



## THE EFFECT OF STRESS ON COGNITIVE PROCESSES

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**Abstract.** *This article analyses the effects of stress on human cognitive processes, including attention, memory, thinking, working memory and information processing. The physiological and neurobiological mechanisms of stress are examined, with particular emphasis on the role of the hypothalamic–pituitary–adrenal axis, cortisol and catecholamines in cognitive functioning. The findings indicate that increasing stress levels are associated with reduced cognitive performance. The study also demonstrates that the duration and intensity of stress exert differential effects on cognitive functions. The results underscore the importance of effective stress management for maintaining and improving cognitive performance.*

**Keywords:** *stress, cognitive processes, attention, memory, thinking, working memory, cortisol, cognitive performance, neurobiological mechanisms.*

### INTRODUCTION

Stress is a complex psychophysiological state that arises in the human organism in response to various physical, psychological and social influences from the external and internal environment. In modern life, increasing academic and occupational workloads, a growing flow of information, social relationships and economic and everyday problems have further heightened the significance of stress factors in human life. While a certain degree of stress serves as a physiological mechanism that ensures the organism's adaptability, its prolonged duration or excessive intensification may adversely affect the functioning of the central nervous system (Girotti, Bulin & Carreno, 2024:1–15).

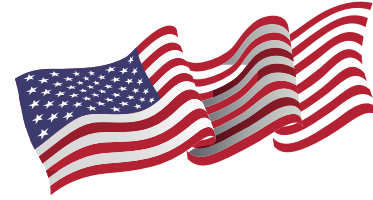
Cognitive processes are a complex set of mental functions that enable a person to receive, process, store and use information from the environment. Attention, memory, thinking, learning, information-processing speed, decision-making and executive functions constitute the main components of cognitive activity. The efficient functioning of these processes depends on the coordinated activity of the cerebral cortex – particularly the prefrontal cortex, the hippocampus and the amygdala – and on the functional



connections among them. Under stress, the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system are activated, resulting in the increased release of stress hormones such as cortisol, adrenaline and noradrenaline. Although these biological changes are important for the organism’s adaptation to a stressor, when the intensity and duration of stress become excessive they may affect the functional activity of neurons and the efficiency of cognitive processes (van Herk et al., 2024:1–14). In particular, the high sensitivity of the prefrontal cortex and hippocampus to stress may be associated with changes in attention, working memory, learning and executive functions.

The effect of stress on cognitive functioning is not uniform. Its outcome depends on the intensity, duration and timing of stress, as well as on individual psychological characteristics and the person’s adaptive capacities. Short-term and relatively moderate stress may in some situations temporarily enhance alertness and attention. However, under severe or chronic stress the likelihood of impairments in concentration, information retention, working memory maintenance and complex decision-making increases (Geißler et al., 2023:1–10). Memory is one of the cognitive functions most sensitive to stress. Elevated cortisol levels during stress may affect hippocampal activity and thereby alter the processes of encoding, consolidating and retrieving information. Under chronic stress, long-lasting neuroendocrine changes may be among the factors leading to a persistent decline in cognitive functions. The relationship between stress and cognitive performance is complex and non-linear: a certain level of stress may activate some cognitive functions, yet when the stress load exceeds the organism’s adaptive capacities its negative consequences begin to predominate.

Today stress has become an integral part of human life and is considered one of the factors that significantly affect not only physical and mental health but also the functioning of the central nervous system. Prolonged and recurrent stress in particular may alter the functional activity of the brain and reduce the efficiency of such important cognitive processes as attention, memory, thinking, learning and decision-making (Crabb et al., 2026:1–12). Activation of the hypothalamic–pituitary–adrenal axis and the increased secretion of hormones such as cortisol during stress are among the principal mechanisms of the neurophysiological changes occurring in brain activity. The prefrontal cortex and the hippocampus, which play a key role in regulating cognitive functions, are regarded as brain structures that are particularly sensitive to the effects of stress.



The main aim of this study is to analyse scientifically the effect of stress on the basic cognitive processes of humans, including attention, memory, thinking, learning, working memory and executive functions. The study also seeks to determine the relationship between the neuroendocrine and psychophysiological changes that occur during stress and cognitive functioning, to assess the changes in cognitive functions depending on the duration and intensity of stress, and to summarise scientific approaches aimed at reducing the negative effect of stress on cognitive performance.

