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Comparison of original and revised reinforcement sensitivity theory in clinically-stable schizophrenia and bipolar disorder patients

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ABSTRACT

Introduction: The study of personality can help explicate the pathology of psychological disorders. To this end, our study compared the profile of factors from the original (o) and revised (r) reinforcement sensitivity theory (RST) of personality in schizophrenia (SC), bipolar disorder (BD) patients, both compared with healthy controls (HC).

Method: 34 SC patients, 52 BD patients, and 72 matched HC completed: Yang Mania Rating Scale (YMRS), Positive and Negative Syndrome Scale (PANSS), Beck Depression Inventory (BDI), BAS/BIS scale, and the Jackson-5 scale. Data were analyzed by chi square, independent *t*-test, analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA).

Results: SC patients had lower o-BIS, r-BIS and o-BAS, and r-BAS scores than the BD and HC groups. Compared to HC, SC and BD patients had higher Freeze and Fight scores. Depression in SC was significantly higher than other two groups; and in BD it was higher than HC.

Conclusion: SC, BD, and HC differ on both o-RST and r-RST; however, the more nuanced knowledge from r-RST may be helpful in the diagnosis, etiology and psychotherapy.

1. Introduction

Personality has been implicated in the etiology, development and continuation of mental disorders. Recent studies have assessed the relevance of various biological theories of personality for schizophrenia (SC) and bipolar disorders (BD). For example, psychosocial personality dimensions, such as extraversion, inhibition, and impulsivity, are higher in BD patients than normal controls (Qiu, Akiskal, Kelsoe, & Greenwood, 2017; Sparding, Pålsson, Joas, Hansen, & Landén, 2017). Regarding SC, the profile of personality dimensions is somewhat different. Using the Big Five Personality Questionnaire, Smeland et al. (2017) showed that SC patients had lower levels of extraversion and conscientiousness, and higher levels of neuroticism. As expected, neuroticism was associated with negative emotions, such as anxiety, depression and anger. Also, Cloninger's personality theory has been used widely for mood disorders, and in BD higher scores have been reported for novelty seeking, reward dependence, and self-transcendence (Hajirezaei et al., 2017).

One major advance in the personality-psychopathology field came

with the reinforcement sensitivity theory (RST), initiated by Jeffrey Gray (1981, 1982). This o-RST proposed two emotional-motivational systems based on two dimensions of personality: Anxiety (behavioral inhibition system, responsive to *conditioned* punishment; o-BIS) and Impulsivity (behavioral approach system, responsive to *conditioned* reward; o-BAS). In o-RST, the Fight and Flight System (o-FFS) was conceived as a defensive mechanism sensitive to *unconditioned* punishment and unconditioned aversive stimulus (e.g., frustration; Gray, 1987). For the complex neurobiology of these systems, see McNaughton & Corr (2008) (for an overview of RST, see Corr & McNaughton, 2012).

The original version of RST assumes that individual differences between people reflect the differential sensitivity of o-BAS and o-BIS. People who have a strong o-BAS are reward-sensitive, are more likely to engage in high-risk behaviors, and they are more impulsive. The o-BAS system is responsible for controlling positive emotions; and excessive sensitivity (or reactivity) of this system leads to behaviors that are likely lead to a reward, but at the expenses of failing to pay due regard for the possibility of negative consequences. The BAS is controlled by a dopaminergic route, as well as a limbic system and includes components

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such as amygdale (Pickering & Smillie, 2008). With the second system, people with strong o-BIS are more likely to be inhibited and activity of this system leads to anxiety and rumination, and makes the person more generally aware of signs of danger (Gray, 1982). This system is under the control of septo-hippocampal and serotonergic pathway (McNaughton & Corr, 2008; for an overview of this literature, see Corr, 2008).

