Emotional Health, from Science to Whole Being

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By

Carol Dillon

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This book is dedicated to my husband, Pablo; my son, Ian Luka;
and my daughter, Katherina Luna, who are always by my side.

Emotions rule our everyday lives and so it is crucial to learn how to cope with them. Discovering ourselves and understanding our biological rhythms, as well as the environment that surrounds us, can help us to handle emotions. This book intends to facilitate the acquisition of skills to deal with emotions positively and productively.

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PREFACE

Both the scientific and social interest in mental health and illness has experienced an outstanding expansion during the last four decades. The continuous appearance of new and safer pharmacological treatments and the application of diverse psychotherapies specifically designed to help individuals suffering from mood and anxiety disorders have significantly changed the lives of many patients and their families.

We have gained a better understanding of the neural system functioning by studying, among other aspects, the mechanisms of action in our medications. Additionally, the development of increasingly accurate technologies has allowed the scientific community to have a deeper knowledge of many of our brain's intrinsic mysteries and functions. At the same time, the impact of mental illnesses on personal, familiar, and social levels is on the rise globally. Severe and long-standing emotional struggles, such as unipolar major depression, bipolar, and anxiety disorders, are steadily increasing and affect millions all over the world. Moreover, depression is the current leading cause of disability and, at its worst, could even lead to suicide.

Dr. Carol Dillon's first book explores the multiple components that sustain our emotional health, including neurons, glial cells, the central and peripheral nervous systems, and relevant anatomical structures and their functions. We will find a variety of scientific definitions and concepts regarding our normal emotions and feelings. Dr. Dillon expertly covers the history of depression and describes the different clinical presentations of the main emotional disturbances, anxiety, and depression, through the analysis of interesting case reports. The inclusion of chapters explaining the close interactions between the environment, nutrition, and lifestyles with our mental health will be greatly appreciated by readers, as these topics are usually ignored by most researchers and specialists in our field. Finally, the most recent pharmacological and psychotherapeutic approaches that help people to deal with these devastating mental illnesses are explained concisely.

This book gently guides the reader toward a broader and holistic understanding of our emotional internal world, with its multiple levels of

interactions with the environment. Dr. Dillon has achieved one of the most difficult challenges in science, which is making concepts that are often only available to a limited number of researchers and clinicians understandable to the general public. In the following pages, she clearly explains the amazing interactions between proteins, cells, inner organs, and systems, and sociocultural and environmental factors in a comprehensive manner but, at the same time, with a very didactic and neat style, and that is not an easy task at all! Congratulations!

Professor Gustavo H. Vazquez, MD, PhD, FRCPC
Department of Psychiatry and Center for Neuroscience Studies
School of Medicine,
Queen's University,
Kingston, Ontario,
Canada

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INTRODUCTORY NOTE

Mental health can be defined by the presence of a bio-psycho-socio-cultural balance. Emotions are an exquisite combination of our past and present experiences and external influences; they can also have an impact on our mental and physical health. When our emotions are not in balance, mental health disorders, such as depression, anxiety, and dysthymia, can occur. Therefore, multiple aspects should be considered when diagnosing and treating mood disorders.

The social and cultural environment, biology (personal and family history), and personality (resiliency ability) are important aspects to consider in a holistic examination. The bio-psycho-socio-cultural approach requires integration between conventional medicine and complementary modalities. This strategy will make us appreciate the body-mind connection and achieve a cure using multiple levels (nutrition, movement, healthy lifestyle, relaxation, proper and effective medication, psychotherapy, etc.).

In this field, it is important to encourage creativity, alertness, and enthusiasm; to stimulate intelligence and ambition; and to increase calmness, receptiveness, and affectivity.

CHAPTER 1

A BRIEF REVIEW OF THE BOOK'S AIMS

Emotional health: from science to the whole being intends to do the following:

- Introduces the concept of emotional health defined through the neurosciences and different medical and psychological approaches.
- Defines neuroscience (biological) concepts and mental health through both a psychiatric perspective (mood and anxiety disorder, DSM IV and DSM-5 classification) and a clinical one by presenting case reports.
- Develops the concept of a bio-psycho-socio-cultural balance.
- Describes the features of nutrition, lifestyle, and physical and cognitive activities, as well as their influence on mental health and emotions.
- Introduces the concepts of planetary health, environmental changes, and epigenetics.
- Develops the concept of holistic medicine and how it can work alongside medical treatments.

