

The Impact of Stress on Emotion Regulation and Cognitive Flexibility: A Cross Study of Psychology and Neuroscience

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ABSTRACT

In modern society, emotion regulation and cognitive flexibility play an important role in coping with daily stress. Stress, as a physiological and psychological reaction, may affect the individual's cognitive function and emotional regulation ability, and the flexibility of emotional regulation is closely related to the individual's psychological adaptability. This paper first reviews the concepts of stress, emotion regulation and cognitive flexibility. Secondly, the related theoretical models are introduced, especially the flexibility of emotion regulation and the cognitive control model. Finally, the interaction between stress, mental flexibility and depression was discussed, and the influence mechanism of different stress perception and emotion regulation strategies on depression was analyzed.

KEYWORDS

Emotion regulation; Cognitive flexibility; Psychology; Neuroscience

1. INTRODUCTION

The pressure of life and work faced by individuals is increasing, which leads to mental health problems gradually becoming the focus of public health in today's society [1]. Stress not only affects the physical health of individuals, but also may cause or aggravate psychological disorders, especially depression, by changing emotional regulation and cognitive flexibility. Emotional regulation is an important mechanism to cope with stress, and the emotional regulation strategies of individuals in the face of stress directly affect their psychological adaptability. Cognitive flexibility refers to the ability of individuals to adjust their way of thinking to cope with changes, which has an important impact on individual stress coping and emotional regulation. The purpose of this paper is to explore the interaction among stress, emotion regulation and cognitive flexibility, and its impact on depression.

2. OVERVIEW OF STRESS, EMOTION REGULATION AND COGNITIVE FLEXIBILITY

2.1. Pressure

In today's fast-paced society, individuals need to face a variety of challenges. In urgent and dangerous situations, individuals will have a series of physiological and psychological reactions, such as high mental tension, rapid heartbeat, shortness of breath, sweating and so on. The sum of these non-specific reactions is called "stress". Stress is the result of the interaction between the body and the environment [2]. It is a comprehensive response caused by stimulus events that break the homeostasis of the body and exceed the load and control of the body. Pressure can be divided into acute pressure and chronic pressure according to the duration of pressure. Laboratory research is mainly through some means of intervention to trigger transient stress state. Compared with chronic stress, acute stress has shorter

duration, greater intensity and is easy to operate, so it is widely used in research. According to the nature of stressors, stress can be divided into physiological stress (such as cold stimulation, hot stimulation, pain stimulation, etc.) And psychological stress (such as examination, speech, etc.). Physiological stress is mainly induced by breaking the original physiological balance of the body (for example, body temperature, pain). Commonly used paradigms include extremity cold compression technique and elbow and wrist cold compression technique. Psychological stress is induced by creating stress situations with two key factors of social evaluative threat and uncontrollability, and the inducing paradigms include Tellier social stress assessment task and Montreal brain imaging stress task. In addition, there are also studies using complex stressors dominated by both physical and psychological factors, such as social assessment and cold pressure techniques.

2.2. Emotion Regulation

Emotion regulation has been studied for a long time, but the definition of emotion regulation has been controversial because of its late emergence as an independent research field and its close relationship with many psychological concepts in other fields. Considering that the object of emotion regulation research is emotion, researchers have been working to define emotion regulation by clarifying the relationship between the two. There are two main theoretical views in the early stage: the two-factor view and the single-factor view. Scholars regard emotion and emotion regulation as two stages of different processes. Emotion occurs first, and emotion regulation occurs after emotion is fully stimulated. This view clearly distinguishes the process of emotion production from the process of emotion regulation. However, it is hard for us to imagine that our emotional experience and emotional regulation in our daily life are separate two-stage processes [3]. Therefore, based on criticizing this view, scholars have put forward the view of single factor. They believe that emotion generation and emotion regulation belong to different aspects of a process, rather than two separate phenomena. Both influence each other in all stages of their occurrence, action and extinction, and show consistency in time course. Regulation occurs at any time during the emotional process and plays a role in the whole process of emotional production and expression until extinction. Emotion regulation runs through all levels and stages of the process of emotion generation, and emotion generation and emotion regulation are an integrated process.

2.3. Cognitive Flexibility

Executive function refers to the ability of individuals to coordinate the activities of multiple cognitive subsystems dynamically and flexibly in the process of completing tasks. The executive function has three independent sub-components: inhibit, refresh, and convert. Among them, conversion is also called cognitive flexibility. Cognitive flexibility is the ability of humans to adapt cognitive processing strategies to face new and unexpected conditions in the environment, such as multitasking and finding novel, adaptable solutions to changing needs. Cognitive flexibility involves three important conceptual characteristics: first, cognitive flexibility is a capacity that may imply a learning process, that is, cognitive flexibility can be acquired through experience; second, cognitive flexibility involves the adaptation of cognitive processing strategies; Finally, adjustments will be made to the new environment or changes to the new task after a person has performed the task for some time.

