Impairment of Romantic Emotion and Empathy in Schizophrenics: A Preliminary Study

Zhangxiu Lu

Medical Psychological Institute, Second Xiangya Hospital, Central South University

Sizhu Huyang

Medical Psychological Institute, Second Xiangya Hospital, Central South University

Daxing Wu (✉ wudaxing2017@csu.edu.cn)

<https://orcid.org/0000-0002-6786-8109>

Youqiao Chen

Medical Psychological Institute, Second Xiangya Hospital, Central South University

Zhishuai Jin

Medical Psychological Institute, Second Xiangya Hospital, Central South University

Qixiong Li

Medical Psychological Institute, Second Xiangya Hospital, Central South University

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Abstract

Background Some articles revealed a relationship between empathy and felt-musical emotion in normal people. Whether the dysfunction of felt-musical emotion exist in schizophrenics is not clear, but several findings indicated these patients had impairments of all-round empathy. The objective of our research is to explore musical felt emotion elicited by music(sad/happy) of schizophrenics and compare the differences between schizophrenic patients and normal subjects; at the same time, we investigated the association between clinical symptoms, empathy and musical felt emotion in schizophrenic patients. **Methods** We recruited 47 people with schizophrenic and 47 matched normal subjects who met the criteria to complete our semi-structured interview, musical emotion experience test and other behavioral tests. The IRI-C(Chinese version of Interpersonal Reactivity Index test) was used to assess the empathy of the subjects. In addition, the Self-Rating Depression Scale (SDS) and self-rating Anxiety Scale (SAS) were also filled out. **Results** In line with previous findings, part of emotional experience of happy and sad music in schizophrenic patients is impaired. With respect of empathy dimensions, we found the higher the fantasy ability is, the easier schizophrenics are to experience Romantic with the stimulation of happy/sad music. In addition, there are some relationships between clinical symptoms and music experience. **Conclusion** This conclusion may provide us subsequent idea, if we enhance the romantic emotion of schizophrenics on happy music experience via certain ways that may be beneficial to improve the level of their Empathy and fantasy-dimension.

1 Background

Schizophrenia is a complex psychiatric illness caused by interaction of environment and heredity[1]. Clearly, current findings pointed out obvious deficits of sound intensity features [2] and pitch processing in people with schizophrenic[3] is related to disability in recognizing the emotion of voices [4, 5].

It is universally acknowledged that perceived emotion and felt emotion form a complete musical experience. According to the study of Gabrielsson [6] and Juslin [7] in normal populations, audiences are able to perceive emotions what a music wants to express, but they do not necessarily feel the same emotions. Further brain images evidences proved their findings, two different actived brain areas take responsibility to these two different abilities [8, 9], which respectively corresponds to ventrolateral mPFC (media prefrontal cortex) and the dorsal mPFC. Nevertheless, there is overwhelming evidence that schizophrenia express less emotions compared to normal people [10], Van't Wout reported people with psychosis performed much more excitement in physiology, but they had trouble in distinguishing and expressing their own emotions [11]. But some researchers supported that they share similar inner emotional experience, even in certain cases, the patients experience richer [12, 13]. Kantrowitz and his colleagues[5] used 5 kinds of emotional sounds to investigate the differences of auditory emotional recognition between schizophrenias and controls. People with mental illness showed impairments of ability to recognize the emotion, and they were intended to overestimate the low level of emotionality [5]. Also, Miriam Dyck [14], Daijyu Abe [15], Makoto Arai and Weisgerber [16] operated different music segments to explore the music emotional experience in schizophrenias. Their results all pointed to the

same conclusion, patients had impaired in emotional expression, and they cannot identify musical emotion accurately. Conversely, a meta-analysis article written by Kring [13] reported, in most researches, there was no difference of emotional experience between schizophrenics and health people, no matter what the stimulus are (pictures, movies or smells).

