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The Role of Emotion Regulation Strategies and Emotional Creativity in Predicting Brain-Behavioral Systems

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Abstract

Introduction: The present study investigated the role of emotion regulation strategies, emotional regulation, and emotional creativity in predicting brain-behavioral systems.

Methods: This descriptive and predictive correlational study was conducted on a statistical population comprising 110 students from the University of Sistan and Baluchestan during the 2023-2024 academic year. The participants were selected using a convenience sampling method and, after being informed about the research objectives, voluntarily completed three questionnaires: the Garnefski and Kraaij Emotional Regulation Questionnaire (2006), the Averill and Thomas-Knowles Emotional Creativity Questionnaire (1991), and the Carver and White Behavioral Inhibition and Activation Scales (1994). Pearson correlation and simultaneous regression analysis were employed to test the research hypotheses.

Results: The results showed a significant positive relationship between the behavioral inhibition system and emotion regulation, as well as a significant negative relationship between the behavioral inhibition system and emotional creativity ($P<0.01$). Additionally, emotion regulation strategies and emotional creativity significantly predicted the behavioral inhibition system ($P<0.001$).

Conclusion: Based on the findings, it can be concluded that emotion regulation strategies and emotional creativity can predict brain-behavioral systems and contribute to their improved functioning.

Keywords: Emotion regulation strategies, Emotional creativity, Brain-behavioral systems

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Introduction

One of the theories that examines the role of brain motivational systems and their close connection to emotions, feelings, and their manifestations is the Reinforcement Sensitivity Theory. This theory provides a sound theoretical framework for understanding the underlying causes of maladaptive behaviors and their persistence. Based on this theory, behaviors and emotions are governed by three biological systems: the Behavioral Activation System (BAS), the Behavioral Inhibition System (BIS), and the Fight/Flight/Freeze System (FFFS) (1). The BAS is triggered by rewarding stimuli without punishment, while the BIS responds to punishment cues. Finally, the FFFS, representing the avoidance/defensive system, is activated in response to threatening or aversive stimuli to promote avoidance and escape (2).

Gray argued that the predominance of these systems in an individual could lead to distinct emotional states, such as fear and anxiety (3). Studies have shown a significant relationship between emotion regulation and brain-behavioral systems (4). Dysfunction in emotion regulation can expose individuals to a wide range of psychological disorders (5). Increased BIS activity, for instance, is associated with a higher likelihood of internalizing disorders such as anxiety and depression. Conversely, heightened BAS activity may lead to externalizing problems, such as delinquency, aggression, and socially harmful behaviors (6).

Since research has demonstrated a strong relationship between emotion regulation and brain-behavioral systems, it appears that emotion regulation—which involves managing behaviors and thoughts—does not exclusively encompass brain-behavioral systems but also includes higher intermediary processes such as cognitive functions (4).

Emotion regulation refers to self-control, specifically the evaluation, understanding, monitoring, and adjustment of emotional responses to align with goals and ensure optimal functioning. The emotion regulation and recognition process allows individuals to, consciously or unconsciously, modify their emotions using cognitive processes (7). Cognitive emotion regulation involves managing and regulating the entry of stimulating information and employing cognitive strategies to cope, which begins after experiencing stressful events. This process influences the

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experience of emotions, the duration of their occurrence, and how they are expressed (6).

As a fundamental cognitive and behavioral strategy, emotion regulation is crucial in managing emotions and controlling related behaviors. Recent studies have examined the impact of emotion regulation strategies, such as cognitive reappraisal and emotional suppression, on brain and behavioral systems. These strategies are influenced not only intrapersonally but also interpersonally. For instance, cognitive reappraisal has been associated with broader activation of brain regions, including the prefrontal cortex and areas involved in social cognition and mirror systems. These neural networks, alongside behavioral systems like the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS), significantly contribute to regulating individual behaviors (8).

Broadly, cognitive emotion regulation strategies are categorized into two groups: adaptive strategies, focusing and positive reappraisal, and maladaptive strategies, such as rumination, self-blame, and blaming others (9). Research has shown that employing maladaptive cognitive emotion regulation strategies significantly predicts different levels of emotions and mental health outcomes (10). Moreover, individuals who use adaptive emotion regulation strategies are less likely to experience emotional and functional disorders than those relying on maladaptive strategies (11). On the other hand, emotion regulation enhances interaction with the environment and plays a significant role in maintaining adaptive behaviors and reducing negative emotions (12).

