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# Emotion Regulation, the Function of Stress Hormones & Digital Technologies

**Vasiliki Bravou, Anna Maria Stella Driga, Athanasios Drigas**

Net Media Lab Mind - Brain R&D, I.I.T. - N.C.S.R. "Demokritos", Athens, Greece

#Corresponding author
Vasiliki Bravou
Net Media Lab Mind - Brain R&D, I.I.T. - N.C.S.R. "Demokritos",
Athens, Greece
E-mail address: vbravou@iit.demokritos.gr

**Abstract**. Emotion control in stressful situations is an important aspect of mental health. On the other hand, acute stress, affects the prefrontal cortex control, probably resulting in a loss of emotion regulation abilities. To lessen the threat, the stress response activates a number of defensive systems, including hormone messenger communication. In this article we are going to examine the present literature in relation to emotion control via understanding the function of the primary stress hormone, cortisol, and that of the catecholamines, epinephrine and norepinephrine. We have also presented and underlined the role of ICTs, web and mobile applications, AI & STEM tools, serious games, e-learning, tele-education services, etc., in the support and improvement procedures for achieving emotional self-control and regulation of the stress hormones.

**Keywords**. emotion regulation, stress, hormones, cortisol, catecholamines, epinephrine, norepinephrine, digital technologies, web applications, mobile applications, ICTs, AI, STEM, serious games.

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## 1. Introduction

Emotion control in stressful situations is an important aspect of mental health. On the other hand, acute stress, affects the prefrontal cortex control, probably resulting in a loss of emotion regulation abilities [1]. By definition, a stressor is an occurrence that creates a real or potential threat to one's welfare. To lessen the threat, the stress response activates a number of defensive systems, including hormone messenger communication. Everyday events are considered as stressors, in relation to the person's threat value and coping resources estimations. This is the idea of psychological stress, in which one's physiological response to an incident can be altered by prior experience [2], [3]. A hormone is a signaling molecule that is released by a gland and travels through the blood circulation to a distant target tissue to which is acts.

In this article we are going to examine the present literature in relation to emotion control via understanding the function of the primary stress hormone, cortisol, and that of the catecholamines, epinephrine and norepinephrine, which are connected with severe stress situations. Stress can impact other hormones, such as the sex steroids, but they aren't generally considered as stress hormones [4]. Additionally, we are going to present the role of digital technologies in the support and improvement of emotional self-control and regulation of the stress hormones.

## 2. Cortisol

Cortisol, which is considered as the primordial hormone of stress, is a glucocorticoid and the primary steroid hormone secreted by the adrenal gland's cortex. It was first discovered to be important for glucose metabolism, but it was later discovered to have an impact on all physiological functions and to be necessary for overall health. It fulfills normal homeostatic activities and controls the stress response, via the glucocorticoid receptors [3], [5]. Cortisol affects all peripheral tissues, but it also passes the blood–brain barrier, allowing it to adjust the brain behavior during severe stress situations [6]. Cortisol levels that are too low, as in Addison's disease, or hypercortisolism, as in Cushing's syndrome, have a wide range of physiological implications, including cognitive and emotional disorders [7]. The delayed increase in cortisol in response to a stressor has been connected to effects that protect the mood and the ability to regulate emotions [1].

When the system must shift from normal homeostasis to a stress mode of action, the nature of cortisol release and feedback also changes. In normal conditions, the paraventricular nucleus stimulates the pituitary gland using corticotropin releasing factor as the main peptide hormone. Arginine vasopressin and corticotropin releasing factor are released by the paraventricular nucleus during times of stress, and this combination stimulates about three times more adrenocorticotropin release by the pituitary, which results in a very high release of cortisol into blood circulation from the adrenal gland. Because corticotropin releasing factor- arginine vasopressin neurons respond less to feedback than only corticotropin releasing factor fibers, increased cortisol release is accompanied by decreased negative feedback sensitivity during stress. This switch from a normal homeostatic mode of regulation to a stress level of activity is helpful in dealing with short-term crises, but it may come at a cost in the form of negative health consequences if used frequently or over an extended period of time [3], [5].

## 3. Catecholamines

Dopamine, adrenaline (epinephrine), and noradrenaline (norepinephrine) are catecholamines that are present in specific locations in tissues. Epinephrine is predominantly found in the adrenal medulla, and after being released into the bloodstream, it operates predominantly as a hormone on distant target organs. Norepinephrine acts as a neurotransmitter locally on effector cells of vascular smooth muscle, adipose tissue, liver, heart, and brain. It is found mostly in sympathetic nerves of the peripheral and central nervous system. Dopamine has two functions: it is a precursor to noradrenaline and it is thought to be a neurotransmitter in the parts of the brain involved in motor activity co-coordination, where it is located [8]. When faced with a serious threat, like during moments of stress, the body switches to an emergency mode of action known as the "fight-or- flight" response, which prepares us to fight an attacker or run to safety [9]. During “fight-or-flight” situations, the sympathetic nervous system becomes

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highly active, resulting in enhanced norepinephrine release from sympathetic nerve endings and epinephrine secretion from the adrenal gland medulla [10]. The limbic system, which is involved in the regulation of emotions and cognition, is innervated by norepinephrine projections from the locus coeruleus [11].