The empathy ability has always been a focus problem in research of schizophrenic. Several researchers pointed out there is a defect in empathy of people with schizophrenia. Specifically, they cannot share and understand what other people think about or feel, which results in poor social intercourse. Some experts suggest empathy is a multi-dimensions structure, which containing various cognitive and emotional process [17, 18]. For one thing is cognitive empathy, this is an ability to conclude the internal states (thoughts, emotions and intensions); for another is affective empathy, that is defined as a response to other emotional state or experience [19]. Fantasy- and personal distress under empathy domains were also noticed, patients suffered from schizophrenia [20] reported significant higher personal distress, and lower level PT and EC compared to healthy people, and they were more ego-centricity. Due to few evidences, the mechanism is unclear. Spark [21] found a positive relationship between fantasy and hallucination and delusion. Besides, with prolonging course of disease, the empathy is getting worse because of isolation from outside world and inside closure. Overy and Molnar-Szakacs [22] linked empathy with musical emotion. They borrowed from the core mechanism-synchronization-of empathy to explain what people feel during music. Once music evokes the feelings of people, musical emotion shows up because of empathy toward the composer. Many studies found ambivalent emotions induced by sad music. They speculated the phenomenon appeared because emotion evoked by music is vicarious experience, which is various from sad emotion in daily life[23]. Thus, some researchers [24] specially selected sad music as stimuli, fantasy ability and PT are contributed to enjoying creative art, such as music and literary works. And because of perspective taking ability, people resonated on the emotional level.

Given previous findings, the conclusion of whether there is abnormality of schizophrenia have not reached a consensus. Also, the links between empathy and musical emotional experience still linger on normal people. In our study, we expected to observe empathy have a relationship to musical emotion experience in people with schizophrenia, meanwhile, deep into correlation between subjective level of musical emotion among patients and their clinical symptoms.

2 Method

2.1 Participants

We recruited 47 Schizophrenia outpatients (M=28, F=19) from medical psychology, Xiangya Second hospital, Central South University, aged 16 to 35 (20.11 ± 4.45) years. Among these patients, 19 was taking medicines, including olanzapine (5mg-10mg/day), aripiprazole (10mg-15mg/day) or risperidone (2mg-4mg/day), and remaining 28 had not taken any medicines. All patients were diagnostic by experienced psychiatrists according to the diagnostic criteria of DSM-5 (Diagnostic and Statistical Manual of Mental

Disorders-5) and with good cooperation. People with mental retardation, dementia, severe somatic disease, neurological diseases, alcohol or drug abuse were excluded. The control participants who qualify the inclusion criteria (M=31, F=16; 19.30±3.67 years) were recruited from colleges and high school in Hu Nan (age, gender, and education level-matched).

2.2 Measures

The initial screening was two in one-Wechsler Adult Intelligence Scale (WAIS-RC), containing information subtest and picture completion subtest. Subjects with FIQ>75 were brought into groups. People who met inclusion criteria was conducted semi-structured interview (Positive And Negative Syndrome Scale, PANSS) first (only Schizophrenia Group). Then finished musical perceptive evaluation, musical emotional test (all participants were separated by randomized table, half of them listened to F major and minor of *La Separation*, the rest listened to G major and minor of *Allegro de Concierto*. After each musical excerpt, they filled out one Emotion-related descriptive words or phrases list., Self-Rating Depression Scale (SDS), Self-Rating Anxiety Scale (SAS) and Chinese version of Interpersonal Reactivity Index (IRI-C) test. The entire process was guided by trained psychology postgraduates in the Institute of Medical Psychology, Xiangya Second Hospital. All subjects in both groups voluntarily took part in our research with informed consents and appropriate payments. The experimental protocols were permitted by the Ethical committee of the Second Xiangya Hospital of Central South University.

2.2.1 Musical perceptive evaluation measurement

This measurement was developed by Jake Mandell from the music and neuroimaging lab at Beth Israel/Harvard Medical School in Boston. The test requires subjects to judge whether the pairwise melodies are identical, including 36 pairs music. After test, the percentile rank is showed on the website immediately. Accuracy under 55% of subjects are deemed as a defect in musical perception. (<http://jakemandell.com/tone-deaf/>)

2.2.2 Music excerpts

Two clips were excerpted from *La Separation* by Mikhail Glinka (Russian composer) and *Allegro de Concierto* by Granados (Spanish composer and pianist).

