	9.65		
Affective Empathy	CNR	52	27.10	6.96	24.83	.000[b]
	BNR	50	37.04	4.85		
Total Empathy	CNR	52	54.29	14.48	24.39	.000[b]
	BNR	50	76.50	10.99		

[a] Using t-test analysis.
[b] Using ANCOVA analysis.

total apathy of the AES. Third, only the CNR had deficits in total empathy, cognitive empathy, affective empathy, perspective taking of the C-IRI, and affective apathy of the AES. In contrast, only the BNR had a deficit in cognitive apathy of the AES.

In summary, the CNR had a more significant deficit level in empathy than the BNR. The BNR had a more significant deficit level in apathy than the CNR. Both groups had similar deficit levels in emotional processing and facial expression recognition.

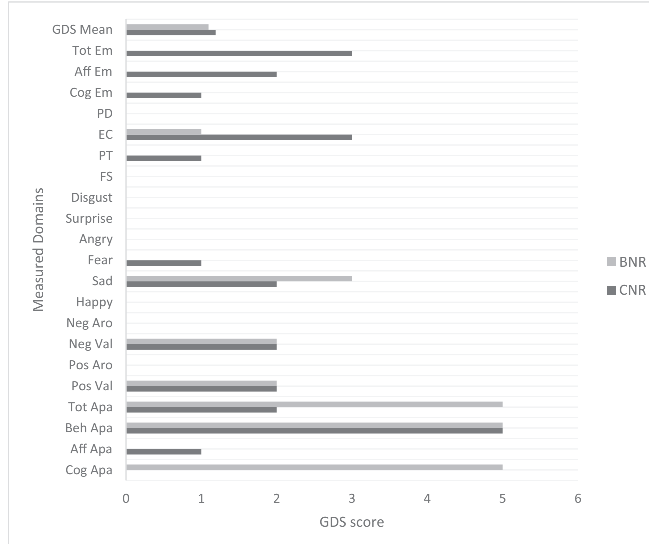

Fig. 2. The profile of GDS of all social cognitive indexes and apathy of the two groups.
Note: GDS: Global Deficit Score; Tot Em: Total Empathy; Aff Em: Affective Empathy; Cog Em: Cognitive Empathy; PD: Personal Distress; EC: Empathic Concerns; PT: Perspective Taking; FS: Fantasy; Neg Aro: Negative Arousal; Neg Val: Negative Valence; Pos Aro: Positive Arousal; Pos Val: Positive Valence; Tot Apa: Total Apathy; Beh Apa: Behavioral Apathy; Aff Apa: Affective Apathy; Cog Apa: Cognitive Apathy.

4. Discussion

4.1. *Apathy and social cognition functions of the two cognitive subtypes*

This study found the two groups had similar deficits in subdomains and impairment levels in emotional processes and facial emotion recognition. For the emotional processing process reflected by the IAPS, two groups displayed the phenomenon of weakness when they were giving a valence judgment to a strong positive or negative picture. However, both groups had no impairment in arousal evaluation. Traditionally, affect models assume the conscious experience of affect is composed of valence, which refers to the experience of pleasure and displeasure, and arousal, which in turn refers to a sense of energy or excitation (Russell, 2003). The results of the current study and Llerena et al.'s (2012) both indicated people with schizophrenia and normal controls reported similar levels of subjective arousal in response to pleasant and unpleasant stimuli. There were two possible explanations for why our participant's response had a weaker valence to a picture with strong positive or negative valence. First, our participants were chronic institutional patients with long term illness. They lack affective solid experience in their daily life in hospital.

Further, this may let them use some heuristics, such as the representativeness heuristic, the availability heuristic, and the adjustment and anchoring heuristic (Tversky and Kahneman, 1974), to perform their valence evaluation. Second, compared to the normal Taiwanese adult norm, our participants, even though the CNR was better than the BNR, had significant impairments in their WMI. Mikels et al. (2008) found domain-specific working memory components specialized for the online maintenance of affective information. In our study, the participants must give valence to a picture after they viewed it. If their impaired working memory could not maintain affective information, it is possible to report less valence to a solid emotional picture.

For facial emotion recognition, some studies found facial processing deficits are similar in both recent-onset and chronic schizophrenia.

Facial processing deficits, especially in negative emotion recognition in schizophrenia, remain stable throughout the illness (Addington et al., 2006; Comparelli et al., 2013), fitting the pattern of a vulnerability indicator (Gao et al., 2021). Weiss et al. (2007) found the accuracy of facial emotion recognition in schizophrenia correlated negatively with the duration of the disease. In this study, the duration of illness of the BNR was significantly longer than the CNR. We found that only anger was related to duration of illness. In addition, the neurocognition functions of the BNR were significantly worse than the CNR. After controlling the covariable, both groups had no facial emotion recognition accuracy differences. Our findings supported that facial negative emotion recognition may be one of the vulnerability indicators of schizophrenia.