Emotion regulation is recognized as a core component of mental health and psychological well-being. Studies have indicated that how emotions are managed and regulated directly impacts individual behavior, particularly in stressful situations or when rapid and accurate decision-making is required. The role of emotion regulation in brain-behavioral systems underscores that emotion regulation strategies can influence the activity of various brain regions, especially those associated with reward and punishment (brain-behavioral systems) (13).

Emotional creativity, one of the emerging concepts in this field, refers to individuals' ability to use emotions to generate creative ideas and solutions. This type of creativity interacts with activating various brain regions responsible for processing emotions and creativity, significantly enhancing brain-behavioral systems (14). Additionally, emotional creativity, a cognitive ability that employs emotions to develop innovative solutions, also has a crucial role in brain systems. Research has shown that emotional creativity is directly associated with the activation of prefrontal networks and areas related to cognitive processes. These studies have also indicated that emotional creativity can enhance an individual's ability to cope with negative emotions and improve behavioral responses (15).

Maghsoudi Mehraban et al. explored the predictive role of brain-behavioral systems in emotion regulation and anxiety sensitivity among mothers of children with autism. Their findings indicated that increased BIS activity is associated with heightened emotional dysregulation and anxiety responses, underscoring the critical role of neural systems in emotional adjustment (16). Another study investigated how brain-behavioral system sensitivity relates to emotion regulation difficulties and substance use temptation, particularly in individuals experiencing loneliness. The results showed that higher BIS sensitivity was significantly linked to greater emotional regulation challenges and increased vulnerability to maladaptive behaviors (11). Hoseini et al. examined the influence of executive functioning and negative automatic thoughts on emotional regulation difficulties in adolescents. They found that impairments in executive control and the presence of persistent negative thoughts significantly predicted problems with emotion regulation, highlighting the cognitive-emotional interaction in youth (17).

Despite the significant findings in this area, gaps remain in understanding the interaction between emotion regulation, emotional regulation, and emotional creativity with brain-behavioral systems. Many previous studies have separately examined the effects of each of these variables on brain-behavioral systems. Still, few have explored the combined effects of these factors on the functioning of brain-behavioral systems. Consequently, it is still not fully understood how emotion regulation strategies and emotional creativity can simultaneously influence brain-behavioral systems and what mechanisms are involved in this process. This raises the question: Can emotion regulation and emotional regulation, along with emotional creativity, significantly predict the functioning of brain-behavioral systems and thought control?

Methods

The present study is descriptive and of a predictive correlational type. The statistical population consisted of 110 students (based on the recommendation of Tabachnick and Fidell (18), suggesting a sample size of over 80 given the study's subscales) enrolled at the University of Sistan and Baluchestan during the academic year 2023-2024. Participants were selected using a convenience sampling method. After being informed of the study's objectives, the participants voluntarily completed the three questionnaires provided in electronic form. Participants were selected from a population of university students. The inclusion criteria were: 1- individuals aged between 18 and 40 years, 2- Willingness to participate voluntarily and provide informed consent. Exclusion criteria included: 1- A self-reported history of neurological or psychiatric disorders that might interfere with emotional processing or regulation, 2- Current use of psychoactive medication, 3- Incomplete or inconsistent responses on the administered questionnaires.

A) Emotion Regulation Strategies Questionnaire (ERSQ)

This questionnaire was developed by Garnefski and Kraaij (2006) and consists of 18 items divided into nine subscales: positive refocusing, positive reappraisal, planning, self-

blame, positive attention to evaluation, blaming others, rumination, acceptance, and catastrophizing. The questions are scored based on a 5-point Likert scale. The questionnaire's validity was established, with Cronbach's alpha ranging from 0.73 to 0.80 (20).

B) Emotional Creativity Inventory (ECI)

The Emotional Creativity Inventory (ECI), designed and validated by Averill and Thomas-Knowles (1991), assesses emotional creativity. It includes 30 items divided into four subscales: emotional preparedness, novelty, effectiveness, and authenticity. The items are scored on a 5-point Likert scale. Research findings indicate that the overall reliability of the questionnaire, based on Cronbach's alpha, is 0.84. Reliability coefficients for the subscales are as follows: emotional preparedness (0.64), novelty (0.85), and effectiveness/authenticity (0.71) (15).