Chapter 2. From neurons and glia cells to neurosciences: neuronal systems. Provides a brief review of different cells composing the nervous system, principally neurons (the most specialized cells of the body); glial cells, such as astrocytes (with several functions concerning neurons and synapses); and oligodendrocytes (in charge of myelination process). Describes the principal neurotransmitters (serotonin, noradrenaline, adrenaline, acetylcholine, dopamine, and glutamate) and their functions.

Chapter 3. Neuroanatomy and brain functions. Introduces the nervous system, as well as neuroanatomy and its principal division (central and peripheral nervous system). Describes different brain regions and their functions.

Chapter 4. Emotions and feelings: A neurobiological approach. Defines emotions and examines their differences from feelings. Also, it mentions various theories (the James Lange Theory, 1884; the Cannon-Bard theory, 1927) and authors (Papez, 1937; Damasio, 1994), who have described the mechanism of emotions. Introduces the neuroendocrine system and its relation to emotions and human behaviors. Describes several structures from this system, such as the hypothalamus, the hypophysis, the epiphysis, the thyroid, the parathyroid glands, the thymus, the pancreas, and the adrenal glands.

Chapter 5. A history of depression and a description of different subtypes. Provides a summary of the history of depression by citing different authors and psychiatric and psychological points of view. Lists the most prevalent depressive disorder subtypes (major depressive disorder, dysthymia, subsyndromal depression, major depression associated with bipolar disorder, depression due to medical conditions, and depression in later life).

Chapter 6. Anxiety disorders: A clinical review with case reports. Defines and describes anxiety disorders (panic disorder, agoraphobia, social phobia, specific phobias, generalized anxiety disorder, obsessive-compulsive disorder, post-traumatic stress disorder, acute stress disorder, substance-induced anxiety disorder, and anxiety due to medical conditions). Discusses comorbidities in anxiety disorders and analyzes two case reports of patients with anxiety disorders.

Chapter 7. Mood disorders: A clinical approach with case reports. Describes mood disorders symptoms (depressive symptoms, cognitive symptoms, anxiety, somatic symptoms, lack of energy and will, impairment in daily life activities, and quality of life) and analyzes five different case reports.

Chapter 8. The environment and mental health: The planetary health concept. Describes issues centered on the environment, mental health, and the planetary health concept. It also develops the relationship between planetary health, daily life, and mental wellbeing. Concepts about genetics and epigenetics in psychiatry are reviewed, as well as the importance of personality. Considers the relationship between the environment and a healthy brain (including visual overstimulation and noise pollution). Includes some information about nutrition and the environment, as well as environmental disruption. Analyzes the impact of education in the

information age. Concludes with a discussion of resilience and its importance about current environmental changes.

Chapter 9. Nutrition and a healthy brain. This chapter presents a more detailed description of emotional health and nutrition. Describes the role of carbohydrates, proteins, essential fatty acids, vitamins, and minerals in depression and mental illness. It also focuses on obesity and the effects of the lack of vitamin D. It finishes with a discussion of nutrition and lifestyle factors for the elderly.

Chapter 10. Lifestyle, the brain, and emotions. Summarizes research papers related to different aspects of the activity. Examines the relationship between physical activity and fragility syndrome, and the impact of physical activity on the quality of life of elderly patients with cognitive impairment, depression, and dementia. Describes cognitive stimulation therapy using a research paper developed by the author's research team. Outlines an approach to lifelong aerobic exercise and stress response. Describes the quality of life in depression.

Chapter 11. Psychotherapy, cognitive stimulation, and mindfulness for mood and anxiety disorders. Names and defines several psychotherapies, such as group and interpersonal psychotherapy, psychoanalytic therapy, counseling, psychodynamic psychotherapy, cognitive behavioral therapy, existential therapy, mindfulness, and cognitive stimulation.

