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Title: The Assessment of Behavioral Approach and Behavioral Inhibition Systems in Mood Disorders

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Abstract:

Introduction: Psychiatric disorders could be evaluated in terms of behavioral activation and inhibition systems. Dysregulation of these systems may lead to development of manic or depressive episodes in patients with mood disorders. The aim of this study was to identify Behavioral Approach System (BAS) and Behavioral Inhibition System (BIS) hypersensitivity as functional brain system behaviors in patients with major depressive disorder and bipolar mood disorder I, compared to healthy individuals.

Methods: A case-control study was conducted at Razi psychiatric hospital that served as a mental health referral center in Northwest of Iran. The study consisted of two groups of patients with major depressive and bipolar mood disorders and one healthy group. In each group, we included 40 patients (20 men and 20 women). Data were elicited through BIS and BAS questionnaire, Beck Depression Inventory (BDI-II), Young Mania Rating Scale (YMRS) and analyzed using SPSS software version 18.

Results: The findings showed a significant negative correlation between BIS, BAS and BAS sub-scales with the severity of depression and positive correlation with mania symptoms($P<0.05$).

Conclusions: Dysregulations of BAS and BIS may predispose mood disorder symptoms. BAS is hyperactive during manic phase and may predict the symptom severity of bipolar mood disorder.

Keywords: Bipolar mood disorder, Behavioral Brain System, Major Depression, BAS, BIS

1: Introduction

Currently, millions of individuals are affected by mental disorders worldwide that have huge economic and social costs which are attributable to the burden of disease and the loss of quality of life. Major depressive disorder (MDD) and bipolar mood disorder (BMD) are serious mental illnesses which have a negative impact on functioning in a variety of important life domains. In fact, depression has 17% lifetime prevalence in the general population, and bipolar mood disorder has a lifetime prevalence of about 3 percent, which makes them the fourth and sixth highest causes on the global disease list worldwide, respectively. In addition, after ischemic heart disease, depression will also be the second-most prevalent mental condition. It is notable that based on the report of the World Health Organization, bipolar disorder remains among the top 10 causes of years lived with a disability worldwide (Murray and Lopez 1996).

Bio-psychological theory of personality was coined by Gray (1977, 1981) .Based on this theory, the BAS is associated with reward sensitivity while BIS is related to avoidance or sensitivity to punishment (Gray, 1977; Watson, Wiese, Vaidya and Tellegen, 1999).

The systems have been suggested to integrate biological and environmental factors with special focus on personality (Gray, 1982; McNaughton, & Corr, 2004). They reflect the different types of reinforcements of two biological broadband (activation/inhibition) motivational systems. These systems are hypothesized to regulate approach and withdrawal behavior in response to environmental cues (Gray, 1982).

Whereas activation of the BIS is thought to decrease the individual's behavior toward stimuli such as threat, punishment, novelty and frustrate non-reward cues, BAS increases one's approach toward stimuli sensitive to reward and non-punishment. Gray and others (Carver and White, 1994; Tomarken and Keener, 1998; Watson, Wiese, Vaidya, and Tellegen, 1999) have proposed that the BAS is associated with negative mood states, and it controls positive affectivity; this refers to goal-seeking behavior in response to reward cues. BIS governs anxiety and may control negative affectivity in response to cues of threat. Originally, Gray's model was applied to anxiety, but Depue and Iacono (1989)and others (Tremblay, Naranjo, Cardenas, Herrmann, & Busto, 2002; Pinto- Meza, Caseras, Soler, Puigdemont, Ferez, & Torrubia, 2006) focused on a broad range of psychological distress and mental problems with the constellations of BIS and BAS scales and subscales. The degree of responsiveness may vary between personalities. Evidence from increasing goal-seeking behavior and BAS activation or fearlessness and BIS inactivity during the manic phase of BMD appear to link between the BIS/BAS scales with MDD and BMD (Carver & White, 1994; Meyer, Johnson, & Winters, 2001).

Several studies have shown an association between bipolar disorder and depression as a spectrum (Meyer, Johnson, Carver, 1999; Johnson, Turner, Iwata, 2003). Other studies have mentioned that people's stable personality traits are congruent with their emotional tone (Rusting, 1998).

