Interactive Role of Reinforcement Sensitivity (BIS/BAS) and Personality Traits in Predicting the Severity of Multiple Sclerosis Disease

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Abstract

Introduction: Multiple sclerosis (MS) is the most common neurologic disorder in young and middle-aged individuals worldwide. This disorder can afflict any part of the Central Neural System (CNS), optic nerves, brainstem, cerebellum and the spinal cord. The present study was an attempt to investigate the interactive role of reinforcement sensitivity (BIS/BAS) and personality traits in predicting the severity of the MS disease.
Methods: The study was a correlational enquiry in which 162 patients with MS were selected by purposive sampling in Shiraz, Iran. The data were collected using NEO Five Factor Inventory (NEO-FFI), Jackson-5 scale, and Expanded Disability Status Scale (EDSS) questionnaires and were finally analyzed using Pearson correlation coefficient and multiple regression. The SPSS software version 21 (SPSS, Inc., Chicago, IL, USA) was used for the statistical analysis.
Results: The results showed that indicators of personality traits (F chanch = 10.562, $p < 0.01$) and reinforcement sensitivity (F chanch = 1.567, $p < 0.01$) significantly predicted the scores of expanded disability status of the MS disease. The interaction between the indicators of personality traits and reinforcement sensitivity factors significantly increased the variance determined in the criterion variable (F chanch = 54.218; 10.214, $p < 0.01$).
Conclusions: The results indicated that the interaction between personality traits and reinforcement sensitivity factors increases the risk of the growth of the MS disease.

Keywords: Multiple Sclerosis, Reinforcement Sensitivity, Personality Traits, Expanded Disability Status of MS

Introduction

The Central Nervous System (CNS) diseases are common and disabling disorders which have received attention by researchers. One of the most common neurological disorders, that is currently the focus of the experts' attention, is Multiple Sclerosis (MS) which is a progressive, chronic disease of the CNS [1]. By the destruction and inflammation of the myelin, MS inflicts each part of the CNS, optic nerves, brainstem, cerebellum, and the spinal cord [2]. The clinical symptoms of this disorder include sensorimotor symptoms such as vision disorder, weakness, bladder dysfunction and sensory defects, neural symptoms [3], cognitive disorders, and emotional changes [4]. MS periods are unique and unpredictable and the pathology of the disease is unknown. Therefore, so far, no treatment has been

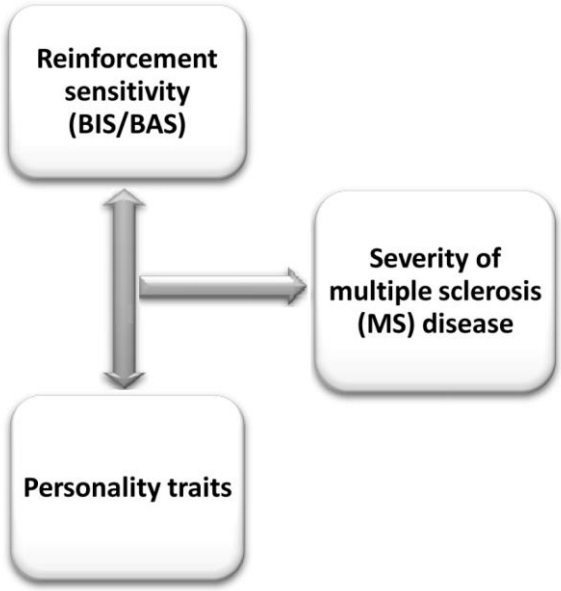
effective [5], and the average life expectancy of the patients with MS has been estimated to be 30 years [6]. The disease starts between 20 and 40 years of age and it is more common among women than men [7].