Chapter 12. Complementary therapies for mood and anxiety disorders. When considering emotional health as part of a much bigger health problem, complementary therapies, such as yoga and Ayurveda may help us to understand and integrate other issues that would not have been considered or acknowledged with a superficial study. Yoga Instructor, Eugenia Dillon, explains how yoga can be used to manage emotional illnesses. She also explains how the flow of emotions from Ayurveda's complementary therapy is formed of three basic energies or Gunas.

Chapter 13. Pharmacology and treatment for mood and anxiety disorders. Examines the aims of the pharmacological treatment of depressive patients and anxiety disorders. It explains treatment planning, medication, and pharmacotherapy for unipolar and bipolar depression. Lists the major depression treatment guidelines since 2000. Describes first-line treatment by the severity of depression, second-line treatment strategies, and continuation and maintenance treatments.

Overall, throughout the different chapters, the author deals with neurobiology and neurosciences, emotions and mood disorders, environmental health, nutrition, healthy lifestyles, and movement concerning brain functioning and emotions. Moreover, different psychotherapies, as well as medical and pharmacological treatments, and their impact on emotions and mood disorders are also addressed. The presented knowledge is integrated with a holistic approach throughout. Finally, a review of the chapters' conclusions is included.

CHAPTER 2

FROM NEURONS AND GLIA CELLS TO NEUROSCIENCE: NEURONAL SYSTEMS

When thinking about emotions, it is important to remember that the actions that people perform every day, the feelings they experience, and their sensations and perceptions of the internal and external world are all a matter of brain activity that is related to different neuronal connections. Signals are received by sensory receptors (input), transmitted through different neuronal pathways, processed, and externalized (output) through tiny specialized cells called neurons.

Neurons are the most specialized cells in the body and they have the capacity for excitability. This property makes them unique and gives them the power of communicating signals and information through neural networks (see Figure 1; a neuron with all its components: dendrites, soma, axon, and synaptic terminal).

The brain is an interconnected and interrelated organized system. Neurons are its main cell type and they have a principal role in this system. However, other cells collaborate with neurons in different processes. These cells are called neuroglia. Neuroglial cells are formed by microglia and macroglia.

For many years, the function of microglia was unclear. However, today it is known that these cells mediate immune responses in the central nervous system by acting as macrophages; they clear cellular debris and dead neurons from nervous tissue through the process of phagocytosis (cell eating).

Macroglia is formed by astrocytes that help neurons in their connectivity process and the information flow through synapsis. Synapsis is a complex process where a neuron transmits information (generally through chemical signals) to another neuron. This chemical process is mediated by neurotransmitters.

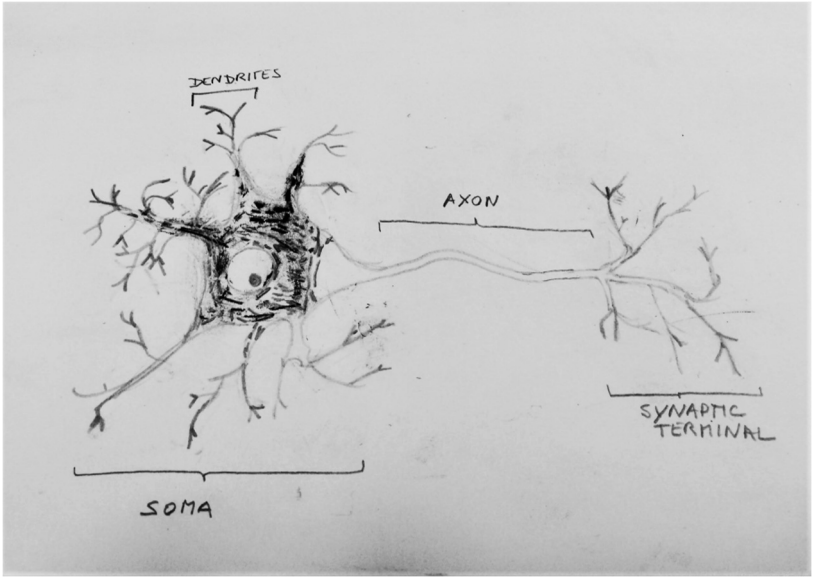

Figure 2.1: A neuron and its different components: dendrites, soma, axon, and the synaptic terminal. Original figure from Katherina Popovich Dillon and Carol Dillon's *Emotional health: from science to the whole being*.