Apathy is a multidimensional symptom of cognitive, behavioral, and emotional facets, including impaired motivation and reduced goal-directed behavior (Bortolon et al., 2018). Robert et al. (2002) and Marin (1991) proposed symptoms of apathy may be separable. Affective apathy can manifest as symptoms of indifference or lack of empathy. Behavioral apathy can present as indolence and requires initiating physical activity. Cognitive apathy refers to the inactivation of goal-directed cognitive activity manifested by the requirement of assistance initiating mental activity or speech. The current study found the BNR and the CNR had significant impairment. Except for the affective and behavioral apathy, the BNR was worse than the CNR in cognitive level and total apathy. Both groups had severe impairment (GDS = 5) in behavior apathy compared to the normal population. However, the CNR appeared to have mild impairment in affective apathy (GDS = 1) and a mild to moderate impairment in total apathy (GDS = 2), and the BNR showed severe cognitive apathy (GDS = 5). In summary, we clarified the specific resources of apathy for the CNR and the BNR.

We found that the CNR had more significant impairment in empathy than the BNR. Surprisingly, these results did not support our hypothesis. Especially when compared to the health control, only the CNR appeared wide-ranging and showed significant impairment in empathy. There were two possible explanations for these findings. Some studies found motivation was crucial in modulating empathetic experiences (Cameron et al., 2019; Zaki, 2014). Lockwood et al. (2017) found although empathy and apathy are distinct constructs, the same latent factor underpinned affective empathy and emotional motivation. Their study found emotional apathy correlated negatively with affective empathy. The current study found the CNR significantly impaired affective apathy. Further, this may lead to the CNR impairment in their empathy. Our findings indicated empathy is a complex social function integrating several social processes and is impaired in schizophrenia (Green et al., 2015b).

4.2. Clinical implications and limitations

Our findings verified different impairment profiles depending on the cognitive subtypes of the patient with schizophrenia. Note, even though the neurocognition functions of the CNR were within normal range, they still presented different levels of impairment in apathy, emotional perception judgment, facial expression judgment, and empathy, and feature impairment in empathy and affective apathy. Their GDS is comparable with the BNR and reached at least a mild impairment level. In contrast, even though the BNR had significant neurocognition impairments, they had almost fully intact empathy but impaired cognitive apathy. In summary, in this study, the CNR and the BNR had similar abilities in emotional perception judgment and facial emotion recognition. They also had differentiable deficits in apathy and empathy. Our findings provide practical clinical implications to practitioners and researchers of schizophrenia.

However, there are several limitations to the current study. First, our participants were chronic institutionalized patients. They rarely experienced social context demands to executive social cognition in daily life. We could not rule out the lack of actual and rich social stimuli. A future study may recruit patients with schizophrenia living in the community as participants. Second, Peyroux et al. (2019) found distinct profiles of social cognition impairments according to negative and positive symptoms in schizophrenia. This study did not collect participants' clinical symptom characteristics, even though we recruited them with stable psychiatric symptoms. Future studies may collect clinical symptoms data and rule out their possible influence on social cognition by statistical control. Third, we assessed social cognition and apathy by self-report measurements from static inventories. The results may lack ecological validity. For example, Van Donkersgoed et al. (2019) found a distinction between self-report empathy and actual empathy performance, which is reflected by static and dynamic materials, respectively. Future studies may use instruments that take ecological validity into account. Fourth, we chose the socio-cognitive domains assessed based on our previous studies (Chiang, 2009; Chiang et al., 2012; Chiang et al., 2014). We could not assess other socio-cognitive domains, such as ToM and attributional styles. Future studies may examine whether there are differences in these domains between the CNR and the BNR.

Ethical approval

This study complied with the principles in the Declaration of Helsinki and was approved by the Institutional Review Board of Yuli Hospital (Approved number: YLH-IRB-10617).

Funding sources

This study did not receive any funding sources.

Preprints

This paper had submitted to SSRN and was posted on 17 Jan 2023 (https://doi.org/10.2139/ssrn.4319913).

CRediT authorship contribution statement

Shih-Kuang Chiang: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision. **Shih-Min Lai:** Formal analysis, Investigation, Data curation. **Tsung-Ming Hu:** Investigation, Resources, Project administration.

Declaration of competing interest

The authors report there are no relevant competing interests to declare.

Acknowledgments

We are grateful to Ting-Tzu Chang for her assistance in collecting participants' research data. We also thank the Taipei Veterans General hospital Yuli branch for providing anonymous research data.

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