3. THEORIES OF STRESS, PSYCHOLOGICAL FLEXIBILITY AND COGNITIVE EMOTION REGULATION

3.1. Physiological Hypothesis that Stress Affects Cognitive Flexibility

Cognitive control has been associated with activation of the dorsolateral and ventrolateral prefrontal cortex (DLPFC and VLPFC), anterior cingulate cortex (ACC), superior and inferior parietal lobes (SPL and IPL), precuneus, and intraparietal sulcus. The dorsolateral cortex is a continuously activated

region in cognitive control tasks. Animal studies have shown that the prefrontal cortex (PFC) is susceptible to both acute and chronic stress. The interaction of receptors located in the hippocampus and prefrontal cortex with corticosteroid hormones during the HPA axis stress response is an important factor in stress-related differences in cognitive performance. Stress affects cognitive control function by affecting the structural and functional plasticity of PFC. Cognitive control has three main components including working memory, inhibitory control, and cognitive flexibility. Because the most important aspect of cognitive function is cognitive flexibility, in recent years, there have been many studies on the impact of stress on cognitive flexibility, but the results are inconsistent, some studies show that stress will damage cognitive flexibility, while others show that stress will play a role in promoting it [4].

3.2. Emotion Regulation Process Model

Emotion regulation was initially considered by researchers as a process in which a person can express and control the emotions he experiences when he is affected by emotional events. The core idea of this statement is that "because emotion itself is a multi-stage process that changes over time, changes in emotional dynamics should be involved in the process of emotion regulation". The early modality model of emotion embodies this view well, which highly abstracts and simplifies the process of emotion regulation into a dynamic sequence: situation-attention-evaluation-response. The conceptual framework clearly points out that the generation of emotion is a series of circular processes, and the potential target of emotion regulation will exist in each process. On the basis of the emotive modality model, some researchers have proposed the emotion regulation process model, which focuses on the cycle of the emotion generation process. They believe that emotion regulation will show periodic changes over time, and that emotion regulation can act on the whole emotion generation process, that is, each stage of emotion generation can be the object of emotion regulation. According to the affected stage, they proposed several emotion regulation strategies, emphasizing that people can regulate their emotions at five key points.

3.3. Cognitive Control Model of Emotion Regulation Flexibility

Based on the theory of flexibility of emotion regulation proposed by some scholars, some scholars have proposed a cognitive control framework model of flexibility of emotion regulation. Previous researchers believe that cognitive control describes a series of higher-order cognitive processes and abilities, which allow goal-directed and control individuals to adjust their appropriate responses in different situations. In the field of cognitive control, many definitions and sub-components of executive function have been proposed, and some scholars have integrated these views into their theoretical frameworks. Three related but partially separable cognitive controls were identified: working memory, cognitive flexibility, and inhibitory control [5]. In recent years, some scholars have perfected the concept of executive function, including the control functions of inhibiting dominant response, switching mental sets, monitoring and regulating performance, updating task requirements, goal maintenance, planning, working memory and cognitive flexibility. Conceptually, there is a significant overlap between successful emotion regulation and executive functioning, as both can be interpreted as a form of goal-oriented regulatory activity in changing contexts. Neuroimaging evidence is also consistent with the conceptual overlap hypothesis. Previous studies have shown that both executive function and emotion regulation involve the prefrontal and parietal cortex. Considering that there is still a lack of systematic review or meta-analysis on the relationship between executive function and emotion regulation, some scholars have discussed the relationship between executive function and emotion regulation from three aspects of inhibition, renewal and transfer. The three components of executive function and the dynamic flexibility of emotion regulation are integrated into this theoretical framework to analyze the relationship between different components of executive function and emotion regulation.

4. EFFECTS OF STRESS, MENTAL FLEXIBILITY, COGNITIVE EMOTION REGULATION AND DEPRESSION

4.1. Integration of Ecological Civilization and Sustainable Development Education

Mental flexibility includes six dimensions, and the research on mental flexibility mainly focuses on two dimensions of experiential avoidance and cognitive fusion, and then deduces mental flexibility in reverse. Experiential avoidance is related to negative emotions such as anxiety and depression. If individuals tend to adopt experiential avoidance at the cognitive level, they will have difficulty in emotional regulation, while accepting their emotional state and talking about it openly can reduce the difficulty in emotional regulation. The research on adolescent alexithymia and emotion regulation shows that experiential avoidance is closely related to emotion regulation, and experiential avoidance plays a mediating role in the relationship between alexithymia and emotion regulation. Mental flexibility is a dynamic adaptive process that matches the situation. Individuals with high level of mental flexibility have low level of cognitive integration, low frequency of experiential avoidance and high degree of acceptance. When evaluating the situation and emotional reaction after unexpected events, they will less blame themselves for adverse events and less use non-adaptive strategies, such as blaming themselves and others.