Viewed in the context of this theory, symptoms of manic and depressive patients relate to neurotransmitters that underlie BIS and BAS, where mania results from an excessive dopamine-mediated responsiveness to rewards correlated with high BAS, depression results from defective serotonin- and norepinephrine-mediated response to threats with low BIS. Also, most

of the studies in cognitive neuroscience suggest that BIS scales, when measured with questionnaires, correlate positively with negative affect, and BAS scales correlate positively with positive affect (Jones, Mansell, & Waller, 2006). Additionally, it has been shown that self-reported BAS sensitivity can predict the occurrence and the severity of MDD in an eight-month follow-up (Kash, Rottenberg, Arnow, & Gotlib, 2002).

Understanding the role of personality underpinnings and behavioral brain system in mood disorders may help clinicians to predict potential symptom development and establish preventive or treatment interventions. A major aim of the current study was to explore BAS and BIS implications in mood disorders. Moreover, we aimed to identify potential bio-markers and experimental paradigms to early intervention based on self-reported BIS and BAS functioning in individuals with mood disorders.

2: Methods

2-1: Setting and Participants

In this case-control study, the subjects were recruited from Razi Psychiatric Hospital in Tabriz, Iran, from June 2013 to July 2014. We employed a simple random sampling method to recruit participants in two groups of patients, one with major Depression (without psychotic features) and one with bipolar mood disorder I (with acute psychotic symptoms) based on DSM-IV-TR criteria. The last group consisted of healthy individuals without a history psychiatric disorders. Twenty male and 20 female participants aged 18-65 were selected for each group. Those who did not fully complete the self-reported questionnaires were excluded.

The study was explained to the participants and a written informed consent was obtained. All people were recruited based on an individual code given by a psychiatrist. Both participants and the examiners were blind to the experimental design.

2-2: Research instruments:

2-2-1: BIS/BAS Scales

The scales were four-point Likert-type questionnaires with a range of 1-4 (1= strongly disagree to 4= strongly agree) consisting of 24 items, where items from the original BIS/BAS Scales were modified based on Azari language. To measure BIS, we included seven items related to anticipation of punishment, while for measuring the BAS -which has three sub-scales of its own- we included five items about anticipation or occurrence of reward, Reward Responsiveness (RR); four items about pursuit of desired goals for Drive (D); four items about desire; Fun-Seeking (FS) for new rewards and impulsive approach to potential. The internal consistency of the BIS subscales was determined based on Moazzen, Fallah, and Safi's (2009) study that was 0.74. and the three subscales of BAS were 0.73, 0.76 and 0.66, respectively.

In our study (N=120), *Cronbach's* alpha was 0.66 for the State BIS, and 0.89 for the State BAS. It was 0.70, 0.64 and 0.61 for Reward Responsiveness, Drive, and Fun-Seeking or response of the BAS subscales, respectively.

2-2-2: **Revised Beck Depression Inventory (BDI-II)**

The (BDI-II) is a screening instrument containing a 21-item self-reported set of questions with a single score, which provides a highly reliable assessment regardless of the population

(Beck, Steer, & Garbin, 1988). Farsi version of BDI-II has been released with high validity and reliability (Ghassemzadeh, , Mojtabai, , Karamghadiri, & Ebrahimkhani, 2005)

2-2-3: Young Mania Rating Scale (YMRS)

This 18-item questionnaire was used to measure the severity of manic symptoms such as irritability, disruptive and aggressive behavior, elevated mood, hyperactivity, impaired language and/or thinking and other signs based on interpretation of scores from this scale. The scores were classified as the following: Grades 0 - 9, without mania; 10 - 17, Hypomania; 18 - 21, manic border; 22 - 35, mild to moderate mania; 36 - 53, moderate to severe mania; and finally, 54 or higher is severe mania. It has been standardized in Persian language (Barekatain, Tavakoli, Molavi, Maroufi, & Salehi, 2007).

2-2-4: Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I)

We used SCID-I, as a tool for the diagnosis of disorders based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), fourth edition. Reliability for the SCID has been shown to be strong. Accordingly, Farsi version of the tests achieved a high rate of agreement (kappa) for SCID used for the diagnostic decision and research approach (Sharifi et al, 2007).

2-2-5: Demographic characteristics

In this study, data about the patients' age, gender, marital status, education, occupation, patient records, treatments and hospitalizations were collected and the relationship between BAS/BIS and major depression and bipolar mood disorder was explored.