Other remarkable macroglia cells are oligodendrocytes, which are in charge of the myelination process. Myelin is a lipid-rich substance that surrounds neuronal axons, insulates them, and speeds up the electrical signal. The myelination process is important for the development of a mature brain. When myelin is damaged, demyelinating diseases can occur.

Neurotransmitters are substances that can be represented by peptides, amines, amino acids, and esters, among others. Neurotransmitters have different properties and play many roles in brain functioning. Some of the more relevant and known neurotransmitters will be described to introduce the concept of the "neurotransmitter system". Each neurotransmitter can be considered to be a network that acts in distinct parts of the brain playing different roles.

For example, **serotonin** (5-HT), one of the most ancient neurotransmitters, is mostly known for its relation to emotions and impulsivity. This neurotransmitter can be found in different brain areas, such as the raphe nucleus; it extends into the entire forebrain and the spinal cord. Serotonin innervation is present in three anatomical regions: the cerebral cortex, the

neostriatum, and the hippocampus. This neurotransmitter may exist in circulating blood or inside cells. An association between low levels of serotonin (in blood platelets, cerebrospinal fluid, or evidenced through neuroimaging studies, such as PET) and depression has been described. Serotonin is also related to anxiety disorders, obsessive-compulsive disorders (OCD), and post-traumatic stress disorders (PTSD).

Serotonergic projections facilitate nociceptive processing. This means that they are involved in chronic pain. For this reason, many antidepressants, such as selective serotonin reuptake inhibitors (SSRI), are used to treat chronic pain, fibromyalgia, headaches, and pain associated with depression.

Dopamine is another neurotransmitter. It exists at various brain anatomical levels and has diverse functions. It can be found in the midbrain's substantia nigra or the red nucleus. These structures are components of the nigrostriatal network and control extrapyramidal movements. The extrapyramidal system coordinates and processes motor commands at a subconscious level. This means movements are performed without cortical control (without thinking about them). A lack or an imbalance of dopamine can produce diseases, such as Parkinson's or Huntington's.

Dopamine is also associated with the mesolimbic network. This system plays a role in affective disorders and psychosis. Schizophrenia is associated with high levels of dopamine in certain areas of the mesolimbic pathway (the ventral tegmental area and the temporal lobe). The mesolimbic pathway projects into the nucleus accumbens and amygdala. It is involved in motivation, reward, gratification, and pleasure. In schizophrenia, high levels of dopamine in the mesolimbic network are related to positive symptoms, such as hallucinations and delusions (the dopaminergic hypothesis). This pathway also mediates aggression. However, negative symptoms of schizophrenia (apathy, dysexecutive disorders, and affective flattening) are related to low levels of dopamine in mesocortical circuits. This circuit extends to the prefrontal cortex, where it regulates cognitive functions (such as executive functions), emotions, and affectivity.

Dopamine also controls the release of a hormone called prolactin. This hormone plays a role in breastfeeding, priming, and maternal behavior. Priming is an implicit memory that determines later responses to other stimuli.

Dopamine is one of the body's most important neurotransmitters and it is related to the development of chronic pain.

Glutamate, which is better known as glutamic acid, is an excitatory neurotransmitter. It has an important role in synaptic plasticity and it is involved in cognitive functions, especially in the memory domain (learning process). Glutamic acid has a role in synaptogenesis and neural plasticity. It is found in a high number of the brain's synaptic processes.

Last but not least is **acetylcholine**. This important neurotransmitter has different roles and functions. It is important in the pyramidal network that controls conscious movement (cortical). It is involved in the memory process and the autonomous nervous system, particularly the parasympathetic nervous system; besides, it participates in the digestive process. Finally, acetylcholine plays a role in extrapyramidal movements and is balanced by dopamine receptors.