Each piece of music was 30 seconds. One musical profession recorded following four piano clips according to music score from appendix to the article by Ai Kawakami: F major and minor of *La Separation* (♩ =80), G major and minor of *Allegro de Concierto* (♩ =70). The major period was happy music, and the minor was sad music.

2.2.3 Emotion-related descriptive words or phrases list

The emotion-related descriptive list was compiled by Ai Kawakami[23], consisted of 62 emotion words. This tool was used to evaluate *Perceived Emotion* and *Felt Emotion*. Based on factor analysis, these 62 words can be divided into four dimensions: tragic emotion, heightened emotion, romantic emotion and

blithe emotion. In our study, we chose four-level grade: from 1(none) to 4(very much); the coefficient of internal consistency was 0.911, and split-half reliability was 0.896.

2.2.4 Interpersonal Reactivity Index

Interpersonal Reactivity Index (IRI) was worked out by Davis on account of multidimensional empathy. We adopted Chinese version of IRI [25]. This self-rating scale was 22 items and divided into 4-dimensions: Perspective Taking (PT), Personal Distress (PD), Fantasy (FS) and Empathy Concern (EC).

2.3 Statistical analyses

SPSS20.0 was used to do the Chi-square or independent-Samples t-test to discuss whether the significant difference of general data (gender, age, education level and musical perceptive ability) exists between two groups. Furthermore, independent-Samples t-test was conducted to evaluate the differences between schizophrenia group and control group. And then, based on correlation analysis, to explore the relationship among musical emotion experience, empathy and PANSS. In the end, the regression analysis was performed to investigate empathy and musical emotion experience relation.

3 Result

3.1 Demographic and clinical variables

As shown in Table.1, schizophrenia and control subjects did not differ on age, education, gender, music perception score and IQ scores. The analysis of t-test showed the score of schizophrenia group with SDS and SAS was significantly higher than control group.

Table 1. Mean (SD) of demographic, clinical and related scales between schizophrenia and control group.

3.2 Between-groups

3.2.1 Musical-felt emotion comparison

We performed Independent-sample t-test to compare the musical-felt score between two groups. The results showed the romantic emotion in both happy ($t=-2.954$, $p=0.004$) and sad music ($t=-2.618$, $p=0.01$) of schizophrenia group was significantly higher than the controls. Besides, the blithe emotion evoked by happy music of schizophrenics was significantly greater than the controls.

Table 2. Comparison of musical-felt score between schizophrenia and control group ($M\pm SD$)

3.2.2 Empathy comparison

The results (Table.3) revealed there were significant differences in three dimensions, including perspective taking ($t=-2.011$, $p=0.047$), fantasy ($t=-3.038$, $p=0.003$), empathy concern ($t=-8.111$, $p<0.001$).

Also, the total IRIC score ($t=-4.351, p<0.001$) was much different. Personal distress of schizophrenia was higher than the controls, but the difference did not reach significant level.

Table 3. Comparison of IRIC score between schizophrenia and control group (M±SD)

3.3 Schizophrenia group

3.3.1 Comparison of happy music and sad music

The emotion experience between happy and sad music in schizophrenia were compared by paired-sample T test. In our study, tragic emotion triggered by happy music was significantly lower than triggered sad music ($t=-4.744, p<0.001$). On the other side, schizophrenics experienced much more romantic ($t=3.158, p=0.003$) and blithe emotion ($t=4.938, p<0.001$) when listening to happy music.

3.3.2 Relationship between musical emotion experience and IRIC

As shown in Table 4, partial correlation analysis controlled with scores of SAS and SDS suggested that there was remarkable positive correlation between Fantasy and Romantic emotion ($r= 0.343, p= 0.021$), Fantasy and Blithe emotion ($r= 0.399, p= 0.007$). In addition, total score of IRIC was significantly positively correlated with romantic emotion felt in happy music.