MS poses various challenges to physical and mental welfare [8]. Empirical evidence demonstrates a high rate of depression and anxiety [9], and stress [10] caused by MS. These researches indicate the necessity of paying greater attention to the psychological aspects of neural diseases including personality traits [11]. One of the models of behavior and emotional and physiological responses related to personality is the Reinforcement Sensitivity Theory (RST) [12], which includes three basic systems of Behavioral Inhibition System (BIS), Behavioral Approach System (BAS), and Fight, Flight, Freeze System (FFFS) with an independent neurological mechanism in the nervous system [13]. These three systems reflect brain structures which influence the sensitivity to the reinforcing and punishing events [9]. For example, neurotic depression is the result of higher activity of the BIS while general depression is the result of low activity on the part of the BAS [14]. In other words, differences in the function of these systems and their interaction lays the ground for human moods [15]. Therefore, it is expected that the differences in the function of these systems in patients with MS influence their emotional experiences and, consequently, the severity of the disease.

In their study, Thomas et al. [16] observed that the prevalence of depression during the lifetime of patients with MS is 50%. Because of the prediction of increased severity of the disease, they suggested that early diagnosis and management of depression in patients with MS, adherence to the treatment of the immune system, prevention of suicide, and improvement of life quality are very important [6]. In another study, high maladjustment and decreased empathy, agreeableness, and conscientiousness were observed in these patients [17]. In such patients, neuroticism, extroversion, openness, conscientiousness, and agreeableness constitute the core of personality traits [18] and they have been clearly described in the Five Factor Model (FFM) of McCrae and Costa [19]. This core of personality traits has genetic modification and comes with healthy behavior and improved consequences in a number of medical population including patients with MS [20]. In an investigation of the relationship between neuroanatomy and personality changes, it was demonstrated that damage to the cerebral cortex has a negative effect on the personality of these patients, just as decreased extroversion, openness, and conscientiousness in MS are significantly related to decreased volume of cerebral cortex [17]. Therefore, further studies are required to gain a better understanding of the issue.

Due to the fact that patients' personality issues are important in psychology, it is hypothesized that some indicators of patients' personality may influence the intensity of diseases and hence affect their emotional stability and emotion regulation. Considering the increasing trend of the number of MS problems and the negative effect of these problems on the patients' performance in their daily life and the consequences they have for the society, and in order to identify the very significant factors of relapse and diminution of the disease, the present study takes account of the biological aspect of patients with MS to investigate the personality traits and their interaction and to determine the degree of prediction of the severity of MS symptoms. Figure 1 illustrates the conceptual model of the present study.

Figure 1. Conceptual model of the research.



Method

The present study was a descriptive-correlational method. The population consisted of all patients with MS in Shiraz, Iran. One-hundred and sixty-two patients in Shiraz were selected as the sample using purposive sampling. A sample size of 50 patients was necessary to evaluate the correlation between the relationships [21]. The patients' data were collected using questionnaires. The patients who referred to physician's offices and the MS Association and were asked to participate in the study. The questionnaires were distributed after obtaining their consent. Prior to the main analysis, the collected data were investigated in terms of observance of statistical presuppositions of Pearson correlation coefficient and multiple regression. Pearson correlation coefficient was used to investigate the linear relationship of personality traits and brain-behavioral systems to the severity of disease symptoms. The interactive role of brain-behavioral systems and personality traits were examined using multiple regression method. Data analysis was performed using Pearson correlation coefficient, and the linear relationship of age, years of education, length of disease, and severity of MS to personality traits and reinforcement sensitivity were investigated. SPSS software version 21 (SPSS, Inc., Chicago, IL, USA) was used for the statistical analysis.

Research instruments

A) NEO Five factor inventory

NEO Five Factor Inventory (NEO-FFI) was developed in

1985 by McRae and Costa. The short version of this inventory is a 60-item questionnaire designed to evaluate 5 main personality traits. The reliability coefficients were calculated between 0.83 and 0.75 [19]. The NEO is a 60-item questionnaire with scales for the five factors labeled as extraversion, agreeableness, conscientiousness, neuroticism, and openness. The patients gave their answers on a 5-point Likert - type scale ranging from 0 = completely disagree to 4 = completely agree. In Iran, NEO-FFI was normalized by Garousi Farshi et al. [22]. The reliability of the questionnaire was calculated at 0.83, 0.75, 0.80, 0.79, and 0.79 for the five factors C, N, E, O, and A, respectively, on a group of 208 students within a three-month interval [23].