We will conclude with brief descriptions of the most relevant neurotransmitters: **adrenaline** and **noradrenaline**. They are commonly known as responses to stressful events when the sympathetic nervous system is activated. They also participate in fear emotions, as they accelerate the body to avoid harmful situations. The hyperactivation of the sympathetic system is related to anxiety disorders.

After enumerating all of these difficult names of the various neurotransmitters, one could wonder why we need to learn all of this information. What is the purpose of this exercise? The answer might be simple: we need to try to understand the biological process that takes place in our brains.

In this chapter, the cellular aspects of brain functioning were described and some of the principal neurotransmitter networks were reviewed. The next chapter provides a brief overview of the different anatomical regions of the brain and examines the functions that characterize them.

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CHAPTER 3

NEUROANATOMY AND BRAIN FUNCTIONS

Nervous system neuroanatomy

The nervous system controls the functions of the organism together with other systems, such as the endocrine. It is composed of specialized cells (neurons), whose function is to receive sensory stimuli and transmit them to the effector, muscular, or glandular organs. The sensory stimulus, which originates from inside or outside the body, is transmitted and correlated within the nervous system. This system will then generate the efferent coordinated impulses or actions so that the effector organs can act together and harmoniously for the well-being of the individual.

The nervous system is divided into two parts:

- The central nervous system (CNS)
- The peripheral nervous system (PNS)

The nervous system has several important functions:

- Sensitive functions: reception and perception of outside (environment) and inside (body) stimuli through the different sensitive receptors or organs.
- Integrative functions: includes the processes of association, reasoning, and understanding.
- Cognitive functions: memory, language, executive functions, attention, gnosis, visuospatial, and praxis.
- Motor functions: motor response, expression, and behaviors.

The central nervous system

The central nervous system is composed of the encephalon and the spinal cord. In turn, the encephalon is comprised of the brain (telencephalon and diencephalon), the brain stem (composed of the midbrain, bulge, and bulb), and the cerebellum.

Figure 3-2. Human brainstem. Sagittal view. Description: The brainstem is divided rostrocaudally into the midbrain (orange), the metencephalon (green), and the medulla oblongata (blue). Source: Grinberg, LT; Rueb, U; and Heinsen, H (2011) Brainstem: neglected locus in neurodegenerative diseases. Front. Neur. 2:42. DOI: 10.3389/fneur.2011.00042 http://journal.frontiersin.org/article/10.3389/fneur.2011.00042/full. License: Creative Commons Attribution 3.0 Unreported

Figure 3-3. Brain MRI. Sagittal view. Source: Patient NHF (case report 3). Authorized informed consent signed. Patient NHF. Diagnosis: Recurrent major depressive disorder. Mild cognitive impairment is associated with depressive symptoms. The patient was treated in CINEP (Centro Interdisciplinario de Neuropsiquiatria), Buenos Aires, Argentina.

The brain and spinal cord are the main centers where nerve information is correlated and integrated. Both are suspended in cerebrospinal fluid and protected by membranes called meninges and, externally, by bones. The brain weighs 1400 grams, which represents 2% of our total body weight. The spine is formed by 7 cervical vertebrae, 12 thoracic or dorsal vertebrae, and 5 lumbar vertebrae.

The brain is divided into the following sections:

- Telencephalon: composed of the two hemispheres (Right hemisphere -RH- and Left hemisphere -LH-).
- Diencephalon: composed of the hypothalamus, the thalamus, and the epithalamus.

The telencephalon consists of two cerebral hemispheres joined by a mass of white matter called the corpus callosum. Each hemisphere extends from the frontal lobe to the occipital lobe. The hemispheres are separated by a deep slit called the longitudinal fissure. The outer layer of each hemisphere is

composed of gray matter (cerebral cortex). The cerebral cortex is presented in the form of folds and circumvolutions, which are separated by grooves and fissures. In this way, the cortical surface is greatly increased. Some large fissures are used to subdivide the surface of each hemisphere into lobes. The lobes are named by the bones of the skull that they are found under:

1. Frontal lobe: occupies a place before the central or Rolando fissure and superior to the lateral fissure or Sylvian fissure.
2. Parietal lobe: located behind the central fissure and above the lateral fissure.
3. Occipital lobe: located below the parieto-occipital fissure.
4. Temporal lobe: located below the lateral fissure.
5. Insula or minor lobe: this is the innermost lobe, which is located deep inside the temporal lobe.