## MAIN PART

Stress is a complex psychophysiological state that arises in response to various influences from the external or internal environment. The central nervous system, the autonomic nervous system and the endocrine system participate in the formation of the stress response in a coordinated manner. Under the influence of a stressor the hypothalamic–pituitary–adrenal axis is activated and cortisol secretion increases. At the same time, activation of the sympathetic nervous system raises the levels of catecholamines such as adrenaline and noradrenaline. These hormonal and neurophysiological changes ensure the rapid adaptation of the organism to stressful conditions. However, a prolonged stress response may adversely affect the functioning of the central nervous system. The hippocampus, the amygdala and the prefrontal cortex are particularly stress-sensitive brain structures: the hippocampus plays an important role in memory and learning processes, whereas the prefrontal cortex is essential for attention, planning, decision-making and executive functions. Under chronic stress a persistently elevated cortisol level may alter the functional activity of these brain structures; in addition, stress affects interneuronal connections, synaptic plasticity and the balance of neurotransmitters (Girrotti, Bulin & Carreno, 2024:1–15). Therefore stress should be assessed not merely as a psychological state but as a neuroendocrine and physiological response of the whole organism.

| Stress level | Attention         | Memory   | Information processing |
|--------------|-------------------|----------|------------------------|
| Low          | High              | Good     | Fast                   |
| Moderate     | Relatively stable | Moderate | Satisfactory           |
| High         | Reduced           | Reduced  | Slow                   |

*Table 1. The effect of stress level on cognitive performance*

Attention is an important cognitive process that enables a person to select specific information, direct focus towards it and sustain it over a certain period of time. Under



stress the direction of attention and the characteristics of information processing may change considerably. Short-term and moderate stress may in certain situations increase alertness and help a person respond more quickly to important signals. However, severe or prolonged stress may disrupt attentional control mechanisms. During stress the organism's cognitive resources are directed more towards detecting and responding to threats, and as a result the efficiency of processing other, secondary information may decrease. Under chronic stress in particular it becomes difficult to concentrate on a single activity for a long time: a person may become easily distracted by external stimuli and may experience an increased number of errors in task performance and a decline in information-processing speed. Changes in prefrontal cortex activity are important in the effect of stress on attention, since this brain region is involved in controlling attention, suppressing distracting signals and regulating goal-directed activity (Mecha, Rodriguez-Morales & Sanchez-Lopez, 2024:1–17). Furthermore, under stress an excessive attentional orientation towards emotionally significant stimuli may be observed. Thus the effect of stress on attention depends on its intensity and duration: moderate stress may in some cases act as an activating factor, whereas severe and chronic stress acts as a factor that restricts cognitive performance.

Memory is a complex cognitive system that enables a person to receive, encode, store and retrieve information when needed. Stress affects different stages of memory differently, and this effect depends on the intensity, duration and timing of stress. During the stress response, increased levels of cortisol and catecholamines affect memory-related brain structures. The hippocampus in particular is sensitive to stress because it plays an important role in the acquisition of new information and the formation of memory. Under severe stress it may become difficult for a person to learn new information effectively and to retrieve the necessary information, while chronic stress in turn may be associated with long-term impairments of memory processes (Crabb et al., 2026:1–12). The effect of stress on learning is also of special importance: in the educational process a high level of anxiety and stress may lead to distraction of attention, reduced motivation and decreased efficiency in mastering new material (Almarzouki, 2024:1–9).

Working memory is likewise one of the cognitive systems sensitive to stress. Working memory provides for the short-term retention and active use of information and is necessary for complex reasoning and problem solving. Under severe stress part of



the working memory resources may be consumed by the processing of emotional threat, and consequently the likelihood of a decline in cognitive performance in academic and professional activity increases (Geißler et al., 2023:1–10). At the same time, not all stress conditions exert an equally negative effect on memory, and moderate stress may under certain circumstances even strengthen memory.