B) Jackson-5 scales

The Jackson-5 scales which was firstly developed by Jackson [13] to appropriately measure r-TST, included the subscale of Behavioral Approach System (BAS), Fight, Flight, Freeze System (FFFS), and Behavioral Inhibition System (BIS). Items are scored on a 5-point Likert scale from 1 (completely disagree) to 5 (completely agree) with higher scores reflecting higher activity of the motivational systems. By using the exploration and confirmatory factor analysis, Jackson attempted to develop and test new scales (Jackson-5 scales). The reliability of these scales has been determined to be between 0.74 and 0.83 [13]. In Iran, by using Cronbach's alpha, the reliability of Jackson-5 scales was determined to be between 0.72 and 0.888 and the retest coefficients were determined to be between 0.64 and 0.78 [24].

C) Expanded Disability Status Scale (EDSS)

The EDSS, developed by John F. Kurtzke, is a method to evaluate the degree of neural disorder in MS patients. This scale determines the amount of disability in EDSS in 8 functional systems, enabling the neurologist to investigate the FSS of pyramidal, cerebellum, brainstem, sensory, intestinal, bladder, visual, brain, and other system functions and to give each function a score [25]. EDSS in patients with MS is determined between 0 and 10 by the neurologist. The neurologist examines the different aspects of patients' physical disabilities and considers a score between 0 and 10 based on those disabilities. For example, a patient with an EDSS of zero is not physically disabled yet, a patient with an EDSS of 6 has to walk with a cane, and a person with an EDSS of 7 is consigned to a wheelchair [26].

Results

Out of 162 patients with MS, 78% were female with an average age of 35 years old. The majority of the subjects were married (74%). In terms of the level of education, 19 patients (11%) had elementary education, 22 patients (13%) had middle school diplomas, 52 patients (32%) had high school diplomas, and 69 patients (42%) had academic degrees. The mean age that the patients suffered from MS was 6 years. Table 1 demonstrates the independent and criterion variables.

Table 1 presents the descriptive statistics including mean and standard deviation of research variables. The results demonstrate that among all the components of reinforcement sensitivity, behavioral inhibition system with a mean of 26.71 had the highest value and of all the components of personality traits, neuroticism (mean = 33.09) and conscientiousness (mean = 35.28) had the highest values.

Table 2 presents the results of multiple regression analysis regarding the interactive role of personality traits and reinforcement sensitivity in influencing the expanded disability status of MS. The results of multiple regression analysis of independent and criterion variables regarding the interactive role of brain-behavior systems and personality traits are showed in Table 2. In the first step, the personality traits and reinforcement sensitivity were predicted as 50.3% and 22.1% of the variance of the scores of expanded disability status of MS, respectively (F_{chanch}= 10.562, 1.567, $p < 0.01$). Afterwards, the interaction between personality traits and reinforcement sensitivity were added to the equation and the variance accounted for in the criterion variable had significantly increased ($p < 0.01$) and reached 59.4% (F_{chanch}= 10.214, $p < 0.01$).

These results demonstrated that the interaction between personality traits and reinforcement sensitivity accounted for 31.8% of the variance of the scores of expanded disability status of MS after controlling the effect of personality trait indicators and reinforcement sensitivity components on the degree of expanded disability status of MS.