The original version of RST was substantially revised by Gray and McNaughton (2000). According to this revised (r-RST) approach: (1) r-BAS is responsible for responding to all potentially rewarding stimuli, conditioned or unconditioned; (2) the expanded Fight-Flight-Freeze (FFFS) mediates responses to all punishing stimuli, conditioned or non-conditioned; and (3) the r-BIS is responsible for solving the target conflict of all kinds but especially ones entailing the BAS and FFFS. Goal conflict is resolved by activation of the FFFS to avoid/escape the threat, or a return to normal BAS functioning – however, especially in clinical conditions, the BIS can be continuously activated and conflict may not be resolved leading to clinical symptoms (this can occur for a number of reasons; see Corr & McNaughton, 2012).

Research on o-RST has revealed enhanced BIS sensitivity in SC (Barch, Yodkovik, Sypher-Locke, & Hanewinkel, 2008; Strauss et al., 2011); and there is evidence that enhanced BAS activity in SC patients is a positive predictor of recovery from a depressive episode (Reddy et al., 2014). More studies have been conducted on BAS in BD (Qiu et al., 2017; Sparding et al., 2017) with the general finding that activity in this system is significantly stronger than in normal people - also, it has been reported that BD patients expend more effort when striving towards their goals, further supporting the role of the BAS.

In addition, the higher levels of BAS activity in BD patients are associated with high rates of behavioral, emotional and cognitive responses, as well as a weakened inability to postpone rewards. Alloy et al. (2012) showed that symptoms of depression and hypomania were associated with higher levels of BAS activity. Also, Meyer, Johnson, and Winters (2001) showed that BAS scores related to mania and BIS scores related to depression. Reddy et al. (2014) pointed out that pathology of SC can be related to the dominance of one of the two BAS and BIS systems; also these authors showed that strengthening BAS in SC is a protective factor against social isolation.

The literature to date has largely focused on o-RST; in contrast, very little research has employed r-RST. The aim of this study is to address this issue by comparing o-RST and r-RST subscales in SC and BD patients. The results may help us understand better the personality-related pathology underlying these disorders.

2. Method

2.1. Participants

From October 2016 to June 2017, 34 SC patients and 52 BD patients, who had been referred to Kargarnejad hospital and six different mental health clinics were recruited in Kashan, Iran. Their RST scores were compared with 72 matched relatives and friends of these patients selected on the basis of the absence of current axis I disorders of DSM-IV and confirmed by psychiatric assessment. After referral from mental health centers, mental health status assessment was made by a trained psychiatrist through a structured clinical interview for DSM-IV Axis I disorders (First, Spitzer, Gibbon, & Williams, 1995).

Patient inclusion criteria were the presence of SC and BD, and an educational level higher than eighth grade – this was needed to ensure that the personality questionnaires were understood. Exclusion criteria were current mania and psychotic episodes. All SC and BD patients were on medication: The most commonly used medication in SC patients were Clonazepam, Depakine, Clozapine, and Quetiapine; and most commonly used medication in BD included lithium, SSRIs, Clozapine, and Carbamazepine. The SC group included 17 females (50%) and 17 males (50%), with a range of 18–44 years ($M = 31.00$,

Table 1

Demographic and clinical characteristics of subjects.

Characteristics	SC (N = 34)	BD (N = 52)	HC (N = 72)	Statistics	p
Average age (years)	31.8 (6.2)	36.7 (7.0)	29.0 (7.2)	18.1 ^F	0.001
Gender (M/F)	17/17	21/31	26/46	1.8 ^{χ²}	0.39
Years of education	11.05 (2.00)	10.00 (2.00)	13.00 (2.00)	24.5 ^F	0.001
Age at first hospitalization (years)	23.00 (3.00)	25.01 (7.00)		2.1 ^t	0.038
Number of hospitalization	2.00 (1.00)	3.07 (2.00)		0.3 ^{χ²}	0.76
Comorbidity BDI-II	20.58% 25.05 (12.00)	30.76% 9.00 (5.00)	7.00 (2.00)	1.1 ^{χ²} 80.5 ^F	0.29 0.001

t, t value; F, F value; or χ^2 , chi square value.