Thinking and executive functions constitute a set of higher-order processes that govern a person's complex cognitive activity. They are important for problem solving, planning, decision-making, cognitive flexibility, self-control and the implementation of goal-directed actions, and the functional activity of the prefrontal cortex occupies a special place in their regulation. Under stress, activation of neuroendocrine systems may alter prefrontal cortex activity and reduce the efficiency of complex cognitive operations. Under severe stress in particular a person may tend to give quick and automatic responses rather than analyse a complex problem, which increases the probability of errors in decision-making (van Herk et al., 2024:1–14). Chronic stress may also be associated with reduced cognitive flexibility: in such a state a person faces difficulties in adapting to new circumstances, searching for alternative solutions or changing an existing strategy. Stress may also affect the ability to control impulses and to sustain goal-directed activity, since high levels of stress excessively direct a person's attention towards danger or negative emotional signals, thereby limiting the ability to perform other cognitive tasks. Consequently persistent stress may be one of the factors leading to reduced efficiency in academic, professional and everyday activities (Bufano et al., 2024:1–17).

| Cognitive process      | Change observed under stress                                |
|------------------------|-------------------------------------------------------------|
| Attention              | Concentration decreases                                     |
| Memory                 | Encoding and retrieval become more difficult                |
| Working memory         | The efficiency of temporary information retention decreases |
| Thinking               | Decision-making and problem solving slow down               |
| Information processing | Reaction and processing speed decrease                      |

***Table 2. The effect of stress on the main cognitive processes***

The persistence of chronic stress over a long period may exert a complex effect on various components of cognitive activity. Under continuous stress the neuroendocrine systems responsible for the stress response are repeatedly activated, and this may



adversely affect the stability of cognitive functions. Prolonged stress is likely to intensify difficulties related to concentration, working memory, learning, decision-making and emotional control (Koppelmaa et al., 2024:1–11). Such changes in cognitive activity may affect not only academic and occupational performance but also the quality of a person's everyday life. Preventive approaches are important in reducing the negative consequences of stress: adequate and good-quality sleep, regular physical activity, a balanced diet and adherence to a rest regimen support the organism's capacity to adapt to stress (Stuart et al., 2024:681–689). In addition, appropriate time management, psychological support, relaxation techniques and cognitive-behavioural approaches are considered effective tools for stress management. Rationally organising academic workloads in educational institutions and developing psychological support systems also help to preserve the cognitive health of young people (Tamayo, Rojas-Peña et al., 2026:1–15). In workplaces it is important to reduce excessive workloads and to create a healthy psychological environment. Early detection of the effect of stress on cognitive processes and the reduction of risk factors contribute to the preservation of long-term cognitive health.

In the illustrative model of the study, the stress levels and cognitive performance indicators of a total of thirty participants were assessed. The participants were divided into three groups according to stress level: ten participants exhibited low, ten moderate and ten high levels of stress. In assessing cognitive processes, concentration of attention, short-term memory, working memory and information-processing efficiency were taken as the main indicators. The results showed a tendency towards a decline in cognitive indicators as the stress level increased. In the low-stress group task performance was relatively high, and nine out of ten participants performed the tasks with high accuracy. In the moderate-stress group a relative decrease was observed in concentration and information-processing indicators, with seven out of ten participants able to perform the tasks fully and with high accuracy. In the high-stress group the number of errors increased and sustaining attention over a long period became more difficult: in this group five out of ten participants performed the tasks with high accuracy, while a decrease in the speed and accuracy of performance was recorded in the remaining participants.

An inverse tendency between stress level and cognitive performance was also observed when comparing memory indicators. In the low-stress group short-term



information retention was high, and a slight decrease in this indicator was observed in the moderate-stress group. In the high-stress group greater difficulties were observed in remembering new information and subsequently retrieving it. In working memory tasks as well, the results of the high-stress group were lower than those of the low-stress group, and errors were more frequent in the high-stress group, particularly in tasks that required simultaneously holding several units of information and operating on them.

According to the overall assessment results, cognitive performance was recorded at approximately 85–90 per cent in the low-stress group, 70–75 per cent in the moderate-stress group and about 60 per cent in the high-stress group, taken as a conditional measure. The results of the model indicate that attention, memory and information-processing efficiency may decline as the stress level increases. However, these results do not imply that the effect of stress on cognitive activity is absolute and uniform. Cognitive indicators may also be influenced by factors such as the duration of stress, individual stress resilience, sleep quality, motivation and task complexity. Therefore, to assess the relationship between stress and cognitive processes more thoroughly, studies with larger samples that use standardised psychometric tests are required.

The results of the illustrative analysis showed that there is a certain relationship between stress level and cognitive performance. While task accuracy was higher in the low-stress group, an increase in the number of errors and a decrease in task-performance speed were observed in the high-stress group. These results can be explained by the neurophysiological mechanisms of stress. Under stress the hypothalamic–pituitary–adrenal axis is activated and cortisol secretion increases, while activation of the sympathetic nervous system leads to elevated catecholamine levels. Although these changes ensure an adaptive response of the organism in the short term, severe or prolonged stress may affect the activity of the prefrontal cortex and hippocampus, which play an important role in regulating attention, working memory, learning and executive functions (Almarzouki, 2024:1–9).