Table1. Descriptive Statistics (Mean and Standard Deviations) for the variables of the study (N=162)

Variables	Mean	Standard Deviations
Neuroticism	33.09	8.22
Extraversion	28.37	6.80
Openness	24.08	4.14
Agreeableness	28.54	5.58
Conscientiousness	35.28	6.29
Behavioral Inhibition System	21.17	3.11
Behavioral Approach System	26.71	2.19
fight system	17.59	4.34
flight system	19.99	4.69
freeze system	20.45	5.33
EDSS	2.49	1.79

Table 2. Summary of the results of multiple regression analysis for examining the interactive role of brain-behavior systems and personality traits in influencing the severity of MS symptoms

Dependent variable EDSS	predictive variables	Durbin-Watson	Total R 2	R 2 Change	Beta	SE Beta	T	Sig	F Change
First step	Neuroticism				.519	.141	6.599	.000	
	Extraversion				.063	.156	.725	.470	
	Openness				.020	.124	.284	.777	
	Agreeableness				-.008	.138	-.107	.915	
	Conscientiousness				.011	.152	.124	.902	
		2.138	.503	.253				.000	10.562
	Behavioral Inhibition System				.177	.149	2.124	.000	
	Behavioral Approach System				-.174	.149	-2.086	.000	
	fight system				.024	.143	.294	.769	
	flight system				-.008	.157	-.088	.930	
	freeze system				.079	.156	.898	.371	
		2.172	.221	.149				.000	1.567
second step	Interaction (BIS/BAS) & Neuroticism	1.848	.507	.252				.000	54.218
			.594	.318				.000	10.214

Discussion

The present study was an attempt to determine the interactive role of reinforcement sensitivity and personality traits in predicting the expanded disability status of the MS disease. The results demonstrated that the components of reinforcement sensitivity by themselves can significantly predict the variance of the scores of the expanded disability status of MS.

The results of the present study also revealed that patients with MS have higher mean scores in terms of the behavior inhibition system. This analysis can be explained by referring to the theoretical model developed by McRae. This system is activated by aversive stimuli (e.g. adverse emotional experiences such as fear, anxiety, disappointment, sadness, sorrow, and depression) [27]. In the case of anxiety, the patient has an active behavioral inhibition system. This causes intense anxiety, behavioral inhibition, and risk avoidance. Based on BIS functioning, such patients are expected to be shy, socially isolated, sensitive to punishment, and vulnerable to failure, and they often lose their courage and have difficulty or fail to develop active ways to encounter situations [28]. Such individuals seem to experience more anxiety than others in facing stressful events [29].

Hatamlou and Babapour [28] conducted a study on the relation between brain-behavior systems and physical diseases. Based on their study, diabetic patients exhibit more behavioral inhibition sensitivity than ordinary individuals [30]. It can be argued that MS patients with more active behavior inhibition systems are prone to MS symptoms and this confirms the relation between reinforcement sensitivity and the expansion of the disability status of MS.

Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS were suggested by Gray and colleagues in their reinforcement sensitivity theory. The BAS responds to conditioned stimuli of reward and non-punishment, elicits positive emotions, and leads to approach behavior and active avoidance (or conditioned flight). The neuroanatomical basis of this system is the prefrontal cortex, the amygdala, and the basal ganglia. The BIS responds to conditioned stimuli of punishment and non-reward, as well as to novel stimuli and innate fear stimuli. It elicits the affective state of anxiety and leads to behavioral inhibition, passive avoidance, extinction, heightened arousal, and heightened attention. The neuroanatomical basis of the system is the orbital frontal cortex, the Septo Hippocampal system (SHS), and the Papez-circuitry (connected to SHS) [31].

Recently, Sutton and Davidson [32] suggested that the BIS corresponds to an approach system. An approach and a withdrawal system were proposed by Davidson in the model of anterior asymmetry and emotion [33]. The approach system is activated by the perception of goals, elicits approach related (pre-goal-attainment) positive effect, and initiates appetitive behavior towards these goals. The neuroanatomical basis of the system is thought to be the left dorsolateral and medial prefrontal cortex and the basal ganglia. [31].