SD = 6.00); the BD group included 31 women (59.62%) and 21 men (40.38%), with a range of 22–45 years ($M = 36.00$, $SD = 7.03$); and the HC group included 46 females (63.88%) and 26 males (36.22%) with a range of 18–45 years ($M = 29.04$, $SD = 7.00$). The demographic and clinical characteristics of the groups are shown in Table 1.

2.2. Procedure

Participants were given information about the study and provided informed consent in writing. They provided demographic information. In addition, an assessment battery was completed that included the following measures.

2.3. Measures

2.3.1. Structured clinical interview for DSM-IV Axis I disorders (SCID-I)

The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) has a screening form for various Axis I disorders (First et al., 1995). Diagnostic agreements between test and retest SCID administration were fair-to-good for most diagnostic categories in Iranian community. Overall weighted kappa was 0.52 for current diagnoses and 0.55 for lifetime diagnoses. Specificity values for most psychiatric disorders were high (> 0.85); the sensitivity values were somewhat lower (Sharifi et al., 2009).

2.3.2. Activation/Inhibition Behavioral Systems Scale (BAS/BIS)

This self-report scale was developed by Carver and White (Carver & White, 1994) – it is based on o-RST. It comprises 20 items that measure the two dimensions of BIS and BAS – the latter contains three subscales: Drive, Reward Responsiveness, and Fun-Seeking. Carver and White (1994) reported the internal stability of the BIS subscale of 0.74 and the internal consistency of BAS 0.71. Mohammadi (2008) has demonstrated acceptable and good reliability as well as the current study for all four subscales (Cronbach's α 0.61 to 0.90; Table 2).

2.3.3. Jackson-5 Questionnaire

Jackson (2009) developed this 30-item questionnaire to measure r-RST. The questionnaire consists of five subsystems: Behavioral Activation System (BAS), Behavioral Inhibition System (BIS), Fight, Flight, and Freeze system – each subscale containing 6 items. Response is on a 5-point Likert scale (1 = 'always', and 5 = 'never'). Jackson indicated the internal reliability and the construct validity. In an Iranian sample of this Jackson-5, Cronbach's alpha was reported to be: r-BAS = 0.81; r-BIS = 0.88; Fight = 0.74; Flight = 0.72; and Freeze = 0.77 (Hasani & Rasoli Azad, 2012). The questionnaire demonstrates acceptable and good reliability in the current study for all five subscales (Cronbach's α 0.68 to 0.87; Table 2).

Table 2
Correlation matrix, means, standard deviations, reliability coefficients for dependent variables ($n = 158$).

Variables	1	2	3	4	5	6	7	8	9
r-RST									
1: r-BAS	1	0.59**	0.08	0.15	-0.24**	0.52**	0.45**	0.58**	0.32**
2: r-BIS		1	0.23**	0.23**	-0.05	0.52**	0.55**	0.53**	0.31**
3: r-FIGHT			1	0.15	0.01	0.05	0.05	-0.08	0.32**
4: r-FLIGHT				1	0.22**	0.27**	0.11	0.15	0.25**
5: r-FREEZE					1	0.08	0.02	0.03	-0.26**
o-RST									
6: BAS-Drive						1	0.68**	0.68**	0.38**
7: BAS-Fun Seeking							1	0.73**	0.19*
8: BAS-Reward Responsiveness								1	0.33**
9: o-BIS									1
alpha	0.85	0.80	0.87	0.71	0.68	0.76	0.86	0.90	0.61

* $p < 0.05$.
** $p < 0.01$.