2-3: Data analysis

The sample size was estimated forty in each group(totally 120) based on Alloy and colleagues' (Alloy et al, 2008) study data with a significance level of α= 0.05 and power of %80 and mean 17.03±1.97 for BAS-RR and accepting difference equal to 1.5 unit. We assessed each group by means of a set of BIS and BAS, BDI-II, YMRS scales and scales related to the BAS-RR, and analyzed the data through SPSS software version 18, with descriptive statistics, MANOVA, Pearson correlation coefficient significance test and multiple regressions. All tests were two-tailed, with significance level of 0.05.

3: Results

Initial analyses were conducted to examine descriptive statistics. Basic socio-demographic characteristics are shown in Table 1.Then, we compared BIS/BAS levels in mood disorder groups with a normative sample. Basic correlations between the BIS/BAS levels were evaluated. The mean and standard deviations are illustrated by sex and groups (Table 2).

Table 1: Demographic and clinical characteristics presented separately by sex and group.

Cases (N)	Healthy	BMD	Depression	Total

Sex	Male	20	20	20	60
	Female	20	20	20	60
Education	Primary	2	4	4	10
	Secondary	8	10	21	39
	High School	18	19	17	54
	University	6	5	6	17
Marital status	Single	11	9	9	29
	Married	34	15	3	85
	Divorced	0	5	1	6
Job	Self-employed	0	5	2	7
	Employed	12	3	4	19
	Unemployed	15	14	19	48
	Retired	0	2	0	2
	Student	0	1	0	1
	Homemaker	13	15	15	43

The results revealed a significant difference between the three groups in terms of activity level of BAS/BIS.

Table2-Means and Standard Deviations for Scales and sub scales by Group				
Groups	Total	Major Depression	BMD	Healthy

Scale and Subscales	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BIS	20.57	5.07	26.35	1.66	15.68	2.24	19.68	3.32
BAS	33.76	11.83	20.35	4.73	47	3.06	33.93	5.60
BAS- Fun	10.03	3.47	6.18	1.38	13.55	1.65	10.38	2.01
BAS- Drive	10.90	3.97	6.43	1.60	14.95	1.32	11.33	2.49
BAS-RR	12.83	5.29	7.75	2.72	18.50	1.57	12.23	3.96
BDI-II	19.64	23.51	52.28	4.50	0.50	0.82	6.15	3.34
YMRS	25.29	28.99	4.63	2.58	65.48	7.92	5.78	3.23

Based on a regression model, it is suggested that the BIS and BAS could predict depression with its related positive and negative intense impacts, and predict depressive episodes in three groups of participants. BAS-RR subscale is a negative predictor for bipolar disorder and major depression, while in healthy participants, we did not find any significant relationship.

BAS seems to be a significant predictor of mania symptom intensity. The results obtained from the Fun-Seeking subscale in bipolar patients showed a significant predictor value but among individuals with major depression, we could not find any significant relationship.

As shown in Table 3, there are significant correlations between BIS and severity of mania symptoms, and BAS as well as BAS subscales (BAS-RR, BAS-Drive, AS-Fun) with the severity of depression. In addition, significant relationships between BIS and severity of depression and BAS with severity of mania symptoms were detected (P<0/005).

Table 3: correlations between variables

Variables		BIS	BAS	BAS-Fun	BAS-Drive	BAS-RR	BDI-II	YMRS
BIS	Correlation	1	-0.76	-0.77	-0.72	-0.65	0.84	-0.68
	P Value		0.000	0.000	0.000	0.000	0.000	0.000
BAS	Correlation	-0.76	1	0.90	0.94	0.94	-0.85	-0.80
	P Value	0.000		0.000	0.000	0.000	0.000	0.000

BAS-FUN	Correlation	-0.77	0.90	1	0.82	0.75	-0.82	0.74
	P Value	0.000	0.000		0.000	0.000	0.000	0.000
BAS-DRIVE	Correlation	-0.72	0.94	0.82	1	0.81	-0.83	0.73
	P Value	0.000	0.000	0.000		0.000	0.000	0.000
BAS-RR	Correlation	-0.65	0.94	0.75	0.81	1	-0.74	0.78
	P Value	0.000	0.000	0.000	0.000		0.000	0.000
BDI-II	Correlation	-0.84	-0.85	-0.82	-0.83	-0.74	1	-0.58
	P Value	0.000	0.000	0.000	0.000	0.000		0.000
YMRS	Correlation	-0.68	0.80	0.74	0.73	0.78	-0.58	1
	P Value	0.000	0.000	0.000	0.000	0.000	0.000	

4: Discussion

Patients with bipolar disorder had stronger BAS, while those with major depressive disorder scored lower in BAS scales than healthy people. At the same time, we noticed that the highest and lowest activity levels in the BAS-Fun subscale were shown in BMD and MDD, respectively. These results are in line with the studies conducted by Pinto-Meza et al (2006) and Alloy (2008) and the colleagues.