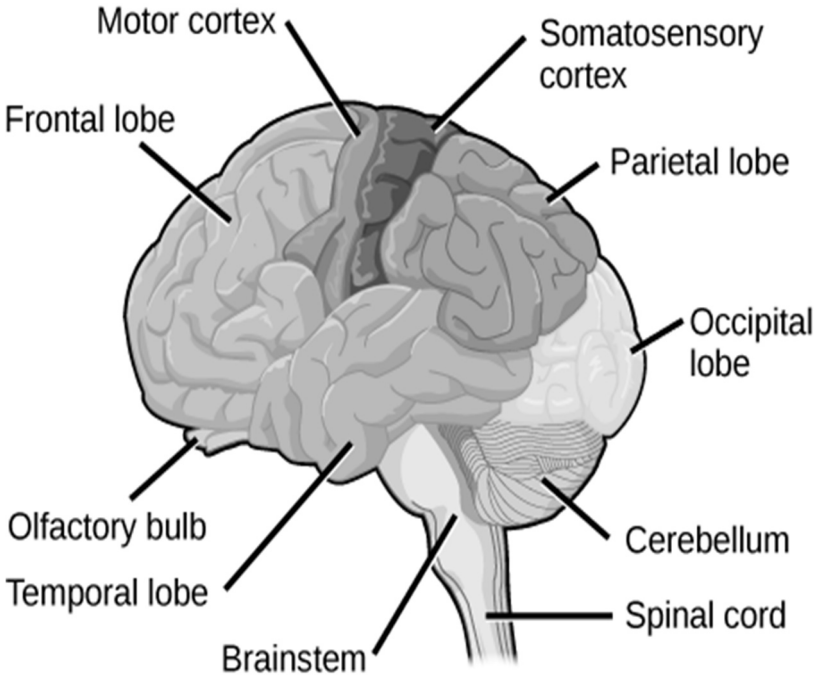

Figure 3-4: Sagittal view of Brain. Author: CNX OpenStax. Source: May 27, 2016. Licensed by Creative Commons Attribution 4.0 International.

The **frontal lobe** is divided into several regions: the prefrontal cortex; the primary, secondary, and complementary motor areas; and the Broca area. Each area has completely different functions; however, all of its functions are integrated and connected and to other brain regions or structures, such as the cerebellum, the brainstem, and the spinal cord (see Figure 3.5).

The **prefrontal cortex** is usually divided into three sections:

1. Dorsolateral cortex, which regulates inhibitory response and executive functions. This is in charge of ideation, programming, sequencing, and organization (executive functions). The executive functions are part of the cognitive domains. This area is also in charge of the inhibitory responses that are important for correct social and intellectual functioning.
2. Orbitofrontal cortex, which is involved in our social behavior and social cognition.
3. Cingulate cortex, which is important for generating initiative in our everyday activities.

The **primary and supplementary motor areas** and **premotor areas** are in charge of voluntary motor control and movements. They are connected with the spinal cord to generate voluntary movement. The primary motor cortex provides a topographical representation of our muscles; it governs the execution of voluntary movements. The premotor and supplementary motor areas are in charge of planning and sequencing movements (see Figure 3.5).

The Broca area is associated with motor or expressive language skills. Motor aphasia develops when it is damaged, which leads to language impairment (see Figure 3.5).

The **temporal lobe** has also different areas:

1. *Primary and secondary auditory areas* that receive, perceive, and integrate the auditory sense: the primary auditory area receives the sounds, while the secondary auditory area interprets them.
2. *Wernicke's area*, which is related to sensory and comprehensive language skills. Damage in this area would lead to sensory fluent aphasia, with alterations in the comprehension of language (see Figure 3.5).