2.3.4. Beck Depression Inventory (BDI-II)

This 21-item self-report questionnaire is designed to evaluate syndrome of depression (Beck, Steer, & Brown, 1996). The internal stability of the test in Iranian students is moderate-to-good (Cronbach's $\alpha = 0.58$) and its reliability by test-retest is 0.73 (Meygoni & Ahadi, 2012). Studies on the concurrent validity of BDI report moderate to high correlation coefficient with mean from 0.58 to 0.79 (Richter, Werner, Heerlein, Kraus, & Sauer, 1998).

2.3.5. Young Mania Rating Scale (YMRS)

This 11-item scale has 7 items scored from 0 to 4, and 4 items from 0 to 8 based, on a clinical interview with the patient. The YMRS (Yang et al., 2015) is a tool with validity, sensitivity, specificity, and is suitable for clinical and research work.

2.3.6. Positive and Negative Symptom scale (PANSS)

Positive and Negative Symptom Scale (PANSS) was designed to measure the severity of the positive and negative symptoms of schizophrenia patients - the name of the scale refers to both the positive and negative symptoms of schizophrenia (Lehoux, Gobeil, Lefèbvre, Maziade, & Roy, 2009; Obermeier et al., 2011).

2.4. Data analysis

Chi-square, Kolmogorov-Smirnov, univariate analysis of variance (ANOVA) and the independent t -tests were used to compare demographic and clinical variables in three groups. In this research, MANOVA was employed for the four subscales on BAS/BIS scale and five factors at Jackson-5 scale.

3. Results

In the SC group, the number of women and men was equal, but in the BD and HC groups there were more women than men, but this difference was not statistically significant ($\chi^2 = 1.85, p = 0.39$; Table 1). The mean age of the BD group ($F = 18.1, p < 0.01$), and level of education of the HC group ($F = 24.5, p < 0.01$), were higher than the other two groups. The age of the first hospitalization was lower in the BD group ($t = 2.1, p < 0.05$). The history of hospitalization number mean ($t = 0.3, p = 0.76$) and co-morbidity with other disorders was equal in the two clinical groups ($\chi^2 = 1.1, p = 0.29$). Table 2 presents the correlations between BAS/BIS subscales and the Jackson-5 questionnaire (o-RST and r-RST).

The mean, standard deviation, significance, and effect size of the four subscales of BAS/BIS and also the 5 subscales of the Jackson-5 questionnaire among the three groups are shown in Table 3. Except for o-BIS ($F_{2,155} = 23.33; p < 0.01$) and r-BIS ($F_{2,155} = 1.98; p > 0.05$), Levene's test showed the equality of variances of all subscales

($p > 0.05$) in the three groups.

The rate of depression in the SC group ($M = 25.05, SD = 12.00$) was more than the other groups ($F = 80.5, p < 0.001$).

3.1. o-RST

The results of MANOVA showed a significant difference between the SC, BD, and HC in terms of their scores on the Carver-White's BAS/BIS subscales (Pillai's Trace = 0.659; $F_{8,306} = 18.79; p < 0.001$; Partial $\eta^2 = 0.329$). MANOVA showed significant differences between the three groups in all subscales of behavioral activation system and o-BIS. The results are shown in Table 3 and Fig. 1.

The results of the post hoc Games Howell test showed SC patients had lower BAS-DR scores than BD patients and HC group; and a trend towards significance suggested BD patients had higher score than HC group. These results were also repeated in BAS-RR and BAS-FS and o-BIS, but BD patients and HC group had no differences in these subscales. Effect size in BAS-RR was more than other subscales.

3.2. r-RST

The results of MANOVA showed a significant difference between the SC, BD, and HC in terms of their scores in Jackson-5 scales (Pillai's Trace = 0.79; $F_{10,304} = 18.79; p < 0.001$; Partial $\eta^2 = 0.396$). The results of the post hoc Games Howell test showed that this difference lies between the SC patients and other two groups. In other words, patients with SC had a lower r-BAS and r-BIS scores than those with BD and HC group (Table 3 and Fig. 1).