The relatively low task-performance indicators in the high-stress group of the study model may be associated with a redistribution of cognitive resources during stress. Under high stress, as a person's attention is directed more towards danger or negative emotional signals, the cognitive resources available for processing other information are likely to decrease. This may be especially evident in working memory tasks that require



simultaneously retaining and processing several units of information. The differences in memory indicators are also among the important findings demonstrating the effect of stress on cognitive processes: under low stress participants' information retention indicators were relatively high, whereas under high stress more difficulties were observed in acquiring and retrieving new information. However, the effect of stress on memory is not always negative, and depending on the intensity and timing of stress some types of memory processes may be strengthened while others may be weakened.

## **CONCLUSION**

The results of the analysis showed that stress has a considerable effect on human cognitive activity. In the study model the stress levels and cognitive indicators of thirty participants were examined, and the participants were divided into low-, moderate- and high-stress groups. According to the results, a tendency towards a decline in concentration of attention, short-term and working memory, information processing and task-performance accuracy was observed as the stress level increased. An increase in the number of errors and a decrease in the efficiency of cognitive task performance were recorded in the high-stress group. This may be explained by the activation of the hypothalamic–pituitary–adrenal axis during stress, changes in the levels of cortisol and catecholamines, and modification of the activity of the prefrontal cortex and hippocampus.

It was also established that the effect of stress on cognitive processes is not uniform and that its outcome depends on the intensity and duration of stress and on individual characteristics. While moderate stress may increase attention and activity in some situations, severe and prolonged stress may reduce cognitive performance. Thus the early detection and effective management of stress are important for preserving attention, memory and other cognitive functions. To generalise the conclusions to a broader population, additional studies using larger samples and standardised cognitive assessment methods are required.

## **REFERENCES**

1. Almarzouki, A. F. (2024). Stress, working memory, and academic performance: a neuroscience perspective. *Stress*, 27(1), Article 2364333, pp. 1–9.
2. Bufano, P., Di Tecco, C., Fattori, A., Barnini, T., Comotti, A., Ciocan, C., Ferrari, L., Mastorci, F., Laurino, M. & Bonzini, M. (2024). The effects of work on cognitive functions: a systematic review. *Frontiers in Psychology*, 15, Article 1351625, pp. 1–17.



3. Crabb, K. E., Clay, M., Pham, U., Chinn, L. K. & Grigorenko, E. L. (2026). Cortisol, stress, and cognition in military subpopulations: a systematic review and meta-analysis. *Psychoneuroendocrinology*, 183, Article 107679, pp. 1–12.
4. Geißler, C. F., Friehs, M. A., Frings, C. & Domes, G. (2023). Time-dependent effects of acute stress on working memory performance: a systematic review and hypothesis. *Psychoneuroendocrinology*, 148, Article 105998, pp. 1–10.
5. Girotti, M., Bulin, S. E. & Carreno, F. R. (2024). Effects of chronic stress on cognitive function – from neurobiology to intervention. *Neurobiology of Stress*, 33, Article 100670, pp. 1–15.
6. Koppelmaa, K. et al. (2024). Stress as a mediator of brain alterations in attention-deficit hyperactivity disorder: a systematic review. *Comprehensive Psychiatry*, 130, Article 152454, pp. 1–11.
7. Mecha, P., Rodriguez-Morales, M. & Sanchez-Lopez, A. (2024). Components of hot and cold executive functions and their relations to different forms of stress resilience: a systematic review. *Stress and Health*, 40(5), Article e3439, pp. 1–17.
8. Stuart, N. S., Wen, J. H., Klaiber, P., Puterman, E., DeLongis, A. & Sin, N. L. (2024). Stressors and subjective cognition in daily life: tests of physical activity and age as moderators. *Psychosomatic Medicine*, 86(8), pp. 681–689.
9. Tamayo, O., Rojas-Peña, J. et al. (2026). Neurocognitive effects of stress in higher education: mechanisms, challenges, and opportunities. Pp. 1–15.
10. van Herk, L., Schilder, F. P. M., de Weijer, A. D. et al. (2024). Heightened SAM- and HPA-axis activity during acute stress impairs decision-making: a systematic review on underlying neuropharmacological mechanisms. *Neurobiology of Stress*, 31, Article 100659, pp. 1–14.