Table 4. Partial correlation analysis on happy music felt emotion and empathy

The same method was used when the music type was sadness (Table 5). The outcome suggested Fantasy was notable positively correlated with heightened emotion ($r= 0.272, p= 0.009$) and romantic emotion ($r= 0.242, p= 0.020$). The positive correlations between total score IRIC and above-mentioned two emotions were significant as well.

Table 5. Partial correlation analysis on sad music felt emotion and empathy

3.3.3 Correlation between music-felt emotion and PANSS

The score of SAS and SDS was seen as control variable, using partial correlation analysis to explore the relationship between happy music-felt emotion and PANSS. Tragic emotion felt in happy music was remarkable correlation with score of negative symptoms ($r= 0.426, p= 0.003$) and total PANSS ($r= 0.335, p= 0.022$). No significant correlations were found between other variables.

Table 6. Partial correlation analysis on happy music felt emotion and empathy

Instead, tragic emotion felt in sad music was detected significantly positive correlation with general psychopathology ($r= 0.291, p= 0.047$).

Table 7. Partial correlation analysis on sad music felt emotion and empathy

3.7 Regression Analyses for Incremental Prediction of Social Competence

Applying stepwise regression to predict entire empathy ability (IRIC score) in schizophrenia group, musical emotion experience (four emotions felt in happy and sad music) was taken as argument. The results showed in Table.8, only romantic emotion felt in happy music was entered. The significant positive linear relationship was observed, and the emotion explained 16.2 % of the variances in IRIC total score ($t=3.141$, $p=0.003$). The regression equation was: $Y=25.111+0.424X$. This suggested romantic emotion-felt when schizophrenics listened to happy music can highly predict score of IRIC, the empathy ability is greater as the higher romantic emotion.

Table 8. (n=47) regression analysis for prediction of IRIC in people with schizophrenia based on musical-felt emotion elicited by music(happy/sad)

The result was showed in Table 9, the Fantasy dimension was dependent variable in this analysis. Similarly, also romantic emotion felt in happy music entered into the regression equation, and the values of explained variances was 12% ($t=2.697$, $p=0.010$). The equation established: $Y=4.078+0.373X$. This pointed out, once the schizophrenia group listened to the happy music, the more romantic emotion they experienced, the greater fantasy ability they had.

Table 9. (n=47) regression analysis for prediction of Fantasy-dimension in people with schizophrenia based on musical-felt emotion elicited by music(happy/sad)

4 Discussion

Previous findings suggested schizophrenics cannot link tragic emotion with sad music, which indicated music-felt emotion of patients may be impaired [16]. Conversely, in our study, there was no significant difference of sadness emotion in both happy and sad music between schizophrenia group and control group. The result is consistent with research of Miriam Dyck [14]. These may reflect the music-perception ability of schizophrenics is intact. This probably is because the pleasant experience of patients with psychosis is retained instantly. Alternatively, because of insensitivity to auditory emotion, schizophrenics bring more emotion clues into to compensate for emotional impairment caused by auditory cues [26]. Another point, the similarity in two groups may prove the theory of vicarious emotion raised by Kawakami, in other words, emotions induced by sad music seems to linked with aesthetic feeling[23]. Despite slight difference on heightened emotion in schizophrenia group compared to healthy controls elicited by both type music, the level of romantic emotion was notably lower in schizophrenia patients. Likewise, blithe emotion evoked by happy music was significant lower. These results suggest patients have a decrease in feeling pleasure from positive stimulus, it might be a sign of anhedonia[27]. In another sense, patients may not awake more pleasant sensation in comparison with normal people, because they are likely to lack regulating unpleasant emotions. Besides, the ability of emotional felt was not restrained. In our study, the difference existed between two groups, but they may have similar emotional valence evoked by music. Schizophrenias and health controls experience tragic, heightened, romantic and blithe emotions. The results take a step further, they experience emotion on the basis of same two-dimension model (valence and arousal).