BAS-Drive had the highest score in bipolar patients and the lowest score in major depressive disorder, but BAS-RR was the highest in patients with bipolar disorder and lower in those with depression which was also previously revealed (Henriques, & Davidson, 1990).

Bipolar patients scored higher in BAS-Fun, BAS-Drive and BAS-RR, while patients with major depression had lower scores on BAS-Fun, BAS-Drive and BAS-RR subscales compared to the healthy individuals. The results are in agreement with the findings of most recent studies (Quilty, Mackew & Bagby, 2014; Fletcher , Parker , & Manicavasagar , 2013).

The negative correlation between BAS and major depression suggests that these individuals have deficits in controlling desire, goal-seeking behavior, and positive emotions. Therefore, anhedonia in depressed individuals is justified by a low activity level of BAS.

We also found a positive correlation between BIS and depression which suggests that the patients with depression had sensitivity and hyperactivity in BIS leading to negative emotions. The results of some published works are in agreement with the current study (Kash, Rottenberg, Arnow, & Gotlib, 2002; Kash, Rottenberg, Arnow, Gotlib, 2002), meanwhile a few studies disagree (Meyer, Johnson, Carver, 1999; Jones, Mansell, & Waller, 2006).

Our findings suggest that BAS is hyperactive in bipolar disorder which supports the dysregulation in these patients. An inverse relationship between BAS, RR and depression

suggests a dysregulation in the BAS in depressive patients. Depressed patients had lower responsiveness to reward and receive little reward as a motivation.

While all patients scored higher on BIS in comparison with normal individuals, patients with bipolar mood disorder scored higher on BAS scales compared to patients suffering from depression.

5: Conclusions

Dysregulations of BAS and BIS may predispose affected individuals to mood disorder symptoms.

The findings in this study emphasize the role of the behavioral-brain systems as integrated models of bio-psychological aspects in the occurrence and continuation of mood disorders. Any difficulty of these systems or related domains may predict the development of mood disorders.

6: Limitations

Small sample size, inability to discontinue medications, and self-reporting nature of BAS/BIS scales all constitute major limitations of this study.

7: Acknowledgments

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References

- Alloy, L. B., Abramson, L. Y., Walshaw, P. D., Cogswell, A., Grandin, L. D., Hughes, M. E., et al. (2008). Behavioral approach system and behavioral inhibition system sensitivities and bipolar spectrum disorders. *Bipolar Disorders*, 10, 310– 322.
- Barekatain, M., Tavakoli, M., Molavi, H., Maroufi, M., Salehi,M.(2007) [*Standardization, reliability and validity of the Young Mania Rating Scale(Persian)*]. *Psychology,* 11, 150-66
- Beck, A. T., Steer, R. A., Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. *Clinical Psychology Review*, 8, 77–100.
- Carver, C., S. & White, T., L. (1994). Behavioral Inhibition, Behavioral Activation, and Affective Responses to Impending Reward and Punishment: The BIS/BAS Scales, *Journal of Personality and Social Psychology,* 67, 319-333.