## 4. Digital Technologies

The society is passing through the Information Age Era. E-services and e-tools are available in everyday life of each individual, as well as in the practices, policies and strategies of educational activities in all levels of education. As a consequence, the individual, as well as the trainer and the teacher have many opportunities available to use ICTs in various forms, in order to help students improve themselves in the ability of understanding, recognizing and regulating their emotions. Through this action it is possible to regulate and keep their stress hormones in control. The e-services and e-tools are available in various forms such as information and communication technologies (ICTs), web and mobile applications, AI & STEM tools, serious games, e-learning, tele-education services, etc.

ICTs can be used in all levels of education, general and special, as a tool for diagnosis and intervention and can be used to sooth stress hormones and improve emotional regulation [12,13,48-52].

Mobile applications and technologies are very promising tools for intervening within education and can support emotional regulation in wide scales of population of students and common citizens [14-18].

Artificial Intelligence (AI) and STEM are powerful tools for intervening and improving various domains of education, as well as in the assessment and improvement of emotional abilities, regulation and intelligence [19-22].

Serious games are a new trend in educating students and common citizens in various themes of digital skills and a range of scientific domain, as well as for personal development and emotional regulation and intelligence [23-25].

E-learning and tele-education services can be used in various domains of educating students in general and special education, but also can be used for educating and training in emotional recognition, regulation and intelligence [26, 27].

Digital technologies can support various educational procedures [60-65] more effectively from an emotional perspective. Digital technologies in various forms also, can be used and be combined with emotional intelligence techniques, metacognitive strategies, consciousness practices, executive function training, in order to raise awareness of all individuals and more specifically the awareness on emotional self-regulation and intelligence [28–33, 55-57].

Concluding, we should underline the role of all forms of ICTs, like web and mobile applications, AI, VR & STEM tools, serious games, e-learning and tele-education services, etc., [56-59, 71-73], in the service of improving the stress regulation abilities and in training and improving the emotional intelligence knowledge, consciousness and awareness of emotions, stress and hormones.

## 5. Conclusion – Discussion

In this study we have analyzed the role of knowledge for the regulation of emotions along with the regulation of the related stress hormones. We presented studies that focus into the subject of emotion regulation via understanding the function of the stress hormones and there is definitely room for further research, since, in the aftermath of stressful events, there is a great possibility of re-establishing emotional stability by regulating these hormones.

Additionally, we have presented and underlined the role of ICTs, web and mobile applications, AI & STEM tools, serious games, e-learning and tele-education services, etc., in the support and improvement procedures of the individuals for emotional self-control and stress hormones regulation.

The need for knowledge about the relation of stress hormones and emotional disturbances is somehow mandatory in the education society, as well as in the everyday life of people, both in their personal, as well as in their professional life, as it has been analyzed in various studies. Drigas and Sideraki (2021), state that emotional intelligence is a term, which includes various abilities and skills,

which enable a person to perceive and handle emotional situations both his own and those of other individuals with the aim of his social and personal development. More specifically, the first part of this work presents an analysis of the role of emotional intelligence in the individual [34].

Drigas and Mitsea (2021), examine the interaction between metacognition and stress response. Specifically, the main purpose of this study is to trace the interaction between metacognition, sympathetic-parasympathetic nervous system and the basic stress-related hormones/neurotransmitters. To achieve this aim, the research seeks to address the following questions: Can metacognition regulate the stress-related hormones and the sympathetic nervous system hyperactivity? How can it contribute to the regulation of uncontrollable stress? What is the role of executive functions? Can metacognition stop the cells and neurons from degeneration and the brain from shrinking? The evidence supports the hypothesis that there is a deep relationship between metacognition, stress-related hormones and autonomic nervous system. Therefore, the above finding paves the way for the design of new stress management strategies, which could be implemented in family, in school and in workplace [35].

Zavitsanou and Drigas (2021), state that eating habits are crucial for human health. People around the world have health problems due to their diet. Malnutrition combined with a lack of essential nutrients and obesity with overconsumption of sugar is significant problems. For the most part, the human daily diet should include foods rich in vitamins, fatty acids, minerals, and trace elements. On the other hand, the consumption of substances such as sugar and trans fats causes negative effects on the human body. Fish, vegetables, and nuts are some of the foods that contributes to good health. Also, specific foods help the hormones of happiness to increase in our body. This has the effect of reducing stress and increasing happiness [36].

Although, stress is a growing problem affecting many people, it is important to learn how to deal with it [37]. In this case, prevention and management of work-related stress and related mental problems are a great challenge and mobile applications are a promise to integrate prevention strategies too [38]. Chronic stress presents a growing pervasive burden in health care, but mobile applications have the potential to deliver stress management strategies as well as to lessen stress in educational procedures. [53-55]. The most common strategies are metacognition, mindfulness and meditation [39, 66-70]. Cultivation of empathy and development of emotional and social skills can reduce stress hormones and improve emotional intelligence and social abilities for common and social sensitive social groups and they can be cultivated by the usage o ICTs, Music, Metacognition, multisensory & attention training etc. [40-46]. Stress and related hormones are also within the range of causes of ADHD and should be soothed and controlled [47].

Concluding, we underline the role of the knowledge for the relationship between the hormones of stress and the emotional regulations on one hand and on the other hand the importance of digital technologies in order to assimilate this important knowledge into everyday life practices, especially in education domain.

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