The scores of BD group in r-BIS were higher than those in the control group, but in r-BAS, the two groups were equal. Also, BD and SC groups were higher on Fight than control group, and there was no difference between SC and BD groups on this scale. For the Flight scale, the scores of the control group were lower than BD group, but there was no difference between SC and BD groups. In the Freeze scale, the results were different between the three groups. SC, BD, and HC groups had the highest scores, respectively. The effect size of the groups for Flight and Freeze was lower than the other scales, and the greatest effect size was for r-BIS.

4. Discussion

This is the first study to compare o-RST and r-RST in schizophrenia (SC) and bipolar disorder (BD) patients. According to o-RST findings, SC patients had lower scores than BD and HC groups on all BIS and BAS scales. Consistent with this finding, we found that SC patients had a lower r-BAS and r-BIS scores than those with BD and HC. But the findings in SC patients are inconsistent and our data help to resolve these differences. In contrast to current study, Barch et al. (2008) and

Table 3
Results of the multivariate analysis of variance (MANOVA) in o-RST and r-RST subscales.

Variable	SC n = 34		BD n = 52		HC n = 72		P	η^2	Games-Howell
	M	SD	M	SD	M	SD			
BAS/BIS Scale									
BAS-DR	9.26	2.00	11.98	2.42	11.01	2.36	0.001	0.155	SC < BD&HC***, HC < BD*
BAS-RR	11.52	2.10	17.28	2.58	17.11	2.02	0.001	0.523	SC < BD&HC***, BD = HC
BAS-FS	8.76	3.11	12.21	2.44	11.33	2.34	0.001	0.200	SC < BD&HC***, BD = HC
o-BIS	15.91	2.90	18.36	3.26	18.47	1.52	0.01	0.146	SC < BD&HC***, BD = HC
Jackson-5 Scale									
r-BAS	15.32	4.85	20.80	4.69	21.50	3.87	0.001	0.240	SC < BD&HC***, BD = HC
r-BIS	17.05	2.72	24.15	3.02	22.65	3.96	0.001	0.376	SC < BD&HC***, BD > HC**
Fight	20.08	4.85	21.90	5.10	16.59	2.72	0.001	0.253	HC < BD&SC***, SC = BD
Flight	15.11	2.94	16.17	4.13	14.01	3.16	0.003	0.071	HC < BD**, SC = BD, SC = HC
Freeze	16.52	4.00	15.19	3.68	13.94	2.46	0.001	0.089	SC > HC***, BD < HC*, SC = BD

* Tend to significance.

** $p < 0.05$.

*** $p < 0.01$.

Strauss et al. (2011) reported that, compared with healthy controls, SC patients had higher BIS sensitivity and no difference in BAS sensitivity. Other findings indicate lower BIS scores in SC patients (Scholten, van Honk, Aleman, & Kahn, 2006). Strauss et al. (2011) reported BAS-FS and BAS-DR are higher in SC patients. High rate of anhedonia among SC patients in Strauss et al. (2011) study is consistent with the means scores for depression in current study. Some studies show mediating effect of anhedonia on the influence of the BAS scale in SC patients but not for BIS (Reddy et al., 2014; Strauss et al., 2011). According to Reddy et al. (2014), low Inhibition/Low Activation subgroup of SC patients had higher negative symptoms, anhedonia and impaired community functions in compared with other subgroup of SC patients. Also, Low Inhibition/Low Activation subgroup is marked by low BAS scores and higher anhedonia. This subgroup of SC patients is so similar to current SC patients according to BIS, BAS and depression scores.

There are some psychometric issues to consider. Walker, Jackson, and Frost (2017) explained that the BIS scale from the Jackson-5 measures a form of social comparison, which narrows down the content of the BIS. As SC can be seen as a disorder with motivational impairments (Reddy et al., 2014) and social isolation (APA, 2000), it may be for this reason that the BIS score of the Jackson-5 may be reduced among SC patients, compared with other groups.