Romantic emotion of sad music was also sensed. Kawakami A et al.,[24] pointed out not only tragic emotion but also pleasant emotion can be aroused by sad music, this is a kind of enjoyable experience with sadness. That is also mean, sad music play an important role in regulating moods. However, the different intensity of four emotions between two groups suggested dysfunction in music emotional recognition of schizoprenias [15, 16]. But it is not same as emotional experience disorders, so they can experience accurate and exuberant emotions inside [12, 28]. It is better for patients to elevate positive emotion level when listen to happy music instead of sad music. In addition, the marked difference of romantic emotion may be affected by empathy ability. The items of romantic emotion word in the test contain the higher level emotional experience, people may use imagination and other abilities to evaluate the degree of which feeling they may be affected by the short music, which relates to empathy ability, to recall the similar past life experiences, such as *be in love*, *nostalgic*, *cherished* and so on. But the damage caused by the severe disease may have affected feeling about the previous memory[29, 30].

A meta-analysis [31] reported schizophrenics suffered from all-round empathy impairment. They cannot stand on the others' point to consider problems, especially in daily interaction. Simultaneously, patients performed more indifferent and self-centered compared to normal population, they cannot feel concerned from other people give them as well. But in present research, as compared with health controls, there was no significant difference of personal distress. But other three-dimensions (Empathic concern, Perceptive-taking and Fantasy) shows notably lower which is consistent with the literature by Fengfeng Zhang [27]. Also, the results of self-reports are opposed to behavioral tests [31]. The discrepancy in personal distress might be cultural difference. Some Chinese may use some effective strategy to deal distressful troubles. This need to be further explored. Of note, some findings revealed patients with schizophrenia had significant deficiencies in fantasy ability, but others indicated the ability was intact or they can experience richer [31]. Likewise, that is possible to directly linked to positive symptoms like illusions and delusions.

According to previous study on healthy people, a close correlation existed between empathy and music emotional experience. Individuals with high empathy sense accordant emotion with expressed by music. Nevertheless, we applied partial correlation analysis in schizophrenic group, only part of result is consistent. The positive correlation is only between fantasy-dimension and romantic emotion, or IRI-C score and romantic emotion-felt in happy/sad music. Different study population might bring about these results. But this outcome indicates schizoprenias with high empathy also feel delight more easily while playing happy music. During follow-up treatment, positive musical therapy can be used to advance their positive emotion reaction. Another study [32] revealed normal people felt some positive emotion when the music is tragic, also IRI-FS had impacts on the intensity of emotional response to sad music. But the difference in our study is that there was no significant relationship between IRI-FS and blithe emotion aroused by sad music. We conclude, the relation is present between empathy and musical emotion felt in patients. Because of the dysfunction of emotional recognition, the relation was dissimilarity compared to average person. In accordance with a research, although schizoprenias had trouble in distinguishing and conveying their emotions, but the more accurate emotion cognition, more clear insight and lower degree of positive and depressive symptoms they have [33], the deficits of empathy compared to normal persons are no obvious.

In 2011, Strauss and Herbener [34] set pictures as stimulus, the results showed schizophrenias with worse negative symptoms reported more negative emotions under the situation of positive or negative pictures stimulus. Our results supported this finding, there are significant correlations between negative scale/PANSS and tragic emotion caused by happy music. This further verifies schizophrenias, who show blunting and serious emotional performances, experience stronger tragic emotion induced by happy music. It might be also the sign of anhedonia.

In some articles, researchers noted, self-feeling and the quality of social intercourse of schizophrenias was obviously improved after standard treatment coalesced with musical therapy[35]. Meanwhile, they felt more relaxed when associate with others. We found romantic emotion induced by happy music had striking positive predictable functions on empathy ability and IRI-FS. Combined with existing findings, happy music might make patients relaxed through evoking romantic emotion, to enhance their ability of understand other persons and imagination in the real life so that they can handle possible difficulty in social situations. Further reminds therapists to pay more attention to guide patients feel romantic emotion when listen to pleasant music to maximize the effects of musical therapy.