4.2. The influence of stress perception, psychological flexibility and depression

Negative emotions such as depression are not necessarily caused by stress. Studies have shown that low mental flexibility can easily lead to depression, and mental flexibility is one of the important factors affecting depression. There is a significant negative correlation between mental flexibility and depression, and mental flexibility has a significant predictive effect on depressive personality, which can establish a good model between them. Mental flexibility can effectively alleviate individual depression, and it is an important psychological protective factor to maintain individual normal social function. Experiential avoidance and cognitive fusion are the mediating factors of depression and anxiety. Experiential avoidance exacerbates depression in migraine patients. There were significant correlations between adults' perception of stress and experiential avoidance and cognitive fusion. The existing system model theory expounds the influence of individual external factors and internal factors (cognitive tendency, volition, etc.) On resilience. Individual interpretation and perception of stressful events, that is, stress perception (cognitive tendency), as an internal factor, will have a greater impact on resilience. Resilience factors refer to the ability to actively recover from adversity and cope with stressful events in life. An underlying, evidence-based model of these abilities is the mental flexibility model, which is an important psychological resilience factor for mental health problems. Therefore, it can be inferred that stress perception will have an impact on psychological flexibility, and then affect depression.

4.3. The Influence of Stress Perception, Cognitive Emotion Regulation and Depression

Studies have shown that cognitive emotion regulation has a significant predictive effect on depression. Suppressing the expression of emotion will affect the individual's ability and vision of life, and eventually deteriorate into depression. Adaptive cognitive emotion regulation is significantly negatively correlated with depression, while non-adaptive cognitive emotion regulation is significantly positively correlated with depression. Cognitive emotion regulation plays a role as a mediating variable in the process of emotional expression conflict affecting depression. The cognitive theory of stress points out the importance of cognitive process. The generation of stress is mainly determined by the individual's evaluation of the situation and their own coping resources. The change of negative emotions may not be directly attributed to stress, and there are other variables. Cognitive emotion regulation is a cognitive process of monitoring, evaluation, and modification, so it can be

inferred that stress perception will have an impact on depression through the mediation of cognitive emotion regulation.

5. CONCLUSION

There is a close interaction among stress, emotion regulation and cognitive flexibility. Stress not only directly affects the individual's physiological and psychological state, but also may further shape the individual's ability to adapt to the environment by affecting the way of emotion regulation and cognitive flexibility. Emotion regulation is an important regulatory mechanism for individuals in the face of stress, and its flexibility plays a key role in determining emotional experience and behavioral responses, while cognitive flexibility affects the ability of individuals to adjust their thinking patterns and problem-solving strategies in stressful situations. Future studies can further explore the specific mechanisms of different types of stress on emotion regulation and cognitive flexibility, and reveal their physiological basis in combination with neuroscience methods, so as to understand the process and mechanism of individual psychological regulation more comprehensively.

REFERENCES

- [1] Rademacher L, Kraft D, Eckart C, et al: Individual differences in resilience to stress are associated with affective flexibility, *Psychological Research*, Vol. 87 (2023) No. 6: 1862-1879.
- [2] Bernstein E E, LeBlanc N J, Bentley K H, et al: A single-session workshop to enhance emotional awareness and emotion regulation for graduate students: A pilot study, *Cognitive and Behavioral Practice*, Vol. 28 (2021) No. 3: 393-409.
- [3] Elkjær E, Mikkelsen M B, O'Toole M S: Emotion regulation patterns: Capturing variability and flexibility in emotion regulation in an experience sampling study, *Scandinavian Journal of Psychology*, Vol. 63 (2022) No. 4: 297-307.
- [4] Wu C W, Chen W W, Jen C H: Emotional intelligence and cognitive flexibility in the relationship between parenting and subjective well-being, *Journal of Adult Development*, Vol. 28 (2021) No. 2: 106-115.
- [5] Dion-Albert L, Dudek K A, Russo S J, et al: Neurovascular adaptations modulating cognition, mood, and stress responses, *Trends in Neurosciences*, Vol. 46 (2023) No. 4: 276-292.