C) Behavioral Inhibition and Activation Systems Scale (BIS/BAS)

The BIS/BAS scale, developed by Carver and White (1994), measures behavioral systems. It consists of two subscales: Behavioral Inhibition System (BIS) and Behavioral Activation System (BAS), with 24 items scored on a 4-point Likert scale. According to Carver and White (1994), the internal consistency for the BIS subscale is 0.74, while the internal consistencies for the BAS subscales—reward responsiveness, drive, and fun-seeking—are 0.73, 0.76, and 0.66, respectively (20).

It is important to note that all questionnaires were designed and compiled into a single online format using a web-based survey platform. The survey was then made available to volunteer university students who met the inclusion criteria. After the completion of data collection, the responses were thoroughly analyzed using the Statistical Package for the Social Sciences (SPSS). The results of these analyses are presented in full in the following sections.

Data Analysis

Data analysis was conducted in three sections: demographic information, descriptive statistics, and inferential statistics. The demographic and descriptive sections used measures such as mean, frequency, and percentage frequency. Pearson's correlation coefficient and simultaneous regression were applied in the inferential statistics section. All data were analyzed using SPSS software version 26.

Results

Based on the study findings, the frequency and percentage distribution of participants by age group were as follows: 49 participants (44.54%) aged 18–22 years, 35 participants (31.81%) aged 23–27 years, 18 participants (16.36%) aged 28–32 years, and 8 participants (7.27%) older than 32 years. Gender distribution indicated 52 males (47.3%) and 58 females (52.7%). Regarding marital status, 73 participants (66.36%) were single, and 37 participants (33.63%) were married.

Table 1 presents the descriptive statistics for the scales and subscales of the three questionnaires on emotion regulation, emotional adjustment, emotional creativity, and behavioral systems.

Mean and standard deviation for emotion regulation: 55.54 ± 11.24

Mean and standard deviation for emotional creativity: 99.24 ± 7.85

The mean and standard deviation for the behavioral activation system: 17.70 ± 3.90

The mean and standard deviation for the behavioral inhibition system: 29.23 ± 6.87

Table 2 demonstrates that Pearson's correlation coefficient revealed a significant and positive relationship between the behavioral inhibition system and emotion regulation ($P < 0.001$, $r = 0.25$). Conversely, an essential and negative relationship was observed between the behavioral inhibition system and emotional creativity ($P < 0.001$, $r = -0.54$). Simultaneous regression analysis examined the predictive role of emotion regulation and emotional creativity on the behavioral inhibition system.

According to Table 3, emotion regulation and emotional creativity significantly predicted the behavioral inhibition system ($P < 0.001$, $R^2 = 0.33$).

Table 4 shows the behavioral inhibition system's standard and unstandardized regression coefficients. It highlights that emotional creativity had a stronger role in predicting the behavioral inhibition system than emotion regulation among the two predictors, emotion regulation and emotional creativity.

Discussion

This study examined the role of emotion regulation strategies, emotional adjustment, and emotional creativity in predicting brain-behavioral systems and thought control. The first hypothesis posited a significant relationship between brain-behavioral systems and emotional regulation strategies, adjustment, and creativity. The findings revealed a significant positive correlation between the behavioral inhibition system (BIS) and emotion regulation strategies and a significant negative correlation between BIS and emotional creativity. This suggests that higher emotion

Table 1. Mean and standard deviation of research scales

	M	SD
Emotion regulation	55.54	11.24
Emotional creativity	99.24	13.33
BAS	17.70	3.90
BIS	29.23	6.78

Table 2. Pearson correlation between research scales

	1	2	3	4
Emotion regulation	-	-0.15	0.09	0.25 $P<0.001$
Emotional creativity	-		0.06	-0.54 $P<0.001$
BAS	-			0.14
BIS	-			

Table 3. Summary of simultaneous regression analysis in predicting the behavior inhibition system

Predictor variable	R	R^2	F	Sig
Emotional regulation and emotional creativity	0.57	0.33	26.48	$P<0.001$

Table 4. Standard and non-standard regression coefficients in the behavior inhibition system

Variable	b	Beta	T	Sig
Constant	50.02		9.50	$P<0.001$
Emotional regulation	0.10	0.17	2.19	0.3
Emotional creativity	-0.26	-0.52	-6.50	$P<0.001$

regulation enhances BIS activity, while greater emotional creativity reduces BIS activity. These results highlight the importance of how individuals perceive, express, and understand emotions, which can significantly influence the emergence or suppression of behaviors.