BD patients had higher BAS-DR subscale than other groups. This is a subscale of activity-pursing desired goals. Due to the lower scores of SC group on this subscale, the activities of these patients are less target-based than other groups. BAS-DR is concerned with actively-pursing desired goals, and reward responsiveness is concerned with excitement at doing things well and winning, especially to rewarding stimuli associated with fulfilling sub-goal procedures: both processes seem to reflect the process of behavioral maintenance needed during complex approach behavior involving multiple sub-goals (McNaughton & Corr, 2008). BAS is responsible for controlling positive emotions. Excessive activities in BAS lead to close and impulsive behaviors and patients do behaviors that are likely lead to a reward without paying too much attention to the possibility of negative outcomes (Pickering & Smillie, 2008).

In line with present study, many studies have reported higher BAS-DR in BD patients (Qiu et al., 2017; Sparding et al., 2017). There are no differences in other o-BAS subscales between BD and HC in current study as well as r-BAS that could result from patient's medication. One hypothesis is that mood stabilizers can reduce BAS sensitivity. Also, BD show more effort to achieve the goal and respond more to rewards. Alloy et al. (2012) showed that the symptoms of depression and hypomania are associated with an increase in BAS. Also, in the present study, increasing BAS in BD group is consistent with previous studies on

increased dopamine levels and more dopaminergic activity (Aguilar, Giuffrida, & Lodge, 2018). BAS controlled by dopaminergic route as well as the limbic system and its components such as amygdala (Pickering & Smillie, 2008). Meyer et al. (2001) showed that BAS score is related to mania and BIS score is related to depression. Individuals with strong BAS are reward sensitive, are more likely to use high-risk behaviors, and show more impulsive behaviors. The scores of BD in r-BIS were higher than HC. According to Depue and Iacono (1989), only BAS is of relevance for BD. This finding likely is related to construct validity of r-BIS in Jackson-5; BD patients are more tendencies to social comparison due to their symptoms (APA, 2000).

In the Fight scale, the scores of the BD and SC group were equal, and both groups were more than HC. In the Flight, the score of the BD and SC group was equal, but the score of the BD was more than HC. In the Freeze, the score of the BD and SC group was equal, but SC was higher than HC and BD was lower than HC. This finding is consistent with previous studies of BD and SC like turbulent and impulsive behaviors (Johnson, Carver, & Tharp, 2017). Increased freezing in SC in present study is in line with previous studies of high prevalence of depression in this disorder (APA, 2000). FFFS in r-RST is found in association with anxiety, depression, restrictive anorexia nervosa, schizophrenia and cluster C personality disorders as well as o-BIS (Bijttebier, Beck, Claes, & Vandereycken, 2009).

Finally, our results have some implications. In diagnosis, BAS and BIS subscales of BAS/BIS and Jackson 5 scales can implement to differentiate SC patients from BD. In psychotherapy, behavioral activation treatment is suitable for improving SC negative symptoms as a recent pilot study has showed (Choi, Jaekal, & Lee, 2016). It activates behaviors that increase contact with environmental contingency reinforcements. Indeed, emotion regulation focused psychotherapies (e.g. DBT) possibly are more appropriate for BD patients that had higher BAS sensitivity.

All patients were under medication and this may have affected their personality scores. We suggest future researches should try to obtain SC/BD patients samples not on medication – although this may be problematic and these patients may be less severe in symptomology. Also, the study was conducted in Iran, and generalization of results to other cultures should be done cautiously. Another limitation concerns the use of specific personality questionnaires. We suggest using other tools (e.g. RST-PQ; Corr & Cooper, 2016) to examine the differences between o-RST and r-RST. Krupić and Corr (2017) classified the BAS scales of several RST questionnaires into four distinct categories. Whereas, Jackson-5 just has only one scale for the BAS (Corr, 2016).