Still some deficiencies in our research can be avoided in further study. The sample of this present study is less, and part of schizophrenics were taking medicines; in addition, our research was confined in psychologic tests and self-reported. To an extent, this method was easily affected by subjective factors. The next step of exploration was to enlarge the sample size and eliminating the influence of antipsychotic medicines. On the other side, electroencephalogram (EEG), fMRI and other precision instruments can be imported to measure relevant physiological and biochemical indexes during designed mental tasks.

5 Conclusions

In conclusion, our findings suggest the patients with schizophrenic are impaired in partial emotion-felt, which may be related to anhedonia. According to previous research, romantic emotion is a special emotion which can elicited by sad and happy music, this emotion is a kind of pleasant sense linked to aesthetics[24]. Although schizophrenias can experience romantic emotion evoked by music, the level of this emotion is significant lower compared to normal person. Of note, the higher scores of FS or total scores in IRI-C, the more feeling of romance patients have. Moreover, it might be an available method by using happy music as a supplementary tool of musical therapy to enhance the romantic emotion-felt, which may improve the ability of empathy and fantasy.

Abbreviations

mPFC: media prefrontal cortex; WAIS-RC: Wechsler Adult Intelligence Scale; PANSS: Positive and Negative Syndrome Scale; SDS: Self-Rating Depression Scale; SAS: Self-Rating Anxiety Scale; IRI-C: Chinese version of Interpersonal Reactivity Index test; PT: Perspective Taking; PD: Personal Distress; FS: Fantasy; EC: Empathy Concern

Declarations

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Ethics approval and consent to participate

This study was approved by the Second Xiangya Hospital of Central South University Ethics Committee. All participants or their legal guardians signed an approved informed consent document and were willing to participate in this study. The researchers assert that each procedure is relevant to this work comply with the ethical standards.

Consent for publication

Not applicable.

Availability of data and material

The datasets used during the present study will be available from the corresponding author on reasonable request.

Authors' contributions

DX Wu conceived and designed the study. All authors were involved in the study conduction. ZX Lu, SZ HY and DX Wu performed the analysis and prepared the manuscript. All co-authors contributed substantially to its revision and approved the final manuscript.

Competing interests

The authors declare no competing financial interest.

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Tables

Table 1. Mean (SD) of demographic, clinical and related scales between schizophrenia and control group.

	Schizophrenia Group [N=47]	Control Group [N=47]	t/ χ^2	p
Age	20.91±5.02	19.30±3.67	1.783	0.078
Education	4.34±0.62	4.55±0.58	-1.744	0.084
Gender [M/F]	28/19	31/16	0.410	0.522
Music Perception	62.00±9.71	62.78±7.46	-0.439	0.662
SDS	46.64±9.85	32.35±4.78	8.954	<0.001
SAS	40.47±10.97	31.44±5.57	5.029	<0.001
IQ	100.04±14.30	101.23±11.33	-0.448	0.655
Positive Scale	13.49±5.17			
Negative Scale	15.72±6.38			
General Psychopathology Scale	32.23±9.38			
PANSS Score	61.45±18.57			
Course of Disease (Month)	9.13±19.45			

Table 2. Comparison of musical-felt score between schizophrenia and control group (M±SD)

	Music Type	Schizophrenia Group [n=47]	Control Group [n=47]	t	p
Tragic Emotion	Happiness	21.88±6.76 ^a	20.72±4.49	0.975	0.333
	Sadness	27.51±9.51 ^a	29.06±9.49	-0.792	0.430
Heightened Emotion	Happiness	32.23±9.62	34.40±9.29	-1.111	0.269
	Sadness	31.79±7.64	31.52±7.78	0.169	0.866
Romantic emotion	Happiness	30.49±7.77 ^a	35.19±7.65	-2.954	0.004 ^{□□}
	Sadness	27.02±6.98 ^a	31.13±8.18	-2.618	0.01 [□]
Blithe emotion	Happiness	21.59±6.52 ^a	25.83±7.14	-3.008	0.003 ^{□□}
	Sadness	16.29±4.49 ^a	16.06±6.11	0.200	0.842