The second hypothesis suggested that emotion regulation strategies, emotional adjustment, and emotional creativity can significantly predict brain-behavioral systems. The results demonstrated that only emotion regulation strategies and emotional creativity could significantly predict BIS. This indicates that leveraging emotions effectively plays a critical role in behavioral outcomes. Understanding the impact of emotion regulation strategies on brain systems provides insights into managing emotions across various contexts. These strategies are pivotal, especially in interpersonal settings such as marital relationships, family dynamics, and leadership interactions.

The results align with findings from previous research, such as that by Maqsoudi Mehraban (2023) (18), which demonstrated a significant relationship between emotion regulation and the sensitivity of brain-behavioral systems. Behavioral systems influence reward-seeking and avoidance behaviors, as evidenced by studies like Ghanbari Zarandi et al. (19), highlighting the reciprocal interaction between emotion regulation and brain-behavioral systems. The present study's findings are also consistent with the findings of the studies by Panksepp (2019) (15), Hoseini et al. (20), Moradkhani and Yazdanbakhsh (2021) (6), and Kelley et al. (4), further validating the significance of the interaction between emotion regulation, emotional creativity, and brain-behavioral systems.

For example, emotional suppression, compared to cognitive reappraisal, activates different neural pathways, potentially leading to long-term mental fatigue and decreased psychological well-being (13). This finding underscores that different emotion regulation strategies have varying effects on mental health and behavior, influencing brain and behavioral systems in distinct ways.

From a behavioral system perspective, emotion regulation and emotional creativity are closely tied to BIS, which governs the inhibition of undesirable behaviors. Emotion regulation strategies can modulate BIS activity, helping individuals manage responses in challenging situations and improving their ability to handle conflicts and obstacles. Emotional creativity, as a crucial ability, enables individuals to address challenges innovatively by harnessing their emotions. This capability interacts with neural and cognitive systems, enhancing problem-solving skills and cognitive flexibility. Individuals with higher emotional creativity are better equipped to manage negative emotions and predict their behavioral reactions in diverse circumstances. This is evident in academic and occupational stress studies, where emotional creativity is a buffer against stress (14).

Overall, emotion regulation strategies and emotional creativity significantly influence brain and behavioral systems, helping individuals adapt to challenging situations. These findings can inform the development of new therapeutic interventions to enhance psychological well-being by targeting neural and behavioral synchronization and regulation (15).

This study is subject to several limitations that should be acknowledged. First, the reliance on self-report questionnaires may have restricted the depth and scope of the data collected, as such tools inherently limit the researcher to predefined response options and may not fully capture the complexity of emotional processes. Qualitative methods, such as interviews, could provide richer, more nuanced insights in future research. Second, the way individuals express and regulate emotions is deeply rooted in sociocultural and familial learning patterns. Given that the sample primarily consisted of university students within a specific age range, caution should be exercised when generalizing the findings to broader populations with different generational or cultural backgrounds.

Despite these limitations, the study offers valuable practical implications. Due to time constraints, an intervention-based design was not feasible; however, future studies are encouraged to examine the effectiveness of emotion-focused therapies in modulating brain-behavioral systems and enhancing cognitive control. Additionally, based on the significant predictive relationships observed in this study, it is recommended that educational programs or training modules be developed to improve emotional awareness, regulation, and expression. These could be particularly beneficial in enhancing performance and psychological resilience among employees, students, and military personnel, and should be considered for implementation across institutions, organizations, and universities.

Conclusion

In conclusion, emotion regulation strategies and emotional creativity improve quality of life, reduce daily stress, and enhance an individual's ability to cope with complex situations by influencing brain and behavioral systems. Recent studies have suggested that incorporating these strategies into psychological and cognitive therapies can significantly improve mental health. Furthermore, findings related to the synchronization of brain activity and cognitive networks associated with these strategies open new avenues for future research in emotion regulation and emotional creativity.

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Competing Interests
The authors declared no conflict of interest.

Data Availability Statement
All necessary data will be available from the corresponding author upon reasonable request.

Ethical Approval
The present research was approved by the Ethics Committee of Sistan and Baluchistan University (Ethical code: IR.USB.REC.1403.016).

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