r-RST subscales

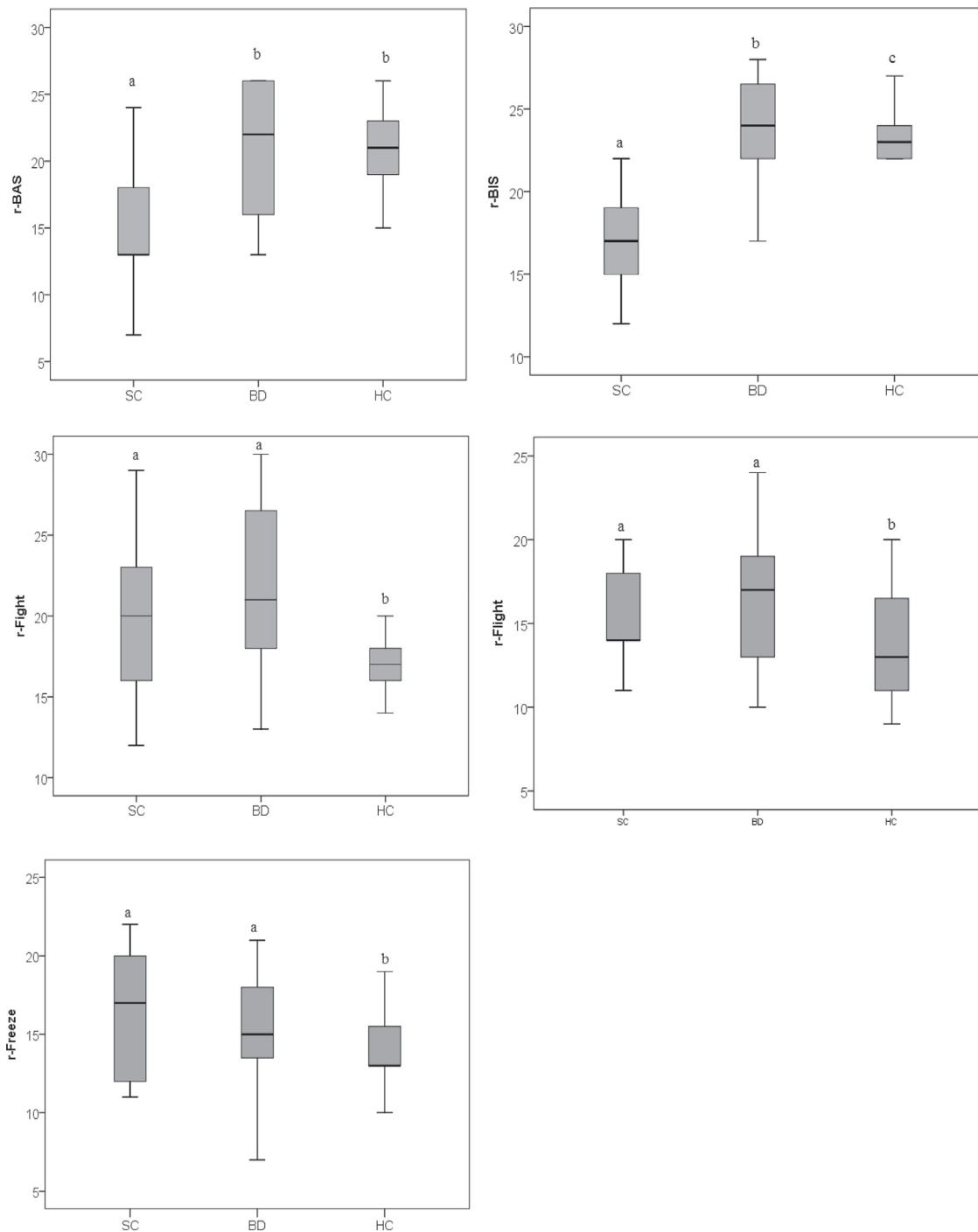


Fig. 1. BAS/BIS and Jackson 5 subscales mean comparison between SC, BD, and HC groups.