- Chang, K., Adlean, N.E., Dienes, K., Simeonova, D.I., Menon, V., Reiss, A. (2004). Anomalous prefrontal- Subcortical activation in familial pediatric bipolar disorder: a functional magnetic resonance imaging investigation. *Archives of General Psychiatry*, 61, 781- 792.
- Depue, R. A., Iacano, W. G. (1989). Neurobehavioral aspects of affective disorder. *Annual review in psychology*, 40, 457- 492.
- Fletcher, K., Parker, G., Manicavasagar, V. (2013). Behavioral Activation System (BAS) differences in bipolar I and II disorder. *Journal of Affective Disorder*, 2013, 151, 121-8.
- Ghassemzadeh, *H.,* Mojtabai, R*.,* Karamghadiri, N*.,* Ebrahimkhani,N*. (2005). Psychometric properties of a Persian-language version of the Beck Depression Inventory--Second edition: BDI-II-PERSIAN. Depression Anxiety*, 21, 185-192.
- Gray, J. A. (1977). Drug effects on fear and frustration: possible limbic site of action of minor tranquilizers. In L. L. Iversen, S. D. Iversen, & S. H. Snyder (Eds.), *Handbook of psychopharmacology,* 8, 433- 529.
- Gray, J. A. (1981). A critique of Eysenck`s theory of personality. In Eysenck, H. J. (Ed), A Model of Personality. *Springer- Verlag, New York*, 246- 276.
- Gray, J. A. (1982). The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system. New York: *Oxford University Press*.
- Henriques, J. B., Davidson, R. J. (1990). Regional brain electrical asymmetries discriminate between previously depressed and healthy control subjects. *Journal of Abnormal Psychology*, 99, 22– 31.
- Johnson, S. L., Turner, R. J., Iwata, N. (2003). BIS/BAS levels and psychiatric disorder: An epidemiological study. *Journal of Psychopathology and Behavioral Assessment*, 25, 25– 36.
- Jones, S., Mansell, W., & Waller, L. (2006). Appraisal of hypomania-relevant experiences. *Journal of Affective Disorders*, 93, 19– 28.
- Kash, K. L., Rottenberg, J., Arnow, B, A, Gotlib, I, H. (2002). Behavioral activation and inhibition systems and the severity and course of depression. *Abnormal Psychology,* 111, 589- 597.
- McNaughton, N., Corr, P. J. (2004). Two- dimensional neuropsychology of defense: fear/ Anxiety and defensive distance. *Neuroscience and Biobehavioral Reviews*, 28, 285- 305.
- Meyer, B., Johnson, S. L., & Carver, C. S. (1999). Exploring behavioral activation and inhibition sensitivities among college students at risk for bipolar spectrum symptomatology. *Journal of Psychopathology and Behavioral Assessment*, 21, 275− 292.
- Meyer, B., Johnson, S. L., Winters, R. (2001). Responsiveness to threat and incentive in bipolar disorder: Relations of the BIS/BAS scales with symptoms. *Journal of Psychopathology and Behavioral Assessment*, 23, 3,133– 143.
- Moazen, S., Azad, F., Safi, P. (2009). System of behavioral and dimensions of perfectionism in coronary heart disease and healthy people, *Journal of Behavioral Sciences*, 2, 8, 199- 206.
- Murray, J., L. & Lopez, A., D. (1996). *The Global Burden of Disease.* WHO
- Muris, P., Meesters, C., De Kanter, E., Eek Timmerman P.E (2005). Behavioral inhibition and behavioral activation system scales for children: Relationships with Eysenks

personality traits and psychopathological symptoms. *Personality and individual Differences*, 28, 831- 841.

- Pinto-Meza, A., Caseras, X., Soler, J., Puigdemont, D., Ferez, V., Torrubia, R. (2006). Behavioral Inhibition and behavioral Activation System in Current and Recovered major depression participants. *Personality and individual Differences*, 40, 215- 226.
- Quilty, L.C., Mackew L., Bagby, R.M. (2014). Distinct profiles of behavioral inhibition and activation system sensitivity in unipolar vs. bipolar mood disorders. Psychiatry Research. 2014, 219, 228-31
- Rusting, C., L. (1998). Personality, mood, and cognitive processing of emotional information: Three conceptual frameworks. *Psychological Bulletin*, 124, 165-196.
- Sharifi, V.,Assadi, S.M., Mohammadi, M.R., Amini, H., Kaviani, H., Semnani, Y., et al. Structured Clinical interview For DSM-IV (SCID): Persian Translation and Cultural Adaptation. *Iranian Journal of Psychiatry*, 2, 46-48
- Tomarken, A.J., Keener, A.D. (1998). Frontal brain asymmetry and depression: a self-regulatory Perspective. *Cognition and Emotion*, 12, 387-420
- Tremblay, L. K., Naranjo, C. A., Cardenas, L., Herrmann, N., Busto, U. E. (2002). Probing brain reward system function in major depressive disorder: Altered response to dextroamphetamine. *Archives of General Psychiatry,* 59, 409- 416.
- Urosevic, S., Abramson, L., Harmon-jones, E., Alloy, L. (2008). Dysregulation of the behavioral approach system (BAS) in bipolar spectrum disorder: Review of theory and evidence. *Clinical Psychology Review*, 28. 1188- 1205.
- Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The Two General Activation Systems of Affect: Structural Findings, Evolutionary Considerations, and Psychobiological Evidence. Journal of Personality and Social Psychology, 76, 820-838.