^a significant difference within-group

□ $p<0.01$

□□ $p<0.001$

Table 3. Comparison of IRIC score between schizophrenia and control group (M±SD)

	Schizophrenia Group $n=47$	Control Group $n=47$	t	p
Perspective Taking (RT)	9.72 $\pm$ 4.57	11.38 $\pm$ 3.33	-2.011	0.047 [□]
Personal Distress (PD)	8.72 $\pm$ 4.467	7.40 $\pm$ 3.83	1.541	0.127
Fantasy (FS)	11.91 $\pm$ 4.75	14.82 $\pm$ 4.53	-3.038	0.003 [□]
Empathy Concern (EC)	12.23 $\pm$ 4.03	17.96 $\pm$ 2.68	-8.111	□0.001
IRIC(Total)	42.60 $\pm$ 10.53	51.57 $\pm$ 9.43	-4.351	□0.001

□ $p < 0.01$

□□ $p < 0.001$

Table 4. Partial correlation analysis on happy music felt emotion and empathy

	PT	PD	FS	EC	IRIC (Total)
Tragic Emotion	-0.276	0.053	-0.202	-0.227	-0.280
Heightened Emotion	-0.001	-0.072	0.196	-0.053	0.038
Romantic emotion	0.155	0.237	0.343*	0.215	0.399**
Blithe emotion	0.183	-0.139	0.319*	0.154	0.229

PT: Perspective Taking; PD: Personal Distress; FS: Fantasy; EC: Empathy Concern

□ $p < 0.05$

□□ $p < 0.01$

Table 5. Partial correlation analysis on sad music felt emotion and empathy

	PT	PD	FS	EC	IRIC (Total)
Tragic Emotion	0.045	0.093	0.154	-0.031	0.108
Heightened Emotion	0.182	0.020	0.272**	0.127	0.245*
Romantic emotion	0.171	0.166	0.242*	0.157	0.293**
Blithe emotion	0.115	-0.078	0.077	0.069	0.076

PT: Perspective Taking; PD: Personal Distress; FS: Fantasy; EC: Empathy Concern

□ $p < 0.05$

□□ $p < 0.01$

Table 6. Partial correlation analysis on happy music felt emotion and empathy

	Positive	Negative	General Psychopathology	PANSS
Tragic Emotion	0.206	0.426**	0.259	0.335*
Heightened Emotion	0.098	0.233	0.185	0.197
Romantic emotion	0.160	0.028	0.273	0.192
Blithe emotion	-0.090	-0.107	0.025	-0.049

PANSS: the total score of Positive and Negative Syndrome Scale

□ $p < 0.05$

□□ $p < 0.01$

Table 7. Partial correlation analysis on sad music felt emotion and empathy

	Positive	Negative	General Psychopathology	PANSS
Tragic Emotion	0.091	0.238	0.291*	0.254
Heightened Emotion	0.023	0.145	0.261	0.188
Romantic emotion	0.231	0.052	0.170	0.168
Blithe emotion	-0.052	-0.005	-0.057	-0.045

PANSS: the total score of Positive and Negative Syndrome Scale

□ $p < 0.05$

□□ $p < 0.01$

Table 8. (n=47) regression analysis for prediction of IRIC in people with schizophrenia based on musical-felt emotion elicited by music(happy/sad)

IRIC	β	SE	Standardized- β	t	p	ΔR^2
Happy music-Romantic emotion	0.573	0.183	0.424	3.141	0.003	0.162

β : beta; SE: standard error; t: t-statistic; p: p-value.

Table 9. (n=47) regression analysis for prediction of Fantasy-dimension in people with schizophrenia based on musical-felt emotion elicited by music(happy/sad)

Fantasy	β	SE	Standardized- β	t	p	ΔR^2
Happy music-Romantic emotion	0.228	0.084	0.373	2.697	0.010	0.120

β : beta; SE: standard error; t: t-statistic; p: p-value.