5. Conclusions

The results of the present study should be of significant value for future research which has the aim of: (1) examining o-RST and r-RST in psychiatric disorders; (2) understanding the role of personality vulnerabilities in mental disorders; (3) using new, reliable and credible tools to assess r-RST in psychopathological research. It is likely that such research will throw new light onto the etiology, development of continuation of common mental disorders.

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o-RST subscales

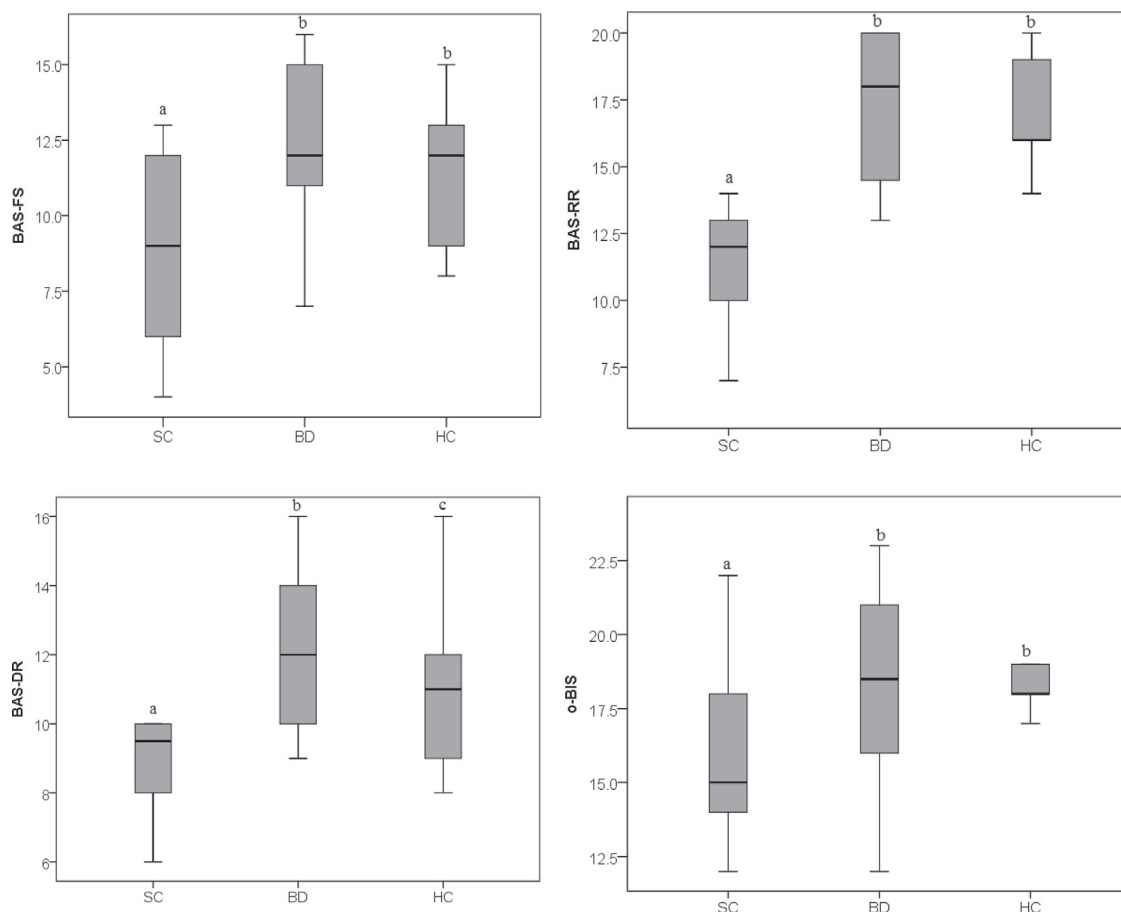


Fig. 1. (continued)

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