The withdrawal system is activated by aversive stimulation, elicits negative emotions, and leads to withdrawal behavior. The neuroanatomical basis of this system is supposed to be the right dorsolateral prefrontal cortex, the right temporal polar region, the amygdala, the basal ganglia, and the hypothalamus. Taken together, according to this model and the extension of Sutton and Davidson [32], greater left frontal cortical activity is related to behavioral activation, positive affect and approach behavior and greater right frontal cortical activity is related to behavioral inhibition, negative effect, and withdrawal behavior [31].

The personality trait index significantly predicted the scores of the intensity of the expansion of the disability status of MS patients. In explaining the results which are indicative of the relationship between personality traits and the intensity of MS symptoms, it can be argued that neuroticism, extroversion, openness, conscientiousness, and agreeableness constitute the core of personality

traits, and that they regulate the health of behavior [30]. Each of these indicators constitutes the main core of personality. These results can be confirmed by referring to the study by Benedict et al. [34] which demonstrated higher incompatibility (neuroticism) and reduced empathy, agreement, and conscientiousness in patients with MS [20]. Neuroticism is an aspect of personality which affects the patient's tendency to negative emotions and their dealing with such emotions. In the five factor model, this indicator represents differences in individuals' nervousness, emotional stability, compatibility, neuroticism, and incompatibility. Such patients often find it difficult to understand the reality of problems and threats and always feel negative emotions such as fear, danger, anger, sadness, or shame [27].

Various brain systems associated with these reactions to threat and punishment have been linked to neuroticism. For example, neuroimaging has demonstrated that neuroticism is associated with brain activity at rest or in response to aversive or novel stimuli, in the amygdala, insula, and anterior cingulate. Neuroticism has also been associated with neural activity in medial prefrontal cortex that is suggestive of poor emotion regulation [35] and with reduced volume in that region [36].

Gray and McNaughton [37] suggested that neuroticism is jointly determined by sensitivities of the BIS, with the BIS responsible for passive avoidance in situations where goals are in conflict (e.g., an approach avoidance conflict, such as wanting to initiate social contact but fearing rejection). Important brain structures in the BIS are the hippocampus and amygdala. Neuroticism has been associated with higher baseline levels of the stress hormone cortisol, but with reduced phasic increases of cortisol in response to specific stressors [38]. This pattern suggests that those high in neuroticism tend to be not only chronically stressed but also less able to mobilize resources to deal with particularly stressful situations [39].

The characteristics often observed in patients suffering from neuroticism include irritability and sensitivity, and such individuals react emotionally to problems and events which may seem unimportant to others. They also exhibit symptoms of depression and anxiety [27]. Besides, the findings made by Ozura et al. [17] demonstrated that patients with MS have lower self-esteem [17]. Considering that evaluation of MS as a controllable threat or problem (challenge) and the style used by the patients to tackle it affect the trend of the disease, the findings of the present study help to balance personality traits against MS severity.

The interaction between personality traits and the components of reinforcement sensitivity can increase the variance accounted for in the criterion variable. The results indicated that the interaction between personality traits and the components of reinforcement sensitivity could account for the scores of severity of expanded disability status of MS after controlling the effect of indicators of personality traits and reinforcement sensitivity on the severity of expanded disability status of MS. Therefore, it can be concluded that the neuroticism index and behavioral inhibition system facilitate the progress of disease symptoms.

Conclusion

It is concluded from the results of the present study that the interaction between personality traits and reinforcement sensitivity factors increases the risk of the growth of the MS disease and some personality traits. The brain system components can actually endanger health when they are in interaction with each other. It is also concluded that an individual's active inhibition system makes them biologically prone to anxiety, and the neuroticism index causes extreme sensitivity to events, sadness, and depression and enervates the individual. Besides, the clinical phenotype of MS patients exhibits the non-predictability of attacks and the sudden growth of the disease. Together, these factors raise the question as to whether or not MS patients who suffer from high neuroticism and have a more biologically active inhibition system are more prone to MS. Therefore, it is recommended that further research should be conducted and psychological treatment projects should be implemented.

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